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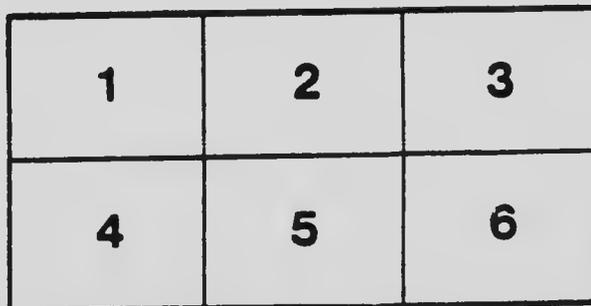
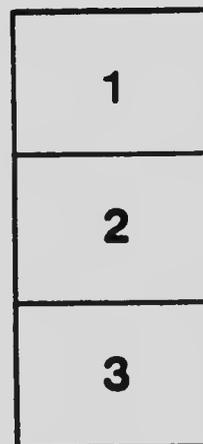
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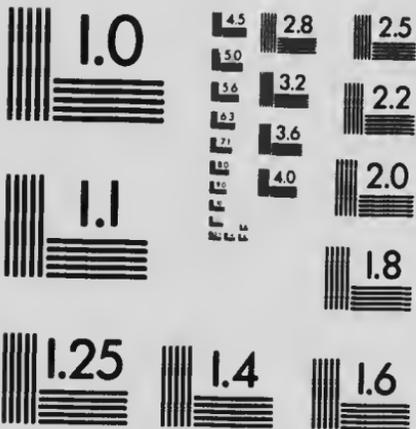
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GAGE'S EDUCATIONAL SERIES

ARITHMETIC

BOOK II

BY

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ARITHMETIC

BOOK II

CHAPTER I

GENERAL REVIEW

I. Notation and Numeration

Point off the following numbers, and read :

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
1.	32256	45045	20721	87000
2.	90463	91007	607073	420015
3.	230467	500607	728300	500006
4.	1783459	28738457	20503007	200719000
5.	70070220	700702202	770077077	6076076

Express by figures :

1. Thirteen thousand, two hundred forty.
2. Three hundred thousand, eight hundred seven.
3. Fifteen thousand, six hundred seventy-six.
4. Nine hundred eight thousand, two hundred six.
5. Eight hundred seventy-three thousand, nine.
6. Four million, three hundred eight thousand, fifty-six.

7. Forty-five million, four hundred five thousand, four hundred forty.

8. Eighty thousand, eight hundred eight

ROMAN NOTATION

The Roman notation uses seven letters combined in different ways to represent numbers.

These are :

I	V	X	L	C	D	M
1	5	10	50	100	500	1000

Examples :

2 = II	12 = XII	9 = IX
14 = XIV	37 = XXXVII	44 = XLIV
84 = LXXXIV	97 = XCVII	1900 = MCM

EXERCISE

Write in Roman notation :

1. 444	999	748	4. 1919	1607	539
2. 73	66	119	5. 1794	1497	1983
3. 1800	1896	1910			

Write in figures :

6. MCIX	MCXXIX	CMXC
7. CMXCIV	DLIV	MIX
8. CDLXIII	DCXLIX	MMDC
9. MDXLIV	MCDX	MCMXCV
10. MCMIX	MDCVII	MCDXCII

II. The Simple Rules

ADDITION

Example: Add:
$$\begin{array}{r}
 7458 \\
 395 \\
 4867 \\
 3065 \\
 4276 \\
 563 \\
 98 \\
 4263 \\
 759 \\
 8237 \\
 \hline
 61 \\
 62 \\
 33 \\
 30 \\
 \hline
 33981
 \end{array}$$

The following method of addition is frequently used by commercial houses.

Under each column put down the sum without carrying.

This enables you to check each addition column. Add each column in reverse order.

Now add the sums of all the columns, and the result will give you the sum of the numbers to be added.

EXERCISE

Add the following, and check your work:

1.	2.	3.	4.
380457	296783	568397	425839
27856	78564	283476	48376
179608	836584	57839	491978
435674	36478	276989	729536
62893	596597	954678	874390
297578	42693	365783	28375
3654	506470	29756	562938
82697	28967	473579	728957
7598	834056	80469	260583
728396	7839	705435	4895
<u>42657</u>	<u>42837</u>	<u>24683</u>	<u>65834</u>

ARITHMETIC

5.	6.	7.	8.
748596	897368	29658	703085
589677	89658	477839	29873
768497	757346	28605	265839
69895	875970	984873	26576
2327	98773	26589	465983
787809	767658	739659	26717
73843	29394	82959	749385
296959	454573	477637	29575
668492	386497	26566	176589
97898	28756	738399	29639
287639	748393	20056	298347
<u>54038</u>	<u>29756</u>	<u>473793</u>	<u>947089</u>

9. A man commenced farming, making the following outlay: cost of 320 acres of land at \$27.00 per acre; horses, 4 teams at \$385.00 per team; 6 cows at \$89.00 each; 27 one-year-old steers at \$43.00 each; 9 hogs at \$17.00 each; machinery, \$1,895.00; drilling a well, \$235.00. Find his total outlay.

10. The following shipments of grain were made from Fort William and Port Arthur, for the crop year ending August 31st, 1918:

GRAIN	BY RAIL	BY VESSEL	TOTAL
	<i>Bush.</i>	<i>Bush.</i>	<i>Bush.</i>
Wheat	17,408,487	99,753,979	
Oats	11,508,066	18,002,124	
Barley	1,690,737	5,108,398	
Flaxseed	906,909	3,261,534	
Rye	139,415	63,586	
Totals			

Find the total amount of grain shipped: (1) by rail; (2) by vessel; (3) altogether.

11. In 1918 the railway mileage in Canada according to provinces was as follows :

Ontario	11,049 miles
Quebec	4,734 miles
Manitoba	4,194 miles
Saskatchewan	6,124 miles
Alberta	4,444 miles
British Columbia	3,885 miles
New Brunswick	1,959 miles
Nova Scotia	1,422 miles
Prince Edward Island	278 miles
Yukon	103 miles

Find the total mileage of railways in Canada.

12. The freight handled by the Canadian Railways in 1917 was as follows :

PRODUCTS	TONS HAULED
Products of Agriculture	25,127,454
Products of Animals	3,980,887
Products of Mines	42,534,637
Products of Forests	19,090,782
Manufactures	21,921,307
Merchandise	6,070,858
Miscellaneous	3,151,203

Find the total amount of freight hauled.

13. The production of coal in the different provinces in Canada during the year 1917 was as follows :

PROVINCE	TONS
Nova Scotia	6,324,684
New Brunswick	188,660
Saskatchewan	355,304
Alberta	4,723,139
British Columbia	2,418,929
Yukon Territory	4,872
Total	<u>14,915,598</u>

Find the total amount of coal produced in Canada.

14. Write down the following statement of cash receipts. Add the amounts vertically and horizontally, and prove the correctness of your work by adding your totals.

	MON.	TUES.	WED.	THURS.	FRI.	SAT.	TOTAL.
1st	\$89.37	\$75.68	\$57.47	\$193.85	\$57.36	\$142.79	
2nd	75.39	65.43	83.29	81.09	74.23	136.95	
3rd	84.96	47.62	95.54	86.57	128.47	95.86	
4th	112.73	54.98	76.46	64.98	96.05	78.59	
5th	75.86	49.17	49.89	72.36	85.73	83.69	
6th	143.78	65.85	89.27	153.88	49.59	98.74	
Totals							

15. The following gives a statement of the deposits made in one week at one branch of The Canadian Bank of Commerce. Find the total deposits for the week.

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY.
\$539 42	\$384 75	\$865 73	\$834 72	\$565 25	\$986 38
1896 57	946 79	2653 76	365 36	793 65	765 65
265 39	385 76	764 89	2643 79	2638 17	839 25
9378 75	2965 78	829 63	856 35	598 95	743 16
468 39	643 64	3506 75	7269 75	1836 37	298 37
2654 36	5398 15	295 83	336 33	429 65	659 39
728 39	284 73	7653 27	428 57	843 79	794 79
4563 84	7659 83	643 75	6583 42	656 37	836 65
769 83	296 59	2983 43	928 67	959 83	795 89
2954 65	865 43	698 36	7265 38	2657 79	264 75
7647 83	2906 75	8465 78	865 49	989 35	695 83

Check your result by adding vertically and horizontally, and by adding your totals.

16. The acres and yields of field crops in Canada in 1917 were as follows :

FIELD CROP	AREA IN ACRES	YIELD IN BUSHELS
Wheat, Fall	906,000	20,753,000
Wheat, Spring	10,281,000	193,984,000
Oats	10,186,000	359,064,000
Barley	1,700,000	45,781,000
Rye	128,000	2,380,000
Peas	268,000	4,496,000
Beans	527,000	947,000
Buckwheat	352,000	8,017,000
Flaxseed	844,000	9,012,000
Mixed Grains	493,000	16,127,000
Potatoes	501,000	75,237,000
Total		

Find the total number of acres under crop, and the total number of bushels produced.

17. The number of pupils in the schools of Canada in 1917 was as follows :

PROVINCE	BOYS	GIRLS	TOTAL
Prince Edward Island	9,291	8,899	
Nova Scotia	53,560	55,472	
New Brunswick	32,025	32,751	
Quebec	122,338	130,399	
Ontario	266,255	261,409	
Manitoba	55,654	51,934	
Saskatchewan	71,246	67,485	
Alberta	51,446	53,281	
British Columbia	30,406	29,871	
Total			

Find: (1) the number of boys in school in Canada; (2) the number of girls in school in Canada; (3) the number of pupils in school in Canada.

ARITHMETIC

SUBTRACTION

Example: Subtract, and prove your result.

From 3407 take 2938.

3407

2938

469

Prove $2938 + 469 = 3407$

EXERCISE

Subtract, and prove your result in each of the following :

	A	B	C	D
1.	9438 2759	36406 <u>27658</u>	\$26003 <u>475639</u>	72000 <u>65839</u>
2.	731065 467289	960583 750786	940326 <u>738747</u>	\$600034 <u>7269538</u>
3.	\$568.72 298.95	\$1306.15 965.78	\$7350.35 <u>2985.67</u>	\$8394.02 <u>965.75</u>
4.	\$8395.15 2607.79	\$6500.00 <u>2835.75</u>	\$3795.00 <u>2643.65</u>	\$2908.00 <u>1497.68</u>

5. A poultry farmer sold \$4569.44 worth of eggs and \$1416.15 worth of poultry in one year. His expenses for the year were as follows:

Labor	\$145.00 a month for 12 months
Feed	\$135.00 a month for 12 months
Marketing fowl	\$585.75

Find his net gain on the year's business.

6. The total number of dairy cattle in Canada in 1917 was 4,718,657. Of these, Ontario had 1,082,119; Quebec, 911,923; Nova Scotia, 131,442; Prince Edward Island, 16,032; and New Brunswick, 100,221. The remainder were in the four Western Provinces. Find the number of dairy cattle in the Western Provinces.

7. In 1914 Canada exported fish valued at \$20,623,560. In the same year we imported \$635,231 worth of fish free of duty and \$1,469,305 worth of dutiable fish. What was the amount of the difference of our exports over our imports of fish for this year?

MULTIPLICATION AND DIVISION

Introductory.

The number by which we multiply another number is called the *multiplier*.

The number that is multiplied is called the *multiplicand*.

The result obtained by multiplying a number by another is called a *product*.

The multiplicand and multiplier are known as *factors of the product*.

To test the accuracy of multiplication, divide the product by the multiplier; the quotient obtained should be the multiplicand.

Example:

$$239 \times 47$$

239	Multiplieand
<u>47</u>	Multiplier
1673	
956	
<u>11233</u>	Product

<i>Test</i>	
	<u>239</u>
47	)11233
	<u>94</u>
	183
	<u>141</u>
	423
	<u>423</u>

$$\$38.25 \times 36$$

\$38.25
<u>36</u>
22950
<u>11475</u>
\$1377.00

If the multiplicand is a concrete number, the product will be a concrete number of the same kind.

The *dividend* is the number divided.

The *divisor* is the number by which the dividend is divided.

The result of the division is the quotient.

The part of the dividend that is left when the division is not exact is called the *remainder*.

To test the accuracy of division, multiply the quotient by the divisor and add the remainder; the result should be the dividend.

Example: 1. $86523 \div 327$.

86523	Dividend,	327	Divisor.		<i>Test</i>
264			Quotient		264
327	)	86523			327
		654			1848
		2112			528
		1962			792
		1503			86328
		1308			195
		195	Remainder		86523
					Remainder
					Dividend

2. $\$473.25 \div 35$.

\$13.52	
35)
35)
123	
105	
182	
175	
75	
70	
5	Remainder

If the dividend is a concrete number and the divisor is an abstract number, the quotient will be a concrete number of the same kind as the dividend.

3. $864354 \text{ pecks} \div 3 \text{ pecks.}$

$$\begin{array}{r} 288118 \\ 3 \text{ pecks} \overline{)864354 \text{ pecks.}} \end{array}$$

If dividend and divisor are concrete numbers of the same kind, the quotient will be an abstract number.

NOTE TO THE TEACHER.— Review carefully the multiplication tables, giving oral work also on the division processes.

For example:

How many 8's are in 40, 68, 36, 54, etc.

How many 7's are in 14, 24, 35, 58, etc.

EXERCISE

Multiply, and verify your answers :

A	B
1. 2349×78	7365×39
2. 50637×37	64097×89
3. 45396×136	784509×178
4. 506308×53	780964×49
5. 76403×507	86427×809
6. 567983×490	836407×730
7. 400068×329	670050×473
8. 561836×726	896537×495
9. 260934×379	546036×786
10. 26975×734	240653×831

Multiply, and verify your answers :

11. $\$526.45 \times 38$	$\$728.38 \times 47$
12. $\$983.03 \times 239$	$\$364.95 \times 278$

Divide, and verify your answers :

13. $426530 \div 36$	$764803 \div 49$
14. $628395 \div 53$	$846576 \div 78$

A

15. $139847 \div 123$
16. $6740384 \div 238$
17. $129704 \div 352$
18. $3658407 \div 783$
19. $756874 \div 767$
20. $1450112 \div 872$

B

- $2836546 \div 189$
- $7648308 \div 369$
- $6023080 \div 479$
- $724680 \div 598$
- $1670009 \div 695$
- $2730413 \div 437$

Divide, and verify your answers :

21. $\$2018.35 \div 39$ $\$56283.39 \div 78$
22. $\$23463.75 \div 129$ $\$43078.65 \div 237$
23. $\$506.38 \div 23$ $\$7298.45 \div 39$
24. $58648 \text{ rods} \div 238 \text{ rods}$ $76483 \text{ tons} \div 179 \text{ tons}$
25. $628947 \text{ sq. yds.} \div 239 \text{ sq. yds.}$

EXERCISE

Test how many of the following can be worked in 10 minutes. Multiply separately :

1. $465,873$; $529,837$; $693,485$; $\times 373$
2. $725,368$; $943,582$; $463,278$; $\times 469$
3. $329,567$; $234,789$; $876,359$; $\times 583$
4. $465,723$; $654,678$; $283,596$; $\times 763$
5. $347,598$; $268,479$; $537,486$; $\times 297$
6. Divide each of the above numbers by 329.
7. Divide each of the above numbers by 573.
8. Divide each of the above numbers by 483.
9. Divide each of the above numbers by 867.
10. Divide each of the above numbers by 749.

EXERCISE

1. The wheat production in the Prairie Provinces for 1917 was as follows :

Manitoba	41,039,700 bushels
Saskatchewan	117,921,300 bushels
Alberta	52,992,100 bushels

If the average price per bushel was \$1.87, what was the value of the wheat crop, (1) for each of the provinces ; (2) for the three provinces.

2. For every \$100.00 borrowed, the Dominion of Canada pays interest at the rate of \$5.50 per year. What amount of interest will there be on Canada's Victory Loan of \$350,000,000 ?

3. In 1917 Manitoba, Saskatchewan, Alberta, and British Columbia produced 17,348,844 lbs. of butter which was worth an average price of 38 cents per lb. What was the total value of the butter production ?

4. A rancher shipped 4 carloads of stock to the Winnipeg Stockyards. Each car averaged 22 head. The cattle were sold at \$9.50 a cwt., and the total weight of the shipment was 115,764 lbs. What was the average price received per head ?

5. A coal dealer bought 450 tons of coal at \$7.25 a ton. The freight charges were 95 cents a ton, and the cost of handling was 75 cents a ton. How much would the dealer gain, if he sold the coal for \$9.65 a ton ?

6. A sheep man bought 225 sheep at \$11.00 each and 350 sheep at \$13.00 each. He sold the wool so that he received for it an average price of \$4.25 per sheep. He sold all the sheep for \$12.00 each. How much did he gain on this transaction ?

7. A farmer sowed 160 acres of wheat. It cost him \$6.00 per acre to prepare the ground for seed. He sowed $1\frac{1}{2}$ bushels to the acre, the seed costing him \$2.20 per bushel. It cost him \$3 per acre to harvest the crop and 6 cents a bushel for threshing. He sold the crop, which averaged 35 bushels per acre, at \$1.85 per bushel.

Find the following :

- (1) What the crop cost him to raise.
- (2) What he sold the entire crop for.
- (3) His profit from the sale of the crop.
- (4) How much he made on each acre of land.

8. In 1916 there were in Alberta and Saskatchewan 599,509 dairy cattle valued at \$31,624,099.75. Find the average value per head.

9. In 1917 there were in Manitoba and Saskatchewan 556,580 milch cows valued at \$83.75 per head. What was the total value of these cows?

10. The average yield of potatoes in Canada in 1915 with the price per bushel was as follows :

PROVINCE	YIELD PER ACRE	PRICE PER BUSHEL
Ontario	93 bush.	76 cents
Quebec	149 bush.	55 cents
Nova Scotia	141 bush.	58 cents
Prince Edward Island	114 bush.	46 cents
New Brunswick	144 bush.	64 cents
Manitoba	86 bush.	64 cents
Saskatchewan	110 bush.	68 cents
Alberta	142 bush.	44 cents
British Columbia	247 bush.	45 cents

Find the following :

- (1) The value per acre of potatoes in each of the provinces.
- (2) The average yield per acre for Canada.
- (3) The average price per bushel for Canada.
- (4) The average price return per acre for Canada.

DENOMINATE NUMBERS

Long Measure, or Measure of Length and Distance

TABLE

12 inches (in.)	= 1 foot (ft.)
3 feet	= 1 yard (yd.)
$5\frac{1}{2}$ yards	= 1 rod (rd.)
320 rods	= 1 mile (mi.)
1760 yards	= 1 mile
5280 feet	= 1 mile

REVIEW EXERCISES

1. Reduce 18 rods 4 yards 2 feet to feet.
2. Reduce 52 yards 2 feet 9 inches to inches.
3. Reduce 4 miles 180 rods 4 yards to yards.
4. Reduce 6248 inches to yards, feet, and inches.
5. Reduce 4578 feet to rods, yards, and feet.
6. Reduce 36,578 yards to miles and yards.
7. Reduce 29,800 feet to miles and feet.
8. A merchant in taking stock of the cotton in his store finds he has 4 pieces containing the following lengths: 48 yards 2 feet 9 inches, 56 yards 10 inches, 74 yards 2 feet 8 inches, and 18 yards 2 feet. How much cotton has he in stock?

9. What is the total width in feet and inches of 2 doors each 54 inches wide and 5 windows each 38 inches wide?

10. A man walks $1\frac{1}{2}$ miles. If he takes a step 30 inches in length, how many steps will he take in his walk?

11. A piece of land has a frontage of 120 rods on a street. Into how many lots with a frontage of 40 feet each can this land be subdivided?

12. Telephone poles are placed 8 rods apart. How many poles will be required for a telephone line 15 miles long?

Square Measure, or Measure of Area and Surface

TABLE

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards	= 1 square rod (sq. rd.)
160 square rods	= 1 acre (ac.)
640 acres	= 1 square mile (sq. mi.)
160 acres	= $\frac{1}{4}$ section of land
320 acres	= $\frac{1}{2}$ section of land
640 acres	= 1 section of land
36 sections	= 1 township

TOWNSHIP

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

SECTION

160 acres
320 acres

REVIEW EXERCISES

1. Reduce 36 acres 80 square rods to square rods.
2. Reduce 4 square rods 6 square yards to square feet.
3. Reduce 3 square yards 26 square feet 96 square inches to square inches.
4. Reduce 4800 square rods to acres.
5. Reduce 16,500 acres to square miles and acres.
6. How many quarter sections are there in 6 square miles?
7. A school district contains 18 sections of land. How many acres does it contain?
8. I have 500 sheets of paper, each sheet measuring 36 inches by 24 inches. How many smaller sheets 6 inches by 4 inches can be cut from the 500 sheets?
9. How many square yards of linoleum are required to cover the floor of a room 15 feet long and 12 feet wide? What is the cost of the linoleum at \$1.50 per square yard?
10. A field is 40 rods wide and contains 20 acres. What is the length?

Surveyor's Measure

TABLE

100 links or 4 rods	= 1 chain
80 chains or 5280 feet	= 1 mile
16 square rods	= 1 square chain
10 square chains	= 1 acre

EXERCISE

Find the areas of the following fields in acres :

1. A field 16 chains long and 12 chains wide.
2. A field 23 chains long and 14 chains wide.

3. A field 36 chains long and 18 chains wide.
4. A field 40 chains by 25 chains.
5. A field 24 chains 2 rods long and 12 chains wide.
6. A field 36 chains 2 rods long and 12 chains 2 rods wide.
7. A field 15 chains 20 links long and 12 chains wide.
8. A field 24 chains 50 links long and 16 chains 25 links wide.

Board Measure or Lumber Measure

1 *Board foot* is a piece of board or lumber that is 1 foot long, 1 foot wide, and 1 inch or less in thickness.

Note. — Lumber less than 1 inch in thickness is considered as if it were 1 inch thick. If the lumber is more than 1 inch in thickness, the thickness is taken into consideration.

EXERCISE

1. Find the number of board feet in the following pieces of lumber : (1) a board 12 inches long, 8 inches wide, and 1 inch thick ; (2) a board 18 feet long, 1 foot wide, and 2 inches thick ; (3) a joist 20 feet long, 4 inches wide, and 4 inches thick ; (4) a piece of timber 20 feet long, 1 foot wide, and 12 inches thick.
2. Find the number of feet of lumber in 24 pieces of fir, each piece being 18 feet long, 6 inches wide, and 1 inch thick.
3. A sidewalk is 50 feet long and 4 feet wide. It is made of planks 10 feet long, 6 inches wide, and 2 inches thick.
How many planks are required for the sidewalk?
How many feet of lumber are in the sidewalk?
What is the cost of the lumber, if 1000 feet cost \$30.00?
4. How many feet of 1 inch lumber are required for the boards of a close board fence built about a garden 25 feet long and 40 feet wide, the fence being 6 feet high?

5. Find the number of board feet of 1 inch flooring required for a hall 75 feet long and 40 feet wide.

What is the cost of the floor, if the lumber is worth \$175.00 per thousand board feet?

6. Find the number of board feet of 1 inch lumber required to make a box without a cover, 24 feet long, 6 feet wide, and 4 feet deep.

7. A man measured a pile of lumber and found that it contained 15,000 boards each 12 feet long, 6 inches wide, and 1 inch thick.

How many feet of lumber were in the pile?

What is the value of the lumber at \$28.00 per thousand feet?

Cubic Measure, or Measure of Volume

TABLE

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet	= 1 cubic yard (cu. yd.)
128 cubic feet	= 1 cord (cd.)

1 cubic foot of water contains $6\frac{1}{4}$ gallons.

1 cubic foot of water weighs 1000 ounces or $62\frac{1}{2}$ pounds.

REVIEW EXERCISES

- Reduce 5 cubic feet 85 cubic inches to cubic inches.
- Reduce 28 cubic yards 15 cubic feet to cubic feet.
- Reduce 3 cords 96 cubic feet to cubic feet.
- Reduce 56,780 cubic inches to cubic feet and cubic inches.
- Reduce 576 cubic feet to cubic yards and cubic feet.
- Reduce 6400 cubic feet to cords.
- A reservoir is 12 feet long, 10 feet wide, and 6 feet deep. How many gallons of water does it hold?

8. If 1 load of earth contains 27 cubic feet, find the number of loads of earth removed in excavating a cellar 28 feet long, 27 feet wide, and 7 feet deep.

9. How many cords of wood are in a pile 8 feet long, 6 feet high, and 4 feet wide? Find the cost of the wood at \$5.60 per cord.

10. A tank filled with water is 8 feet long, 4 feet wide, and 3 feet deep. What is the weight of the water in the tank?

Dry and Liquid Measures

TABLE

Dry Measure	Liquid Measure
2 pints = 1 quart	2 pints = 1 quart
8 quarts = 1 peck	4 quarts = 1 gallon
4 pecks = 1 bushel	8 pints = 1 gallon
1 bushel contains $1\frac{1}{2}$ cubic feet (approximately).	
1 gallon contains 231 cubic inches (approximately).	

REVIEW EXERCISE

- Reduce 5 gallons 3 quarts to pints.
- Reduce 24 bushels 3 pecks 1 gallon to gallons.
- Reduce 257 pints to gallons, quarts, and pints.
- Reduce 640 quarts to bushels.
- Reduce 475 pints to pecks, quarts, and pints.
- A milk dealer buys 36 gallons of milk. How many quart bottles of milk can he fill from this?
- A milk dealer buys milk at \$3.60 per 10 gallons and sells it at 15 cents a quart. If he sells 240 gallons of milk in a day, how much money does he make over the cost of the milk?

8. How many gallons of fresh water should a ship carry that has on board 1500 people for a voyage of 12 days, if 3 quarts per day are carried for each person?

9. A gardener sold 3 quarts of green beans to each of 48 customers and 6 quarts of green peas to each of 36 customers. The price of the beans was 75 cents per peck, and the peas were sold at 10 cents per pint. How much did he receive from the sales?

10. A man feeds $1\frac{1}{2}$ gallons of oats per day to each of his horses during the spring season of 12 weeks. If he had 8 teams working, how many bushels of oats did he feed? What was the cost of the oats at 78 cents per bushel?

Avoirdupois Weight

TABLE

16 ounces	= 1 pound	(lb.)
100 pounds	= 1 hundredweight	(cwt.)
2000 pounds	= 1 ton	(T.)
20 hundredweight	= 1 ton	

REVIEW EXERCISES

1. Reduce 42 ozs. to lbs. and ozs.
2. Reduce 5 tons 75 cwt. to lbs.
3. Reduce 6578 lbs. to tons, cwt., and lbs.
4. A barn is 48 feet long, 32 feet wide, and 14 feet high. Allowing 6 lbs. of hay to every cubic foot, estimate how many tons of hay can be stored in the barn.
5. If 1 cubic foot of water weighs 1000 ounces, find the weight in tons, cwt., and lbs., of water 4 inches deep covering 25 acres of land.

6. A coal dealer bought 3 car loads of coal at \$3.75 per ton. The loads weighed 64,800 lbs., 72,450 lbs., and 81,500 lbs. Find the cost of the coal.

7. A woman marketed her fowl, being paid the following prices: turkeys 32 cents per lb.; chickens 26 cents per lb.; geese 28 cents per lb. She sold 27 turkeys averaging in weight 19 lbs. 8 oz.; 48 chickens averaging in weight 6 lbs. 7 oz.; 16 geese averaging in weight 11 lbs. 3 oz. How much did she receive for the poultry?

8. A man sold 25 head of cattle which averaged in weight 1320 lbs. at \$8.75 per cwt. How much did he receive for the cattle?

Table of Miscellaneous Weights

TABLE

1 bushel wheat weighs	60 lbs.
1 bushel oats weighs	34 lbs.
1 bushel barley weighs	48 lbs.
1 bushel rye weighs	56 lbs.
1 bushel potatoes weighs	60 lbs.
1 bushel Timothy seed weighs	48 lbs.
1 bushel flaxseed weighs	56 lbs.
1 bushel beans, peas, carrots, parsnips, beets, turnips, each weighs	60 lbs.

196 lbs. flour = 1 barrel.

200 lbs. pork = 1 barrel.

100 lbs. nails = 1 keg.

REVIEW EXERCISES

1. A farmer sold 6 loads of wheat, the average weight of each load being 1740 lbs. at \$1.78 per bushel. How much did he receive for the wheat?

2. I sold 15 loads of oats, the average weight of which was 1598 lbs., at 69 cents a bushel. How much did I receive for the oats?

3. A gardener raised the following crops on the different plots: 4 acres potatoes, 28,080 lbs.; 2 acres turnips, 14,760 lbs.; 3 acres beans, 17,640 lbs. Find the average yield of each in bushels per acre.

4. Find the total cost of the following farm products:

2640 lbs. of wheat at \$2.15 per bushel.

2210 lbs. oats at 67 cents per bushel.

3600 lbs. barley at 98 cents per bushel.

5280 lbs. of potatoes at \$1.35 per bushel.

5. An elevator holds 2,500,000 bushels of wheat. Find in tons the capacity of the elevator.

Time Measure

TABLE

60 seconds (sec.) = 1 minute (min.)	January	31 days
60 minutes = 1 hour (hr.)	February	28 days
24 hours = 1 day (da.)	March	31 days
7 days = 1 week (wk.)	April	30 days
365 days = 1 year (yr.)	May	31 days
366 days = 1 leap year	June	30 days
52 weeks = 1 year	July	31 days
	August ^t	31 days
	September	30 days
	October	31 days
<i>Note.</i> In leap year February has	November	30 days
29 days.	December	31 days

1. A man borrowed money on April 5th and paid it back on September 18th. How many days did he have the money?

2. Find the number of days between March 21st and November 24th.
3. A man works 44 hours per week during a season of 28 weeks. How many hours does he work altogether? If he earns 65 cents an hour, find his wages for the season.
4. Find the number of days between Dec. 17th, 1915 and March 20th, 1916.
5. A train leaves Lethbridge at 4.35 P.M. and arrives at Calgary at 10.15 P.M. Find the time in hours and minutes it takes to make the journey.
6. A train leaves Winnipeg at 10.00 P.M. Tuesday and arrives at Calgary at 2.45 A.M. Thursday. How many hours and minutes does it take to make the trip?

MISCELLANEOUS TABLE

12 units or things	= 1 dozen
12 dozen	= 1 gross
12 gross	= 1 great gross
20 units or things	= 1 score
24 sheets of paper	= 1 quire
20 quires	= 1 ream

REVIEW EXERCISES

1. How many quires are in 48 sheets? 144 sheets? 216 sheets?
2. How many pencils are in a shipment containing 15 gross?
3. A man shipped each day for 15 days a case of eggs containing 24 dozen. How many eggs did he ship?
4. Oranges are sold at 60 cents per dozen. How many should I get for 25 cents?

5. Bananas are sold at 2 for 15 cents. What is the price of 3 dozen?

6. I bought 5 reams of paper at \$2.50 per 500 sheets. How much did I pay for the paper?

7. A dealer buys lead pencils at \$6.50 per gross and sells them at 10 cents each. How much does he make on each gross of pencils?

8. Find the cost of 80 dozen pen holders at \$4.75 per gross.

BILLS

A *Bill* is a written statement in detail of indebtedness for goods sold or for services rendered.

The *Creditor* is the person, firm, or corporation to whom the debt is owing.

The *Debtor* is the person or firm, etc. who owes the debt.

A *Receipt* is a written statement showing that the bill has been paid.

Example:

VANCOUVER, March 28th, 1920

MR. GEORGE R. WILLIAMS

Bought of

THE HUDSON'S BAY COMPANY

March	3	25 lbs. rolled oats	at 15 cents per lb.	\$ 3	75
"	3	50 lbs. flour	at \$7.50 per cwt.	3	75
"	3	6 lbs. rice	at 12 cents per lb.		72
"	12	10 lbs. granulated sugar	at 9 cents per lb.		90
"	12	6 cans corn	at 15 cents per can		90
"	18	5 dozen eggs	at 45 cents per doz.	2	25
"	27	4 lbs. butter	at 52 cents per lb.	2	08
				\$ 14	25

Received payment in full

March 28th, 1920

THE HUDSON'S BAY COMPANY

Per W. WILSON

EXERCISE

Make out the following bills in correct form and receipt each bill :

1. William Rogers bought of Rylands Limited, Lethbridge, Alberta : 8 yards table-cloth at \$2.75 per yard, 64 yards of cotton at 8 cents per yard, 35 yards of towelling at 18 cents per yard, 24 yards curtain scrim at 28 cents per yard, 5 yards denim at 22 cents per yard. The goods were purchased on May 6th, and the bill was paid on May 31st.

2. Joseph Sanderson bought of the Regina Hardware Co., Regina, Sask. : 3 Kootenay ranges at \$62.50 each, 6 gas ranges at \$26.75, 8 oak heaters at \$18.00 each, 3 dozen double boilers #5 at \$1.45 each, 4 dozen granite dishes #6 at 98 cents each.

The goods were purchased on August 28th, and the bill was paid on September 15th.

3. Robert Wilson in account with the Patterson Motor Co., Ltd., Montreal, Que.

May 2, Repairing tire and vulcanizing, \$5.75, 5 gallons gasoline at 45 cents, 1 quart mobile oil at 45 cents a quart.
May 9th, washing car \$1.50, 6 gallons gasoline at 45 cents, 1 pint mobile oil at 25 cents. May 14th, charging battery \$1.25, 4 gallons gasoline at 45 cents, 1 quart mobile oil at 45 cents. May 28th, greasing car 75 cents, grease 50 cents, labor adjusting car \$1.50. May 31st, storage \$8.00.

This bill was paid on June 1st.

4. Wilson School District, No. 3856, Province of Manitoba, bought of The Canadian School Supplies Company, Brandon, Manitoba : April 27th, 4 single seats #2 at \$7.45, 4 single seats #3 at \$7.25, 6 single seats #4 at \$6.75, 6 single seats #5 at \$6.25, 1 teacher's desk at \$22.50, 3 chairs at \$7.50, 6 roller blinds at \$2.35, 4 maps at \$12.75, 5 hanks raffia at

75 cents, 8 half pound packages plasticine at 90 cents per lb., 1 globe (hanging) \$13.75. The bill was paid on June 3rd.

5. Frank Buchanan bought from the United Grain Growers Company Limited, Calgary, on March 8th: 1 two-furrow horse gang plow at \$128.75, 1 drag harrow at \$33.00, 1 double disk seed drill at \$186.70, 1 farm wagon at \$128.60, 2 sets heavy team harness at \$47.50 per set, 4 horse collars at \$3.30 each, 1 spring tooth cultivator at \$193.25, 1 wheelbarrow at \$6.10. This bill was paid on April 17th.

6. William Robertson bought of The Smith Manufacturing Co., Ltd., Winnipeg, Manitoba, on November 15th: 11 refrigerators at \$57.00, 16 tables at \$48.00, 18 porcelain sinks at \$75.00, 8 kitchen cupboards at \$45.00, 6 gas ranges at \$28.00, 1 dozen scales at \$6.00 each. This bill was paid on December 14th.

7. Donald Holinan bought of The Edgar Trading Co., Ltd., Halifax, Nova Scotia: March 2, 17½ yards flannel at 46 cents per yard, 18¼ yards gingham at 14 cents per yard, 24¼ yards of tweed at \$2.70 per yard. March 12th, 24 yards ribbon at 12 cents per yard, 38 yards of cotton at 12½ cents per yard, 6 pairs blankets at \$12.50 per pair, 1 dozen spools at 2 spools for 15 cents. This bill was paid on March 31st.

8. The Royal Fruit Company, bought of the Creston Fruit Growers Company, Ltd., the following fruits: September 2nd, 350 cases of plums at \$1.95 a case, 45 dozen baskets of pears at 45 cents per basket, 75 dozen cases of apples at \$1.75 per case; September 5th, 78 dozen cases of peaches at \$2.45 per case, 45 dozen cases of pears at \$1.65 per case, 24 dozen cases of plums at \$1.85 per case, 16 dozen cases of apples at \$1.75 per case. This bill was paid on September 30th.

ACCOUNTS

An account is a record of a business transaction carried on by a person, firm, or corporation with another person, firm, or corporation.

The amounts charged against the person, firm, or corporation are entered on the left hand side in the *debit column*.

The amounts paid by the person, firm, or corporation are entered on the right hand side in the *credit column*.

Example:

THE HUDSON'S BAY COMPANY,
Calgary, Alberta

WILLIAM A. SMITH

1919	DR.		1919	CR.	
Jan. 5	$\frac{1}{2}$ dz. kitchen chairs	\$ 24 00	Jan. 5	By Cash	\$ 10 00
" 8	1 sideboard	37 50	" 15	By Cash	38 00
" 15	1 rug	42 00	" 31	By Cash	75 00
" 15	1 library table	26 00	" 31	Balance	19 00
" 24	8 yards linoleum	12 50			
		\$142 00			\$142 00
Feb. 1	Balance	19 00			

EXERCISE

Prepare the following accounts, enter the items, and balance the accounts:

1. Northern Hardware Co. in account with Woods, Valance & Adams.

Debits. March 2nd, 1915, 2 dozen axes at \$2.15 . . .
March 12th, hardware \$350.75. March 15th, saws and hammers \$178.00. March 27th, hardware \$225.35.

Credits. March 15th, 1915, cheque \$45.00. March 18th, cheque \$250.00. March 31st, cheque \$175.00. March 31st, goods returned \$150.00.

2. William Robertson on account with A. H. Jones & Co.

Debits. May 2nd, 1918, 5 lb. roast of beef at 23¢ lb. May 4th, 2 lbs. butter at 45¢, 3 lbs. sausages at 28¢ per lb. May 6th, 5 lbs. chicken at 32¢ a lb. May 8th, 3 lbs. fish at 29¢ a lb. May 10th, 2 lbs. steak at 35¢ per lb. May 12th, 3 lbs. bacon at 65¢ per lb., 4 dozen eggs at 47 cents. May 15th, 6 lbs. lamb at 30¢. May 18th, 3 lbs. butter at 47¢ a lb., 5 lbs. roast beef at 27¢ a lb.

Credits. May 4th, cash \$2.50. May 11th, cash \$5.00. May 18th, cash \$5.00.

3. R. A. Smith opens an account with the Lunenburg Clothing Company, Ltd.

Make out an account showing the following items and balance the account at the end of the month :

May 3rd, 1 suit of clothes \$56.00, 3 shirts at \$3.50 each, 4 pairs of socks at 75 cents a pair. May 10th, raincoat \$25.00, rubbers \$2.50, half a dozen handkerchiefs at 2 for 35 cents. May 15th, paid cash on account \$40.00. May 17th, 1 pair shoes at \$7.50 per pair; paid cash on account \$15.00. May 26th, 1 straw hat \$3.75, 3 suits of underwear \$1.50 each; paid cash on account \$25.00.

4. W. A. Ross bought of the Western Lumber Company of Revelstoke, B. C., the following goods. An account was opened and the following items appeared for March :

March 8th, 28 boards 12 feet by 1 foot by 2 inches, 48 pieces 2" x 4" and 14 feet long; price of lumber \$27.50 per thousand feet. March 15th, 12 bundles of shingles containing 250 to the bundle at \$6.75 per thousand; 24 planks 12 feet long,

14 inches wide, and 2 inches thick, costing \$28.00 per thousand feet ; paid on account, \$35.00. March 24th, 75 scantlings 12 feet long, 6 inches wide, and 4 inches thick at \$25.00 per thousand feet ; 38 boards 16 feet long, 6 inches wide, and 1 inch thick at \$32.00 per thousand ; paid in cash \$50.00 on account.

Write out the account in correct form and balance the account at the end of the month.

5. The Western Lumber Company of Edmonton bought from the Revelstoke Lumber Company, Limited :

May 2nd, 2700 feet of pine at \$52.00 per thousand ; 12,570 feet of spruce at \$23.00 per thousand. May 14th, 8400 cedar posts at \$9.50 per hundred ; 38 bundles of shingles each bundle containing 250 at \$4.75 per thousand. May 20th, paid on account \$145.00. May 28th, 5600 feet of spruce at \$23.00 per thousand ; 8500 feet of fir at \$35.00 per thousand. May 31st, paid balance of account in full.

EXERCISE

1. Telegraph poles are placed 80 yards apart along a railway. A passenger riding on a train notices that a pole is passed every 5 seconds. How fast is the train travelling per hour?

2. If 1 head of stock requires 3 tons of hay to winter, and a horse requires 15 lbs. of hay and 2 gallons of oats per day, what will it cost to winter 225 head of cattle and 18 horses during the winter season of 18 weeks? Hay is worth \$26.00 per ton and oats 72 cents per bushel.

3. A box with a cover is 2 feet long, 2 feet wide, and 2 feet deep on the outside and is made of boards 1 inch thick. How many feet of lumber are required to make it? What are the contents of the interior of the box in cubic inches?

4. A man plows a field 160 rods long and 80 rods wide with a plow turning a 16-inch furrow. How far does he travel in plowing this field?

5. A farmer delivered the following grain at the elevator : 155,160 lbs. of wheat, 148,784 lbs. oats, and 99,680 lbs. of barley. He received the following prices for his grain : wheat \$1.89 per bushel, oats 78 cents per bushel, and barley \$1.27 per bushel. Find the total amount received for the grain.

6. A farmer sold his hay at \$19.50 per ton. He sold three loads ; the first weighed 2975 lbs., the second weighed 3065 lbs., and the third 3225 lbs. If the weight of the wagon in each case was 1085 lbs., find the total amount received for the hay.

7. A man builds a close board fence about his garden which is 100 feet wide and 150 feet long. The fence is 5 feet high. What will the boards in the fence cost at \$17.50 per thousand feet? Find the cost of painting both sides of the fence at 18 cents per square yard.

8. Rule and make out in correct form the following account : William Robinson bought of The John Carson Furniture Co., Moncton, N. B.

May 2nd, 6 dining chairs at \$18.00 each, 1 sideboard at \$38.00, 2 enamel beds at \$28.00 each, 4 living room chairs at \$65.00 each. May 10th, 54 yards of carpet at \$3.50 per yard. May 15th, 20 yards of linoleum at \$1.45 per yard.

The following payments were made on account :

May 7th, cash \$38.00. May 15th, cash \$50.00. May 21st, cash \$65.00. May 28th, cash \$55.00. Find the balance due on May 31st.

9. A man has 35 acres in alfalfa. He cuts 3 crops. From the first he secures an average yield of 2650 lbs. per

acre, the second cutting 2200 lbs. per acre, and the third 1975 lbs. per acre. He sells the crop at \$27.00 per ton. Find the total amount of money realized from the 35 acres.

10. Make out the following bill in correct form. Find the total cost of the products and receipt the bill.

William Smith purchased from J. R. May & Co., Yarmouth :
April 2nd, 1 piece bacon weighing 3 lbs. 12 ozs. at 49 cents a lb., 3 lbs. butter at 54 cents a lb. April 3rd, $3\frac{1}{2}$ lbs. steak at 28 cents a lb., 4 dozen eggs at 38 cents per dozen, 240 lbs. potatoes at \$1.75 per bushel. April 7th, 13 lbs. 8 ozs. ham at 48 cents per lb., $2\frac{1}{2}$ lbs. cheese at 38 cents per lb. Payment was made in full on April 15th.

EXERCISE

1. In 1919 there were 35,964 motor car licenses issued in the Province of Alberta. What was the revenue derived from these licenses by the Provincial Government, if the average license fee was \$18.75?

2. A man has a field $\frac{1}{2}$ mile long and 40 rods wide sowed in wheat. He finds that the average yield from this field is 27 bushels per acre. If he sells the wheat at \$1.95 per bushel, what does he receive for his crop?

3. What is the cost of painting both sides of a tight board fence enclosing a garden 60 feet long and 35 feet wide? The fence is 6 feet high, and the paint costs \$6.75 per gallon. 1 gallon of paint will cover 350 square feet.

4. How many bricks 8" by 4" by 2" will be required for the walls of a brick house 30 feet 6 inches long, 26 feet wide, and 28 feet high? The walls are 2 bricks in thickness. Allowance must be made for 250 square feet of openings; this should be deducted. Find the cost of the bricks at \$23.00 per thousand.

5. Two boys having the same ability attend the same public school. One boy stopped school at the age of 14 and went to work ; the other attended high school for 4 years until he was 18 years of age, when he went to work. When each was 30 years old, it was found that the first boy had earned \$10,320, while the second boy who had attended school 4 years longer had earned \$15,920.

Find the average earnings of each boy per year, from the time he left school until he was 30 years old.

For each year of high school what is the increase of the yearly earning power of the boy? .

6. A steamer on a voyage of 2400 miles 96 rods goes on an average 14 miles, 92 rods, 3 yards per hour. How many days will it take to complete the voyage?

7. Find the amount of the following bill of grain :

4,284 lbs. oats	at	69 cents per bushel
21,480 lbs. wheat	at	\$1.78 per bushel
10,024 lbs. rye	at	\$1.75 per bushel
11,520 lbs. barley	at	\$1.19 per bushel

8. A young man, who attended college from October 1st to April 30th, spent the following amounts : board and room, \$245.00 ; fees and books \$91.00 ; clothing \$105.00 ; laundry \$22.40 ; athletic fees and expenses \$21.00 ; incidentals \$31.50. What were his average monthly expenses?

9. A wholesale merchant in Winnipeg wishes to ship 15,650 lbs. of merchandise from Winnipeg to Brandon, by the cheapest means. He has two choices : 1st, to ship by open freight at the rate of 27 cents per cwt., plus cost of cartage which amounts to 6 cents per cwt. ; 2nd, to ship by carload paying a flat rate of \$35.00 per carload with an additional cartage charge of \$8.00. Which is the cheaper way and by how much?

EXERCISE

1. Lead weighs 11 times as much as water, and 1 cubic foot of water weighs 1000 ounces. Find the weight in lbs. and ozs. of a bar of lead 8 feet long, 2 inches wide, and $\frac{1}{2}$ inch thick.
2. A school-room is 32 feet long, 28 feet wide, and 10 feet high. There are 40 pupils in attendance. How many cubic feet of air space does this provide for each pupil? How many cubic feet per pupil does your own classroom provide?
3. On a certain day a coal dealer made the following deliveries of coal: 2240 lbs., 2573 lbs., 3425 lbs., 2843 lbs., 5359 lbs., and 2560 lbs. The coal was sold at \$4.85 per ton. What was the total amount of the sales?
4. A farmer delivered 4 loads of wheat at the elevator. The weights of the loads were as follows: 2356 lbs., 2754 lbs., 2580 lbs., and 2690 lbs. He was paid \$1.79 cents per bushel. What amount did he receive for the wheat?
5. A rug 14 feet long and 12 feet wide is laid on the floor of a room, leaving a margin of floor uncovered all about the room 2 feet wide. What is the total area of the floor of the room? What would it cost to lay a hardwood floor in this room, if the flooring costs \$2.25 per square yard?
6. What must be the length of a coal bin 6 feet high and 5 feet wide, which will hold 10 tons of coal? One ton of coal requires 33 cubic feet of space.
7. A farmer raised 18,000 lbs. of potatoes from a field 20 rods long and 16 rods wide. What was the yield in bushels per acre from this crop?
8. On March 30th, 1918, the following stocks of wheat were in Canada: In elevators 20,525,213 bushels; in flour mills 4,802,236 bushels; in transit by rail 20,011,179

bushels; in the hands of farmers 31,684,700 bushels. If the average price of wheat was \$1.79, what was the total value of the wheat supply in the country?

9. A close board fence 4 feet high is built around a garden 50 feet long and 40 feet wide. The boards are nailed to two lines of scantlings 2" by 4". The posts are placed 10 feet apart and cost 25 cents each. Find the total cost of the lumber in the fence at \$38.00 per thousand feet.

EXERCISE

1. Reduce each of the following to yards:
 - (a) 43 rods 2 yards
 - (b) 151 rods 1 yard
 - (c) 5780 feet
 - (d) 15,280 feet
2. Reduce each of the following to rods:
 - (a) 16,780 feet
 - (b) 4840 yards
3. An aviator makes an altitude of 28,000 feet. Find the height in miles, rods, and yards.
4. Reduce to acres:
 - (a) 76,840 square yards
 - (b) 1670 square rods
5. A man put a 3 strand wire fence about his farm, which has 160 rods frontage and is 20 rods deep.
 1. Find the number of yards of wire used in the fence.
 2. At 7 cents a foot for wire, find the cost of the fence.
6. If a bushel contains 2160 cubic inches, how many bushels of grain will there be in a grain bin 15 feet long, 10 feet wide, and 8 feet high?

7. If 1 cubic foot of water weighs 1000 ounces, find the weight in tons, cwt., and lbs., of the water that has fallen on a field 80 rods wide and 160 rods long, if the rainfall is $\frac{1}{2}$ an inch.
8. A man is paid 55 cents an hour. Find how much he would earn in a month of 25 working days, if he works 8 hours each day, except Saturday, when he works 5 hours, and there were four Saturdays in the month.
9. A man ploughs 5 acres a day. How far has he travelled at the end of the day, if each furrow ploughed is 18 inches wide?
10. A man borrowed some money on April 12th, 1918 and repaid it on September 29th, 1918. How many days did he have the money?

EXERCISE

1. If 1 ton of coal requires 33 cubic feet of space, find the number of cubic feet of a ship's hold that will be required to store the coal for an Atlantic Liner that burns 242 tons of coal per day and carries a 15 days' supply on the trip.
2. A roadway 36 feet wide is built along the four sides of a city block 800 feet long and 350 feet wide. Find the cost of making the road at \$1.75 per square yard.
3. Find the cost of excavating the basement of a building 50 feet wide and 120 feet long. The basement is 9 feet deep. The cost of excavating is 47 cents per cubic yard. What will be the cost of making a cement floor over the entire basement at 57 cents per square yard?
4. Find the cost of the shingles for the two sides of the roof of a barn, each side of the roof being 80 feet long and 35 feet wide. It requires 1000 shingles to cover 100 square feet. Shingles are put up in bundles of 250 each, and the cost is \$6.75 per thousand.

5. Find the cost of the carpet for the floor of a room 15 feet long and 12 feet wide. The carpet is laid lengthwise in strips 30 inches wide. The carpet costs \$4.75 per yard.

6. Find the cost of laying a hardwood floor in a living room 18 feet long and 14 feet wide at \$1.75 per square yard.

7. What will it cost to carpet the same room with carpet at \$3.95 per yard, if the carpet is laid lengthwise, and a strip of carpet is 30 inches wide? (A strip of carpet is not cut, but is turned under if too wide.)

8. Sound travels at the rate of 1120 feet per second. How far distant is a thunderstorm, when the time between the flash of lightning and the thunder is 8 seconds? Give your answer in miles and feet.

9. Find the cost of plastering the walls and ceiling of a room 15 feet long, 14 feet wide, and 10 feet high. There are three windows in the room each 6 feet by 4 feet, and 2 doors each 8 feet high and 5 feet wide, and one-half the area of the openings is deducted. The cost of plastering is 18 cents per square yard.

10. Find the cost of the following lumber, making out the bill in correct form and using your own choice of names and dates: 28 boards 18 feet long and 10 inches wide, the lumber being 1" lumber, at \$35.00 per thousand feet; 15 scantlings 12 feet long, 4" wide and 4" thick at \$28.00 per thousand feet; 18 joists 12 feet long, 6" wide and 2" thick at \$30.00 per thousand feet; 38 bundles of shingles containing 250 shingles each at \$6.00 per thousand.

CHAPTER II
FACTORS, MEASURES, TESTS OF DIVISIBILITY,
CANCELLATION, MULTIPLES

I. Factors

Definition:

When two or more numbers are multiplied together, they make a product. These numbers which make up the product are called factors.

$$4 \times 3 = 12.$$

4 and 3 are factors of 12.

$$2 \times 3 \times 5 = 30.$$

2 and 3 and 5 are factors of 30.

The multiplicand and multiplier are factors of the product.

Factoring is the process of breaking up a number or a product into its factors.

Thus

$$27 = 3 \times 9.$$

$$105 = 3 \times 5 \times 7.$$

A *Prime Factor* or a *Prime Number* is a number that is not exactly divisible by any whole number except 1 and itself.

Thus 1, 2, 3, 5, 7, 11, 13, etc. are prime numbers.

EXERCISE — ORAL

1. Give 2 factors of : 15 ; 35 ; 36 ; 77 ; 63 ; 21.
2. Give 3 factors of : 12 ; 30 ; 66 ; 20 ; 42 ; 56.

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3. If 3 is one factor, what is the other factor of 21; 45; 36; 24; 18; and 33?

4. If 12 is one factor, what is the other factor of 60; 48; 72; 96; 24; and 108?

EXERCISES — WRITTEN

Find the second factor in each of the following:

	<i>Factor</i>	<i>Product</i>	<i>Other Factor</i>
1.	9	63	
2.	7	105	
3.	11	132	
4.	17	153	
5.	23	161	
6.	29	145	
7.	13	520	
8.	31	341	
9.	37	333	
10.	43	559	

EXERCISE — ORAL

Give the prime factors of the following: 15; 18; 35; 28; 42; 56.

Example: To find the prime factors of a large number, for example, 156.

$$\begin{array}{r}
 2 \overline{) 156} \\
 \underline{2 } \\
 3 \\
 \underline{3 } \\
 13 \\
 \underline{13} \\
 1
 \end{array}$$

Divide first by 2, a prime number; then again by 2; then by 3, another prime number. Continue the division by prime numbers.

The prime factors are $2 \times 2 \times 3 \times 13$.

Rule: To find the prime factors of any number, divide the number by prime factors and continue this division until the final quotient is a prime number.

EXERCISE — WRITTEN

Find the prime factors of the following numbers :

	<i>a.</i>	<i>b.</i>	<i>c.</i>	<i>d.</i>
1.	28	32	33	48
2.	65	66	72	96
3.	35	36	39	147
4.	49	52	54	108
5.	77	78	81	144
6.	84	88	91	186
7.	165	336	392	297
8.	189	195	396	715
9.	170	105	396	1463
10.	168	576	315	1365

Definition :

If a number is a factor of *two* or *more* numbers, it is called a *Common Factor*.

2 is a common factor of 4 and 14.

7 is a common factor of 21 and 35.

EXERCISE

Find the common factors of each of the following pairs of numbers :

1. 16 and 24

4. 39 and 52

2. 36 and 42

5. 84 and 210

3. 21 and 56

6. 78 and 195

The largest factor that is a common factor of two or more numbers is called the *Highest Common Factor* or *H. C. F.* of the numbers.

Thus 9 is the H. C. F. of 27 and 36.

To find the Highest Common Factor of two or more numbers:

Find the prime factors of the given numbers. The product of the prime factors that are common to all the numbers is the Highest Common Factor of the numbers.

1. Find the Highest Common Factor of 48, 72, and 96.

$$48 = 2 \times 2 \times 2 \times 2 \times 3$$

$$72 = 2 \times 2 \times 2 \times 3 \times 3$$

$$96 = 2 \times 2 \times 2 \times 2 \times 2 \times 3$$

The factors common to 48, 72, and 96 are $2 \times 2 \times 2 \times 3$.

The product of these factors, 24, is the Highest Common Factor.

EXERCISE

Find the Highest Common Factor of the following:

- | | | | | | | |
|-------|----|----|-------|-----|-----|-------------------|
| 1. 16 | 20 | 24 | 5. 81 | 108 | 162 | 9. 309 and 315 |
| 2. 26 | 78 | 52 | 6. 42 | 63 | 147 | 10. 1908 and 2736 |
| 3. 19 | 76 | 95 | 7. 56 | 96 | 128 | |
| 4. 36 | 54 | 72 | 8. 45 | 75 | 90 | |

II. Measures

1. Find the common factors of 248 and 356. Ascertain whether each common factor of 248 and 356 is also a factor of 108, their difference.

2. Write two numbers having a common factor. Find their sum and their difference and discover whether the common factor of the two numbers is a factor of their sum and also of their difference.

3. Write two numbers having a common factor. Take any multiple of one of them and find whether the common factor of the two numbers is a factor of the difference between this multiple and the other number.

It will thus be seen that a common factor of two numbers is also a factor of the difference between the numbers, or of the sum of the difference between a multiple of one of them and the other.

To find the Highest Common Factor when the numbers are large:

Example: Find the H. C. F. of 52 and 91.

$$\begin{array}{r} 52)91(1 \\ \underline{52} \\ 39)52(1 \\ \underline{39} \\ 13)39(3 \\ \underline{39} \end{array}$$

13 is a divisor of 39 and therefore of 13 plus 39 or 52. Since it divides 39 and 52, it also divides 39 plus 52 or 91; 13 is, therefore, a divisor or factor of 52 and 91. It is also the Greatest Common Factor. If not, let a greater number divide 52 and 91; it will then divide 39, their difference, and dividing 39 and 52 it will also divide their difference, or 13. That is, a greater number than 13 will divide 13, which is impossible; 13 is therefore the Greatest Common Divisor, or H. C. F., of 52 and 91.

Hence to find the H. C. F. of two numbers:

- (1) Divide the greater number by the less.
- (2) Divide the less by the remainder.
- (3) Divide the first remainder by the second and continue this process, always dividing the last divisor by the last remainder. The last remainder which divides the preceding divisor is the *Greatest Common Divisor*, or *Highest Common Factor*.

EXERCISE

Find the H. C. F. of:

- | | |
|------------------|---------------------|
| 1. 115 and 161 | 7. 6006 and 3318 |
| 2. 333 and 592 | 8. 2871 and 4213 |
| 3. 697 and 820 | 9. 43902 and 49593 |
| 4. 392 and 672 | 10. 23940 and 28350 |
| 5. 405 and 900 | 11. 32480 and 44544 |
| 6. 1220 and 2013 | 12. 18577 and 40012 |

To find the H. C. F. of more than two numbers:

First find the H. C. F. of two of them; then find the H. C. F. of the common factor thus found and a third number; and so on through all the numbers. The last common factor found will be the H. C. F. of all the numbers.

EXERCISE

Find the H. C. F. of:

- | | |
|------------------------|---------------------|
| 1. 1435; 1064; 2135 | 3. 4795; 3395; 6048 |
| 2. 14385; 20391; 49287 | 4. 5463; 6677; 7891 |

EXERCISE

1. A land-owner has three fields containing 24 acres, 18 acres, and 42 acres. He wishes to cut them into smaller fields of an equal number of acres each, but the largest possible. How large will the fields be?

2. Three men living on a new street own land fronting as follows: A, 600 ft.; B, 720 ft.; C, 900 ft. They wish to cut their land into lots of an equal width. How wide will the lots be and how many will each have, if they are as wide as possible?

3. Three rooms are 120, 132, and 156 inches wide, respectively. What is the width of the widest boards that will exactly floor each room?

4. A and B purchased horses at the same rate per head. The value of A's horses was \$623.00 and of B's, \$1068.00. How many horses did each buy?

5. Find the largest and the smallest numbers that will divide 64,610 and 72,204, leaving as remainders 27 and 23, respectively.

6. What is the greatest equal length into which three trees can be cut, the first being 84 ft. long, the second, 105 ft., and the third, 119 ft.

III. Tests of Divisibility

There are some easy tests of divisibility of certain numbers that should be known. These are as follows :

1. A number is exactly divisible by 2, if it ends in 0 or in an even number.
2. A number is exactly divisible by 4, if the number represented by the two right-hand digits is exactly divisible by 4, or if the last two digits are zeros.
3. A number is exactly divisible by 5, if it ends in 5 or 0.
4. A number is exactly divisible by 3, if the sum of its digits is exactly divisible by 3.
5. A number is exactly divisible by 9, if the sum of its digits is exactly divisible by 9.
6. A number is exactly divisible by 8, if the number represented by the three right-hand digits is exactly divisible by 8, or if the last three digits are zeros.
7. A number is exactly divisible by 6, if it is an even number, and if the sum of its digits is exactly divisible by 3.

IV. Cancellation

Simplify 12×18 divided by 4×6 .

$(12 \times 18) \div (4 \times 6)$ is the same as

$$\begin{array}{r} 1 \\ 2 \quad 9 \\ \hline 12 \times 18 = 9 \\ 4 \times 6 \\ 2 \quad 1 \\ 1 \end{array}$$

Explanation.

Select common factors from dividend and divisor.

6 is a common factor of 12 and 6

2 is a common factor of 18 and 4

2 is a common factor of 2 and 2

The quotient is the product of the remaining factors of the dividend divided by the product of the remaining factors of the divisor, after the cancellation of all common factors.

EXERCISE

1. Simplify each of the following :

$$\frac{9 \times 7}{3 \times 7} = \quad , \quad \frac{7 \times 5 \times 120}{7 \times 4 \times 30} = \quad , \quad \frac{15 \times 20 \times 25}{30 \times 50} = \quad .$$

2. Simplify $(25 \times 36 \times 11) \div (55 \times 4)$.

3. Simplify $(24 \times 27 \times 32) \div (36 \times 48)$.

4. Find the value of : $\frac{18 \times 22 \times 35 \times 42}{49 \times 33 \times 15}$.

5. Divide the product of 20, 35, and 60 by the product of 14, 15, and 25.

6. A farmer exchanged 8 barrels of apples for 240 lbs. of sugar at 12 cts. a pound. Find the selling price of the apples.

7. If 128 dozen eggs pay for 56 yards of cloth at 96 cents per yard, what is the price of the eggs?

8. If 240 sheep are exchanged for 25 horses at \$144.00 each, what is each sheep worth?

9. A man worked 8 days and received in payment 24 bushels of potatoes worth 96 cents a bushel. How much did he earn each day?

10. How many tubs of butter weighing 54 lbs. each, worth 42 cents a pound, will pay for 378 yards of cloth which sells at 30 cents a yard?

11. At what price per dozen must 260 dozen eggs be sold to pay for 78 yards of silk at 95 cents per yard?

12. Divide the product of 8, 15, 24, 42, 65, and 77 by the product of all the prime numbers less than 15.

13. If a farmer raises 1050 bushels of wheat on a 30-acre field, how many bushels should he raise at the same rate from 96 acres?

V. Multiples

Definition:

Instead of saying that one number may be divided by another number exactly, we sometimes say that the first number is a *Multiple* of the second number.

For example: 18 is a multiple of 3, 6, and 9.

ORAL EXERCISE

1. Name 3 multiples of each of the following numbers: 5, 7, 8, 9, and $2\frac{1}{2}$.
2. What are the following numbers multiples of: 35, 48, 27, 63, 56?
3. Name all the multiples of 2 of the numbers from 4 to 40 inclusive.
4. Name all the multiples of 3 of the numbers from 6 to 57 inclusive.
5. 38 is a multiple of what *two* factors?

Definition:

When a number is exactly divisible by two or more numbers it is said to be a *Common Multiple* of these numbers.

For example: 42 is a common multiple of 6 and 7.
105 is a common multiple of 3, 5, and 7.

Definition:

The smallest number that is exactly divisible by two or more numbers is called the *Least Common Multiple* (L. C. M.) of those numbers.

For example: 105 is the L. C. M. of 21 and 35.

ORAL EXERCISE

1. Name *four* numbers that contain both 2 and 7 as factors.

2. Name *four* numbers that contain both 3 and 5 as factors.

3. Name the *Least Common Multiple* of each of the following pairs of numbers :

4 and 7

6 and 9

5 and 11

7 and 8

9 and 12

3 and 7

To Find the Least Common Multiple of Two or More Numbers

Example: To find the L. C. M. of 56, 60, 84, and 112.

Factor each of the numbers.

$$56 = 2 \times 2 \times 2 \times 7$$

$$60 = 2 \times 2 \times 3 \times 5$$

$$84 = 2 \times 2 \times 7 \times 3$$

$$112 = 2 \times 2 \times 2 \times 2 \times 7$$

The Least Common Multiple of these numbers must be a number which will contain all the prime factors of each of the numbers.

2 will be a factor of the L. C. M. repeated *four* times, since 112 contains 2 as a factor repeated *four* times.

3 will be a factor of the L. C. M. *once* since 60 and 84 contain 3 as a factor *once*.

5 will be a factor of the L. C. M. *once* since 60 contains 5 as a factor *once*.

7 will be a factor of the L. C. M. *once* since 56, 84, and 112 each contains 7 as a factor *once*.

The L. C. M. is $2 \times 2 \times 2 \times 2 \times 3 \times 5 \times 7$, or 1680.

The work of factoring may be put down in shortened form.

2	56, 60, 84, 112
2	28, 30, 42, 56
2	14, 15, 21, 28
3	7, 15, 21, 14
7	7, 5, 7, 14
	1, 5, 1, 2

Divide by prime factors beginning with the lowest. Continue the division so long as there are common factors.

L. C. M. is $2 \times 2 \times 2 \times 2 \times 3 \times 5 \times 7$.

EXERCISE

1. Find the L. C. M. of 12, 15, 20, and 18.
2. Find the L. C. M. of 5, 15, 7, and 35.
3. Find the L. C. M. of 36, 72, 60, and 84.
4. Find the L. C. M. of 11, 7, 21, 28, and 66.
5. Find the L. C. M. of \$2.00, \$3.00, \$4.00, \$5.00, \$20.00, and \$50.00.

REVIEW EXERCISES

1. Find the H. C. F. and the L. C. M. of 32 and 80.
2. Find the H. C. F. and the L. C. M. of 42 and 49.

Find the H. C. F. and the L. C. M. of the following sets of numbers :

- | | |
|---------------|--------------------|
| 3. 64 and 224 | 6. 12, 15, and 54 |
| 4. 68 and 187 | 7. 24, 36, and 204 |
| 5. 21 and 231 | 8. 18, 54, and 144 |

Find the prime factors of the following numbers :

- | | | |
|----------|----------|------------|
| 9. 2730 | 11. 6270 | 13. 3828 |
| 10. 7140 | 12. 7245 | 14. 14,091 |

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Find the Least Common Multiple of the following sets of numbers :

15. 16, 80, and 960

17. 16, 96, and 108

16. 18, 66, and 242

18. 21, 63, and 399

19. A room is twice as long as it is wide and contains 288 square feet of flooring. Find the dimensions of the room.

20. Divide \$60.00 between two boys, so that the first boy will receive half as much again as the second.

21. How many times is the H. C. F. of 32, 72, and 192 contained in their L. C. M. ?

22. The divisor and quotient are equal, and the remainder which is the greatest possible is 382. Find the dividend.

23. Find the number of boards of the greatest possible equal length each that will be required to enclose a field 2002 feet long and 1470 feet wide. The fence is straight and 6 boards high.

GENERAL REVIEW

EXERCISE

1. Divide \$20.00 between A and B, giving to B half as much again as to A.

2. Find the prime factors of 5005.

3. A room twice as long as it is broad contains 162 sq. ft. of flooring. Find its length and breadth.

4. Find all the common divisors of 560 and 840.

5. Divide 2520 by 280 by resolving each number into its prime factors and cancelling the common factors.

6. The sum of the products of 7 and two other numbers is 231. Find the sum of the three numbers.
7. If the multiplier is 704 and the product is 217,536, find the multiplicand.
8. A cistern is 6 ft. long, 4 ft. wide, and 8 ft. deep. How many additional cubic feet of earth must be removed to make it 7 ft. long, 6 ft. wide, and $8\frac{1}{2}$ ft. deep?
9. A house is 44 ft. long and 21 ft. wide, outside measurement. What will it cost to put two floors in it of $\frac{1}{2}$ in. lumber, the walls being 18 in. thick, and lumber being worth \$60.00 per M?
10. The divisor and quotient are equal, and the remainder, 907, is the largest possible. Find the dividend.
11. How many rails will enclose a rectangular field 1859 ft. long by 1365 ft. wide, the fence being straight, six rails high, the rails of equal length and the longest that can be used?
12. Find the prime factors of 8400, 3820, and 1380, and from these write down the H. C. F. and the L. C. M. of these numbers.
13. Find the least amount of tea which can be put up in packets of $\frac{1}{2}$ lb., $\frac{3}{4}$ lb., $1\frac{1}{2}$ lbs., or $2\frac{1}{2}$ lbs.
14. A rectangular court 42 ft. 6 in. long and 31 ft. 8 in. wide is to be paved with square tiles of equal size and as large as possible. How many tiles will be required?
15. Find all the divisors of 360.
16. Resolve the numbers 3252 and 4248 into prime factors, and from these write down the following:
 - (a) All the common divisors.
 - (b) The greatest common divisor.
 - (c) The least common multiple.

17. A wooden pillar is 2 ft. square and 84 ft. high. Find how many cubic feet of wood it contains and its weight, if a cubic foot of wood weighs 30 lbs.

18. How high is a square pillar, each side being 18 in. long, if it weighs 360 lbs. and the wood weighs 24 lbs. to the cubic foot?

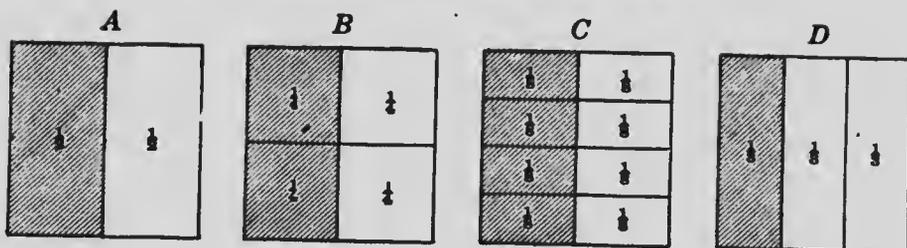
19. A boy buys a kodak for \$5.00. His films cost 45 cts. for 12 pictures, and it costs 3 cts. to develop and print each picture. Each picture sells for 10 cts. Find the profit on 8 doz. pictures, if none are spoiled.

20. The lumber of a packing case 6 ft. long, 4 ft. 6 in. wide, and 3 ft. 4 in. deep cost \$3.10. What did the lumber cost per M?

CHAPTER III

FRACTIONS

Common or Vulgar Fractions



ORAL EXERCISE

When anything is divided into 2 equal parts, what is each part called?

What is each part called when it is divided into 4 equal parts? into 8 equal parts? into 3 equal parts? into 6 equal parts? into 5 equal parts?

We write these as $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{3}$, $\frac{1}{6}$, $\frac{1}{5}$.

In Figure B we see that if we divide $\frac{1}{2}$ into 2 equal parts, we get $\frac{1}{4}$.

That is,

$$\frac{1}{2} \text{ of } \frac{1}{2} = \frac{1}{4}$$

$$\frac{1}{4} + \frac{1}{4} = ?$$

In Figure C we divided $\frac{1}{2}$ into 4 equal parts, and each part is called $\frac{1}{8}$.

That is,

$$\frac{1}{4} \text{ of } \frac{1}{2} = \frac{1}{8}$$

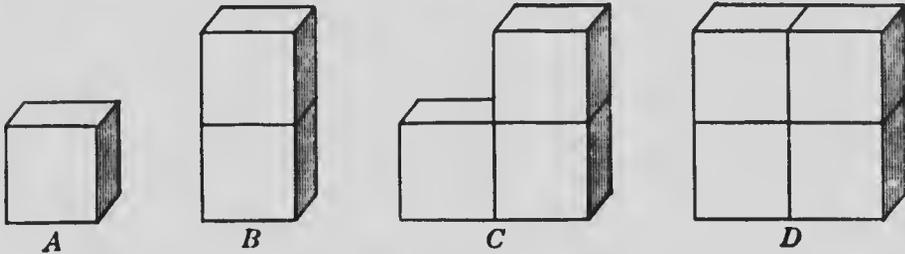
$$\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = ?$$

In Figure C each $\frac{1}{4}$ is divided into 2 equal parts, and each part is called $\frac{1}{8}$.

That is,

$$\frac{1}{4} \text{ of } \frac{1}{4} = \frac{1}{8}$$

$$\frac{1}{8} + \frac{1}{8} = \frac{1}{4}$$



ORAL EXERCISES

Consider the Figures A, B, C, and D.

A is what part of B? of C? of D?

B is what part of C? of D?

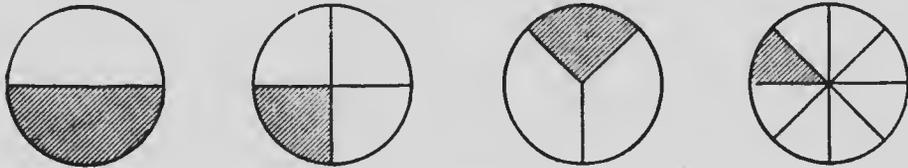
C is what part of D?

If we call D 1, then we shall call A 1 quarter, B 2 quarters, C 3 quarters.

If we call A 1, then we shall call B 2, C 3, and D 4.

If B is called 1, what shall we call A? C? D?

If C is called 1, what shall we call A? B? D?



ORAL EXERCISES

If we divide a circle into two equal parts, what do we call each part?

If we divide a circle into 4 equal parts, each part is called a $\frac{1}{4}$.

How many quarters are there in the whole circle?

If we took three of these equal parts, we would have 3 quarters of the circle.

This is written $\frac{3}{4}$.

If we take 2 of these equal parts, we have 2 quarters.

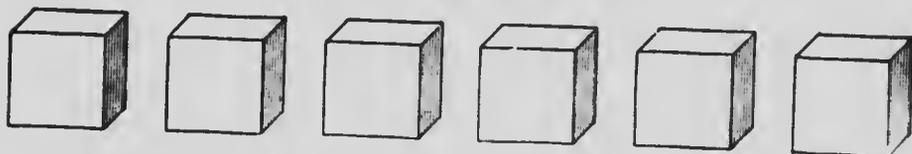
This is written $\frac{2}{4}$.

If we divide a circle into 3 equal parts and take 2 of them, how much of the circle have we?

This is written $\frac{2}{3}$.

If we divide a circle into 8 equal parts and take 3 of them, 4 of them, 5 of them, 7 of them, 6 of them, 2 of them, how much of the circle have we?

These are written : $\frac{3}{8}$ $\frac{4}{8}$ $\frac{5}{8}$ $\frac{7}{8}$ $\frac{6}{8}$ $\frac{2}{8}$.



To find a fraction of a number of units:

We have six cubes. Let us divide these into two groups. There are three in each group. The group 6 has been divided into 2 equal groups. Each of the smaller groups is *one-half* the larger group. Then $\frac{1}{2}$ of 6 is 3.

Similarly if we had 10 objects and divided these into 5 groups with the same number in each group, each of the smaller groups would contain 2 objects. Each of the smaller groups is one-fifth the larger group.

$\frac{1}{5}$ of 10 is 2. $\frac{2}{5}$ of 10 is 4. $\frac{3}{5}$ of 10 is 6.

DRILL EXERCISES

1. What is $\frac{1}{2}$ of 12? $\frac{1}{3}$ of 15? $\frac{1}{3}$ of 18? $\frac{1}{4}$ of 20?
 $\frac{1}{4}$ of 18? $\frac{1}{11}$ of 33? $\frac{1}{3}$ of 27?

2. What is $\frac{1}{2}$ of 12? $\frac{2}{3}$ of 15? $\frac{3}{4}$ of 16? $\frac{4}{5}$ of 25?
 $\frac{5}{6}$ of 36? $\frac{6}{7}$ of 54? $\frac{7}{8}$ of 60?

3. One unit = $\frac{2}{2} = \frac{3}{3} = \frac{4}{4} = \frac{5}{5} = \frac{6}{6} = \frac{7}{7} = \frac{8}{8} = \frac{9}{9} = \frac{10}{10} = \frac{11}{11} = \frac{12}{12} = \frac{13}{13} = \frac{14}{14} = \frac{15}{15} = \frac{16}{16} = \frac{17}{17} = \frac{18}{18} = \frac{19}{19} = \frac{20}{20}$.

4. Show by drawings or by cutting a square of paper the following: $\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{5}{10} = \frac{6}{12} = \frac{7}{14} = \frac{8}{16}$.

5. $\frac{1}{3} = \frac{2}{6} = \frac{3}{9} = \frac{4}{12} = \frac{5}{15} = \frac{6}{18}$.

6. $\frac{1}{4} = \frac{2}{8} = \frac{3}{12} = \frac{4}{16} = \frac{5}{20} = \frac{6}{24}$.

7. Arrange in order of magnitude beginning with the largest fraction: $\frac{1}{3}, \frac{1}{5}, \frac{1}{2}, \frac{1}{7}, \frac{1}{8}, \frac{1}{4}, \frac{1}{6}, \frac{1}{15}$.

8. Arrange in order of magnitude, beginning with the smallest fraction: $\frac{3}{4}, \frac{5}{8}, \frac{1}{2}, \frac{2}{3}, \frac{3}{5}, \frac{7}{8}, \frac{9}{10}, \frac{7}{8}, \frac{8}{9}$.

Prove your result by drawing squares and dividing them into the fractional parts, and comparing.

Draw a line 5 inches long.

What part of 1 foot is this line?

Draw a line 7 inches long.

What part of 1 foot is this line?

The line 5 inches long is what part of the line 7 inches long?

A man has to make a journey of 12 miles. He has gone 4 miles. What part of his journey is completed?

What part of his journey has he yet to go?

A boy earned \$15 in one month. He spent \$9 of this. What part of his earnings did he spend?

What part of his earnings did he save?

3 ounces is what part of 1 lb.?

10 is what part of 1 dozen?

27 inches is what part of 1 yard?

3 days is what part of 1 week?

25 minutes is what part of 1 hour?

A *unit* is one thing considered as an undivided whole.

A *fraction* is one or more of the equal parts into which a unit has been divided, as: $\frac{1}{2}$, $\frac{2}{4}$, $\frac{5}{8}$, $\frac{7}{8}$, $\frac{1}{3}$, etc.

The *denominator* of a fraction shows the number of equal parts into which the unit has been divided. It is written below the line in writing fractions. 8, 6, 5, 4 are the denominators of $\frac{2}{8}$, $\frac{2}{6}$, $\frac{1}{5}$, $\frac{3}{4}$.

The *numerator* of a fraction shows how many of the equal parts have been taken to make the fraction. The numerator is written above the line. In the fractions, $\frac{5}{8}$, $\frac{4}{7}$, $\frac{1}{3}$, $\frac{7}{7}$, 5, 4, 1, and 7 are the numerators.

The *numerator* and *denominator* are called the *terms* of the fractions.

A *proper fraction* is one whose numerator is smaller than its denominator, as: $\frac{2}{3}$, $\frac{1}{4}$, $\frac{5}{18}$.

A *unit fraction* is a fraction having 1 as numerator.

An *improper fraction* is one whose numerator is equal to or greater than the denominator.

For example: $\frac{5}{8}$, $\frac{7}{7}$, $\frac{12}{9}$.

A *mixed number* is the sum of a whole number and a fraction expressed as one number.

For example: $7\frac{2}{3}$, $3\frac{1}{2}$, $24\frac{1}{4}$.

Read the following:

1. $\frac{5}{8}$, $\frac{3}{4}$, $\frac{11}{12}$, $\frac{7}{15}$, $\frac{2}{3}$, $\frac{3}{7}$, $\frac{8}{5}$, $\frac{11}{8}$.

2. $\frac{15}{4}$, $\frac{75}{100}$, $\frac{28}{38}$, $\frac{37}{25}$, $\frac{17}{50}$, $\frac{281}{300}$.

3. $4\frac{5}{6}$, $28\frac{7}{8}$, $389\frac{4}{15}$, $157\frac{7}{8}$, $36\frac{5}{11}$.

WRITTEN EXERCISE

1. In the preceding examples, arrange the fractions given under the following heads: Proper fractions, improper fractions, and mixed numbers.

2. Write the following fractions or mixed numbers:

- a. Forty-seven sixtieths.
- b. Thirteen thirty-sixths.
- c. Fifteen and four-twelfths.
- d. Eight one-hundredths.
- e. Twenty-five seventy-fifths.
- f. Seventeen nineteenths.

3. Change to improper fractions:

- | | | | |
|--------------------|--------------------|--------------------|--------------------|
| a. $3\frac{1}{2}$ | b. $1\frac{1}{3}$ | c. $9\frac{2}{3}$ | d. $14\frac{5}{8}$ |
| e. $82\frac{1}{2}$ | f. $35\frac{1}{4}$ | g. $11\frac{3}{8}$ | h. $12\frac{3}{4}$ |

4. Change to mixed numbers:

$$\frac{26}{5}, \frac{17}{3}, \frac{24}{7}, \frac{53}{6}, \frac{12}{4}, \frac{256}{12}$$

5. William has 3 oranges. To each of how many boys can he give $\frac{1}{4}$ of an orange?

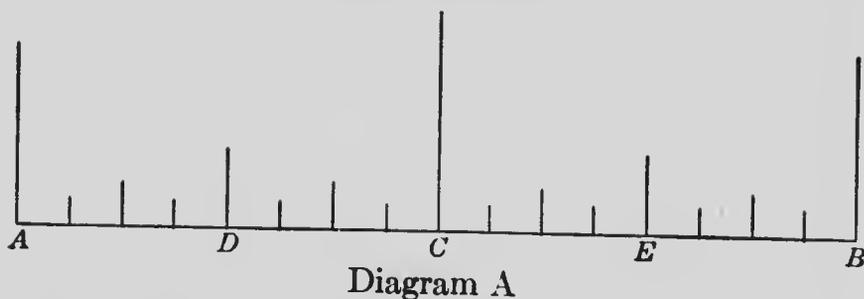
6. A man rode a mile each $\frac{1}{10}$ hour. How far did he ride in $2\frac{3}{10}$ hours?

7. Mary has a ribbon $7\frac{3}{4}$ yards long. She cuts it into pieces each $\frac{1}{4}$ of a yard long. How many pieces will she have?

8. A man gave a quarter out of a five-dollar bill to each of 17 boys. How many quarters has he left?

9. If $\frac{2}{3}$ of a yard of cloth is required for a towel, how many towels can be made from $11\frac{1}{2}$ yards?

10. How many more sixths of a yard are there in $5\frac{3}{4}$ yards than in $4\frac{3}{4}$ yards?



The line AB is divided into 16 equal parts; at C the line is divided into two equal parts. At D and E , AC and CB are each divided into 2 equal parts, and the line AB at D , C , and E is divided into 4 equal parts.

1. What part of the line AB is the line AC ?
2. What part of the line AB is the line AD ?
3. What part of the line AC is the line AD ?
4. Mark on the line the following fractions :

$\frac{3}{4}$, $\frac{4}{8}$, $\frac{5}{16}$, $\frac{1}{2}$, $\frac{7}{8}$, $\frac{1}{4}$, etc.

5. Consider the fractions, $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$. If we multiply the denominators of each of these by 2, we get

$$\frac{1}{2 \times 2} = \frac{1}{4}, \quad \frac{1}{4 \times 2} = \frac{1}{8}, \quad \frac{1}{8 \times 2} = \frac{1}{16}.$$

Compare $\frac{1}{2}$ and $\frac{1}{4}$; $\frac{1}{4}$ and $\frac{1}{8}$; $\frac{1}{8}$ and $\frac{1}{16}$.

By reference to Diagram A, what is the relation of these fractions to each other?

If we multiply the denominator of a fraction, what is the result upon the value of the fraction?

6. Consider the fractions $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$.

Divide the denominators of each of these by 2.

We obtain $\frac{1}{2 \div 2} = \frac{1}{1} = 1$, $\frac{1}{4 \div 2} = \frac{1}{2}$, $\frac{1}{8 \div 2} = \frac{1}{4}$.

Dividing the denominator of a fraction produces what change in the value of the fraction?

7. If we multiply the numerator of a fraction by a number, what change do we make in the value of the fraction?

Show by taking the fractions $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ and multiplying by 2.

8. If the numerator of a fraction is divided by a number, what change is there in the value of the fraction?

Consider again the line AB , Diagram A. It is divided into four equal parts at D , C , and E , and also into 16 equal parts.

$\frac{1}{4}$ is equal to how many sixteenths?

$\frac{3}{4}$ is equal to how many sixteenths?

$$\frac{1}{4} = \frac{4}{16} \quad \frac{4}{16} = \frac{1}{4}$$

$$\frac{3}{4} = \frac{12}{16} \quad \frac{12}{16} = \frac{3}{4}$$

Both terms of the fraction may be multiplied or divided by the same number without changing the value of the fraction.

A fraction such as $\frac{12}{36}$ is said to be reduced to *lower terms* when it is changed to the fraction $\frac{1}{3}$, where it has a smaller denominator.

A fraction is changed to its *lowest terms* when the terms of the fraction have not a common factor.

$$\frac{6}{18} = \frac{1}{3} \quad \frac{14}{21} = \frac{2}{3}$$

To change a fraction to its lowest terms, divide each term by the H. C. F. of these terms.

Example: Reduce $\frac{36}{60}$ to its lowest terms.

Factors of 36 = $2 \times 2 \times 3 \times 3$

Factors of 60 = $2 \times 2 \times 3 \times 5$

Common factors $2 \times 2 \times 3$

$$\text{H. C. F.} = 12$$

Dividing both terms by 12.

$$\frac{36}{60} = \frac{3}{5}$$

The work may be shortened by cancellation of common factors in both terms of the fraction.

EXERCISE

Reduce the following fractions to their lowest terms :

- | | | | | |
|-----------------------|------------------------|------------------------|------------------------|-------------------------|
| 1. $\frac{15}{30}$ | 2. $\frac{43}{38}$ | 3. $\frac{14}{34}$ | 4. $\frac{24}{38}$ | 5. $\frac{75}{90}$ |
| 6. $\frac{80}{112}$ | 7. $\frac{648}{720}$ | 8. $\frac{288}{864}$ | 9. $\frac{54}{81}$ | 10. $\frac{63}{81}$ |
| 11. $\frac{735}{840}$ | 12. $\frac{284}{1158}$ | 13. $\frac{455}{1092}$ | 14. $\frac{824}{1428}$ | 15. $\frac{1368}{1638}$ |

To reduce an improper fraction to a mixed number :

Example: Reduce $\frac{36}{15}$ to a mixed number.

$$\frac{36}{15} = 36 \div 15 = 2\frac{6}{15} = 2\frac{2}{5}$$

Rule: — Divide the numerator by the denominator.

EXERCISE

Reduce the following improper fractions to mixed numbers :

- | | | | | |
|-------------------|---------------------|---------------------|---------------------|----------------------|
| 1. $\frac{15}{4}$ | 2. $\frac{27}{6}$ | 3. $\frac{82}{9}$ | 4. $\frac{54}{7}$ | 5. $\frac{17}{8}$ |
| 6. $\frac{21}{6}$ | 7. $\frac{125}{24}$ | 8. $\frac{374}{18}$ | 9. $\frac{472}{25}$ | 10. $\frac{526}{15}$ |

To reduce a mixed number to an improper fraction :

Example: Reduce $3\frac{5}{8}$ to an improper fraction.

$$\begin{aligned} 3\frac{5}{8} &= 3 + \frac{5}{8} \\ 3 &= \frac{3 \times 6}{6} = \frac{18}{6} \\ 3\frac{5}{8} &= \frac{18}{6} + \frac{5}{8} = \frac{23}{8} \end{aligned}$$

Rule. — Multiply the whole number by the denominator of the fractional part, add the numerator of the fractional part to this product and you obtain the numerator ; the denominator of the fractional part becomes the denominator of the improper fraction.

EXERCISE

Reduce to improper fractions :

- | | | | |
|---------------------|----------------------|---------------------|----------------------|
| 1. $3\frac{1}{4}$ | 2. $5\frac{7}{10}$ | 3. $4\frac{8}{11}$ | 4. $17\frac{5}{28}$ |
| 5. $29\frac{5}{8}$ | 6. $18\frac{1}{11}$ | 7. $12\frac{2}{3}$ | 8. $9\frac{4}{7}$ |
| 9. $236\frac{1}{7}$ | 10. $83\frac{1}{13}$ | 11. $27\frac{1}{4}$ | 12. $39\frac{5}{17}$ |

EXERCISE

1. How many whole yards are there in 6 half yards?
2. Twelve quarter hours make how many whole hours?
3. Express each of the following as whole numbers :

$$\frac{6}{2}, \frac{12}{3}, \frac{15}{5}, \frac{18}{9}.$$

4. Write as mixed numbers :

$$\frac{17}{3}, \frac{15}{4}, \frac{17}{6}, \frac{26}{8}.$$

5. Reduce to whole or mixed numbers :

$$\frac{9}{3}, \frac{14}{4}, \frac{24}{8}, \frac{35}{6}, \frac{46}{7}, \frac{21}{9}.$$

Reduce the following improper fractions to whole or mixed numbers :

6. $\frac{45}{7}$

7. $\frac{76}{5}$

8. $\frac{86}{11}$

9. $\frac{97}{4}$

10. $\frac{149}{12}$

11. $\frac{253}{15}$

12. $\frac{725}{45}$

13. $\frac{476}{17}$

14. $\frac{982}{19}$

15. $\frac{4407}{136}$

Reduce the following mixed numbers to improper fractions :

16. $225\frac{73}{100}$

17. $583\frac{1}{2}$

18. $127\frac{17}{8}$

19. $430\frac{3}{5}$

20. $285\frac{1}{3}$

To change a fraction to a fraction of the same value, but having a larger denominator :

Introductory.

ORAL EXERCISE

$\frac{3}{4}$ is how many 8ths?

$\frac{7}{8}$ is how many 24ths?

$\frac{5}{6}$ is how many 27ths?

$\frac{5}{8}$ is how many 36ths?

$\frac{2}{3}$ is how many 15ths?

$\frac{4}{3}$ is how many 36ths?

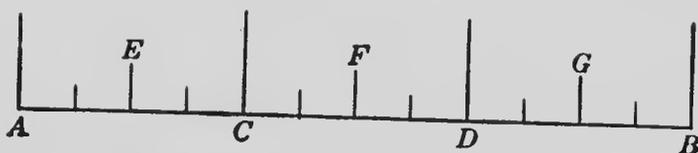
$\frac{2}{3}$ is how many 12ths?

$\frac{2}{7}$ is how many 28ths?

Example: To change $\frac{1}{3}$ to 6ths.

$$1 = \frac{6}{6}, \frac{1}{3} \text{ of } 1 \text{ is } \frac{1}{3} \text{ of } \frac{6}{6} \text{ or } \frac{2}{6}$$

$$\frac{1}{3} = \frac{2}{6}$$



The line AB is divided at C and D into *three* equal parts. Each part viz. AC , CD , and DB is $\frac{1}{3}$ of the line. The line AB is divided into *Six* equal parts at E , C , F , D , and G . Each part viz. AE , EC , CF , FD , DG , and GB is $\frac{1}{6}$ of the line. By comparing the lengths of AC and AE and EC we see that AC is equal to AE and EC together, that is $\frac{1}{3}$ is equal to $\frac{2}{6}$. From a study of the figure, we also see that

$$\begin{array}{l} \frac{1}{3} = \frac{2}{6} \\ \frac{2}{3} = \frac{4}{6} = \frac{8}{12} \\ \frac{5}{6} = \frac{10}{12} \\ \frac{3}{6} = \frac{6}{12} \end{array}$$

Example: To change $\frac{2}{3}$ to 18ths.

You may multiply both terms of a fraction by the same number without changing its value.

To change the denominator 3rds to 18ths, we multiply by 6.

Hence, in order that the fraction may not have its value changed we must multiply the numerator by the same number 6.

$$\frac{2}{3} = \frac{2 \times 6}{3 \times 6} = \frac{12}{18}$$

Rule. — To change a fraction to a fraction having the same value but of larger denominator, write down the new denominator, divide the new denominator by the old denominator, and multiply the numerator by the quotient, for the new numerator.

EXERCISE

Oral.

1. Change to 8ths: $\frac{1}{2}$, $\frac{3}{4}$, $\frac{1}{4}$.
2. Change to 12ths: $\frac{2}{3}$, $\frac{5}{6}$, $\frac{3}{4}$.

3. Change to 10ths : $\frac{1}{2}$, $\frac{1}{5}$, $\frac{3}{5}$, $\frac{4}{5}$.

4. Change to 18ths : $\frac{7}{9}$, $\frac{5}{9}$, $\frac{2}{3}$, $\frac{1}{2}$, $\frac{5}{9}$.

5. Change $\frac{5}{7}$ to fractions having 14, 21, 28, and 35 as denominators.

6. Change $\frac{5}{8}$ to fractions having 12, 18, 24, 30, and 36 as denominators.

7. Change $\frac{2}{3}$ to fractions having 6, 12, 15, 18, 27, and 36 as denominators.

Written.

1. Change $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{1}{2}$ to 12ths.

2. Change $\frac{5}{6}$, $\frac{3}{4}$, and $\frac{7}{8}$ to 36ths.

3. Change $\frac{4}{7}$, $\frac{3}{5}$, and $\frac{7}{10}$ to 70ths.

4. Change $\frac{5}{8}$, $\frac{2}{7}$, and $\frac{3}{4}$ to 56ths.

5. Change $\frac{4}{5}$, $\frac{2}{3}$, $\frac{5}{8}$, and $\frac{3}{4}$ to 60ths.

6. Change $\frac{4}{5}$, $\frac{2}{3}$, and $\frac{5}{7}$ to 105ths.

Fractions having the same denominator are said to be *Similar Fractions*.

Examples: $\frac{1}{4}$, $\frac{3}{4}$, $\frac{2}{4}$, $\frac{5}{7}$, $\frac{2}{7}$, $\frac{9}{7}$, $\frac{3}{7}$.

Fractions not having the same denominator may be reduced to similar fractions. The smallest common denominator which may serve for several fractions is called their *Least Common Denominator*.

Example: $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$ are not similar fractions. They may be changed to similar fractions with 36 as denominator.

$\frac{24}{36}$, $\frac{27}{36}$, and $\frac{30}{36}$.

They may be changed to similar fractions with 72 as denominator.

$\frac{48}{72}$, $\frac{54}{72}$, $\frac{60}{72}$.

But 24 is the least common denominator.

From observation it will be seen that the least common denominator of fractions is the L. C. M. of their denominators.

To find the least common denominator of a set of fractions we find the L. C. M. of the denominators.

Example:

Reduce $\frac{7}{10}$, $\frac{3}{18}$, and $\frac{5}{24}$ to similar fractions having the least common denominator.

Find the L. C. M. of the denominators.

$$10 = 2 \times 5$$

$$16 = 2 \times 2 \times 2 \times 2$$

$$24 = 2 \times 2 \times 2 \times 3$$

$$\text{L. C. M.} = 2 \times 2 \times 2 \times 2 \times 3 \times 5$$

$$= 240$$

$$\frac{7}{10} = \frac{168}{240}$$

$$\frac{3}{18} = \frac{40}{240}$$

$$\frac{5}{24} = \frac{50}{240}$$

EXERCISE

Change to similar fractions having the least common denominator:

1. $\frac{3}{8}$, $\frac{4}{7}$, $\frac{2}{3}$

2. $\frac{3}{5}$, $\frac{5}{8}$, $\frac{7}{9}$

3. $\frac{3}{4}$, $\frac{4}{5}$, $\frac{3}{10}$

4. $\frac{3}{3}$, $\frac{3}{7}$, $\frac{5}{8}$

5. $\frac{7}{24}$, $\frac{7}{8}$, $\frac{9}{10}$

6. $\frac{3}{5}$, $\frac{7}{9}$, $\frac{17}{30}$

7. $\frac{3}{10}$, $\frac{19}{25}$, $\frac{47}{30}$, $\frac{89}{100}$

8. $\frac{9}{12}$, $\frac{17}{36}$, $\frac{1}{3}$, $\frac{5}{8}$

9. Reduce to 100ths:

$$\frac{1}{2}, \frac{1}{4}, \frac{1}{5}, \frac{1}{10}, \frac{1}{20}, \frac{1}{50}, \frac{3}{4}, \frac{3}{5}, \frac{2}{5}, \frac{3}{10},$$

$$\frac{4}{10}, \frac{7}{10}, \frac{9}{10}, \frac{3}{20}, \frac{17}{20}, \frac{11}{20}, \frac{13}{20}, \frac{19}{25}, \frac{17}{25}$$

Reduce to similar fractions having the least common denominator:

10. $\frac{4}{7}$, $\frac{5}{11}$, $\frac{6}{17}$

11. $\frac{7}{8}$, $\frac{5}{14}$, $\frac{5}{12}$, $\frac{17}{12}$

12. 3, $4\frac{3}{4}$, $1\frac{7}{8}$

Change the following fractions to similar fractions having the least common denominator and arrange them in order of their value, putting the greatest first:

13. $\frac{3}{4}, \frac{6}{8}, \frac{5}{10}, \frac{7}{12}$

14. $\frac{15}{18}, \frac{18}{21}, \frac{3}{4}$

15. $\frac{9}{10}, \frac{17}{20}, \frac{21}{25}, \frac{1}{2}$

16. $\frac{17}{81}, \frac{13}{18}, \frac{19}{27}, \frac{37}{81}, \frac{5}{9}$

17. $\frac{13}{18}, \frac{7}{9}, \frac{23}{32}, \frac{7}{8}$

18. $\frac{9}{10}, \frac{17}{20}, \frac{43}{50}, \frac{67}{75}$

19. $\frac{2}{3}, \frac{4}{5}, \frac{6}{7}, \frac{11}{15}, \frac{19}{21}, \frac{23}{30}$

20. $\frac{3}{4}, \frac{7}{8}, \frac{13}{16}, \frac{27}{32}, \frac{59}{64}$

EXERCISE

1. From $\$6\frac{3}{8}$ a man paid away \$7. How much money had he left out of this sum?

2. John has $\$2\frac{7}{8}$. He pays out \$5. How much money has he left?

3. A number of pies were cut into 5 equal parts; there were 45 pieces. How many pies were there?

4. From $2\frac{1}{2}$ yards of ribbon, $\frac{7}{8}$ yards were cut. How many eighths of a yard remained?

5. If a bottle holds $\frac{1}{2}$ gal., how many gallons will 7 doz. such bottles hold?

6. How far has A gone, if he rides on his bicycle for $\frac{9}{7}$ hr. at the rate of a mile each $\frac{1}{4}$ hour?

7. A wishes to measure some oats. He has a bucket which holds one-third of a bushel. The oats fill this bucket 167 times. How many bushels of oats are there?

8. The perimeter of a rectangular room is $2\frac{1}{4}$ ft. It is $5\frac{2}{3}$ ft. longer than wide. Find the dimensions of the room.

9. In walking, A takes 7 steps to a rod. How far has he walked when he has taken 5000 steps?

10. A road 5 mi. long has telegraph poles placed at intervals of $\frac{1}{8}$ mi. How many poles are there?

11. In one scale of a balance there are $1\frac{9}{17}$ lb. How many pound weights must be placed in the other scale to balance them?

12. If it takes a man the sixth part of an hour to make a cardboard box, how many hours would he take to make 200 boxes? What is the least number of additional boxes he may make to be employed an exact number of hours?

ADDITION AND SUBTRACTION OF FRACTIONS

Introductory.

1. Add 3 cents, 8 cents, and 7 cents.
2. Add 5 yards, 3 yards, and 6 feet.
3. Add 5 pints, 3 quarts, and 2 gallons.
4. Add 2 weeks, 8 weeks, and 10 days.
5. Add 5 tenths, 3 tenths, and 7 tenths.
6. Add 11 twentieths, 7 twentieths, 9 twentieths.
7. Add $\frac{1}{20}$, $\frac{7}{20}$, and $\frac{9}{20}$.
8. Add $\frac{1}{15}$, $\frac{2}{15}$, and $\frac{4}{15}$.
9. Add $\frac{7}{8}$, $\frac{3}{8}$, and $\frac{5}{8}$.
10. Subtract 1 fourth from 3 fourths.
11. Subtract 2 fifths from 4 fifths.
12. Subtract 5 twelfths from 9 twelfths.
13. Subtract $\frac{4}{7}$ from $\frac{7}{7}$.
14. Subtract $\frac{3}{15}$ from $\frac{11}{15}$.

Examples:

1. Add $\frac{3}{4} + \frac{7}{8} + \frac{1}{2}$.

Change to similar fractions having the least common denominator. The least common denominator is 8.

$$\frac{3}{4} = \frac{6}{8} \qquad \frac{7}{8} = \frac{7}{8} \qquad \frac{1}{2} = \frac{4}{8}$$

$$\frac{3}{4} + \frac{7}{8} + \frac{1}{2} = \frac{6}{8} + \frac{7}{8} + \frac{4}{8} = \frac{17}{8} = 2\frac{1}{8}$$

2. Add $\frac{5}{12} + \frac{4}{3} + \frac{2}{3}$.

The least common denominator is 12.

$$\frac{5}{12} + \frac{4}{3} + \frac{2}{3} = \frac{5}{12} + \frac{16}{12} + \frac{8}{12} = \frac{29}{12} = 2\frac{5}{12}$$

3. Subtraction. $1\frac{7}{8} - \frac{1}{2}$.

The least common denominator is 18.

$$1\frac{7}{8} - \frac{1}{2} = 1\frac{7}{8} - \frac{4}{8} = 1\frac{3}{8}$$

4. Add $4\frac{5}{6} + 8\frac{3}{11} + 5\frac{3}{4}$.

Adding the whole numbers $4 + 8 + 5 = 17$.

The least common denominator of the fractions is 132.

$$\frac{5}{6} + \frac{3}{11} + \frac{3}{4} = \frac{110 + 36 + 99}{132} = \frac{245}{132} = 1\frac{113}{132}$$

Adding this to the sum of the whole numbers.

$$17 + 1\frac{113}{132} = 18\frac{113}{132}$$

5. Subtraction. $29\frac{1}{2} - 13\frac{7}{12}$.

The least common denominator is 60.

$$29\frac{1}{2} = 29\frac{30}{60} = 28\frac{50}{60}$$

$$13\frac{7}{12} = 13\frac{35}{60} = \underline{13\frac{35}{60}}$$

Subtracting:

$$15\frac{15}{60}$$

We cannot take $\frac{35}{60}$ from $\frac{30}{60}$. Take 1 from the 29 leaving 28, and add 1 or $\frac{60}{60}$ to $\frac{30}{60}$ making $\frac{90}{60}$.

To add or subtract fractions, reduce the fractions to similar fractions having the least common denominator.

When mixed numbers are to be added or subtracted, the fractional part may be added or subtracted separately from the whole numbers.

EXERCISE

Oral. Add or subtract as indicated:

1. $\frac{3}{4} + \frac{1}{2}$

2. $\frac{1}{3} + \frac{2}{3}$

3. $\frac{7}{8} + \frac{3}{4}$

4. $\frac{7}{8} - \frac{1}{4}$

5. $\frac{5}{12} - \frac{2}{3}$

6. $\frac{2}{3} + \frac{1}{3}$

7. $\frac{1}{2} + \frac{1}{3} + \frac{3}{4}$

8. $\frac{7}{8} - \frac{2}{3}$

9. $\frac{7}{8} - \frac{2}{3}$

10. $\frac{1}{2} + \frac{3}{10} - \frac{7}{20}$

Written. Add or subtract as indicated:

- | | | |
|-------------------------------------------------------------|----------------------------------------------|-------------------------------------------------|
| 1. $\frac{1}{2} + \frac{2}{3} + \frac{1}{4}$ | 2. $\frac{1}{2} + \frac{2}{3} + \frac{1}{4}$ | 3. $\frac{1}{25} + \frac{2}{30} + \frac{3}{20}$ |
| 4. $\frac{1}{6} - \frac{1}{3}$ | 5. $\frac{2}{35} - \frac{1}{30}$ | 6. $\frac{2}{3} + \frac{1}{4} - \frac{1}{3}$ |
| 7. $\frac{1}{10} + \frac{1}{5} - \frac{1}{3}$ | 8. $\frac{1}{8} - \frac{1}{9} + \frac{1}{7}$ | 9. $\frac{1}{2} + \frac{1}{18} - \frac{1}{20}$ |
| 10. $\frac{1}{3} + \frac{1}{5} - \frac{1}{8} + \frac{1}{3}$ | | |

EXERCISE

- | | |
|----------------------------------------------------|----------------------------------------------------|
| 1. $3\frac{2}{3} + 5\frac{1}{4} + 7\frac{1}{2}$ | 2. $15\frac{2}{3} + 12\frac{2}{3} + 12\frac{2}{3}$ |
| 3. $15\frac{1}{2} + 23\frac{1}{3} + 17\frac{1}{2}$ | 4. $29\frac{2}{3} + 17\frac{1}{6} + 9\frac{2}{3}$ |
| 5. $59\frac{2}{3} + 26\frac{1}{7} + 7\frac{1}{3}$ | 6. $9\frac{1}{6} + 28\frac{1}{6} + 15\frac{1}{6}$ |
| 7. $28\frac{2}{3} - 15\frac{1}{2}$ | 8. $19\frac{2}{3} - 15\frac{1}{4}$ |
| 9. $238\frac{1}{2} - 119\frac{1}{4}$ | 10. $328\frac{1}{2} - 198\frac{1}{2}$ |

EXERCISE

Add first, then subtract each of the following:

- | A. | B. | C. | D. | E. |
|----------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------|
| 1. $15\frac{1}{2}$
<u> 9$\frac{2}{3}$</u> | $26\frac{2}{3}$
<u>17$\frac{1}{3}$</u> | $19\frac{2}{3}$
<u> 7$\frac{1}{3}$</u> | $25\frac{1}{2}$
<u>13$\frac{1}{2}$</u> | $15\frac{2}{3}$
<u> 7$\frac{2}{3}$</u> |
| 2. $73\frac{2}{3}$
<u>16$\frac{5}{12}$</u> | $89\frac{2}{3}$
<u>46$\frac{1}{2}$</u> | $75\frac{1}{2}$
<u>28$\frac{2}{3}$</u> | $83\frac{1}{2}$
<u>39$\frac{2}{3}$</u> | $27\frac{1}{2}$
<u>19$\frac{1}{4}$</u> |
| 3. $89\frac{2}{3}$
<u>29$\frac{1}{3}$</u> | $37\frac{2}{3}$
<u>19$\frac{1}{2}$</u> | $48\frac{1}{2}$
<u>19$\frac{1}{2}$</u> | $65\frac{2}{3}$
<u>37$\frac{1}{2}$</u> | $43\frac{2}{3}$
<u>36$\frac{2}{3}$</u> |

Add:

- | | | | |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 4. $26\frac{2}{3}$
$38\frac{1}{2}$
<u>49$\frac{1}{2}$</u> | $39\frac{1}{5}$
$54\frac{2}{3}$
<u>82$\frac{3}{10}$</u> | $28\frac{2}{3}$
$75\frac{1}{3}$
<u>94$\frac{1}{3}$</u> | $47\frac{1}{2}$
$23\frac{2}{3}$
<u>89$\frac{1}{6}$</u> |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|

Simplify :

$$5. \frac{1}{3} + \frac{2}{5} + \frac{3}{7} + \frac{1}{2}$$

$$6. \frac{1}{5} + \frac{2}{3} + \frac{9}{7} + \frac{1}{21}$$

$$7. \frac{5}{8} + \frac{3}{5} + \frac{1}{3} + \frac{3}{8}$$

$$8. \frac{5}{8} + \frac{5}{8} + \frac{1}{4} + \frac{1}{4}$$

$$9. 2\frac{1}{2} + 4\frac{3}{5} - 3\frac{3}{4} - \frac{1}{8}$$

$$10. 5\frac{3}{8} - 3\frac{1}{5} + 4\frac{3}{4} + 7\frac{3}{4}$$

$$11. \frac{5}{8} + 3\frac{1}{3} + 4\frac{3}{8} - 5\frac{3}{8}$$

$$12. 7\frac{1}{4} + 5\frac{1}{5} - 8\frac{2}{5} + 7\frac{7}{8}$$

$$13. 50\frac{3}{8} - 4\frac{3}{4} - 8\frac{1}{4} - 5\frac{7}{8}$$

$$14. 11\frac{1}{10} - 7\frac{2}{5} + 14\frac{1}{2} - 3\frac{7}{10}$$

EXERCISE

1. A farmer sold to one customer $3\frac{1}{2}$ bushels of potatoes, to another $5\frac{3}{4}$ bushels, and to a third $7\frac{1}{2}$ bushels. How many bushels did he sell to the three?

2. One box of provisions is $2\frac{3}{8}$ lbs heavier than a second box. The lighter box weighs $18\frac{3}{8}$ lbs. What is the weight of both boxes?

3. One number is $14\frac{3}{8}$, a second one is $2\frac{1}{2}$ greater than this, and a third one is $4\frac{5}{8}$ greater than the second. Find the sum of the three numbers.

Find the sum of the following fractions :

$$4. 2\frac{1}{2}, 7\frac{3}{4}, 9\frac{5}{8}, 6\frac{1}{4}, 9\frac{1}{2}$$

$$5. 2\frac{1}{2}, \frac{5}{12}, 6\frac{7}{8}, 7\frac{1}{4}, 9\frac{3}{4}$$

$$6. 3\frac{1}{2}, 14\frac{7}{10}, 12\frac{3}{8}, 9\frac{1}{2}$$

$$7. 4\frac{2}{5}, 3\frac{1}{2}, 6\frac{3}{5}, 25\frac{7}{5}, 9\frac{3}{4}$$

8. One piece of cloth contains $7\frac{1}{2}$ yards, a second piece $13\frac{3}{4}$ yards, a third $2\frac{3}{8}$ yards, a fourth $9\frac{3}{4}$ yards, and a fifth $35\frac{1}{2}$ yards. How much cloth is there in the five pieces?

9. A certain town A is $35\frac{1}{2}$ miles west of another town B, a third town C is $18\frac{3}{8}$ miles east of B, and a town D is $27\frac{1}{4}$ miles east of C. Draw a diagram and find the distance between A and D.

10. A farmer sold $145\frac{3}{4}$ bushels of wheat, $356\frac{3}{8}$ bushels of oats, $567\frac{3}{8}$ bushels of barley, and $764\frac{3}{8}$ bushels of rye. How much grain did he sell altogether?

EXERCISE

1. The sum of two numbers is $26\frac{1}{4}$, and the smaller number is $7\frac{3}{4}$. Find the greater number.
2. From a barrel of vinegar containing $31\frac{1}{4}$ gallons, there were drawn off $16\frac{1}{8}$ gallons. How many gallons were left?
3. To what fraction must the sum of $\frac{1}{3}$ and $\frac{7}{15}$ be added that the sum may be $\frac{1}{3}$?
4. From a roll of cloth containing $35\frac{3}{8}$ yards a merchant sold $27\frac{3}{8}$ yards. How many yards were left in the roll?
5. A father divided \$15.00 among his four children. To John he gave $\$3\frac{1}{4}$, to William he gave $\$3\frac{1}{4}$, to Jane he gave $\$3\frac{1}{4}$, and the remainder to Mary. What did Mary receive?
6. A man owns two farms. The first contains $168\frac{3}{8}$ acres; the second contains $137\frac{7}{16}$ acres. He sells $85\frac{3}{4}$ acres. How much land has he left?
7. A man started on a journey of 219 miles. The first day he travelled $78\frac{1}{2}$ miles; the second day he went $64\frac{3}{4}$ miles; the third day he went $45\frac{5}{8}$ miles. How much farther has he to go to complete his journey?
8. A man sold a horse for $\$185\frac{3}{4}$, gaining $\$47\frac{3}{8}$ on the sale. What did the horse cost him?
9. A motorist travelled directly east $45\frac{3}{4}$ miles; he turned south and went $67\frac{1}{2}$ miles, then turned east and went $26\frac{7}{8}$ miles, then north $35\frac{1}{2}$ miles. Draw a diagram, and find how far he travelled.
10. What is the weight of 4 loads of coal: the first weighed $2\frac{3}{8}$ tons, the second $1\frac{7}{8}$ tons, the third $2\frac{1}{2}$ tons, and the fourth $1\frac{3}{8}$ tons?

EXERCISE

1. To make a raffia basket a girl requires $\frac{2}{3}$ lbs. of plain raffia, $\frac{1}{4}$ lb. red raffia, and $\frac{1}{8}$ lb. of green raffia. What is the weight in ounces of the raffia in the basket?

2. I bought $\frac{7}{8}$ of a yard of silk, $\frac{3}{4}$ of a yard of poplin, $\frac{2}{3}$ of a yard of velvet, and $\frac{5}{8}$ of a yard of satin. How many yards did I purchase in the four pieces?

3. John lives $\frac{3}{4}$ miles from school, William lives $\frac{1}{3}$ of a mile farther than John, and Robert lives $\frac{2}{3}$ of a mile farther than William. Find the distance in yards each boy has to go in order to reach the school.

4. Two boys planted a garden. They had $\frac{3}{4}$ acre planted in potatoes, $\frac{1}{8}$ acre planted in onions, $\frac{1}{3}$ acre planted in cabbages, and $\frac{5}{8}$ acre planted in beets and carrots. How many acres were there in the garden?

5. Four boys ran a relay race. The first boy took $9\frac{3}{8}$ seconds, the second boy $8\frac{7}{8}$ seconds, the third $10\frac{3}{4}$ seconds, and the fourth $9\frac{5}{8}$ seconds. How long did it take the four boys to run the race?

6. A farmer has a 10-acre field of alfalfa. The first cutting he had $17\frac{5}{8}$ tons, the second cutting $11\frac{3}{4}$ tons, and the third cutting $9\frac{5}{8}$ tons. How many tons did he get from the three cuttings?

7. The rainfall at Portage la Prairie for 5 months was as follows: April $1\frac{5}{8}$ inches, May $2\frac{3}{4}$ inches, June $3\frac{1}{3}$ inches, July $3\frac{7}{16}$ inches, and August $1\frac{1}{3}$ inches. What was the total rainfall for the five months?

8. Three boys went on a walking trip. The first day they walked $9\frac{3}{4}$ miles; the second day they went $12\frac{1}{3}$ miles; the third day $10\frac{5}{8}$ miles; and the last day $8\frac{3}{8}$ miles. How far did they walk in the four days?

9. A dealer bought 6 turkeys, the weights of which were $19\frac{3}{4}$ lbs., $17\frac{5}{8}$ lbs., $24\frac{1}{2}$ lbs., $18\frac{1}{2}$ lbs., $22\frac{1}{4}$ lbs., and $19\frac{3}{4}$ lbs. Find the total weight of the turkeys.

10. A boy took a summer vacation, travelling $235\frac{1}{2}$ miles by train, $78\frac{3}{4}$ miles by automobile, $47\frac{1}{2}$ miles by steamer, and $39\frac{3}{8}$ miles by pack pony. How far did he travel on his trip?

EXERCISE

1. A man spends $\frac{1}{2}$ of his salary for food, $\frac{1}{3}$ for clothes, and $\frac{1}{10}$ for rent. What part of his salary does he spend?

2. A dealer sold 4 loads of coal. The first weighed $\frac{3}{4}$ of a ton, the second $\frac{2}{3}$ of a ton, the third $\frac{7}{8}$ of a ton, and the fourth $\frac{5}{6}$ of a ton. How many tons of coal did the dealer sell?

3. A man has a journey to make. The first day he travelled $\frac{2}{3}$ of it; the second day he travelled $\frac{1}{10}$ of it; and the third day he travelled $\frac{2}{3}$ of it. What part of the journey has he gone in the 3 days?

4. At a picnic the following amount of refreshments was prepared: $2\frac{3}{8}$ gallons of coffee, $5\frac{5}{8}$ gallons of milk, $4\frac{1}{10}$ gallons of tea, and $8\frac{1}{2}$ gallons of lemonade. How many gallons were there altogether?

5. A man drove $18\frac{3}{4}$ miles the first hour, $23\frac{1}{4}$ miles the second hour, $19\frac{7}{8}$ miles the third hour, and $26\frac{5}{8}$ miles the fourth hour. How far did he go in the four hours? If he has to travel 95 miles, how much further has he to go?

6. If a room is $17\frac{3}{4}$ feet wide and $22\frac{5}{8}$ feet long, how far is the total distance around the room? How much greater is the length of the room than its width?

7. A woman sold 4 tubs of butter; the first weighed $25\frac{1}{4}$ lbs., the second weighed $26\frac{5}{8}$ lbs., the third weighed $27\frac{7}{8}$ lbs., and the fourth weighed $30\frac{1}{4}$ lbs. Find the total weight of the butter.

8. The first number is $23\frac{3}{8}$, the second number is $7\frac{1}{2}$ greater than the first, the third number is $9\frac{3}{4}$ less than the first. Find the sum of the three numbers.

9. A certain town A is $18\frac{3}{4}$ miles west of a town B, another town C is $17\frac{2}{3}$ miles east of B, and another town D is $35\frac{1}{3}$ miles east of C. Draw a diagram showing the positions of the towns, and find the total distance between A and D.

10. A farmer sold $1897\frac{7}{8}$ bushels of oats, $2486\frac{3}{8}$ bushels of wheat, and $986\frac{5}{8}$ bushels of barley. How much grain did he sell altogether?

11. A farmer owns three pieces of land. The first contains $79\frac{2}{3}$ acres, the second $118\frac{6}{5}$ acres, and the third $87\frac{1}{2}$ acres. How much land does he own?

12. A field is $387\frac{3}{4}$ yards long and $168\frac{7}{8}$ yards wide. What is the length of the fence around the field?

13. A dealer bought 384 tons of coal. He sold $18\frac{1}{2}$ tons to one customer, $189\frac{3}{4}$ tons to a second, $59\frac{5}{8}$ tons to a third, and $29\frac{5}{8}$ tons to a fourth. How much coal has he left?

14. A grocer mixed $15\frac{3}{4}$ lbs. tea with $39\frac{1}{2}$ lbs. of another kind. He sold $28\frac{1}{2}$ lbs. of the mixture. How much did he have left?

15. In a relay race the first boy took $6\frac{3}{4}$ seconds to run his part of the course, the second boy $5\frac{3}{8}$ seconds, the third $5\frac{7}{8}$ seconds, and the fourth $4\frac{1}{2}$ seconds. How long did it take to run the race? How much less than $\frac{1}{2}$ a minute did it take to run the race?

16. From a board 18 feet long a man saws off 3 pieces of the following lengths: $5\frac{1}{3}$ feet, $2\frac{3}{4}$ feet, and $4\frac{7}{8}$ feet. What length remains?

17. The rainfall at Edmonton for a certain year was as follows: January $2\frac{1}{4}$ inches, February $1\frac{7}{10}$ inches, March

$\frac{5}{12}$ inch, April $1\frac{1}{2}$ inches, May $2\frac{3}{8}$ inches, June $3\frac{1}{2}$ inches, July $1\frac{2}{10}$ inches, August $\frac{5}{8}$ inch, September $\frac{3}{10}$ inch, October $\frac{7}{12}$ inch, November $\frac{2}{10}$ inch, and December $1\frac{1}{4}$ inches. Find the total rainfall for the year.

18. A steamship burns the following amounts of coal on a five-day voyage: first day $89\frac{3}{4}$ tons, second day $118\frac{3}{8}$ tons, third day $129\frac{5}{7}$ tons, fourth day $98\frac{5}{8}$ tons, fifth day $119\frac{1}{4}$ tons. Find the total amount of coal used.

19. There are three numbers the sum of which is 279. The first number is $28\frac{5}{8}$ greater than the second, and the second is $15\frac{7}{12}$ greater than the third. Find the numbers.

20. A owns $71\frac{1}{8}$ acres of land; B owns $29\frac{5}{12}$ acres more than A; C owns $157\frac{1}{4}$ acres more than B; and D owns $73\frac{1}{2}$ acres more than C. How many acres do they together own?

Cancellation in Fractions

We may divide the numerator and denominator of a fraction by the same factor. This process is called *cancellation*.

Example:

Reduce $\frac{56}{42}$ to a mixed number.

$$\frac{56}{42} = \frac{7 \times 4 \times 2}{7 \times 3 \times 2}$$

$$= \frac{4}{3} = 1\frac{1}{3}$$

Or,

$$\frac{56}{42} = \frac{4}{3} = 1\frac{1}{3}$$

We may cancel the common factors 7 and 2 in numerator and denominator by dividing by these numbers.

Dividing first by 7. Then dividing by 2.

EXERCISE

Find the value of each of the following in their lowest terms by cancellation.

1. $\frac{540}{315}$
2. $\frac{1008}{105}$
3. $\frac{9 \times 5 \times 36 \times 7}{21 \times 8 \times 15}$
4. $\frac{14 \times 8 \times 30 \times 63}{28 \times 72 \times 25 \times 9}$
5. $\frac{27 \times 36 \times 45 \times 17}{18 \times 9 \times 51 \times 25}$
6. $\frac{125 \times 72 \times 24 \times 44}{75 \times 9 \times 33 \times 8}$
7. $\frac{3}{4} \times \frac{12}{15} \times \frac{9}{16} \times \frac{20}{24}$
8. $\frac{9}{12} \times \frac{27}{45} \times \frac{18}{24} \times \frac{56}{72}$
9. $\frac{210}{78} \times \frac{3}{4} \times \frac{195}{63} \times \frac{18}{24} \times \frac{72}{125}$

Multiplication of Fractions

EXERCISE

Introductory.

1. Draw a line 1 foot long and find $\frac{2}{3}$ of it.
2. Draw a line $\frac{3}{4}$ of a foot long and find $\frac{2}{3}$ of it.
3. Draw a rectangle 5 inches by 2 inches and find the area of $\frac{2}{3}$ of it.
4. Draw a rectangle 12 inches long and 1 inch wide and mark off $\frac{2}{3}$ of it; then find the area of $\frac{1}{2}$ of the part you have marked off.
5. How do you find $\frac{2}{3}$ of a foot? $\frac{1}{2}$ of a rectangle?
6. How do you find $\frac{2}{3}$ of $\frac{3}{4}$ of a foot? $\frac{1}{2}$ of $\frac{2}{3}$ of a rectangle?
7. Find $\frac{1}{2}$ of $\frac{1}{3}$ of 120.
8. Show by folding paper that :

$$\frac{1}{2} \text{ of } \frac{1}{3} = \frac{1}{6}$$

$$\frac{1}{2} \text{ of } \frac{1}{4} = \frac{1}{8}$$

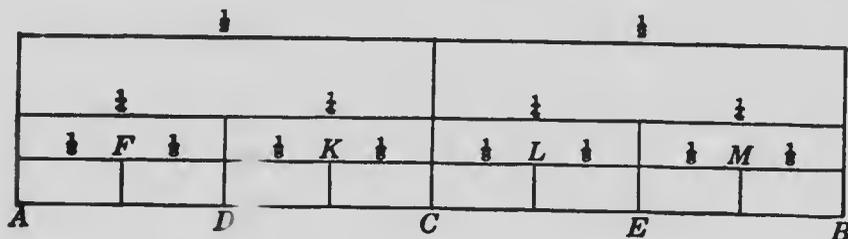
$$\frac{1}{3} \text{ of } \frac{1}{4} = \frac{1}{12}$$

9. What is one half of 6 ninths? of 10 elevenths? of 16 twentieths?

10. Find $\frac{1}{2}$ of the following: $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$.

11. Find $\frac{2}{3}$ of the following: 20, $\frac{2}{3}$, $\frac{1}{4}$.

12. A boy had $\frac{1}{2}$ of a dollar and he lost $\frac{1}{4}$ of what he had. What part of a dollar did he lose?



The line AB is divided into 8 equal parts. Each part is $\frac{1}{8}$ of the whole line.

At C the line AB is divided into 2 equal parts. Each part is $\frac{1}{2}$ of the whole line.

At D and E , AD and CB are divided each into 2 equal parts. Each part is $\frac{1}{4}$ of the whole line.

$AC = \frac{4}{8}$ of the whole line

$AC = \frac{2}{4}$ of the whole line

$AC = \frac{1}{2}$ of the whole line

4 times $\frac{1}{8}$ of the line = $\frac{4}{8}$ of the line = $\frac{2}{4}$ of the line = $\frac{1}{2}$ of the line.

If we multiply the numerator of a fraction, we increase the value of the fraction, *e.g.* 4 times $\frac{1}{8} = \frac{4}{8} = \frac{1}{2}$.

If we divide the denominator of a fraction, we increase the value of the fraction, *e.g.* dividing the denominator of the fraction $\frac{1}{8}$ by 4 we get $\frac{1}{8 \div 4} = \frac{1}{2}$, which is the same as multiplying the numerator of the fraction by 4.

Multiplying the numerator of a fraction increases the number of equal parts and hence multiplies the fraction.

Dividing the denominator increases the size of the equal parts and hence multiplies the fraction.

ORAL EXERCISE

- | | | | |
|----------------------------|------------------------------|-------------------------------|-----------------------------|
| 1. $4 \times \frac{2}{3}$ | 2. $5 \times \frac{7}{10}$ | 3. $6 \times \frac{5}{8}$ | 4. $7 \times \frac{1}{4}$ |
| 5. $6 \times \frac{2}{15}$ | 6. $7 \times \frac{3}{14}$ | 7. $5 \times \frac{7}{10}$ | 8. $9 \times \frac{7}{18}$ |
| 9. $5 \times \frac{7}{8}$ | 10. $17 \times \frac{7}{51}$ | 11. $13 \times \frac{25}{39}$ | 12. $11 \times \frac{2}{7}$ |

Example:

$$\frac{7}{8} = 7 \text{ times } \frac{1}{8}, \text{ or } \frac{7}{8} = \frac{1}{8} \text{ of } 7, \text{ or } 7 \div 8$$

Find $\frac{7}{8}$ of 24.

$$\begin{aligned} \frac{7}{8} \text{ of } 24 &= 7 \text{ times } \frac{1}{8} \text{ of } 24 = 7 \times \frac{1}{8} \text{ of } 24 \\ &= 7 \times 3 = 21 \end{aligned}$$

We use the word "of" for multiplication

Thus $\frac{7}{8} \times \frac{5}{7}$ is read $\frac{7}{8}$ of $\frac{5}{7}$.

Find $\frac{7}{8}$ of $\frac{5}{7}$.

$$\frac{7}{8} \text{ of } \frac{5}{7} = \frac{7 \times 5}{8 \times 7} = \frac{35}{56}$$

To find $\frac{7}{8}$ of any number we divide the number into 8 equal parts, and take 7 of them. To find $\frac{7}{8}$ of $\frac{5}{7}$ we

Reducing to the lowest terms we get $\frac{5}{8}$: or

$$\frac{7}{8} \text{ of } \frac{5}{7} = \frac{7 \times 5}{8 \times 7} = \frac{5}{8}$$

divide $\frac{5}{7}$ into 8 parts, obtaining $\frac{5}{8 \times 7}$, and taking 7 of these we get $\frac{7 \times 5}{8 \times 7} = \frac{35}{56}$.

Rule: To multiply a fraction by a fraction, multiply the numerators together for the new numerator and multiply the denominators together for the new denominator.

Reduce the new fraction to its lowest terms by cancelling factors common to denominators and numerators.

Example:

Multiply $6\frac{2}{3}$ by $7\frac{1}{2}$.

$$6\frac{2}{3} = \frac{20}{3}$$

$$7\frac{1}{2} = \frac{14}{2}$$

$$\frac{13}{5} \quad \frac{4}{3}$$

$$7\frac{1}{2} \times 6\frac{2}{3} = \frac{39}{5} \times \frac{20}{3} = \frac{39}{5} \times \frac{20}{3} = 52$$

Example:

Find the value of: $\frac{3}{4}$ of $\frac{8}{9} \times \frac{15}{16}$

$$\frac{3}{4} \text{ of } \frac{8}{9} \times \frac{15}{16} = \frac{3 \times 8 \times 15}{4 \times 9 \times 16}$$

By cancellation.

$$\frac{\overset{2}{3} \times \overset{5}{8} \times \overset{15}{16}}{\underset{3}{4} \times \underset{8}{9} \times \underset{8}{16}} = \frac{5}{8}$$

EXERCISE ORAL

- | <i>a.</i> | <i>b.</i> | <i>c.</i> |
|---------------------------------------|-------------------------------------|--------------------------------------|
| 1. $4 \times \frac{5}{8}$ | $3 \times \frac{7}{9}$ | $5 \times \frac{7}{10}$ |
| 2. $3 \times \frac{1}{2}$ | $\frac{2}{3}$ of $\frac{9}{7}$ | $\frac{1}{2}$ of $\frac{12}{5}$ |
| 3. $\frac{7}{8}$ of $\frac{3}{4}$ | $\frac{2}{7}$ of $\frac{3}{11}$ | $\frac{5}{12}$ of $\frac{3}{4}$ |
| 4. $\frac{9}{11}$ of $\frac{22}{7}$ | $\frac{1}{3}$ of $\frac{15}{24}$ | $\frac{3}{7}$ of $\frac{14}{5}$ |
| 5. $\frac{1}{7}$ of 35 | $\frac{8}{9}$ of 72 | $\frac{5}{11}$ of 77 |
| 6. $3\frac{1}{3} \times 2$ | $5\frac{3}{4} \times 4$ | $66\frac{2}{3} \times 30$ |
| 7. $12\frac{1}{2} \times 8$ | $6\frac{1}{4}$ by 40 | $16\frac{2}{3} \times 30$ |
| 8. $\frac{1}{3} \times \frac{15}{20}$ | $\frac{3}{4}$ of $\frac{12}{21}$ | $\frac{4}{8}$ of $\frac{18}{24}$ |
| 9. $\frac{12}{20} \times \frac{5}{9}$ | $\frac{11}{17} \times \frac{34}{7}$ | $\frac{12}{20} \times \frac{40}{70}$ |
| 10. $\frac{7}{9}$ of $5\frac{1}{2}$ | $\frac{2}{3}$ of $16\frac{1}{2}$ | $\frac{7}{8}$ of $9\frac{3}{4}$ |

EXERCISE

Find the value of :

1. $\frac{5}{8} \times 18$
2. $\frac{3}{8}$ of 45
3. $\frac{5}{8}$ of 45
4. $\frac{7}{15} \times 76$
5. $\frac{1}{12}$ of $\frac{9}{10}$
6. $\frac{9}{10}$ of $\frac{5}{21} \times \frac{7}{5}$
7. $3\frac{1}{4} \times 5\frac{2}{7}$
8. $6\frac{2}{3} \times 7\frac{2}{3}$
9. $17\frac{2}{3} \times 16\frac{2}{3}$
10. $\frac{1}{11} \times \frac{3}{10} \times \frac{7}{2}$
11. $\frac{7}{8} \times \frac{4}{5} \times \frac{1}{4}$
12. $39\frac{2}{3} \times 33\frac{1}{3}$
13. $5\frac{2}{3} \times 4\frac{3}{11} \times 4\frac{1}{4}$
14. $3 \times 7\frac{1}{2} \times \frac{1}{4} \times 3\frac{3}{11}$
15. $37\frac{1}{4} \times \frac{1}{7}$ of $\frac{21}{5}$
16. $\frac{4}{7} \times \frac{1}{3} \times \frac{5}{8} \times \frac{3}{10}$
17. $16\frac{2}{3} \times 12\frac{1}{2} \times \frac{1}{2}$ of $\frac{3}{5}$
18. $87\frac{1}{2} \times \frac{3}{5}$ of $\frac{5}{8} \times \frac{3}{5}$
19. $\frac{7}{8}$ of $\frac{4}{21}$ of $\frac{1}{3}$ of 125 square inches
20. $\frac{5}{8} \times \frac{1}{2}$ of $\frac{2}{3}$ of $4\frac{2}{3}$ tons

ALIQUOT PARTS

Introductory.

25 cents is contained in \$1.00 exactly *four times*, or

$$$.25 = \frac{1}{4} \text{ of } \$1.00$$

$$25 = \frac{1}{4} \text{ of } 100$$

$$250 = \frac{1}{4} \text{ of } 1000$$

The following relations are evident :

$$20 = \frac{1}{5} \text{ of } 100$$

$$12\frac{1}{2} = \frac{1}{8} \text{ of } 100$$

$$33\frac{1}{3} = \frac{1}{3} \text{ of } 100$$

$$16\frac{2}{3} = \frac{1}{6} \text{ of } 100$$

$$50 = \frac{1}{2} \text{ of } 100$$

$$66\frac{2}{3} = \frac{2}{3} \text{ of } 100$$

25, 20, 50, $33\frac{1}{3}$, $12\frac{1}{2}$, $16\frac{2}{3}$, $66\frac{2}{3}$ are *aliquot parts* of 100.

An *aliquot part* of a number is a part that divides that number exactly.

Multiplying by the method of aliquot parts.

$$25 \times 36 = \frac{1}{4} \text{ of } 100 \times 36 = \frac{1}{4} \text{ of } 3600 = 900$$

or $25 \times 36 = \frac{1}{4} \text{ of } 36 \times 100 = 9 \times 100 = 900$

$$33\frac{1}{3} \times 18 = \frac{1}{3} \text{ of } 100 \times 18 = \frac{1}{3} \text{ of } 1800 = 600$$

or $33\frac{1}{3} \times 18 = \frac{1}{3} \text{ of } 18 \times 100 = 6 \times 100 = 600$

ORAL EXERCISE

How shall we multiply by the following numbers, using the method of aliquot parts?

50, 25, 20, 10, $6\frac{1}{2}$, $16\frac{2}{3}$, $12\frac{1}{2}$

EXERCISE

At sight give the products of the following:

- | | | | |
|------------------------------|------------------------------|------------------------------|------------------------------|
| 1. 25×64 | 2. 20×65 | 3. 50×36 | 4. $16\frac{2}{3} \times 72$ |
| 5. $33\frac{1}{3} \times 18$ | 6. $12\frac{1}{2} \times 64$ | 7. $6\frac{1}{2} \times 32$ | 8. 25×72 |
| 9. $16\frac{2}{3} \times 48$ | 10. 20×85 | 11. $6\frac{1}{2} \times 64$ | 12. 25×360 |

Memorize the following table of aliquot parts:

$50 = \frac{1}{2}$ of 100	$33\frac{1}{3} = \frac{1}{3}$ of 100
$25 = \frac{1}{4}$ of 100	$16\frac{2}{3} = \frac{1}{6}$ of 100
$20 = \frac{1}{5}$ of 100	$12\frac{1}{2} = \frac{1}{8}$ of 100
$10 = \frac{1}{10}$ of 100	$6\frac{1}{2} = \frac{1}{16}$ of 100

EXERCISE

Using the method of aliquot parts find the following products:

- | | | |
|-------------------------------|--------------------------------|--------------------------------|
| 1. 25×384 | 2. 50×537 | 3. 20×289 |
| 4. $33\frac{1}{3} \times 267$ | 5. $16\frac{2}{3} \times 426$ | 6. $6\frac{1}{2} \times 512$ |
| 7. $12\frac{1}{2} \times 384$ | 8. 25×683 | 9. 10×783 |
| 10. 50×4329 | 11. $6\frac{1}{2} \times 2048$ | 12. $16\frac{2}{3} \times 744$ |

13. Find the cost of 36 yards of cheesecloth at $16\frac{2}{3}$ cents per yard.

14. Find the cost of 48 yards of cotton at $12\frac{1}{2}$ cents per yard.

15. Eggs are sold at the rate of 3 dozen for a \$1.00. Find the cost of 45 dozen eggs.

16. Find the cost of 258 drawing sets at $12\frac{1}{2}$ cents per set.

Division of Fractions

To divide a fraction by a whole number:

Introductory.

$$\frac{1}{2} \text{ of } 4 \text{ ninths} = 2 \text{ ninths}$$

$$\frac{1}{2} \text{ of } \frac{4}{9} = \frac{2}{9}, \text{ or } \frac{4}{9} \div 2 = \frac{2}{9}$$

$$\frac{1}{3} \text{ of } 6 \text{ elevenths} = 2 \text{ elevenths}$$

$$\frac{1}{3} \text{ of } \frac{6}{11} = \frac{2}{11}, \text{ or } \frac{6}{11} \div 3 = \frac{2}{11}$$

$$\frac{1}{3} \text{ of } 6 \text{ sevenths} = 2 \text{ sevenths}$$

$$\frac{1}{3} \text{ of } \frac{6}{7} = \frac{2}{7}, \text{ or } \frac{6}{7} \div 3 = \frac{2}{7}$$

Multiplying the denominator of $\frac{6}{7}$ by 3, we have the result $\frac{6}{21}$.

Reducing $\frac{6}{21}$ to its lowest terms, we get the fraction $\frac{2}{7}$.

Comparing $\frac{6}{7 \times 3}$ with $\frac{6}{7} \div 3$, we see that the results are the same.

Rule. — To divide a fraction by a whole number, divide the numerator of the fraction or multiply the denominator of the fraction by the whole number.

Find the value of the following :

1. $\frac{3}{5} \div 2$

6. $\frac{1}{2} \div 5$

11. $11\frac{1}{2} \div 5$

2. $\frac{1}{3} \div 6$

7. $\frac{3}{4} \div 7$

12. $16\frac{2}{3} \div 19$

3. $\frac{1}{4} \div 7$

8. $\frac{2}{5} \div 8$

13. $73\frac{1}{2} \div 7$

4. $\frac{3}{4} \div 2$

9. $\frac{2}{3} \div 5$

14. $43\frac{1}{2} \div 47$

5. $\frac{5}{8} \div 3$

10. $\frac{1}{2} \div 7$

15. $353\frac{1}{2} \div 25$

To divide a fraction or a whole number by a fraction:

Example:

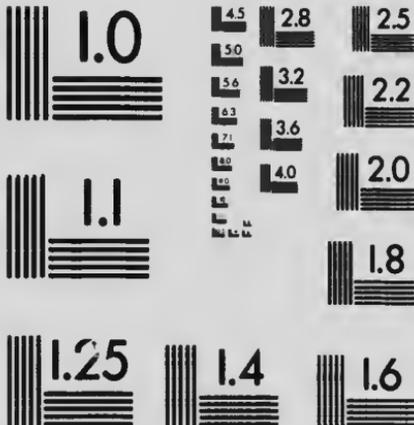
Divide $\frac{3}{4}$ by $\frac{5}{7}$.

$$\frac{3}{4} \div \frac{5}{7} = \left(\frac{3}{4} \times \frac{7}{5}\right) \div \left(\frac{7}{5} \times \frac{7}{5}\right)$$



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Since multiplying dividend and divisor by the same number does not change the value of the quotient :

$$\begin{aligned} & \left(\frac{2}{3} \times \frac{7}{5}\right) \div \left(\frac{5}{7} \times \frac{7}{5}\right) \\ &= \frac{2}{3} \times \frac{7}{5} \div 1 = \frac{14}{15} \div 1. \\ &= \frac{14}{15} = \frac{2 \times 7}{3 \times 5}. \end{aligned}$$

That is, to divide by $\frac{5}{7}$ we invert the fraction and multiply.

Rule. — Any number may be divided by a fraction by inverting the terms of the fraction which is the divisor, and multiplying.

Example:

Divide $2\frac{3}{4}$ by $1\frac{1}{2}$.

$$\begin{aligned} 2\frac{3}{4} &= \frac{11}{4} & 1\frac{1}{2} &= \frac{3}{2} \\ 2\frac{3}{4} \div 1\frac{1}{2} &= \frac{11}{4} \div \frac{3}{2} \\ &= \frac{11}{4} \times \frac{2}{3} = \frac{22}{12} = \frac{11}{6} = 1\frac{5}{6} \end{aligned}$$

Example:

Divide 48 by $1\frac{3}{5}$.

$$\begin{aligned} 1\frac{3}{5} &= \frac{8}{5} \\ 48 \div 1\frac{3}{5} &= 48 \div \frac{8}{5} \\ &= 48 \times \frac{5}{8} = \frac{48 \times 5}{8} = 30 \end{aligned}$$

EXERCISE

Divide :

- | | | |
|-------------------------|-----------------------------------------|-----------------------------------------|
| 1. 10 by $\frac{5}{7}$ | 5. $\frac{3}{4}$ by $\frac{7}{12}$ | 9. $9\frac{3}{4}$ by $\frac{9}{16}$ |
| 2. 18 by $\frac{3}{8}$ | 6. $\frac{15}{17}$ by $\frac{9}{18}$ | 10. $7\frac{5}{4}$ by $12\frac{8}{15}$ |
| 3. 30 by $\frac{6}{7}$ | 7. $\frac{13}{14}$ by $\frac{7}{15}$ | 11. $21\frac{3}{7}$ by $12\frac{8}{21}$ |
| 4. 40 by $3\frac{1}{2}$ | 8. $\frac{185}{288}$ by $\frac{15}{22}$ | 12. $45\frac{3}{8}$ by $2\frac{3}{8}$ |

Find the quotients :

13. $16\frac{2}{3} \div 14\frac{1}{2}$

17. $\frac{5}{8} \div 12\frac{3}{4}$

14. $62\frac{1}{2} \div 16\frac{2}{3}$

18. $\frac{7}{10} \div 16\frac{1}{3}$

15. $87\frac{1}{2} \div 37\frac{1}{2}$

19. $15\frac{7}{8} \div 3\frac{1}{4}$

16. $28\frac{4}{7} \div \frac{25}{49}$

20. $\frac{5}{9} \div 3\frac{24}{27}$

EXERCISE

1. A shipment of salt weighed 6120 lbs. How many sacks weighing $25\frac{1}{2}$ lbs. each were in the shipment?

2. A barrel holds $2\frac{3}{4}$ bushels of apples. How many barrels will be required for 1056 bushels?

3. A farmer sold $27\frac{3}{8}$ acres of land for \$1150.00. How much per acre did he receive?

4. It takes 1 man $19\frac{1}{2}$ days to dig a ditch. How long would it take 12 men to dig the same ditch?

5. It requires $43\frac{1}{3}$ yards of cloth to make 5 suits of clothes. How many yards will be required for 17 suits?

6. A pole 28 feet high casts a shadow $64\frac{3}{10}$ feet long. What length of shadow will a pole 15 feet high cast at the same time?

7. If 21 acres of land yield $735\frac{3}{5}$ bushels of oats, how many bushels will 78 acres yield at the same rate?

8. A train goes $184\frac{3}{4}$ miles in 6 hours. How far does it go in $1\frac{1}{3}$ hours?

9. A farmer raised 1078 bushels of wheat from $36\frac{3}{4}$ acres of land. What was the average yield per acre?

10. How many lbs. of butter at $42\frac{3}{8}$ cents per lb. will pay for $22\frac{3}{4}$ lbs. of tea at $37\frac{1}{2}$ cents per lb.?

11. I exchange 46 bushels of onions at $\$2\frac{1}{2}$ per bushel for sugar at $11\frac{1}{2}$ cents a lb. How much sugar should I receive?
12. The price of an excursion ticket from Calgary to Banff is $\$3\frac{3}{4}$. The total amount received from an excursion party was $\$1275$. How many tickets were sold?
13. Vinegar is put up in bottles holding $\frac{7}{8}$ quart each. How many dozen bottles will be required to hold $47\frac{1}{4}$ gallons of vinegar?
14. How many hand towels $\frac{3}{4}$ yard long can be made from a roll of towelling containing 75 yards? At $12\frac{1}{2}$ cts. per yard what is the price of each hand towel?
15. A man owned $\frac{3}{4}$ of a farm. He sold $\frac{1}{4}$ of what he owned for $\$15,750$. What was the farm worth?
16. If 1 cubic foot of water weighs $62\frac{1}{2}$ lbs., find the weight of water in a rectangular reservoir $8\frac{1}{2}$ feet long, $4\frac{3}{4}$ feet wide, and $4\frac{3}{4}$ feet deep.
17. A man earns $\$5\frac{1}{2}$ per day. He spends $\$3\frac{5}{8}$. How long will it take him to save $\$258.00$?
18. A reservoir holds 4370 gallons of water. It is filled by two pipes discharging water into the reservoir at the rate of $7\frac{3}{4}$ gallons each per minute. How many hours will it take to fill the reservoir?
19. A man receives $\$5\frac{1}{4}$ interest every year for every $\$100.00$ worth of Victory bonds. If he buys $\$1150.00$ worth of bonds, how much interest does he get each year?
20. The distance from Halifax to Montreal is $756\frac{1}{2}$ miles; from Montreal to Toronto the distance is $338\frac{1}{2}$ miles; from Toronto to Chicago the distance is $512\frac{3}{10}$ miles; and from Chicago to Winnipeg is $787\frac{5}{8}$ miles. How far is it from Halifax to Winnipeg?

COMPOUND FRACTIONS

Complex Fractions

1. Write down one-fourth of four-fifths.

$$\frac{1}{4} \text{ of } \frac{4}{5}$$

Such a fraction is called a *compound* fraction.

2. Write down 6 divided by $3\frac{1}{2}$, thus $\frac{6}{3\frac{1}{2}}$

3. Write down $4\frac{5}{8}$ divided by 7, thus $\frac{4\frac{5}{8}}{7}$

4. Write down $3\frac{1}{2}$ divided by $4\frac{5}{7}$, thus $\frac{3\frac{1}{2}}{4\frac{5}{7}}$

Definition.—Fractions like $\frac{6}{3\frac{1}{2}}$, $\frac{4\frac{5}{8}}{7}$, and $\frac{3\frac{1}{2}}{4\frac{5}{7}}$, in which there is a fraction for numerator or denominator or for both numerator and denominator, are called *Complex Fractions*.

Compound fractions are treated as multiplication of fractions.

Complex fractions are treated as division of fractions.

Example: Simplify $3\frac{3}{4}$ of $\frac{4}{5}$.

$$3\frac{3}{4} \text{ of } \frac{4}{5} = \frac{15}{4} \text{ of } \frac{4}{5} = \frac{15}{4} \times \frac{4}{5} = 3$$

Examples: Simplify $\frac{2\frac{1}{2}}{3\frac{1}{3}}$.

$$\frac{2\frac{1}{2}}{3\frac{1}{3}} = \frac{\frac{5}{2}}{\frac{10}{3}} = \frac{5}{2} \div \frac{10}{3} = \frac{5}{2} \times \frac{3}{10} = \frac{3}{4}$$

Simplify $\frac{\frac{3}{5} + \frac{1}{2}}{\frac{3}{5} - \frac{1}{4}}$.

Complete the addition and subtraction first.

$$\frac{2}{3} + \frac{1}{2} = \frac{4+3}{6} = \frac{7}{6} = \frac{7}{6} \div \frac{7}{20}$$

$$\frac{3}{5} - \frac{1}{4} = \frac{12-5}{20} = \frac{7}{20}$$

$$= \frac{7}{6} \times \frac{20}{7} = \frac{10}{3} = 3\frac{1}{3}$$

EXERCISE

Simplify :

1. $\frac{1\frac{1}{2}}{2\frac{1}{2}}, \frac{2\frac{1}{3}}{3\frac{2}{3}}, \frac{4\frac{3}{4}}{2\frac{1}{4}}, \frac{6\frac{3}{5}}{8\frac{1}{5}}, \frac{4\frac{5}{7}}{6\frac{3}{7}}, \frac{7\frac{1}{4}}{8\frac{3}{4}}, \frac{8\frac{2}{3}}{16\frac{1}{3}}$
2. $\frac{2\frac{1}{2}}{3\frac{3}{4}}, \frac{4\frac{3}{4}}{5\frac{1}{3}}, \frac{7\frac{2}{5}}{6\frac{7}{8}}, \frac{7\frac{1}{2}}{8\frac{1}{4}}, \frac{4\frac{3}{5}}{5\frac{2}{3}}, \frac{6\frac{5}{6}}{7\frac{1}{4}}$
3. $\frac{52}{3\frac{1}{4}}$
4. $\frac{3\frac{3}{4}}{5}$
5. $\frac{1\frac{4}{5}}{1\frac{1}{2}}$
6. $\frac{1\frac{1}{2}}{7\frac{1}{18}}$
7. $\frac{4\frac{2}{9}}{2\frac{3}{8}}$
8. $\frac{3\frac{4}{5}}{6\frac{7}{8}}$
9. $\frac{9\frac{7}{9}}{2\frac{1}{2}}$
10. $\frac{8\frac{2}{3}}{16\frac{1}{3}}$
11. $\frac{8\frac{3}{4}}{10\frac{5}{8}}$
12. $\frac{15\frac{3}{5}}{7\frac{4}{5}}$
13. $\frac{9}{3\frac{3}{11}}$
14. $\frac{25}{8\frac{3}{4}}$
15. $\frac{5}{57\frac{1}{2}}$
16. $\frac{27}{21\frac{3}{4}}$
17. $\frac{2\frac{2}{3} + \frac{2}{5}}{23}$
18. $\frac{3\frac{3}{4} + \frac{2}{3}}{36}$
19. $\frac{4\frac{1}{2} + \frac{2}{3}}{4\frac{1}{2} - \frac{2}{3}}$
20. $\frac{14\frac{1}{4} - 6\frac{1}{2}}{3\frac{1}{3} + 7\frac{1}{5}}$
21. $\frac{4\frac{1}{2} + 6\frac{1}{8}}{9\frac{1}{5} - 3\frac{1}{4}}$
22. $\frac{2\frac{1}{3} + 1\frac{3}{8}}{9\frac{2}{7} - \frac{3}{11}}$
23. $\frac{3\frac{1}{4} + 4\frac{1}{3}}{4\frac{1}{3} + 5\frac{1}{4}}$
24. $\frac{3\frac{3}{7} \text{ of } \frac{1}{2}}{\frac{1}{3} \text{ of } 8\frac{9}{4}}$
25. $\frac{2\frac{1}{4} + 2\frac{1}{5}}{5\frac{1}{2} \times \frac{1}{3}}$
26. $\frac{\frac{3}{5} - \frac{2}{5}}{\frac{2}{5} + \frac{2}{15}}$
27. $\frac{20\frac{1}{4} - 10\frac{1}{5}}{20\frac{1}{4} + 10\frac{1}{5}}$
28. $\frac{2\frac{1}{2} + \frac{2}{3}}{3\frac{1}{2} - \frac{1}{3}}$
29. $\frac{2}{7} \text{ of } \frac{1}{2} \times \frac{21}{22}$
30. $\frac{2\frac{3}{4} - 1\frac{1}{2}}{\frac{3}{4} + \frac{2}{5} \text{ of } 1\frac{2}{3}}$

To find the whole when a fractional part is known :

Example :

$\frac{3}{5}$ of a number is 21, find the number.

$\frac{3}{5}$ of the number is 21.

$\frac{1}{5}$ of the number is $\frac{1}{3}$ of 21, or 7.

Then $\frac{5}{5}$ of the number = $5 \times 7 = 35$.

The same result may be obtained as follows :

$\frac{3}{5}$ of the number is 21.

The number is $21 \div \frac{3}{5} = 21 \times \frac{5}{3} = 35$.

Rule. — To find a number when a fractional part of it is known, divide the known number by the fractional part, or multiply the known number by the fractional part inverted.

Find the numbers, if :

1. $\frac{9}{10}$ of the number is 45.
2. $\frac{8}{9}$ of the number is 72.
3. $\frac{3}{5}$ of the number is 81.
4. $\frac{5}{8}$ of the number is 105.
5. $\frac{7}{12}$ of the number is 224.
6. $\frac{11}{15}$ of the number is 605.
7. $\frac{9}{17}$ of the number is 1494.
8. $\frac{3}{5}$ of the number is 1347.
9. $\frac{4}{9}$ of the number is 4684.
10. $\frac{6}{11}$ of the number is 4146.

EXERCISE

1. What is the distance between Calgary and Winnipeg, if $\frac{2}{3}$ of the distance is 528 miles?
2. A man spent $\frac{7}{10}$ of his salary each year. If he spent \$1449, what was his salary?
3. A man sold 550 sheep and had left $\frac{4}{5}$ of his flock. How many sheep did he have at first?

4. The width of a room is $\frac{2}{3}$ of its length. The perimeter is 84 feet. What are the dimensions of the room?

5. In dressing hogs the weight is decreased $\frac{1}{11}$. What was the live weight of a hog which when dressed weighed 184 lbs.?

EXERCISE

1. A man wishes to put his grain in bags, each bag holding $2\frac{1}{2}$ bushels. Find the number of bags required for 780 bushels of grain.

2. A man owned $\frac{3}{4}$ of a business. He sold $\frac{1}{4}$ of his share for \$5477.00. What is the whole business worth?

3. If $7\frac{1}{2}$ lbs. of coffee cost $187\frac{1}{2}$ cents, what will a shipment of $507\frac{1}{2}$ lbs. cost?

4. A man earns $\$3\frac{1}{2}$ per day. He spends $\$2\frac{1}{2}$ for his board. How many days will he have to work in order to save enough to buy a suit costing $\$45\frac{1}{2}$?

5. A woman earns $\$21\frac{1}{2}$ every 6 days. How much will she earn in a month of 24 days?

6. A man owned $\frac{5}{8}$ of a farm. He sold $\frac{1}{4}$ of his share to another man, who sells $\frac{1}{4}$ of what he bought to a third man. The third man paid \$1250 for his share. What is the value of the farm?

7. A man spends \$1125 each year, which is $\frac{3}{14}$ of his salary. What is his salary?

8. Find the cost of the following goods:

2 dozen cans of salmon at 3 cans for 50 cents.

8 cans tomatoes at 2 cans for 35 cents.

15 cans corn at 3 cans for 40 cents.

3 dozen cans soup at 2 cans for 45 cents.

9. A merchant bought 5 hams which weighed $12\frac{1}{2}$ lbs., $17\frac{3}{8}$ lbs., $16\frac{3}{4}$ lbs., $18\frac{1}{2}$ lbs., and $19\frac{3}{4}$ lbs., respectively. He paid $19\frac{1}{2}$ cents per lb. Find the total cost of the hams.

10. A party of Boy Scouts set out on a journey of 25 miles. The first day they walked $6\frac{3}{4}$ miles; the second day they walked $2\frac{1}{2}$ miles farther than they walked the first day; the third day they walked $1\frac{1}{2}$ miles less than they walked the second day. They finished the tramp on the fourth day. How far did they walk on the fourth day?

REVIEW OF FRACTIONS

EXERCISE

Simplify :

1. $\frac{2}{3} \times (\frac{1}{2} \times \frac{1}{3})$

7. $(\frac{2}{3} + \frac{5}{8}) \times (\frac{5}{8} - \frac{1}{4})$

2. $5 \times (7 - 2\frac{1}{2})$

8. $\frac{1}{2} \times (\frac{2}{3} - \frac{2}{5}) + \frac{1}{4}$

3. $(3\frac{3}{4} - 2\frac{1}{2}) \times 2\frac{1}{2}$

9. $(2\frac{1}{2} + 3\frac{1}{3} - 4\frac{1}{4}) \times 12$

4. $4\frac{1}{4} - (\frac{1}{2} \text{ of } 3\frac{1}{2})$

10. $60 - (2\frac{1}{4} + 4\frac{3}{8}) \times 8$

5. $(\frac{1}{3} - \frac{1}{4} + \frac{1}{6}) \times 5\frac{3}{4}$

11. $2\frac{1}{4} \times \frac{5}{8} \text{ of } \frac{1}{2}\frac{2}{3} - \frac{3}{20}$

6. $(4\frac{1}{2} + \frac{1}{3} - 4\frac{5}{8}) \times 2\frac{2}{3}$

12. $\frac{5}{8} \text{ of } 1\frac{1}{2} + \frac{2}{5} \text{ of } 4\frac{1}{2}$

EXERCISE

1. Find the cost of three crates of eggs, each crate containing 12 dozen at $37\frac{1}{2}$ cents a dozen.

2. Find the cost of a remnant of silk containing $29\frac{3}{4}$ yards at $98\frac{1}{2}$ cents a yard.

3. A man left $\frac{2}{3}$ of his property to his wife, $\frac{1}{3}$ of it to his daughter, and the remainder to his son. The value of the son's share was \$20,900. How much did the wife and daughter each receive?

4. Mr. Smith rented a house for $\$42\frac{1}{2}$ per month. He kept the house for $3\frac{1}{2}$ years. How much rent did he pay?

5. A man spent $\frac{1}{5}$ of his income and at the end of the year had saved $\$500.00$. What was his income for the year?

6. What will it cost to thresh $116\frac{1}{2}$ acres of wheat at $6\frac{1}{2}$ cents a bushel, if the average yield is $36\frac{1}{2}$ bushels per acre?

7. On $\frac{2}{3}$ of my farm I planted wheat; on $\frac{1}{3}$ of the remainder I sowed oats; on $\frac{1}{3}$ of the remainder I planted barley; and on the rest, consisting of 15 acres, I sowed timothy. Find the number of acres in my farm and the number of acres each sowed to wheat, barley, and oats.

8. It requires $17\frac{1}{2}$ bushels of oats and barley mixed worth $79\frac{1}{2}$ cents a bushel, and $\$5.00$ worth of other feed to raise a pig until it is six months old. If the pig is marketed at the end of six months at $18\frac{1}{2}$ cents a lb., and weighs $189\frac{1}{2}$ lbs., how much has been made on the pig above the cost of feed?

9. A man had a flock of 300 sheep. During the winter, he fed them 80 tons of hay worth $\$14\frac{3}{4}$ per ton, 36 tons of straw worth $\$3\frac{1}{2}$ per ton, and 400 bushels of oats worth $78\frac{1}{2}$ cents per bushel. What was the cost of wintering 1 sheep?

10. If each sheep will shear $9\frac{3}{4}$ lbs. of wool worth $56\frac{1}{2}$ cents a lb., and the farmer has from this flock of 300 sheep an increase of 280 lambs which are worth $\$7\frac{3}{4}$ each, what was his total profit on the flock?

11. A man sowed $18\frac{3}{4}$ acres with peas, using 100 lbs. to the acre. Find the cost of the seed at $\$3\frac{1}{2}$ per bushel. If the crop averaged $29\frac{1}{2}$ bushels per acre, find the value of the crop if he sold it at $\$2\frac{3}{4}$ per bushel.

12. A man raised 105 bushels of potatoes per acre on a 5-acre field. By better cultivation and the use of better seed he increased the production to 140 bushels per acre. What fraction represents the increase in production? Find the total value of the increase on the 5 acres, if potatoes are worth $\$1\frac{3}{4}$ per bushel.

13. Find the cost of the following order :

3 lbs. 5 oz. whitefish at 16¢ per lb.

2 lbs. 8 oz. herring at 22¢ per lb.

$3\frac{1}{4}$ lbs. salt salmon at 15¢ per lb.

$7\frac{3}{4}$ lbs. halibut at 32¢ per lb.

5 lbs. 3 oz. codfish at 24¢ per lb.

14. The rainfall in Edmonton during the years 1910, 1911, 1912, and 1913 was as follows :

1910 — $14\frac{2}{3}$ inches

1911 — $20\frac{1}{2}$ inches

1912 — $20\frac{1}{2}$ inches

1913 — $19\frac{1}{2}$ inches

Find the average yearly rainfall for these years.

15. A man spent $\frac{3}{8}$ of his income for board, $\frac{1}{3}$ of the remainder for clothes, $\frac{2}{3}$ of the remainder for insurance, and saved the remaining part amounting to \$350.00. What was the man's total income?

REVIEW EXERCISE

1. A freight car 36 feet long and 8 feet wide is filled with wheat to a depth of 6 feet. Find the weight of the wheat in the car ; if 1 bushel of wheat requires $1\frac{1}{4}$ cubic feet of space. What is the value of the shipment, if the wheat is worth \$1.78 per bushel?

2. In making a lawn 250 feet long and 120 feet wide it was necessary to fill in earth to a depth of $2\frac{3}{4}$ feet. Find

the number of loads of earth required, allowing 1 cubic yard to the load.

If the top of the lawn is dressed with black earth to a depth of 8 inches, find the cost of the earth for this at 45 cents a cubic yard.

3. A farmer makes a reservoir to store water for the winter. The reservoir is 60 feet long and 40 feet wide, and is filled to a depth of 6 feet. If 1 cubic foot of water contains $6\frac{1}{4}$ gallons, find the number of gallons that are stored in the reservoir.

4. A dealer bought 35 bushels of timothy seed at \$3.75 per bushel. He sold the seed at the rate of 15 cents per quart. How much did he make on the seed?

5. A man bought two farms containing the same number of acres in each. For the first he paid \$47.00 per acre, and for the second he paid \$35.00 an acre. If the two farms cost him a total of \$13,120, find the number of acres in each farm.

6. A merchant bought maple syrup in wholesale quantities, paying 95 cents per gallon. He sold the syrup in quart bottles at 50 cents a bottle. If the bottles cost him 5 cents each, find how much he would make on an order of 300 gallons.

7. A man bought the south half and the north-east quarter of a section of land. Find the cost of fencing the outside of his farm with a wire fence costing him at the rate of 17 cents a yard. Draw a diagram of the farm.

8. A merchant bought four pieces of silk containing $45\frac{1}{4}$ yards, $65\frac{1}{4}$ yards, $52\frac{3}{4}$ yards, and $74\frac{5}{8}$ yards. How many yards of silk did he buy in the four pieces? He sold the following lengths: $12\frac{3}{4}$ yards, $7\frac{1}{2}$ yards, $16\frac{5}{8}$ yards, $29\frac{3}{8}$ yards, $37\frac{1}{4}$ yards, and $28\frac{3}{4}$ yards. How much silk did he sell? How much silk did he have left?

9. If 1 ton of hay requires 512 cubic feet of space, find the amount of hay that can be stored in a barn 48 feet long, 36 feet wide, and 12 feet high. If hay is worth \$17 per ton, find the value of the hay.

10. In a furniture factory there are 85 cabinet makers employed who are paid 85 cents an hour for their work. They work 8 hours a day. The superintendent is paid a salary of \$185.00 per month, the manager a salary of \$250.00 per month, and the two accountants a salary of \$135.00 each per month. Find the total pay roll for a month of 26 working days.

CHAPTER IV

DECIMALS

Introductory.

1. Read the number 2,345,678. In this number name the place occupied by each figure in the number.
2. Read the number 11,111. Name the place occupied by each figure in the number.
3. What part of the ten is the unit?
What part of the hundred is the ten?
What part of the thousand is the hundred?
What part of the ten thousand is the thousand?
4. The ten is how many times the unit?
The hundred is how many times the ten?
The thousand is how many times the hundred?
The ten thousand is how many times the thousand?
5. How are the units related to the tens?
How are the tens related to the hundreds?
How are the hundreds related to the thousands?
How are the thousands related to the ten thousands?
6. How are the tens related to the units?
How are the hundreds related to the tens?
How are the thousands related to the hundreds?
How are the ten thousands related to the thousands?
7. If we start at the units place and move the figure one place to the left, what do we do to the number? Take, for example, 4. If we move it *one* place to the left, we get 40, that is, we multiply 4 by 10.

8. If we start at the units place and move the figure two places to the left, what do we do to the number? Take, for example, 7. If we move it *two* places to the left, we get 700, that is, we multiply by 100.

9. Moving the figure *three* places to the left multiplies the number by 1000. Moving the figure *four* places to the left multiplies the number by 10,000.

10. Let us take the number 60,000. If we move the 6 *one* place to the right, we get 6000. We have divided by 10.

11. Let us move the 6 *two* places to the right, we have 600. We have divided by 100.

12. If we move the figure *three* places to the right, we divide by 1000. If we move the figure *four* places to the right, we divide by 10,000.

The *ten* is ten times the unit.

The *hundred* is ten times the ten and 100 times the unit.

The *thousand* is 10 times the hundred, 100 times the ten, and 1000 times the unit.

The *ten thousand* is ten times the thousand, 100 times the hundred, 1000 times the ten, and 10,000 times the unit.

10 is 10 times the unit.

100 is 100 times the unit.

1000 is 1000 times the unit.

10,000 is 10,000 times the unit.

The unit is one-tenth of the ten.

The unit is one-hundredth of the hundred; the ten is one-tenth of the hundred.

The unit is one-thousandth of the thousand; the ten is one-hundredth of the thousand; the hundred is one-tenth of the thousand.

The unit is one-ten-thousandth of the ten thousand; the ten is one-thousandth of the ten thousand; the hundred is one-hundredth of the ten thousand; and the thousand is one-tenth of the ten thousand.

By writing a figure one place to the right, we take one-tenth of the number. For example 5 is $\frac{1}{10}$ of 50.

By writing a figure two places to the right, we take one-hundredth of the number. For example 5 is $\frac{1}{100}$ of 500.

By writing a figure three places to the right, we take one-thousandth of the number. For example 5 is $\frac{1}{1000}$ of 5000.

By writing a figure four places to the right, we take one-ten-thousandth of the number. For example 5 is $\frac{1}{10,000}$ of 50,000.

Read the following:

\$5.65	\$235.75	\$65.25	\$4756.15
\$1.50	\$1.25	\$1.10	\$1.40

In these numbers we notice that the cents are written with the dollars, but we use a dot to separate the cents and the dollars.

We write 10 cents	\$.10	25 cents	\$.25
5 cents	\$.05	20 cents	\$.20
50 cents	\$.50	70 cents	\$.70

10 cents is one-tenth of a dollar and is written \$.10.

1 cent is one-hundredth of a dollar and is written \$.01.

30 cents is three-tenths of a dollar and is written \$.30.

7 cents is seven-hundredths of a dollar and is written \$.07.

Read the fractions $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, $\frac{1}{10,000}$.

These fractions stand for parts of one or the unit.

If we write down the unit 1, we may write down one-tenth of this by writing it one place to the right of the unit.

Thus:

UNIT	ONE-TENTH
1	1

We may write down one-hundredth by moving two places to the right of the unit.

Thus :

UNIT	TENTH	HUNDREDTH
1	0	1

In the same way we may write down the thousandth and the ten-thousandth.

Thus :

UNIT	TENTH	HUNDREDTH	THOUSANDTH	TEN-THOUSANDTH
1	0	0	1	1

If then we have to the right of the unit place the tenth, hundredth, thousandth, ten-thousandth, and other places, we may write down in this form fractions having 10, 100, 1000, 10,000, etc. as denominators.

Example :

Write down $46\frac{7}{10}$, $8\frac{58}{100}$, $23\frac{562}{1000}$, $75\frac{39}{10000}$.

HUNDREDS	TENS	UNITS	TENTHS	HUNDREDTHS	THOUSANDTHS	TEN-THOUSANDTHS
	4	6	7			
		8	5	6		
	2	3	5	6	2	
	7	5	0	0	3	9

We see therefore that we may write *fractions having as denominators 10 or a multiple of 10* by using the same system as for whole numbers but we write the fractional part to the right of the units. In order that we may not have to write out the names of the fractional places after the units, we place a small dot at the right side of the units to indicate the units place ; thus to write 3 units we write 3.

This small dot placed after the units indicates the units place and shows where the fractional part of the number commences.

We write $\frac{6}{10}$ thus 0.6.

$\frac{7}{100}$ thus 0.07.

$\frac{36}{100}$ thus 0.36.

$\frac{763}{1000}$ thus 0.763.

There being 0 units we place 0 in the units place.

The following chart shows the place value of figures in integers and decimals :

9	8	7	6	5	0	5	6	7	8	9
hundred-thousands	ten-thousands	thousands	hundred	tens	units	tenths	hundredths	thousandths	ten-thousandths	hundred-thousandths

The units place should be regarded as the central place, and the decimal point is used to indicate the units position. The integers or whole numbers are written to the left of the units, and the fractional parts or decimals are written to the right of the units. By reference to the chart we notice the following symmetry :

One place to the left of units is tens ; one place to the right is tenths.

Two places to the left of units is hundreds ; two places to the right is hundredths.

Three places to the left of units is thousands ; three places to the right is thousandths.

Note. — The integral part of the whole number ends in *s* ; the fractional part of the decimal ends in *ths*. For example, tens, tenths ; hundreds, hundredths ; thousands, thousandths.

In reading decimal fractions to the right of the decimal

point, we read them as whole numbers and give them the name of the place of the last figure.

For example: Read 0.6; 0.78; 0.06; 0.034; 0.008.

0.6 is read six-tenths.

0.78 is read seventy-eight hundredths.

0.06 is read six-hundredths.

0.034 is read thirty-four thousandths.

0.008 is read eight thousandths.

In writing decimals it is not necessary always to write the 0 in the units; it is understood that there are 0 units.

In reading a number made up of an integral and a decimal part, we usually separate the fractional part by using the word *and*.

For example: 456.0563 is read, four hundred fifty-six *and* five hundred sixty-three ten-thousandths.

Note. — We may have decimal fractions of the hundred-thousandth, millionth, ten-millionth, hundred-millionth, etc. order. It is not usual to use the decimal fraction much beyond the 4th place or the ten-thousandths order.

Reading and Writing Decimals

Examples:

1. Read the decimal .563. The name of the order of the right-hand figure is thousandths. The decimal is read five hundred sixty-three *thousandths*.

2. Read the decimal .00563. The name of the order of the right-hand figure is hundred-thousandths. The decimal is read five hundred sixty-three *hundred-thousandths*.

3. Read 53.078. The name of the order of the right-hand figure of the decimal is thousandths. Read the

whole number and separate the decimal part with the word *and*. The number is read thus: fifty-three *and* seventy-eight *thousandths*.

EXERCISE

Read the following decimals :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1.	.05	.345	.008	.137	.0563
2.	.456	.2006	.0705	.0063	.345
3.	.0007	.0570	.835	.89	.506
4.	.5604	.6703	.00006	.7895	.0453
5.	.0275	.6703	.67	.085	.08956
6.	56.087	876.9	34.0056	457.98	458.063
7.	3456.87	45.078	2367.08	67.7805	543.0085
8.	19.0006	567.43	32.008	657.0965	17.023
9.	9.006	700.0007	530.032	80.007	75.006
10.	10.007	50.006	70.0008	600.56	85.0085

EXERCISE

Write all the decimals given above from dictation.

NOTE TO THE TEACHER. — The teacher should read aloud the decimals given in the exercise above and have the pupils write down the notation. The decimals should be read as indicated above.

EXERCISE

Write the following decimals :

1. Three and twenty-seven thousandths.
2. Five hundred forty-six and two hundred and nine ten-thousandths.
3. Six hundred and fifty-four millionths.
4. Seventeen and eight hundred-thousandths.

5. Six thousand two hundred thirty-nine and seven hundred and three thousandths.
6. Nineteen and four ten-thousandths.
7. Ten and ten-thousandths.
8. Four hundred eighteen and seventeen hundredths.
9. Eighty-six and three thousandths.
10. Eight hundred and thirty-six hundred thousandths.

EXERCISE

Arrange the following decimal fractions in order of magnitude, the greater fraction being written first :

- | | | | | | |
|-----------|--------|-------|---------|-------|---------|
| 1. .0823 | .12 | .998 | .011989 | .058 | |
| 2. .754 | .09985 | .8 | .09598 | .7999 | |
| 3. .45689 | .05 | .4985 | .467 | .4953 | |
| 4. .95685 | .09856 | .8 | .95 | .9 | 1.00005 |
| 5. .495 | .0959 | .5 | .4995 | .075 | .4998 |

Reduction of Decimals to Common Fractions

Introductory :

Express $.7$ as a common fraction. *Ans.* $\frac{7}{10}$.

Express $.35$ as a common fraction. *Ans.* $\frac{35}{100}$, and reducing to its lowest terms we have $\frac{7}{20}$.

Reduce $.045$ to a common fraction.

$.045$ is the same as $\frac{45}{1000}$, which may be reduced to its lowest terms, $\frac{9}{200}$.

EXERCISE

Reduce the following decimals to common fractions in their lowest terms :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1.	0.08	.85	.625	.0425	.225
2.	.005	.5625	.6875	.3725	.0425
3.	.725	.9375	.0875	.12	.480

Reduction of Common Fractions to Decimal Fractions

Example:

Reduce $\frac{5}{8}$ to a decimal fraction.

$\frac{5}{8}$ indicates the division of 5 by 8.

5 units are not divisible by 8, but we may reduce the units to tenths, obtaining 50 tenths.

50 tenths divided by 8 will give us 6 tenths and 2 tenths over.

We may reduce the 2 tenths to hundredths, obtaining 20 hundredths.

20 hundredths divided by 8 will give us 2 hundredths and 4 hundredths over.

We may reduce the 4 hundredths remainder to thousandths, obtaining 40 thousandths.

40 thousandths divided by 8 will give 5 thousandths.

Writing down our quotients we have: 6 tenths, 2 hundredths, 5 thousandths, or .625.

The work may be shortened thus:

$$\begin{array}{r} 0.625 \\ 8 \overline{)5.000} \end{array}$$

Rule. — To reduce a common fraction to a decimal fraction, place the decimal point to the right of the numerator, annex zeros, and divide by the denominator of the fraction, placing the decimal point in the quotient.

Example:

Reduce $\frac{5}{6}$ to a decimal fraction.

$$\begin{array}{r} .833 \\ 6 \overline{)5.000} \end{array} \quad 2 \text{ remainder}$$

In this case the division is not exact. This decimal usually is carried out to 3 or 4 places only, and the remainder is neglected.

EXERCISE

Reduce the following common fractions to decimal fractions. Where necessary carry the decimal fraction to *four* places.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1.	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{3}{5}$	$\frac{13}{25}$	$\frac{9}{16}$
2.	$\frac{35}{50}$	$\frac{11}{32}$	$\frac{46}{64}$	$\frac{15}{50}$	$\frac{19}{40}$
3.	$\frac{4}{7}$	$\frac{5}{8}$	$\frac{10}{11}$	$\frac{7}{15}$	$\frac{7}{12}$
4.	$\frac{24}{33}$	$\frac{12}{14}$	$\frac{17}{45}$	$\frac{25}{36}$	$\frac{6}{4}$
5.	$\frac{51}{32}$	$\frac{45}{25}$	$\frac{15}{8}$	$\frac{24}{16}$	$\frac{57}{50}$
6.	$\frac{74}{36}$	$\frac{35}{27}$	$\frac{27}{35}$	$\frac{42}{50}$	$\frac{37}{35}$
7.	$\frac{39}{28}$	$\frac{65}{25}$	$\frac{42}{16}$	$\frac{45}{16}$	$\frac{55}{38}$
8.	$\frac{245}{35}$	$\frac{178}{56}$	$\frac{356}{37}$	$\frac{657}{367}$	$\frac{425}{168}$

Addition of Decimals

Introductory :

1. Add 3 yards 2 feet 5 inches and 6 yards 2 feet 7 inches. To add these we write them down with like units arranged under each other thus :

$$\begin{array}{r} 3 \text{ yards } 2 \text{ feet } 5 \text{ inches} \\ 6 \text{ yards } 2 \text{ feet } 7 \text{ inches} \\ \hline 10 \text{ yards } 2 \text{ feet } 0 \text{ inches} \end{array}$$

2. Add 457. 6543. 24. 12.345.

To add these we write them down thus :

$$\begin{array}{r} 457 \\ 6543 \\ 24 \\ 12345 \\ \hline 19369 \end{array}$$

In adding we first add the units, then tens and so on, until the sum is completed.

Example:

Add 34.67, 236.08, 5.007, 64.8.

34.67	Arrange these under each other, placing units under the units, tens under tens, etc., tenths under tenths, hundredths under hundredths, etc. Add figures of the same order; put down the sum, and carry to the next higher order. Begin at the right-hand column of the addition.
236.08	
5.007	
64.8	
<u>340.557</u>	

EXERCISE

Add:

- | | | | |
|-----------------------------------------------|-------------------------------------------------|------------------------------------------------|------------------------------------------------|
| 1. 0.764
7.009
<u>43.06</u> | 2. 34.56
8.007
<u>76.05</u> | 3. 567.09
64.985
46.7
<u>456.006</u> | 4. 435.887
76.09
569.007
<u>56.8</u> |
| 5. 567.08
79.4
457.003
<u>8.978</u> | 6. 23.789
5670.08
78.8
<u>4605.67</u> | 7. 789.006
64.75
5763.9
<u>567.08</u> | 8. 57.4
7439.008
369.84
<u>69.073</u> |
| 9. 3005.67
674.009
7.8
<u>503.67</u> | 10. 69.804
604.79
47.053
<u>4598.8</u> | | |

EXERCISE

Copy and add, arranging the work in columns:

1. 7.49, 346.89, 17.23678, 37.654, 560.895, 567.936, 29.57.
2. 356.78, 89.0874, 3.987, 896.564, 56.984, 326.789, 7.89.
3. 49.327, 0.458, 8317.05, 341.875, 32.4962, 764.983, 18.76.
4. 560.379, 0.45687, 378.834, 54.369, 298.763, 39.45, 0.987.

DECIMALS

5. 367.89, 0.985, 7.836, 456.93, 39.749, 543.749, 0.987.
6. \$38.95, \$345.67, \$785.94, \$56.78, \$93.67, \$327.87.
7. \$456.87, \$78.93, \$89.65, \$78.35, \$684.56, \$97.68.
8. \$356.97, \$56.84, \$467.93, \$367.04, \$273.67, \$56.89.
9. \$85.69, \$793.50, \$239.76, \$58.95, \$349.78, \$38.72.
10. \$456.78, \$534.95, \$675.48, \$347.89, \$479.06, \$56.84.
11. 657.078, 56.895, 543.78, 567.984, 786.543, 789.67.
12. 456.67, 893.75, 678.789, 236.54, 78.93, 873.456.
13. 456.935, 67.089, 0.786, 3.6789, 17.9567, 0.3798, 67.
14. 896.45, 546.38, 0.987, 54.876, 19.87, 0.896, 47.865.

15. 657.987 4,678.047 798.86 98.654.367 <hr style="width: 100%;"/> 69.84	16. 56.098 5679.876 34.07 7489.245 <hr style="width: 100%;"/> 567.097	17. 34,789.09 7, 36 68 74 6.783.085 <hr style="width: 100%;"/> 67.87
------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------

18. 7897.098 783.85 573.078 67.9 <hr style="width: 100%;"/> 3.459	19. .608935 459.0983 560.98 9.72458 <hr style="width: 100%;"/> 67.098	20. .80975 6.78959 49.089 8.45673 <hr style="width: 100%;"/> 56.74
-----------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------

21. .57608 34.02467 578.75 94.3286 <hr style="width: 100%;"/> 9.45	22. .78342 8.0976 459.0652 73.265 <hr style="width: 100%;"/> 6.35
------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------

Write in columns and add :

23. 375.89, 45.098, 5.675, 5489.065, 34.658, 432.8.
24. 386.45, 7.895, .0985, 45.98, 234.075, 65.9856.

25. 36.892, 789.45, 4.785, 25.765, 9.98, 345.9706.
 26. 9.65, 0.786, 296.4, 75.368, 39.67, 54.097, 8.055.
 27. 376.7, 97.76, 3.8764, 674, 27.864, 0.764, 45.098.
 28. 2.345, .0015, 6.0805, 287.6754, .609, 467, 34.098.
 29. 9.1235, 654.098, 567.45, .0985, 5689, 2.0056, 56.78.
 30. 98.84, 9.465, 8.07, 19.765, 83.486, 7.985, 345, .89.

NOTE TO THE TEACHER. — Dictate the following examples in addition of decimals :

1.	.275	2.	.4	3.	46.78	4.	543.09
	436.8		675.075		83.089		67.765
	56.75		6.875		538.07		8.85
	<u>8.034</u>		<u>67.75</u>		<u>56.7</u>		<u>800.085</u>
5.	56.075	6.	54.784	7.	67.098	8.	46.987
	349.8		96.4679		8.985		7.093
	17.56		347.98		4563.78		458.983
	<u>75.056</u>		<u>85.75</u>		<u>78.45</u>		<u>9.753</u>
9.	0.09856	10.	78.953				
	475.78		679.56				
	29.39		85.799				
	<u>5.798</u>		<u>479.326</u>				

EXERCISE

1. A man went on a journey travelling as follows : From Brandon to Regina, a distance of 223.7 miles ; from Regina to Saskatoon, a distance of 181.3 miles ; from Saskatoon to Brandon directly, a distance of 397.6 miles. How far did he travel altogether ?

2. A party took an automobile trip and travelled the following distances : first day, 98.75 miles ; second day, 135.8 miles ; third day, 235.45 miles ; fourth day, 138.56 miles. How far did they travel in the four days ?

3. On my summer vacation I left Calgary and went to Banff, from Banff I went to Vancouver, from Vancouver to Victoria, from Victoria to Seattle, from Seattle back to Victoria, from Victoria back to Vancouver, then back to Banff and returned to Calgary. If the distance from Calgary to Banff is 81.9 miles, from Banff to Vancouver is 559.9 miles, from Vancouver to Victoria is 78.8 miles and from Victoria to Seattle is 289.6 miles, how far did I travel on the entire return trip to Seattle from Calgary?
4. At Vancouver in 1912 the rainfall for the year was as follows: January, 7.64 inches; February, 6.25 inches; March, 0.89 inches; April, 3.92 inches; May, 2.35 inches; June, 2.28 inches; July, 1.54 inches; August, 5.56 inches; September, 2.84 inches; October, 4.64 inches; November, 9.21 inches; December, 8.70 inches. Find the total rainfall for the year.
5. At Moose Jaw the rain and snow fall for the year 1912 was as follows: January, .25 inches; February, .017 inches; March, .14 inches; April, .41 inches; May, 3.78 inches; June, 1.72 inches; July, 2.86 inches; August, 2.15 inches; September, 1.60 inches; October, .33 inches; November, .06 inches; December, .56 inches. Find the total precipitation for the year in inches.
6. A farmer threshed the following number of bushels of grain from 6 fields: first field, 487.56 bushels; second field, 534.05 bushels; third field, 453.85 bushels; fourth field, 395.65 bushels; fifth field, 658.76 bushels; sixth field, 567.84 bushels. How much grain did he thresh from the six fields?
7. I had a 10-acre field of alfalfa. The first cutting I secured 18.45 tons; the second cutting, 13.75 tons; and the third cutting, 8.65 tons. How many tons did I get from the three cuttings?

8. A man bought a farm made up of the following parcels of land: 456.78 acres; 235.8 acres; 164.5 acres; 476.55 acres; and 375.85 acres. Find the total number of acres in the farm.

9. A coal dealer made the following sales of coal in one day: 7.5 tons; 24.5⁶ tons; 56.85 tons; 16.74 tons; 26.72 tons; 15.64 tons and 45.75 tons. Find the total amount of coal sold in the day.

10. At the Manitoba Agricultural College in a dairy test covering one week an Ayreshire cow gave the following daily quantities of milk: Sunday, 31.95 lbs.; Monday, 28.78 lbs.; Tuesday, 36.35 lbs.; Wednesday, 29.8⁶ lbs.; Thursday, 30.72 lbs.; Friday, 28.45 lbs.; Saturday, 29.25 lbs. Find the total weekly supply of milk from this cow.

Subtraction of Decimals

Example: From 45.43 take 7.684.

$$\begin{array}{r} 45.430 \\ 7.684 \\ \hline 37.746 \end{array}$$

Write down the numbers as in ordinary subtraction, taking care that the decimal points are in the same column and that figures of the same order are placed under each other, units under units, etc.

Begin at the right-hand figure.

Since the first figure in the subtrahend is thousandths, we shall annex a zero to the minuend making a thousandth place in it. Subtract as with whole numbers, placing the decimal point of your answer under the decimal points above.

EXERCISE

Subtract: Prove your answers by addition.

1. $\begin{array}{r} 76.083 \\ 37.594 \\ \hline \end{array}$	2. $\begin{array}{r} 456.09 \\ 94.075 \\ \hline \end{array}$	3. $\begin{array}{r} 34.0347 \\ 7.0568 \\ \hline \end{array}$	4. $\begin{array}{r} 2.0432 \\ 0.78 \\ \hline \end{array}$
5. $\begin{array}{r} 67.0052 \\ 8.8964 \\ \hline \end{array}$	6. $\begin{array}{r} 38.94 \\ 7.895 \\ \hline \end{array}$	7. $\begin{array}{r} 57.4 \\ 9.6578 \\ \hline \end{array}$	8. $\begin{array}{r} 53.79 \\ 8.693 \\ \hline \end{array}$

DECIMALS

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<p>9. 65.2 <u>17.562</u></p>	<p>10. 37.3 <u>34.673</u></p>	<p>11. 2.0004 <u>1.2357</u></p>	<p>12. 24.36 <u>19.5804</u></p>
<p>13. $.9357$ <u>.76883</u></p>	<p>14. 6.0002 <u>4.0437</u></p>	<p>15. $56.$ <u>4.478</u></p>	<p>16. 854.36 <u>394.472</u></p>
<p>17. 6.00785 <u>.545</u></p>	<p>18. 76.592 <u>9.583</u></p>	<p>19. $453.$ <u>367.4503</u></p>	<p>20. 56.294 <u>8.758</u></p>

NOTE TO THE TEACHER. -- Dictate the following examples in subtraction:

EXERCISE

<p>1. $5.$ <u>3.0345</u></p>	<p>2. 1.047 <u>.9025</u></p>	<p>3. 345.06 <u>247.375</u></p>	<p>4. 38.0032 <u>9.2345</u></p>	<p>5. 78.56 <u>9.078</u></p>
<p>6. 3.78 <u>.0046</u></p>	<p>7. 45.8 <u>29.095</u></p>	<p>8. 6.083 <u>4.675</u></p>	<p>9. 8.0003 <u>.0765</u></p>	<p>10. 35.6 <u>29.753</u></p>

EXERCISE

1. The thermometer at 8 A.M. registered 46.85 degrees; at 3 P.M. it registered 73.25 degrees. Find the difference in temperature.
2. A coal dealer has a bin of coal containing 45.8 tons. He sells 18.25 tons. How much remains in the bin?
3. For the year 1912 the rainfall at Victoria, B. C., was 29.53 inches; at Calgary the same year the rainfall was 18.80 inches. Find the difference in rainfall.
4. During the year 1913 the snowfall at Edmonton was 47.8 inches; in Ottawa the same year the snowfall was 88.1 inches. Find the difference in snowfall.
5. In 1911 the rainfall for the year at Lethbridge was 17.23 inches; in the same year the rainfall at Regina was 14.56 inches. Find the difference in rainfall.

6. The distance from Winnipeg to Vancouver is 1474.2 miles; the distance from Calgary to Vancouver is 641.8 miles. Find the distance between Winnipeg and Calgary.

7. The distance from Winnipeg to Edmonton by way of Saskatoon is 848.5 miles; from Saskatoon to Edmonton is 368.7 miles. What is the distance from Winnipeg to Saskatoon?

8. From Montreal to Vancouver the distance is 2885.3 miles; from Winnipeg to Vancouver the distance is 1474.2 miles. What is the distance between Montreal and Winnipeg?

9. At the Ontario Agricultural College a test was made of the milk from Ayreshire, Jersey, and Holstein cows. For every 100 lbs. of milk the following number of lbs. of butter fat were secured: Jersey, 50.03 lbs.; Ayreshire, 3.55 lbs.; Holstein, 3.79 lbs. Find the difference in the amount of butter fat of each 100 lbs. of milk from each type of cow.

10. In 100 lbs. of crushed oats there are 78.9 lbs. of digestible animal food; in 100 lbs. of wheat bran there are 54.1 lbs. of digestible animal food. How much more food is there in 100 lbs. of crushed oats than in the same weight of wheat bran?

EXERCISE

1. Simplify $76.5 - 38.43 + 78.23 + 56.34 - 8.045 - 76.54 + 35.06 - 75.54$.

2. Simplify $345.67 - 65.095 + 45.35 - 6.056 + 675.05 - 34.65 - 7.89 + 54.375$.

3. Simplify $53 - 35.56 + 18.0875 + 245.065 - 6.783 + 54.785 - 0.985 + 6.783$.

4. Simplify $0.008 - 14.56 + 75.893 - 0.0765 - 7.575 - 23.5473 + 56.952 - 0.9$.

5. Simplify $45.673 - 9.085 + 0.854 + 46.974 + 345.095 - 6.7532 - 65.0085$.

6. A man owned a farm containing the following parcels of land: 345.65 acres, 256.85 acres, 158.65 acres, and 450.75 acres. From this farm he sold the following parcels of land: 185.65 acres, 245.5 acres, and 350.75 acres. How much land did he have left in the farm?

7. One farmer has 45.65 tons of hay for sale; another farmer who has already sold 37.56 tons has left 28.74 tons to sell. How much hay had both farmers to sell?

8. The Provincial Government has 98.75 miles of roadway to make. It lets contracts for the following pieces of the road: 8.5 miles, 25.56 miles, 17.85 miles, and 36.75 miles. The remainder is built by the Government. How many miles will the Government build?

9. A vessel is going from Sarnia to Montreal and must pass through the following canals: Welland Canal, 26.75 miles long; Murray Canal, 5.167 miles long; Galops, 7.125 miles long; Rapide Plat, 3.5 miles long; Farrens Point, 1 mile long; Cornwall, 11 miles long; Soulanges, 14 miles long; and Lachine, 8.5 miles long. Through how many miles of canals does the vessel pass?

10. The precipitation at Calgary during the year 1911 was as follows: January, .44 inches; February, .56 inches; March, 1.04 inches; April, 1.06 inches; May, 5.03 inches; June, 2.63 inches; July, 2.17 inches; August, 4.36 inches; September, .89 inches; October, .51 inches; November, .61 inches; December, .17 inches.

During the same year the precipitation at Edmonton was as follows: January, 1.18 inches; February, .31 inches; March, .39 inches; April, .45 inches; May, 1.95 inches; June, 3.8 inches; July, 5.83 inches; August, 4.49 inches;

September, .98 inches; October, .51 inches; November, .52 inches; December, .26 inches. Find the difference in precipitation between Edmonton and Calgary for this year.

Multiplication of Decimals

Introductory.

Examples:

1. Multiply 436 by .6.
2. Multiply 546 by 4.03.
3. Multiply 65.4 by 3.8.
4. Multiply .045 by .073.

1. Multiply 436 by .6.

$$436 \times .6 = 436 \times \frac{6}{10} = \frac{2616}{10} = 261\frac{6}{10} = 261.6$$

$$\begin{array}{r} 436 \\ \quad .6 \\ \hline 261.6 \end{array}$$

2. Multiply 546 by 4.03.

$$546 \times 4.03 = 546 \times 4\frac{3}{100} = 546 \times \frac{403}{100}$$

$$= \frac{220038}{100} = 2200\frac{38}{100} = 2200.38$$

$$\begin{array}{r} 546 \\ 4.03 \\ \hline 1638 \\ 21840 \\ \hline 2200.38 \end{array}$$

3. Multiply 65.4 by 3.8.

$$65.4 \times 3.8 = 65\frac{4}{10} \times 3\frac{8}{10} = \frac{654}{10} \times \frac{38}{10}$$

$$= \frac{24852}{100} = 248\frac{52}{100} = 248.52$$

$$\begin{array}{r} 65.4 \\ 3.8 \\ \hline 5232 \\ 1962 \\ \hline 248.52 \end{array}$$

4. Multiply .045 by .073.

$$.045 \times .073 = \frac{45}{1000} \times \frac{73}{1000} = \frac{3285}{1000000} \\ = .003285$$

$$\begin{array}{r} .045 \\ \times .073 \\ \hline 135 \\ 315 \\ \hline .003285 \end{array}$$

Study carefully these examples.

Compare the product in each case. We find that it is made up by multiplying the numbers together as in ordinary multiplication. The number of decimal places in the product is equal to the sum of the number of places in the multiplier and the multiplicand.

Rule. — Multiply as in the case of whole numbers. Mark off as many places of decimals in the product as you have in the multiplicand and multiplier together.

ORAL EXERCISE

A. Without multiplying, tell the number of decimal places there will be in each of the following products :

- | | | |
|------------------|-------------------|-------------------|
| 1. 654 by .4 | 2. 4573 by .74 | 3. 6742 by 3.4 |
| 4. 3.5 by 6.7 | 5. 4.5 by .06 | 6. 34.07 by 2.06 |
| 7. .234 by 56 | 8. .0893 by 3.4 | 9. 34.07 by 4.003 |
| 10. .0089 by 7.4 | 11. 6.98 by 65.02 | 12. 74.2 by .006 |

B. Find the products of each of the above examples.

EXERCISE

Multiply the following :

- | | | | | |
|------------|------------|------------|------------|-------------|
| 1. 0.743 | 2. 8.06 | 3. 347.3 | 4. 2.87 | 5. 65.073 |
| <u>.36</u> | <u>.07</u> | <u>.64</u> | <u>.56</u> | <u>7.03</u> |

6.	$.039$	7.	$.764$	8.	6.007	9.	845.04	10.	54.006
	<u>6.8</u>		<u>43.09</u>		<u>$.78$</u>		<u>$.93$</u>		<u>$.706$</u>
11.	$.734$	12.	74.9	13.	85.05	14.	34.86	15.	$.0874$
	<u>7.034</u>		<u>$.806$</u>		<u>3.57</u>		<u>2.73</u>		<u>$.0073$</u>
16.	$.324$	17.	6.87	18.	23.07	19.	80.563	20.	4.372
	<u>$.0063$</u>		<u>37.06</u>		<u>7.0003</u>		<u>$.0234$</u>		<u>5.073</u>

EXERCISE

Multiply :

- | | | | | | |
|----|--------------------|-----|---------------------|-----|--------------------|
| 1. | 456.78 by 4.36 | 6. | $.34$ by 7.093 | 11. | 63.4 by 7.09 |
| 2. | $.0894$ by 35.08 | 7. | 37.006 by 4.7 | 12. | 2345 by 14.67 |
| 3. | 64.78 by $.087$ | 8. | 75.083 by $.0327$ | 13. | 8.043 by 3.047 |
| 4. | 56.410 by $.763$ | 9. | 89.003 by $.78$ | 14. | 8.346 by $.0083$ |
| 5. | 7.412 by $.0098$ | 10. | 6.73 by 8.0406 | 15. | 7.265 by $.189$ |

EXERCISE

Multiply :

- | | | | | | |
|----|-------------------|-----|----------------------|-----|--------------------|
| 1. | 7.6 by 78.03 | 6. | 74.003 by 32.007 | 11. | 34.008 by 540 |
| 2. | $.00067$ by 350 | 7. | $.00783$ by 600 | 12. | 7.00839 by 300 |
| 3. | 56.009 by 320 | 8. | $.0984$ by $20,000$ | 13. | $.09083$ by 3000 |
| 4. | 7.0065 by 400 | 9. | 43.083 by 2350 | 14. | $.34567$ by 1000 |
| 5. | 49.874 by 345 | 10. | $.08067$ by 5600 | 15. | 6.863 by 3.070 |

EXERCISE

1. A ship travels at the rate of 17 knots per hour. How many miles will it go in 36 hours, if a knot is equal to 1.1515 miles?

2. A field is 35.75 rods long and 24.5 rods wide. How many square rods are there in the field?

3. The circumference of a circle is 3.1416 times the length of its diameter. Find the circumference of the driving wheel of a locomotive which has a diameter of 9.250 feet.

4. What is the weight of the water in a rectangular tank 8 feet long, 4 feet wide, and 4 feet deep, if 1 cubic foot of water weighs 62.5 lbs.?

5. A train is travelling at the rate of 38.75 miles per hour. It runs for 6.25 hours. How far has it gone?

6. A dairy cow produced in one year 8754 lbs. of milk which graded 4.37 lbs. butter fat per 100 lbs. of milk. Find the total amount of butter fat produced in the year.

What is the value of the year's butter fat, if the price received for it was 53 cents per lb.?

7. Find the cost of a shipment of goods weighing 8795 lbs. at a freight rate of \$1.79 per cwt.

8. A shipment of farm machinery weighing 16,785 lbs. was sent from Calgary to Peace River by way of Edmonton. The freight rate from Calgary to Edmonton is \$.49 per cwt., and from Edmonton to Peace River is \$.90 per cwt. What was the total cost of the freight?

9. A man cut 258 acres of wheat which averaged 37.85 bushels per acre. He sold the wheat at \$2.19 per bushel. Find how much he received for his wheat

10. A man has a herd of 28 dairy cattle. He requires 4.5 tons of ensilage for each animal. How many tons does he require for the herd? The ensilage is worth \$23.75 per ton. What is the total cost of the ensilage?

Division of Decimals

To divide a decimal by a whole number:

Introductory.

Example: 1. Divide 3468 by 4.

$$\begin{array}{r} 867 \\ 4 \overline{)3468} \end{array}$$

Note. — We place the figure of the quotient above the corresponding figure of the dividend.

2. Divide 34.7620 by 4.

$$\begin{array}{r} 8.6905 \\ 4 \overline{)34.7620} \end{array}$$

Note. — Place the figure of the quotient above the corresponding figure of the dividend. Place the decimal point of the quotient above the decimal point of the dividend. Proceed as in ordinary division.

3. Divide 2356.784 by 8.

$$\begin{array}{r} 294.598 \\ 8 \overline{)2356.784} \end{array}$$

4. Divide .00384 by 8.

$$\begin{array}{r} .00048 \\ 8 \overline{).00384} \\ \underline{.0} \\ 0 \\ \underline{0} \\ 38 \\ \underline{32} \\ 64 \\ \underline{64} \end{array}$$

Note. — The work should be shortened :

$$\begin{array}{r} .00048 \\ 8 \overline{) .00384} \\ \underline{.0032} \\ 64 \\ \underline{64} \\ \end{array}$$

EXERCISE

Divide the following :

- | | | |
|------------------|-----------------|-----------------|
| 1. 24.563 by 7 | 2. 135.426 by 6 | 3. 457.254 by 9 |
| 4. 326.921 by 7 | 5. 2.814 by 14 | 6. 0.0126 by 18 |
| 7. 16.0032 by 16 | 8. 956 by 14 | 9. 12.978 by 21 |

EXERCISE

Divide the following :

- | <i>a</i> | <i>b</i> | <i>c</i> |
|---------------------|------------------|------------------|
| 1. 45.368 by 4 | 454.24 by 8 | 2168.8415 by 7 |
| 2. 683.487 by 9 | 108.46 by 17 | 181.926 by 27 |
| 3. 19891.832 by 38 | 10005.66 by 378 | 2303.859 by 293 |
| 4. 545.5562 by 179 | 19306.452 by 268 | 5990.056 by 56 |
| 5. 0.02337 by 41 | 1.6184 by 34 | 32.7405 by 365 |
| 6. 741.6006 by 806 | 81069.24 by 937 | 3653.874 by 1234 |
| 7. 7590.304 by 772 | 11530.624 by 128 | 129.219 by 567 |
| 8. 0.0159120 by 255 | 364.1750 by 875 | 329.718 by 614 |
| 9. 4.34172 by 746 | 237.5208 by 792 | 0.047250 by 625 |
| 10. 20.64569 by 403 | 903.2562 by 209 | 968.582 by 359 |

To divide or multiply a number by 10, 100, 1000 or any power of ten :

Multiply .56 by 10. *Ans.* 5.6.

Multiply 0.0567 by 100. *Ans.* 5.67.

Multiply 6.045 by 1000. *Ans.* 6045.

Multiply 2.45 by 1000. *Ans.* 2450.

Note. — A number is multiplied by ten or any power of ten by moving the decimal point as many places to the right as there are zeros in the multiplier, zeros being added to the product where necessary.

Divide 5.6 by 10. *Ans.* 0.56.

Divide 5.67 by 100. *Ans.* 0.0567.

Divide 6045 by 1000. *Ans.* 6.045.

Divide 2450 by 1000. *Ans.* 2.45.

Note. — A number is divided by 10 or any power of ten by moving the decimal point as many places to the left as there are zeros in the divisor, adding zeros to the quotient where necessary.

EXERCISE

Divide each of the following examples by 10, 100, and 1000 :

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1. 38.75	234.7	547.95	46.754
2. 34.57	67.45	43.7885	5.008
3. 45	6.05	0.089	56.05
4. 42.7	60.5	8.097	0.6534
5. 4.27	2.3707	246.9	187.6

EXERCISE

Multiply each of the following examples by 10, 100, 1000 :

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1. 38.65	546.09	65.856	3.452
2. 0.089	5.6704	732.074	0.0653
3. 42.07	4.035	65.456	1.056
4. .678	3.098	.2345	0.56

ORAL EXERCISE

Read aloud each of the following numbers :

By what must we multiply each of the following numbers in order to make them whole numbers or integers ?

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	34.6	.876	0.056	43.09	6.008	345.04
2.	.0087	56.043	0.805	435.7	5.904	67.006
3.	6.875	568.43	8.093	356.98	0.0006	9.0765
4.	43.678	65.092	567.003	28.06	65.009	.000853
5.	0.00985	0.0305	18.305	327.602	13.050	0.9008

To divide a decimal by a decimal:

Introductory.

1. Divide 4624 by 8. *Quotient, 578.*

Multiply both dividend and divisor by the same numbers, and divide.

Multiply by 9, we have

41,616 divided by 72. *Quotient, 578.*

Multiply both dividend and divisor by 10, we have

46,240 divided by 80. *Quotient, 578.*

2. Divide 76,531 by 7. *Quotient, 10,933.*

Multiply both dividend and divisor by the same numbers.

Multiplying by 8, we have

612,248 divided by 56. *Quotient, 10,933.*

Multiplying both dividend and divisor by 10, we have

765,310 divided by 70. *Quotient, 10,933.*

Note. — If we multiply both dividend and divisor by the same number the value of the quotient remains the same.

Example:

Divide 48.96 by .8.

We have learned how to divide by 8. If then we change the divisor to 8, we may proceed with the division. To change the divisor to 8 we multiply by 10. If the divisor is multiplied by 10, the dividend must be multiplied by the same number in order that the quotient may be the same.

Hence 48.96 divided by .8 is the same as

489.6 divided by 8. *Quotient, 61.2.*

Example:

Divide 51.43 by .37.

Make the divisor a whole number by multiplying by 100. Multiply the dividend by 100. Proceed as in ordinary division.

$$\begin{array}{r}
 139. \\
 37 \overline{) 5143} \\
 \underline{37} \\
 144 \\
 \underline{111} \\
 333 \\
 \underline{333}
 \end{array}$$

Example:

Divide .07928 by .04.

The decimal places are moved two places to the left in both dividend and divisor, making the divisor a whole number.

$$\begin{array}{r}
 1.982 \\
 4 \overline{) 7.928}
 \end{array}$$

Example:

Divide 36 by .025.

The decimal point is not written at the end of a whole number but it may be regarded as coming after the units. We annex zeros to the dividend to make up the number of places, thus :

$$\begin{array}{r}
 36,000 \text{ divided by } 25. \\
 1440 \\
 25 \overline{)36000} \\
 \underline{25} \\
 110 \\
 \underline{100} \\
 100 \\
 \underline{100} \\
 00
 \end{array}$$

Example:

Divide .0005691 by .07.

Multiplying both dividend and divisor by 100, we have
.05691 divided by 7.

$$\begin{array}{r}
 .00813 \\
 7 \overline{).05691}
 \end{array}$$

EXERCISE

Divide :

<i>a</i>	<i>b</i>	<i>c</i>
1. 56.7830 by .5	672.849 by .9	51.0041 by .7
2. 74.8664 by .8	3.81504 by .06	.115395 by .03
3. 13.6967 by .29	2.157248 by .37	.221112 by .037
4. 13.427 by .029	1.78542 by .327	.760608 by .278
5. .77794 by 8.02	90 by 7.02	.012 by 77.88
6. 8.236 by .145	1023.82 by 4.97	.545337 by 1.18
7. .03195 by 7.5	769.12 by .0368	.00469 by 17.5
8. .0113391 by 3.87	18.496 by .512	.03931845 by .967

- | <i>a</i> | <i>b</i> | <i>c</i> |
|-----------------------|--------------------------|-------------------|
| 9. 1.10643 by 0.039 | 0.0058893 by 0.067 | .5214227 by .0893 |
| 10. 3294.2808 by 4.37 | 0.001032152
by 0.0296 | 312.7194 by 3.78 |

Sometimes the division is not exact, in which case the quotient is carried out to 3, 4, or 5 places of decimals.

EXERCISE

Divide the following correct to *four* places of decimals :

- | <i>a</i> | <i>b</i> | <i>c</i> |
|----------------------|-----------------|-----------------|
| 1. 1.6803 by 23.8 | 19.8734 by 3.56 | 3.1418 by 27.5 |
| 2. 70.887 by 83.5 | 28 by 5.73 | 20.25 by 6.75 |
| 3. 200 by 2.35 | 150.345 by 37.8 | 35 by .0327 |
| 4. 73 by .085 | 234 by .035 | 500 by .045 |
| 5. 48.591 by 96 | 2.56 by .0032 | 8.4126 by 63.5 |
| 6. 3.1 by .0025 | .0056 by 1.7 | .0774 by 37.5 |
| 7. 203 by 0.019 | 406.8 by 0.185 | 1.0236 by 7.8 |
| 8. 15.78 by 2.039 | 0.0876 by 2.53 | 0.873 by .0739 |
| 9. 34.78 by 3.79 | 35 by .0893 | 245.9853 by 374 |
| 10. .0234568 by 7.85 | 9 by 0.00935 | 47 by 0.0763 |

EXERCISE

- The rainfall for 12 months at Winnipeg in 1915 was 15.78 inches. What was the average monthly rainfall?
- The annual precipitation at Lethbridge for the years 1909-1913 was as follows :

1909	11.69 inches	1910	7.98 inches
1911	22.11 inches	1912	14.20 inches
1913	14.75 inches		

Find the average annual precipitation for this period.

3. A man took a railway journey. His railway fare was \$32.98. If the railway charges 3.45 cents per mile, what was the length of the journey?

4. At a dairy test at the University of Alberta, a Holstein cow gave in the year 21,050 lbs. of milk which produced 809 lbs. of butter fat. How many lbs. of butter fat does this test per 100 lbs. of milk?

5. A herd of dairy cows tested the following amount of butter fat per 100 lbs. of milk during the year's test:

Cow	LBS. OF BUTTER FAT PER 100 LBS. OF MILK	Cow	LBS. OF BUTTER FAT PER 100 LBS. OF MILK
No. 1	3.63	No. 6	3.55
No. 2	3.75	No. 7	3.92
No. 3	3.79	No. 8	5.03
No. 4	3.94	No. 9	5.22
No. 5	3.65	No. 10	4.8

Find the average amount of butter fat per 100 lbs. of milk for the herd.

6. A man bought wheat at \$1.78 per bushel. He invested \$4690.30. How many bushels of wheat did he buy?

7. I invested \$3386.25 in oats which cost me 87.5 cents per bushel. How many bushels did I buy?

8. An aviator flew between two places 352 miles apart. His total time in the air was 2.75 hours. What was his average speed per hour?

9. In 1917 the cattle in the four Western Provinces were valued at \$242,933,000.00. The average value of 1 animal was placed at \$69.25. How many head of cattle were in the provinces?

10. A farmer sold .125 of his crop in November, and in December he sold .585 of the crop. At the end of the year he had 24,679 bushels left. Find the total amount of the crop in tons.

11. A man raised 345.876 bushels of wheat from 20.5 acres of land. At the same rate what should be the amount of his crop off 245 acres?

12. Find the cost of fencing a field 63.75 rods long and 54.5 rods wide at \$2.35 per rod.

EXERCISE

1. The width of a rectangular field is 125.73 yards. The area of the field is 5.715 acres. Find the length of the field in rods.

2. Iron weighs 7.8 times heavier than water, and 1 cubic foot of water weighs 62.5 lbs. Find the weight of a solid bar of iron 15 feet long, 4 inches wide, and 6 inches thick.

3. Wheat is worth \$1.79 per bushel. How many bushels can be bought for \$2500?

4. A man is travelling in an automobile at the rate of 26.75 miles per hour. How long will it take him to go 252.25 miles?

5. A Jersey cow at the Manitoba Agricultural College farm gave in one year 8209 lbs. of milk which tested 5.22 lbs. of butter fat per 100 lbs. of milk. How much butter fat did she produce in the year? What is the value of the year's butter fat at 47 cents per lb.?

6. One ton of timothy hay contains 952 lbs. of digestible nutrients. Alfalfa hay contains 51.6 lbs. of digestible nutrients for every 100 lbs. of hay. If timothy hay is worth \$26 per ton, what should be the price of alfalfa based on nutrient value?

7. Allowing 8.6 lbs. of milk to the gallon, how many gallons of milk are there in 7894.8 lbs. of milk?

8. A Holstein cow produced in one year 13,256.45 lbs. of milk containing 451.42 lbs. of butter fat. How many lbs. of butter fat per 100 lbs. of milk did this milk grade?

9. An aviator travels between London and Paris, making the journey in 1.45 hours. The total distance is 140.5 miles. At what rate per hour is he travelling?

10. On a 20-acre field a man secured 768.45 bushels of wheat. At the same rate of yield per acre what would be his total crop from 240 acres?

EXERCISE

1. A grain dealer invests \$3601.25 in wheat at \$2.15 per bushel and \$3150 in oats at 87.5 cents per bushel. How many bushels of each did he buy?

2. A rectangular field is 725.75 yards long and contains 16.5 acres. How wide is the field?

3. The product of 4 factors is 28.515708. Three of the factors are 86, .78, and 3.9. What is the fourth factor?

4. A boat travels at the rate of 19 knots per hour. How long will it take to go 195.75 miles, if 1 knot is equal to 1.1515 miles?

5. A cow produced during the year 13,097.2 lbs. of milk which contained 449.66 lbs. of butter fat. How many lbs. of butter fat per 100 lbs. does this grade?

6. A warship made the following distance records in 4 trial trips of 1 hour length each:

First hour	19.5 miles.	Third hour	22.2 miles.
Second hour	21.75 miles.	Fourth hour	23.9 miles.

What is the average rate of the ship in miles per hour?

If 1.1515 miles is equal to 1 knot, what is the average rate of the ship in knots per hour?

7. A man bought 56,780 feet of lumber at \$23.75 per thousand feet. He sold 28,775 feet at \$26.00 per thousand and the remainder at \$27.00 per thousand. How much more did he get for the lumber than he paid for it?

8. A fast train makes a journey of 275.8 miles in 6.5 hours; a slow train requires 8.25 hours to make the same journey. What is the difference in the rates of the trains in miles per hour?

9. A farmer had a 20-acre field of alfalfa. From the first cutting he had 27.6 tons, from the second cutting 19.8 tons, and from the third cutting 17.2 tons. What was the average yield per acre? If he sold the entire crop of hay at \$23.75 per ton, how much did he receive for the crop?

10. A dealer received five carloads of coal weighing as follows: 22.815 tons, 21.86 tons, 20.187 tons, 19.885 tons, and 18.953 tons. He paid \$4.95 per ton for the coal. Find the cost of the shipment.

EXERCISE

1. The distance from Toronto to Calgary is 2064.7 miles. From Calgary to Vancouver the distance is 641.8 miles. If the passenger rate from Toronto to Calgary is 3.45 cents per mile, and from Calgary to Vancouver is 4 cents a mile, find the total cost of a railway ticket from Toronto to Vancouver.

2. A man wishes to make the return trip from Brandon to Lethbridge. The distance between these two places is 638.7 miles. If he buys two single tickets, he will pay 3.45 cents per mile going each way. If he purchases a return ticket at Brandon, it will cost him for the return trip $1\frac{1}{2}$ of the single rate of 3.45 cents per mile. What will a man save by purchasing a return ticket rather than two single tickets?

3. I wish to make the journey from Edmonton to Saskatoon, the distance being 368.3 miles. If I purchase single tickets each way, I shall pay 3.45 cents per mile for each ticket. By purchasing a return ticket at Edmonton, I have to pay for it $1\frac{1}{2}$ of the single fare. How much do I save by purchasing the return ticket?

4. A woman travels from Regina to Montreal, a distance of 1768.8 miles. What will her return ticket cost her, if the single fare is 3.45 cents per mile and the return fare is $1\frac{1}{2}$ of the single fare?

5. The distance between Quebec and Liverpool is 2800 miles. If the fare is \$133.00, what is the rate per mile?

6. The distance between Winnipeg and Vancouver is 1474.2 miles. A passenger train takes 2 days and 6 hours to make the journey. What is the average rate per hour at which the train travels, disregarding the time used for stops?

7. A farmer at Weyburn, Sask., received a shipment of goods by freight from Regina. The total weight of the shipment was 23,678 lbs. If the freight rate is \$.475 per cwt., what were the freight charges?

8. A farmer in Moose Jaw ordered the following goods from the United Grain Growers, Regina, having the goods shipped as second-class freight at a charge of \$.27 per cwt.:

1 spring tooth cultivator at \$226.20, weight 1365 lbs.

A disc harrow at \$63.55, weight 599 lbs.

1 mower at \$82.10, weight 805 lbs.

1 sulky rake at \$53.15, weight 475 lbs.

1 wagon at \$134.10, weight 1516 lbs.

Find the total cost of the order, including freight charges.

9. The distance from Winnipeg to Regina is 356.8 miles ; from Regina to Saskatoon the distance is 171.8 miles ; the direct route from Winnipeg to Saskatoon is 480.2 miles.

(a) Find how much farther a person travels going by way of Regina.

(b) If the railway fare is 3.45 cents per mile, find the difference in fares going the direct route and also by way of Regina.

10. A man bought 36 stocker cattle which averaged in weight 837.75 lb. at \$6.75 per cwt. It cost him \$27.50 per head to winter this stock. He sold the lot at \$9.75 per cwt., the average weight of each being 1247.5 lb. How much did he make on the transaction ?

EXERCISE

1. A farmer in the Okanagan Valley plants a 10-acre field of potatoes. His expenses are as follows : rent of land, \$25.00 per acre ; 120 bushels of seed at \$1.95 per bushel ; plowing the land, \$35.00 ; discing and harrowing, \$25.00 ; planting potatoes, \$30.00, cultivating, \$27.00 ; digging potatoes, \$75.00 ; marketing, \$65.00. The average yield of potatoes was 189 bushels per acre, which he sold at \$1.35 per bushel. How much did he make per acre ?

2. Wheat requires 400 lbs. of water to mature 1 lb. of grain. Find the depth in inches of rainfall required to grow a crop of wheat which averaged 42 bushels per acre on a field containing 50 acres. 1 cubic foot of water weighs 62.5 lbs.

3. The British Columbia Electric has 245.59 miles of electric railway. In 1917 the cost of operation was \$2,448,207.00. The total earnings were \$2,700,733.00. Find the average profit per mile of railway.

4. The weekly cost of a family budget of staple foods, fuel and lighting, and rent, in terms of the average prices in Canada in 1910 and 1917:

COMMODITIES	1910	1917	COMMODITIES	1910	1917
Beef, sirloin . . .	57.6 cts.	62.4 cts.	Flour . . .	33.0 cts.	64.2 cts.
Beef, roast . . .	26.0 cts.	41.3 cts.	Rice . . .	10.4 cts.	16.2 cts.
Pork, fresh . . .	18.0 cts.	29.6 cts.	Beans . . .	10.8 cts.	29.8 cts.
Pork, cured . . .	34.4 cts.	53.5 cts.	Sugar . . .	34.8 cts.	58.4 cts.
Bacon . . .	24.5 cts.	38.5 cts.	Potatoes . . .	30.3 cts.	89.2 cts.
Eggs . . .	61.7 cts.	92.3 cts.	Tea . . .	17.8 cts.	22.8 cts.
Milk . . .	48.0 cts.	62.2 cts.	Fuel, etc. . .	175.7 cts.	236.5 cts.
Butter . . .	83.9 cts.	134.4 cts.	Rent . . .	405.0 cts.	432.0 cts.
Bread . . .	66.0 cts.	104.0 cts.			

(a) Find the total cost of the family budget for each of the years 1910 and 1917.

(b) Find the difference in the cost of the weekly budget for these years.

5.

AREA AND POPULATION OF CANADA IN 1911 BY PROVINCES

PROVINCE	AREA IN SQUARE MILES	POPULATION
Prince Edward Island	2,184.4	93,728
Nova Scotia	21,428.0	492,338
New Brunswick	27,980.5	351,889
Quebec	351,872.6	2,003,232
Ontario	260,705.7	2,523,274
Manitoba	73,731.7	455,614
Saskatchewan	251,700.0	492,432
Alberta	255,280.5	374,663
British Columbia	355,850.5	392,480
Yukon	207,076.0	8,512
North-West Territories	1,921,685.0	18,481

- (a) Find the total area of Canada.
- (b) Find the total population of Canada in 1911.
- (c) Find the number of people per square mile in each of the provinces and divisions in Canada in 1911.
- (d) Find the number of people per square mile for the whole of Canada.

6. A man leaves Vancouver and makes the following journey: from Vancouver he goes to Sicamous, a distance of 334.6 miles; from Sicamous he goes to Penticton, traveling 154.8 miles; thence to Nelson, a distance of 135 miles; from Nelson he goes to Calgary, 476.5 miles; and from Calgary returns directly to Vancouver, a journey of 641.8 miles.

- (a) How many miles does he travel in making the complete journey?
- (b) Find the total cost of the trip, if the railway fare is 3.45 cents per mile.

7. A farmer has a herd of 28 dairy cows that produce on an average 19 lbs. each of milk, which grades 3.78 lbs. of butter fat per 100 lbs. of milk. He sells the product at 49 cents per lb. butter fat. What income does he receive from the herd?

8. The surface of a pond containing 4 acres is frozen to a depth of 15 inches. If 1 cubic foot of water weighs 62.5 lbs. and ice weighs 0.92 as much as water, find the weight of the ice in tons.

9. A warship travels 24 miles per hour. Find the time it will take to cross from Vancouver to Sydney, Australia, a distance of 7265 miles.

10. A steamship that travels at the rate of 19.75 miles per hour leaves Liverpool, crosses the Atlantic to New York, and proceeds from New York to San Francisco by way of the Panama Canal. The distance from Liverpool to New York is 3108 miles; from New York to San Francisco the distance is 5309 miles. Find in days and hours the time spent by the steamship in making the journey, neglecting time spent in making the calls.

CHAPTER V

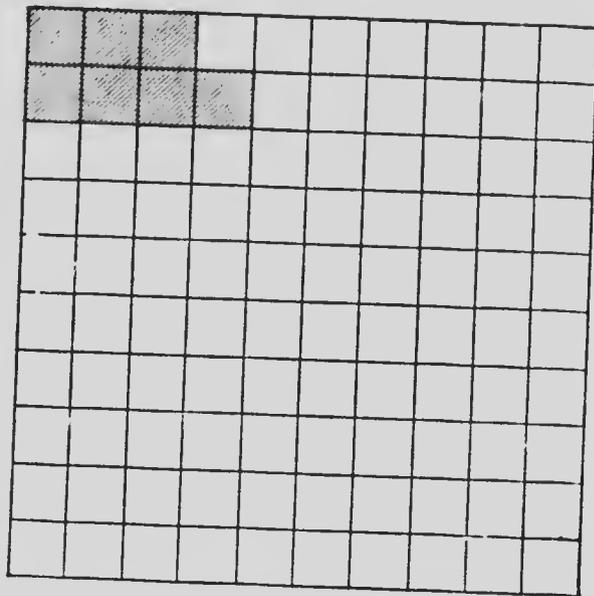
PERCENTAGE

The meaning of per cent.

Introductory.

This square is divided into 100 parts. Each part is $\frac{1}{100}$ of the square. We may write this part in different ways as $\frac{1}{100}$ or as .01.

Another way to write this fraction is as 1 per cent or 1%.



The shaded part of the square is $\frac{7}{100}$, or .07, or 7% of the square.

Example:

A man had 100 sheep. He sold 25 of them. What fraction of his flock did he sell?

Solution: He had 100 sheep. He sold 25 of them. He sold $\frac{25}{100}$ of his flock, or .25 of his flock, or 25% of his flock.

Per cent means per hundred or hundredths of anything.

6%, $\frac{6}{100}$ and .06 all represent the same quantity.

ORAL EXERCISE

State as per cent the following fractions :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	$\frac{1}{100}$	$\frac{1^2}{100}$	$\frac{7}{100}$	$\frac{35}{100}$	$\frac{20}{100}$	$\frac{45}{100}$
2.	.08	.05	.25	.30	.75	.10
3.	.45	.33 $\frac{1}{3}$	.09	.60	$\frac{41}{100}$	.50

State as decimal fractions the following per cents :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	50%	35%	75%	25%	20%	10%
2.	7%	4%	45%	8%	6%	1%
3.	12%	15%	60%	3%	9%	80%

ORAL EXERCISE

State as common fractions the following per cents :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	50%	25%	75%	20%	10%	40%
2.	33 $\frac{1}{3}$ %	66 $\frac{2}{3}$ %	12 $\frac{1}{2}$ %	16 $\frac{2}{3}$ %	60%	80%

Learn the following table :

$10\% = \frac{1}{10}$	$20\% = \frac{1}{5}$	$25\% = \frac{1}{4}$	$50\% = \frac{1}{2}$
$75\% = \frac{3}{4}$	$12\frac{1}{2}\% = \frac{1}{8}$	$16\frac{2}{3}\% = \frac{1}{6}$	
$33\frac{1}{3}\% = \frac{1}{3}$	$66\frac{2}{3}\% = \frac{2}{3}$	$37\frac{1}{2}\% = \frac{3}{8}$	

Note. — In using the per cents given in the table above, it will be found that knowing their equivalent values in common fractions will enable you to do more rapid work.

All other per cents are more easily worked by using the decimal form. For example $6\% = .06$, $8\% = .08$, $15\% = .15$, etc.

EXERCISE

Express as decimals or as common fractions the following per cents :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	35%	16%	25%	50%	7%	75%
2.	45%	20%	9%	11%	33 $\frac{1}{3}$ %	12 $\frac{1}{2}$ %

EXERCISE

Express as per cents the following fractions :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	.12	.65	.07	.45	$\frac{1}{4}$	$\frac{1}{16}$
2.	.17	.03	$\frac{1}{3}$	$\frac{1}{8}$	.85	$\frac{1}{3}$
3.	$\frac{2}{3}$	$\frac{1}{4}$	.52	.06	$\frac{1}{2}$	.09

To find any per cent of a number :

Example :

Find 7% of \$500.

$$1\% \text{ of } \$500.00 = \$5.00$$

$$7\% \text{ of } \$500.00 = 7 \text{ times } \$5.00 \text{ or } \$35.00$$

The work may be shortened thus :

$$7\% \text{ of } \$500.00 \text{ is } .07 \text{ times } \$500.00 \text{ or } \$35.00.$$

Rule. — To find the per cent of any number, multiply the number by the per cent expressed as a decimal fraction.

Example: Find 33 $\frac{1}{3}$ % of \$660.00.

Since 33 $\frac{1}{3}$ % is the same as $\frac{1}{3}$,

$$33\frac{1}{3}\% \text{ of } \$660.00 \text{ is } \frac{1}{3} \text{ of } \$660.00 \text{ or } \$220.00.$$

Note. — Use this method in dealing with the per cents given in the table of per cents and common fractions.

EXERCISE

Work the following examples, using the method of changing the per cent to decimal fractions and multiplying:

1. Find 7% of: 856; 642; 1345; 3456; \$5675; \$3750.
2. Find 6% of: 3456; 1785; 5467; 3450; 6850 sheep.
3. Find 15% of: 657; 458; 3245; \$750; \$857; 9845 bushels.
4. Find 45% of: 345; 1785; 5678; \$750; \$450; 875 acres.
5. Find 60% of: 758; 3456; 5675; \$3250; 8750 lbs.; 986 acres.

EXERCISE

Work the following examples, using the method of changing the per cents to common fractions:

1. 25% of: 4356; 2360; 7852; 6472; \$4800; \$3660.
2. 10% of: 3560; 7580; 6450; 32,790; \$5600; 5470 acres.
3. $33\frac{1}{3}\%$ of: 27,690; 14,919; 20,505; \$450; \$765; 717 acres.
4. $12\frac{1}{2}\%$ of: 5160; 3132; \$3000; \$3416; 5246 bushels.
5. 20% of: 4200; 6570; 32,560; \$4500; \$6700; 68,750 lbs.

EXERCISE

1. A farmer had 4500 bushels of wheat. He sold 25% of it. How many bushels did he sell?
2. A pupil had 25 problems to work on the examination paper and worked 60% correctly. How many were correct?
3. A rancher bought 375 head of stockers. He afterwards sold 28% of them. How many did he sell?

4. A man bought a house for \$8500.00 and sold it to gain 12%. How much did he gain?

5. A man owns a half section of land. 75% of it is broken, 10% is in hay meadow, and the remainder is in pasture. How many acres are there broken? How many acres are in hay meadow? How many acres are in pasture? What per cent of the land is in pasture?

6. A farmer has 480 acres in crop. 45% of it is in wheat, 20% of it is in barley, 15% of it is in rye, and the rest is in oats. How many acres are sowed in each of the following: wheat? barley? rye? oats? What per cent of the land is sowed in oats?

7. 122,250 vessels arrived at and departed from Canadian ports in 1917. Of these 60% were foreign ships, 32% were Canadian ships, and the remainder were British. Find the number of each of the foreign, Canadian, and British ships.

8. In 1913, 402,400 immigrants came to Canada. Of these 37% came from the British Isles, 34% came from the United States, and the remainder from other countries. Find the number of immigrants from each of these three divisions.

9. In 1917, Canada exported goods and products valued at \$1,151,375,768.00. Of these exports 65% were sent to Great Britain, 24% were sent to the United States, and the remainder to the other countries. Find the value of the exports to each of these divisions.

10. The total value of the fisheries of Canada in 1917 was \$52,312,044.00. Of this amount British Columbia marketed 41%, Nova Scotia, 28%, New Brunswick, 12%, and the remaining provinces of Canada the balance. Find the value of the fish marketed in 1917 in British Columbia; in

EXERCISE

What per cent of

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1. 32 is 8?	40 is 4?	42 is 7?	48 is 36?
2. 870 is 58?	375 is 45?	750 is 120?	684 is 456?
3. 928 is 116?	738 is 123?	832 is 624?	650 is 52?
4. 1950 is 273?	920 is 414?	156 is 101.4?	238 is 21.42?
5. 673 is 87.49?	856 is 59.92?	329 is 55.93?	283 is 118.86?

In some cases it is not possible to find an exact per cent, as for example: What per cent is 27 of 59?

Example: Find what per cent of 59 is 27.

$$\begin{array}{r}
 .457 \\
 59 \overline{)27.000} \\
 \underline{236} \\
 340 \\
 \underline{295} \\
 450 \\
 \underline{413} \\
 37
 \end{array}$$

In this case the division is carried out to 3 places. To correct the work to 2 places, we disregard the third place, but if the third figure is 5 or more we increase the second figure by 1. Correcting the answer to 2 places we have .46 or 46%.

Note. — In finding per cent statements the work should be carried out to three places and corrected to 2 places of decimals. If the figure in the third place is less than 5, the second figure is not changed; if the figure in the third place is 5 or over, the second figure of the quotient should be increased by 1.

EXERCISE

- Find what per cent 35 is of each of the following: 56, 79, 136, 459.
- Find what per cent 56 is of each of the following: 97, 765, 832.

3. Give the relation in per cent of 693 to 1384.
4. What per cent of 947 is 856?
5. What per cent of 2359 is 1785?
6. What per cent of 7634 is 2390?
7. What per cent of 5467 is 119?
8. What per cent of 3567 is 379?
9. What per cent of 6531 is 283?
10. What per cent of 65,789 is 43,785?

EXERCISE

1. A man bought 480 acres of land. He broke 160 acres of it. What per cent of the farm did he break?
2. On an examination a boy worked at 24 problems. He had 16 correct. What per cent of his problems were correct?
3. In a seed test there were 400 seeds planted and 348 germinated. What was the per cent of germination?
4. A cow in a year gave 8160 lbs. of milk that produced 354.96 lbs. of butter fat. What per cent did the milk grade?
5. A man's income is \$2800 per year. He spends \$2016 and saves the balance. What per cent of his income does he save?
6. The population of Calgary in 1911 was 43,704. In 1916, the population was 56,514. What per cent of the population of 1911 is the increase during the five-year period?
7. In 1911, the population of the Prairie Provinces was 1,328,725. In 1916, the population was 1,698,220. What per cent of the population of 1911 is the increase during the five-year period?

8. In 1911, the population of Canada was 7,206,643. Of these, 3,925,679 lived in the country, and the remainder lived in the towns and cities. What per cent of the population lived in the country, and what per cent of the population lived in the towns and cities?

9. In 1915, there were 13,267,023 tons of coal produced in Canada. Alberta and British Columbia produced 5,426,431 tons of this. What per cent of the coal production of Canada was produced in Alberta and British Columbia in 1915?

10. In 1918, the total revenue of the Dominion of Canada was \$260,778,953.00. Of this revenue \$144,172,630 was raised from customs duties, \$25,379,901 from special war tax, and \$21,345,394 from the post office service. Find what per cent of the total revenue was raised in 1918 by

- (1) Customs duties.
- (2) Special war tax.
- (3) Post office service.

EXERCISE

1. A man saves \$565.00 during the year. If he has spent 65% of his income, what was his total income for the year?

2. In 1917, 2063 pupils attended the public schools in Lethbridge. In 1918, there were 2369 pupils. What was the per cent increase over 1917?

3. In 1916, there were 47,978 pupils enrolled in rural schools and 51,223 pupils enrolled in graded schools in Alberta. Find what per cent of the total enrolment there were in (1) rural schools, (2) graded schools.

4. A man had two fields of 20 acres each. The first was summer fallow and produced a crop of 785 bushels. The second was spring plowing and produced a crop of 432 bushels. What was the per cent increase of the crop on summer fallow over that on spring plowing?

5. Four farmers decide to buy a carload of coal. The car contains 66,800 lbs. of coal. The cost of the coal was \$3.75 per ton. The first man took 40% of the coal, the second 15%, the third 25%, and the fourth the remainder. How much should each pay?

6. A house valued at \$6500.00 is damaged by fire to the extent of \$2500.00. What per cent of the value of the house is the damage?

7. In 1917, Canada exported 155,782,000 lbs. of cheese to Great Britain; the same year she exported 411,000 lbs. to the United States, and 1,205,000 lbs. to other countries. Find what per cent of her total export of cheese went: (1) to Great Britain; (2) to the United States; (3) to other countries.

8. The total amount of wheat grown in the world in 1917 was 2,241,100,000 bushels. Canada produced 233,743,000 bushels, the United States produced 650,539,000 bushels, and British India produced 379,306,000 bushels. These three countries were the leading wheat producing countries of the world. What per cent of the world's 1917 crop did each of these countries produce?

9. In 1917, there were 105,998 Indians in the Dominion of Canada. There were in the same year 11 583 in Manitoba, 10,646 in Saskatchewan, 8837 in Alberta, and 25,694 in British Columbia. Find what per cent of the total Indian population lived in: (1) Manitoba; (2) Saskatchewan; (3) Alberta; (4) British Columbia.

10. During the European war Canada enlisted 595,441 men. If her population was 7,206,643, what per cent of the population was the total enlistment?

EXERCISE

1. At the Ontario Agricultural College at Guelph a dairy test was made of a herd of Holstein cattle:

Cow No. 1 gave 16,736 lbs. of milk testing 3.67% butter fat.

Cow No. 2 gave 15,976 lbs. of milk testing 3.78% butter fat.

Cow No. 3 gave 21,030 lbs. of milk testing 3.59% butter fat.

Cow No. 4 gave 11,523 lbs. of milk testing 3.47% butter fat.

Cow No. 5 gave 16,466 lbs. of milk testing 3.65% butter fat.

Find the total weight in lbs. of the butter fat produced by the herd in the year. If butter fat is worth 49 cents per lb., what is the total cash return from the product?

2. In milling wheat into flour, approximately 83% of the weight of wheat is made into flour. Find the amount of flour that can be made from the wheat grown on 160 acres that threshed a crop averaging 38 bushels to the acre. What is the value of the flour at \$4.50 per hundred lbs.?

3. A man earns \$2400.00 per year. His expenditures are \$65.00 per month for board, \$450.00 for clothes, and \$250.00 for insurance. He saves \$600.00 per year. What per cent of his yearly salary does he spend: (1) for clothes; (2) for board; (3) for insurance? What per cent of his yearly salary does he save?

4. A wheat crop removes from the soil 2.4% of its weight of nitrogen, 0.9% of its weight of phosphorus, and 0.6% of its weight of potassium. Find the total weights of each of these soil ingredients that will be removed from a field of 80 acres of wheat that produces an average yield of 36 bushels per acre of grain, and an average yield of 1.75 tons of straw per acre.

5. In 1916, there were 144,770 persons employed by the railways of Canada who received in salaries and wages \$104,300,647.00. In 1917, there were 146,175 employees receiving in salaries and wages \$129,626,187.00. Find the average amount earned by an employee in (1) 1916, (2) 1917. Find the increase per cent in the average amount earned by an employee in 1917 over the amount earned in 1916.

6. In 1916, the attendance of pupils at school in the four Western Provinces was as follows: Manitoba, 103,796; Saskatchewan, 125,590; Alberta, 99,201; British Columbia, 59,800. In 1917, the attendance was as follows: Manitoba, 106,588; Saskatchewan, 138,731; Alberta, 107,727; British Columbia, 60,277. Find the total enrolment for the four provinces for (1) 1916, (2) 1917. Find the increase per cent for each of the provinces. Find the increase per cent in the total attendance for the four provinces.

7. During the year 1918, 2130 ships passed through the Panama Canal. Of these 699 were British, 628 belonged to the United States, 52 were French, 53 were Japanese, 296 were Norwegian, and 204 belonged to South American countries. Find the per cent of the total ships which passed through the canal for each of the above countries.

8. The average yearly wages for farm help in the Western Provinces in 1917 were \$752.57. In 1916, the average yearly wages were \$483.00. Find the increase per cent.

9. The total value of the mineral products of British Columbia for the year 1917 was \$37,010,392.00. The value of the gold was \$2,863,190 ; of silver, \$2,265,749 ; of copper, \$16,038,256 ; of coal, \$10,690,172. What per cent of the total value is the value of each of these mineral products ?

10. A farmer raised 25% more wheat in 1919 than in 1918. His total crop for the two years was 6750 bushels. How much did he raise each year ?

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CHAPTER VI

SHARING AND PARTNERSHIP, AVERAGES, AND PROPORTIONAL PARTS

I. Sharing and Partnership

Introductory.

John Smith and David Jones agree to carry on business together and share the profits and the losses in proportion to the sum of money each has in the business. If Smith puts in \$2000 and Jones \$2000, how should a profit of \$500.00 be shared?

An association of two or more persons in business with an agreement to share the profits and losses is a partnership. The association is called a firm or company. The persons associated are the partners. The money or property invested in the business is the capital or stock.

EXERCISE

1. Divide 198 into two parts proportional to 4 and 7.
2. Divide 198 into three parts proportional to 5, 6, and 7.
3. The sum of two numbers is 1260, and they are to each other as 57 and 48. What are the numbers?
4. Divide \$500 among three persons, A, B, and C so that the three portions may be to each other as the numbers 5, 9, and 6, respectively.

5. A bankrupt has three creditors to whom the sums due are as the numbers 3, 4, and 5. If his assets are valued at \$600, find the sums they will respectively receive.
6. Divide 540 into three parts proportional to 3, $3\frac{1}{2}$, and 7.
7. Divide 915 into five parts proportional to 1, 2, 3, 4, and 5.
8. Divide 1815 into three parts which shall be to each other as $2\frac{1}{2}$, $3\frac{1}{3}$, and $4\frac{1}{4}$.
9. Three brothers raise 510 bu. of potatoes. How many bushels did each raise if their amounts are to each other as 9, 10, and 11?
10. A farmer shipped a carload of wheat and oats containing 875 bu. in parts proportional to $\frac{1}{2}$ and $\frac{1}{3}$. Find the number of bushels of each.
11. In a certain school 48% of the pupils are boys, and there are 39 girls. Find the number of boys.

EXERCISE

1. A and B engage in a wholesale business. A invests \$6000 to B's \$4000. They gain \$1250. What is each one's share of the gain?
2. A, B, and C buy a house for \$2500. A pays \$500, B \$1200, and C \$800. They rent it for \$300. What is each one's share of the rent?
3. A man dying willed to his son \$6500, to his widow \$8000, and to his daughter \$5500; but his estate amounted to only \$12,000. How much did each get?
4. A and B jointly rented a pasture for \$24. A put in 36 cows and B 24 cows. How much of the rent ought each to pay?

5. A, B, and C hired a carriage for \$15.75, each agreeing to pay in proportion to the number of miles he rode. A rode 90 mi., B 75 mi., and C 60 mi. What part of the hire ought each to pay?

6. A and B were engaged in business two years, making an annual profit of \$8190. A owned $\frac{2}{3}$ of the stock. What was each partner's share of the total profits?

7. A, B, C, and D formed a partnership with a capital of \$30,000. A furnished \$6000, B \$7000, C \$8000, and D the remainder. They gained 18% of the joint stock. What was each partner's share of the profit?

8. A, B, and C carry on a coal business. A invests \$8500, B \$9000, and C \$12,000. At the end of the year B's share of the gain is \$4050. Find the total gain.

9. Three men engaged in business. A received \$90, B \$115, and C \$148 of the profits. C's capital was \$740. What was the total capital?

10. A, B, and C enter into partnership. A invests \$700 and receives \$105 as his share of the profits. B invests \$580, and C's share of the profits is \$48. Find B's profits and C's capital.

11. A, B, and C are partners in a business in which A has invested \$5000, B \$3000, and C \$2500. C receives $12\frac{1}{2}\%$ of the profits as manager; the remainder is divided among them all in proportion to the capital of each in the business. What does each receive of \$840 profits?

12. The cargo of a ship was worth \$25,000 and was insured for \$17,500. If the cargo belonged to A, B, and C in proportion to 1.4, 1.5, and 1.6 respectively, how much would each lose in case the vessel was lost?

13. In a mixture of 360 gal. of wine and water, there is 1 qt. of water to every gallon of wine. How many gallons of each are there in the mixture?

14. Divide \$9282 among A, B, C, and D, giving to A 10% more than to B, to B 10% more than to C, and to C 10% more than to D.

15. There are three books, A, B, and C. A and B together contain 900 pages, B and C together 845 pages, and C and A together 1025 pages. How many pages are there in each book?

16. A, B, and C enter into partnership. A puts in \$10,500, B \$7500, and C \$13,500. The total gain is \$4725. What per cent of this should A receive?

17. A, B, and C rent a pasture for a season for \$38. A puts in 30 sheep for 13 weeks, B 24 sheep for 15 weeks, and C 20 sheep for 10 weeks. How much of the rent should each pay?

EXERCISE

1. Divide \$1117.60 among A, B, and C so that A may have twice as much as C, and B \$10 more than three times as much as C.

2. A man spent \$240.25 in cloth at \$1.55 a yard and sold it to 3 men. The first man bought 35 yd. more than 3 times the second one and 20 yd. less than the third man. Find the number of yards bought by each man.

3. A man sold 3 sheep for \$37. For the first he received \$3.00 more than for the third and \$4.00 less than for the second. What did he get for each?

4. The cost of a quantity of silk at \$3.25 per yard and tweed at \$2.50 per yard was \$409.75, the whole cost of the tweed being 25 cents more than that of the silk. Find the number of yards of each kind of cloth.

5. The cost of 12 bu. of oats and 17 bu. of wheat was \$14.97. The cost of a bushel of wheat was 42 cents more than that of a bushel of oats. Find the cost of a bushel of wheat.

6. Mary has two dollars in five- and ten-cent pieces. The number of ten-cent pieces is two more than the number of five-cent pieces. How many of each kind has she?

7. A farmer employs a number of men and 8 boys. He pays the boys 65 cents and the men \$1.10 per day. The amount that he paid to all was as much as if each had received 92 cents per day. How many men were employed?

8. The quantity $93\frac{1}{8}$ is the sum of a certain number of ninths, three times as many tenths, and five times as many twelfths. What are the values of the three aggregate parts of the quantity?

9. A farmer bought a number of horses and cows for \$2000. There were three times as many cows as horses, and a horse cost twice as much as a cow. If each horse cost \$80.00, how many cows did he buy?

10. Divide $45\frac{1}{2}$ bu. between A and B, so that when A gives B $\frac{1}{3}$ of his (A's share), their shares may be equal.

II. Averages

1. Find the aggregate and the average of the following:

(a) 250, 306, 402, 211, 309.

(b) $7\frac{1}{2}$, $3\frac{1}{4}$, $4\frac{1}{8}$, $5\frac{3}{8}$, $7\frac{3}{4}$.

(c) 7.5, 5.34, 8.75, 3.48, 6.23.

2. The school register shows that 34 pupils were present on Monday, 32 on Tuesday, 35 on Wednesday, 33 on Thursday, and 36 on Friday. Find the average attendance during the week.

3. The elevation of certain places above the sea level is as follows: find their average elevation:

(a) Calgary	3410 ft.	Red Deer	2806 ft.
Summit	3627 ft.	Battle River	2627 ft.
Olds	3402 ft.	Edmonton	2188 ft.
(b) Fernie	3302 ft.	Crow's Nest	
		Lake	4424 ft.
Michel	3853 ft.	Macleod	3128 ft.
Crow's Nest	4438 ft.	St. Mary's	
		River	2795 ft.
(c) Winnipeg	757 ft.	Virden	1444 ft.
Portage La			
Prairie	854 ft.	Wolseley	1950 ft.
Carberry	1258 ft.	Indian Head	1924 ft.
Brandon	1194 ft.	Regina	1885 ft.

4. What number substituted for each of the addends 36.2, 18.5, 27.3, 36.4, 25.2 will give the same sum?

5. The aggregate weight of 6 boys is 465 lbs. The average weight of four of them is 79.5 lbs. Find the average weight of the remaining two.

6. A farmer received \$17.40 for 8 turkeys which he sold at 15 cents a pound. Find the average weight of a turkey.

7. Six boys weigh on the average 115 lbs. One weighs 135 lbs. Find the average weight of the other five.

8. Find the average length of four boards which are 12 ft. 6 in., 14 ft. 4 in., 16.6 ft., and 16 ft.

9. Eight blocks of granite weigh as follows: 17.4 cwt., 18.5 cwt., 15.8 cwt., 12.75 cwt., 14.25 cwt., 16.3 cwt., 15.5 cwt., and 18.2 cwt. Give their average weight in lbs.

10. In a cricket match the scores of one side were the following: 0, 24, 10, 32, 0, 0, 6, 8, 2, 6. Find the average score per man.

11. The mean height of five mountains is 7850 ft., and the mean height of 4 of them is 5912 ft. Find the height of the fifth mountain.

12. A grocer sold 3 lbs. of tea at 75 cents per lb. and 2 lbs. at 50 cents per lb. What was the average price?

13. Two purchases have been made of 15 lbs. weight at \$2.50 per lb. and 25 lbs. at \$1.80 per lb. What is the average price per lb.?

14. The average temperature of the different months during the past 37 years at Toronto was: of Jan. $22^{\circ}.94$, Feb. $22^{\circ}.58$, March $29^{\circ}.05$, April $40^{\circ}.63$, May $51^{\circ}.68$, June $61^{\circ}.84$, July $67^{\circ}.43$, Aug. $66^{\circ}.32$, Sept. $58^{\circ}.10$, Oct. $45^{\circ}.74$, Nov. $36^{\circ}.03$, Dec. $25^{\circ}.57$. What was the average yearly temperature during that period.?

15. In a class there were six boys whose respective heights were 4 ft. 5 in., 4 ft. 6 in., 5 ft., 4 ft. $7\frac{1}{2}$ in., 4 ft. $9\frac{3}{4}$ in., and 4 ft. $1\frac{3}{4}$ in. What was the aggregate of their heights and their average heights?

16. A mixes 25 gal. of water with 125 gal. of vinegar, which cost him 40 cents per gallon. How much must he charge per gallon so as to make a profit of $33\frac{1}{3}$ per cent?

17. The average price paid for a farm of 320 A. was \$16.25. 80 A. cost \$2240, 160 A. cost on the average \$12.50. Find the average cost of the rest of the farm.

18. A farmer sold 125 head of cattle at \$36 per head, 142 head at \$42.50, and 238 head at \$45. Find the average price he received for them.

III. Ratio and Proportion

EXERCISE

Introductory.

1. John has \$10 ; James has \$5.00. John has how many times as much money as James?
2. What is the relation of a line 3 in. long to one 1 mi. long?
3. How many times 5 is 20?
4. A quart is what part of a gallon?
5. How many pecks make a bushel?
6. What is the relation of \$24 to \$6?

The relation of one quantity to another similar quantity in respect to size is called the *Ratio* of the two quantities.

7. (a) An hour is what part of 2 hr. ?
(b) What is the ratio of 1 hr. to 2 hr. ?
8. What is the ratio of the following :
(a) 8 to 16? (d) 24 mi. to 6 mi. ?
(b) \$15 to \$5? (e) \$12 to \$36?
(c) \$20.00 to \$10.00? (f) 18 marbles to 3 marbles?

9. How is the ratio of two quantities found? The first of the two quantities is called the *Antecedent*, the second the *Consequent*.

Ratio is usually indicated by placing a colon between the two quantities. Thus the ratio of 8 to 4 is written 8 : 4 and is read 8 is to 4.

Ratio is also expressed by the sign of division, thus $8 \div 4$. It is also expressed by writing the numbers in the form of a fraction, thus $\frac{8}{4}$.

Hence 8 : 4, $8 \div 4$ and $\frac{8}{4}$ all denote the same relation.

10. Name the antecedent and the consequent of the following ratios :

- | | |
|--------------------|-------------------|
| (a) 9 mi. : 3 mi.. | (d) 3 qt. : 4 qt. |
| (b) 15 : 3. | (e) 5 ft. : 7 ft. |
| (c) \$18 : \$9. | (f) 3 yd. : 2 ft. |

11. Express the ratio of the following quantities :

- | | |
|---------------------|----------------------------------------|
| (a) \$6 to \$18. | (d) 16 lb. to 3 lb. |
| (b) \$4 to \$20. | (e) 15 apples to 5 apples. |
| (c) 5 hr. to 30 hr. | (f) $2\frac{1}{2}$ to $1\frac{3}{4}$. |

12. The ratio of 8 to 4 is the same as the ratio of 12 to what number?

13. Find the number that will bear the same ratio to 12 that 5 bears to 15.

14. The ratio of 20 to 5 is equal to the ratio of 24 to what number?

15. Find a fourth term for the following ratios :

- | | |
|----------------------|-----------------------------------------|
| (a) 36 : 12 6 : ? | (d) 5 : 8 25 : ? |
| (b) 56 : 7 24 : ? | (e) $1\frac{2}{3} : \frac{1}{3}$ 21 : ? |
| (c) 25 : 5 55 : ? | (f) 54 : 9 72 : ? |

When four quantities are so arranged that the ratio of the first to the second equals the ratio of the third to the fourth, the four quantities form a *Proportion*.

A proportion is usually indicated by writing a double colon (: :) between the equal ratios. Thus, 8 : 6 : : 12 : 9.

The first and fourth terms of a proportion are the *Extremes*. The second and third terms are the *Means*.

16. Name the extremes and the means in the following proportions :

- | |
|-----------------------------------------------------|
| (a) 25 : 7 : : 50 : 14. |
| (b) 3 $\frac{1}{2}$ hr. : 7 hr. : : 72 mi. : 14 mi. |

17. In the following proportions, compare the product of the extremes with the product of the means :

(a) $7 : 5 : : 14 : 10.$

(b) $84 : 12 : : 21 : 3.$

(c) $12 : 24 : : 36 : 72.$

18. In a proportion, how does the product of the means compare with that of the extremes?

19. Find the omitted term in the following :

(a) $12 : 6 : : 4 : ?$

(b) $35 : 6 : : 4 : ?$

(c) $5 : 8 : : 10 : ?$

EXERCISE

Example: Find the cost of 12 lbs. of sugar, if the cost of 4 lbs. is 25 cents.

The ratio of 12 lbs. to 4 lbs. is 3. Hence 12 lbs. will cost 3 times as much as 4 lbs., or 75 cents.

1. If it requires 250 lbs. of coal to run an engine for 6 hr., how much coal will be required to run this engine for 9 hr.?

2. If a pole 18 ft. high casts a shadow 25.5 ft. long, how long a shadow will be cast by a pole 31.5 ft. high?

3. If 156 bu. of wheat are required to make 44 bbl. of flour, how many bushels will be required to make 77 bbl.?

4. If John's money is to Henry's as 4 to 5, and Henry has \$20, how much has John?

5. If 60 sheep were sold for \$450, how much should 96 sheep bring at the same rate?

6. If \$360 gains \$28 in a given time, how much will \$900 gain in the same time?

7. If 24 men can dig a ditch in 5 days, in how many days can 36 men dig a similar ditch?
8. If $\frac{2}{3}$ yd. of cloth costs $\$7\frac{1}{8}$, find the cost of $\frac{5}{8}$ yd.
9. If 120 men earn \$2000 in a given time, how many men will earn \$2500 in the same time?
10. If 32% of an estate is worth \$5200, how much is 75% of the estate worth?
11. How far can a man walk in 12 da. of 8 hr. each, if he can walk 189 mi. in 7 da. of 9 hr. each?
12. The ratio of the weight of white pine to the weight of white oak is 17 to 27. A cubic foot of oak weighs 54 lbs. Find the weight of a cubic ft. of white pine.
13. A man earns \$1300 in a year of 52 weeks. How much does he earn per week?

GENERAL REVIEW

1. A merchant bought 845 bu. of wheat for \$574.60 and sold it at 85 cents per bu. Find his profit and his gain per cent.
2. A can do $\frac{1}{4}$ of a piece of work in 4 days, and B $\frac{1}{5}$ of it in 5 da. In what time can they do the whole working together?
3. Divide 120 into three parts, so that the second part shall be double the first and the third part as much as the sum of the other two parts.
4. If a man can build $1\frac{1}{2}$ of a wall in $8\frac{2}{3}$ da., how long will it take him to finish it?
5. How many board feet are there in 24 planks, 15 ft. long, 16 in. wide, and 6 in. thick?

6. If the divisor were one-fourth what it is, the quotient would be 948 and the remainder 85. Find the dividend, the divisor being 400.

7. At \$6.50 per cord, find the cost of a pile of wood 120 ft. long, 60 ft. wide, and 15 ft. high.

8. What fraction increased by 16% of itself becomes $\frac{2}{3}$?

9. Find the cost of 3 bu. 2 pk. 1 gal. 1 pt. of oats at \$1.75 a bushel.

10. Find the result when five hundred and twenty-five ten-thousandths are taken from ten thousand and the remainder is multiplied by ten hundredths.

11. A lady spent \$63 for jewellery and dress goods, paying 16% more for dress goods than for jewellery. How much did she pay for each?

12. If 78 be added to a certain number, it will contain eighty-seven 1005 times. Find the number.

13. Simplify .6 of $4\frac{2}{3}$ of $\frac{8}{\frac{2}{3}}$ of 6.

CHAPTER VII

APPLICATIONS OF PERCENTAGE

Trade Discount

Wholesale merchants, manufacturers, and publishers usually catalogue their goods at certain fixed prices and then allow a certain deduction from these prices to purchasers. The price in the catalogue is called the *list, invoice, or catalogue price*. Goods catalogued but not subject to these deductions are marked *net*.

The allowance or deduction made by the wholesale merchants, manufacturers, etc. upon their catalogue prices is called *Commercial or Trade Discount*. The price after all discounts have been taken off is called the *Net Price*.

The cataloguing of prices with discounts given enables the wholesalers and manufacturers to meet the fluctuations in the market price by increasing or decreasing the rate of discounts, thus avoiding the frequent publication of large catalogues. It also enables them to meet cash payments and short-term payments.

Sometimes a second or third discount is given. When more than one discount is given, the first discount is reckoned on the list price, and the second is reckoned on the remainder after the first discount has been deducted, and so on. No two successive discounts are reckoned on the same

amount, and, therefore, the single discount equivalent to successive discounts can never be found by adding the successive discounts. These discounts are quoted separately, so that a buyer may take advantage of one or two of the discounts, even though he may be unable to take advantage of the three.

Many merchants have "bargain sales" annually or more frequently to dispose of stock which they have had on hand for some considerable time, or as a means of advertising their business. At such sales they usually sell their merchandise at a certain "per cent off," or at a certain per cent discount. For example merchandise marked \$6.00 with 15% off, would sell for \$6.00 - \$.90 or \$5.10. Some sales are advertised thus: "Goods selling at $\frac{1}{3}$ off," which means that a discount of $33\frac{1}{3}\%$ of the marked price is given.

Introductory.

Example: Find the net price of goods invoiced at \$375.00, there being two successive discounts of 20% and 5%.

The invoice price is	\$375.00
The first discount is 20% of \$375.00	<u>75.00</u>
The first reduced price is	\$300.00
The second discount is 5% of \$300.00	<u>15.00</u>
The net price is	\$285.00

ORAL EXERCISE

1. On goods listed at \$60.00 a discount of 20% is allowed. Find the discount and the net price.
2. What is due on a bill of \$600.00 subject to a discount of 10%?
3. Cloth is marked at \$1.20 per yard, and a discount of $33\frac{1}{3}\%$ is given. What is the sale price per yard?

4. The invoice price of hardware received is \$800.00 subject to a discount of $12\frac{1}{2}\%$ for cash. What is the cash price?

5. The list price of goods is \$150.00, and the net price is \$120.00 after one discount has been allowed. What was the rate of discount?

6. How much will you pay for goods invoiced at \$80.00, the rate of discount being 25% ?

EXERCISE

1. Find the net price of the following bills :

(a) Invoice price \$540, discount 25% .

(b) Invoice price \$248, discount $37\frac{1}{2}\%$.

2. What is due on a bill of \$500.00 subject to a discount of 20% and 5% ?

3. Find the net amount of a bill of \$1600, with 25% , 10% , and 5% off.

4. On a bill of goods listed at \$300.00, I am offered a single discount of 45% , or successive discounts of $33\frac{1}{3}\%$, 10% , and 5% . Which is the better offer and by how much?

5. What is the difference on an invoice of \$340.00 between a discount of 40% and successive discounts of 25% and 15% ?

A wholesale firm usually indicates on its invoice forms the terms of payment as, Terms : 60 days net, 5% 30 da., 10% cash, which means that a buyer is entitled to 60 days credit, but will be allowed 5% discount if the bill is paid within 30 days, or 10% discount for cash.

The following is a common form of invoice of goods purchased from a wholesale firm :

HALIFAX, N. S., June 10, 1919.

MESSRS. McLEOD & SIMPSON,
TRURO, N. S.

Bought of W. R. JONES & SONS,
PUBLISHERS, MANUFACTURERS, STATIONERS,
No. 806 Barrington Street.

TERMS : 60 da. net : 2 % 30 da.

6 doz. Geometry Sets at	\$ 6.00	\$ 36 00	
5 gro. Pens, assorted at	1.20	6 00	
4 gro. Pen Holders at	2.00	8 00	
		50 00	
Less 25 %		12 50	\$ 37 50
Less 2 %			75
			36 75

The foregoing invoice shows that the trade discount listed on these goods is 25% and also shows that the goods were paid within 30 days.

Make out an invoice for the following : 20 brass bedsteads at \$25.00, 30 mattresses at \$15.00, 20 kitchen chairs at \$1.50. Discounts listed on these goods are 25% and 10%. Terms, 5% 30 days.

Example :

What single discount is equal to discounts of 20% and 5%?

The first discount is 20% of the list price.

The first reduced price = $\frac{80}{100}$ of the list price.

The second discount is 5% of the first reduced price.

The second reduced price = $\frac{95}{100}$ of (the first reduced price).

= $\frac{95}{100}$ of ($\frac{80}{100}$ of the list price).

= $\frac{76}{100}$ of the list price.

The total discount = $\frac{24}{100}$ of the list price.

The single discount equivalent to the two discounts = 24%.

EXERCISE

1. Find the single discount equivalent to 25% and 10% off.

2. A merchant buys goods listed at \$500.00 with discounts of 20% and 5% off. He sold these goods at \$600.00, allowing discounts of 25% and 10%. What was his profit?

3. I bought 10 binders at \$225.00 each, less 20% discount, and 15 mowers at \$80.00 each, less 25%. Terms of payment are 60 da. net; 5% 30 da. Find the net amount paid for these implements, if the bill is not paid for 60 days; if the bill is paid within 30 days.

4. Find a single discount equivalent to discounts of 25% and 5%.

5. Find a single discount equivalent to 25%, 10%, and 5%.

6. A dealer buys a book, list price \$2.50, at a discount of 20%. He sells the book for \$2.50. What is his per cent profit?

7. The net price of goods after discounts of 20% and 5% have been taken off is \$190.00. Find the list price of the goods.

8. A dealer bought a piano, the list price of which was \$250.00 at discounts of 20% and 5%. He sold it at 10% above the list price. What was his profit?

9. Two wholesale firms offer the same quality of goods at the same list price. The first firm offers a discount of 10% and 5%, and the second offers a single discount of 15%. What is the difference in their offers on a bill of goods, the list price of which is \$2500?

10. A bill of goods, after successive discounts of $33\frac{1}{4}\%$, 10% , and 5% were taken off, was settled for \$487.35. Find the list price of the goods.

11. A man paid \$190.00 for merchandise, having received discounts of 20% and 5% . Find the list price of the merchandise.

12. A shoe merchant marks his goods at an advance of 50% of the cost. In order to clear out some old stock he advertised a sale at " $\frac{1}{3}$ off." The cost price of the shoes sold during the sale was \$1200. What were his profits from the sale?

13. A hardware merchant bought a shipment of stoves, receiving a discount of 25% off the list price. After paying \$108.00 for freight and cartage, the shipment cost him \$648.00. What was the list price?

14. A dry goods merchant buys 840 yards of cashmere listed at 75 cents per yard, with discounts of $16\frac{2}{3}\%$ and 5% allowed. He retails all of this cloth at 80 cents per yard. What is his profit?

PROFIT AND LOSS

If an article cost \$20 and is sold for \$24, what is the profit?

If an article cost \$20 and is sold for \$16, what is the loss?

When is an article sold at a profit? At a loss?

How is the amount of profit calculated?

How is the amount of loss calculated?

In business transactions the profit or loss is calculated as a certain per cent of the cost of the article sold. In this cost is included freight charges, cartage, and all overhead charges such as rent, insurance, etc.

Introductory.

Examples:

1. A merchant buys goods for \$30.00 and sells them at a profit of 20%. Find the selling price.

The profit is 20% or $\frac{1}{5}$ of \$30 = \$6.00

The selling price = \$30.00 + \$6.00 = \$36.00

2. A merchant buys goods for \$50.00 and sells them at a loss of 10%. Find the selling price.

The loss is 10% or $\frac{1}{10}$ of \$50.00 = \$5.00

The selling price is \$50.00 - \$5.00 = \$45.00

3. A dealer sold an article that cost him \$20.00 for \$24.00. What is his per cent profit?

Amount of profit = \$4.00

\$4.00 is the profit on \$20.00 or the profit = $\frac{4}{20}$ of the cost

= $\frac{1}{5}$ of the cost

= 20% of the cost

rate of profit = 20%.

ORAL EXERCISE

1. An article costing 20 cents was sold at a profit of 25%. What is the sale price?

2. A merchant sold goods that cost him \$120.00 at a profit of 33 $\frac{1}{3}$ %. Find the selling price.

3. A dealer sold goods at 10% below cost. The goods cost \$300. Find the selling price.

4. An article which cost \$50.00 was sold for \$60.00. Find the rate of profit.

5. A dealer in clothing bought a suit of clothes for \$48.00 and sold it for \$54.00. What is his per cent profit?

6. A book costing \$1.20 was sold for 80 cents. What was the loss per cent?

EXERCISE

1. A shoe dealer bought shoes at \$6.00 per pair and retailed them at \$8.00 a pair. Find his rate of profit.
2. A merchant buys hats at \$8.00 per dozen and sells them at \$1.50 each. Find his rate of profit.
3. A grocer bought 1200 bushels of potatoes at 60 cents a bushel. He sold $\frac{2}{3}$ of them at a gain of 25% and the remainder at a loss of $12\frac{1}{2}\%$. Find his profit.
4. A coal dealer buys a carload of 30 tons of coal at \$4.00 per ton. The freight cost him 90 cents a ton and the delivery 60 cents a ton. For how much per ton must he sell this carload to make a profit of $33\frac{1}{3}\%$?
5. A grain dealer bought 12,000 bushels of wheat at \$1.80 per bushel and 6500 bushels of oats at 55 cents per bushel. He sold the wheat at a gain of $16\frac{2}{3}\%$ and the oats at a loss of 20%. What amount did he gain or lose on the whole transaction?
6. A man paid \$1500 for two lots, the cost of one of them being double that of the other. He sold the cheaper lot at a gain of 50% and the dearer one at a loss of 20%. Find his gain or loss per cent on the sale of these lots.
7. Brooms are bought wholesale at \$120.00 per gross. What per cent profit will be made by selling them at 75 cents each?
8. I bought a section of raw land at \$20 per acre and had 120 acres broken at a cost of \$4 per acre. I enclosed the section with a barbed wire fence, the labor and material costing at the rate of 25 cents per rod. What per cent profit would I make, if I accepted an offer of \$30 per acre for the section?

9. A grain dealer sold 4000 bushels of oats for \$300 less than the cost, his rate of loss being $16\frac{2}{3}\%$. What did the oats cost him per bushel?

10. A news agent on the train buys his oranges at 30 cents per dozen and sells them to the passengers at 3 for 10 cents. Find his rate of profit.

11. A merchant bought 720 yards of cotton at 25 cents per yard. He marks the cotton at an advance of 40% of the cost, but, not finding a ready sale, he decides to offer the goods at a discount of 20% off the marked price. Find his profit from the sale.

12. The Dunlop Dairy Company buys milk from the farmers at \$2.50 per 10 gallons and retails the milk to its customers at 8 quarts for \$1.00. What per cent profit is the company making, if it costs $2\frac{1}{2}$ cents per quart for delivery?

EXERCISE

1. A merchant sold a coat for \$24 and thereby gained 20% . What did the coat cost him? What rate of profit would have been made had he sold it for \$28.00?

2. A dealer sold an article for \$8.10 thus losing 16% . What would the sale price of the article have to be to make a profit of 10% ?

3. A coal dealer raised the price of coal 50 cents per ton and by so doing made a profit of 50% instead of 40% . What did the coal cost him per ton?

4. A merchant sold a carpet for \$150. He was able to collect only 90% of the sale price, yet made a profit of 5% . What did the carpet cost the merchant?

5. A clothier sold a suit of clothes for \$40 and made a profit of 25%. The material in the suit cost one-third as much as the tailor's charges. What did the tailor receive for making the suit?
6. A buyer bought a carload of 20 steers, averaging 1250 pounds each, at \$8 per cwt. In shipping them to the Chicago market they lost 4% in weight. What price per cwt. must he receive for them to make a profit of 20%?
7. A shoe merchant sold shoes at 20% less than the marked price, but still made a profit of $16\frac{2}{3}\%$. If the shoes cost him \$4.80 per pair, at what price were they marked?
8. A rancher bought a flock of sheep at a certain price. He sold $\frac{3}{5}$ of them at a gain of 20%, $\frac{1}{5}$ of them at a gain of 25%, and the rest at a loss of 10%. His gain from the sale of the whole flock was \$235.00. How much did he pay for the sheep?
9. I bought out a dry goods business for \$40,000 and at the end of each year invested one-half the profits for that year in the business. The first year I gained 20%, the second year $12\frac{1}{2}\%$, and the third year 10%. Find the amount of money invested in the business at the end of the third year.
10. A merchant adds 40% to the cost price of his goods and gives his customers a reduction of 10% on their bills for cash. What rate of profit does he make on a cash sale?
11. A hardware dealer buys a bankrupt stock at 60 cents on the dollar of the list price of the stock. This stock is sold at a sale at a discount of 10% of the list price. What is the dealer's rate of profit? If the list price of the stock was \$15,000, find the amount of money he made in handling this bankrupt stock.

COMMISSION

The charge made by a person or firm for transacting business for another person or firm is called *Commission*.

The farmer who ships his grain or cattle to Winnipeg or Calgary cannot always take the shipment to these markets himself and therefore requires some person or firm to represent him in these cities, in order that he may sell at the best price. The compensation received for these services is called *Commission*. A merchant in Canada may employ some person in London, England, to buy and ship him certain kinds of goods. The person in London would receive *Commission* for his services.

A person may also transact other business for another person such as the collection of accounts, the selling of farm or city property, etc.

Commission is usually reckoned at a certain per cent of the money involved in the transaction. If goods are sold, the commission is a certain per cent of the selling price; if goods are bought, the commission is a certain per cent of the cost price; if collections are made, the commission is a certain per cent of the amount of the collections.

The person who transacts business for another is called an *Agent*, and, according to the work he does, is spoken of as a *Commission Merchant*, *Broker*, *Collector*, etc.

The total amount received by the agent for the goods sold is called the *Gross Proceeds*.

The amount left after the commission and other charges such as freight, storage, etc. have been deducted, is called the *Net Proceeds*.

The importance of the commission business in Canada has greatly increased through marked development in agriculture, industry, and commerce.

Introductory.

Example:

A real estate agent sold a farm for \$8000. He charges a commission of $2\frac{1}{2}\%$. What is his commission? What does the owner of the farm receive from the sale?

Selling price of farm = \$8000

Rate of Commission = $2\frac{1}{2}\%$

Commission = $\$8000 \times .025$

= \$200

Owner receives $\$8000.00 - \200 , or $\$7800.00$

ORAL EXERCISE

1. At 20% , what is the commission on a \$250 sale?
2. What does a collector receive for collecting a debt of \$90 at 10% commission?
3. A real estate dealer sells a house for \$3000, charging 5% commission. What is the amount of his commission?
4. Working on a 20% commission, a boy during the year earned \$100 selling papers. What did his sales amount to during the year?
5. A man took orders for a grocery store receiving $12\frac{1}{2}\%$ of his sales as commission. For the first week his commission amounted to \$48. What was the amount of his sales for this week?

WRITTEN EXERCISE

1. A collector was successful in collecting 80% of a debt of \$5000.00. What is his commission at 15% ? How much did the creditor receive?
2. A farmer takes some butter, eggs, and vegetables to a commission merchant in the city who sells them for \$175.00, charging 5% commission. What is the net amount received by the farmer?

3. A real estate dealer sells a quarter section of land at \$30 per acre, charging $2\frac{1}{2}\%$ commission. What is the amount of his commission? How much per acre does the owner of the land receive?

4. An agent for an automobile company receives a commission of 20% on all sales. In one month he sold three cars at \$800 each and two others at \$1300 each. If his expenses connected with the sale of these cars amounted to \$250, what were his net monthly earnings?

5. A commission merchant sold 30 boxes of oranges, each box containing 15 dozen, at 45 cents per dozen, charging 10% commission. What was his commission?

6. A farmer ships three cars of wheat, each car containing 1250 bushels, to a commission merchant in Winnipeg, who sells it for \$2.25 per bushel. After paying \$75.00 per car for freight, 5 cents per bushel storage charges, and 1 cent per bushel commission for selling, what will be the farmer's net proceeds from the sale of the wheat?

7. A rancher ships a carload of 24 steers, averaging 1450 pounds each, to the United Grain Growers in Winnipeg, who sell at \$9.75 per hundred on a commission of 1%. The expenses connected with the shipment were as follows: 750 lbs. of hay at \$16.00 per ton for feed on the road, \$80.00 freight charges, and \$8.50 yardage. Find the rancher's net proceeds from the sale of the steers.

8. An architect charges 3% of the cost of a building for plans and specifications and 2% for supervising the construction of the building. What would be his total commission on a building costing \$15,000?

EXERCISE

1. An agent charged \$150 for selling a farm for \$3000. What rate of commission did he charge?

2. An agent sent his employer \$4230 as the net proceeds from the sale of a car of fruit and retained \$270 as his commission. What was the rate of his commission?

3. A commission merchant sells 800 barrels of flour. His commission at the rate of 3% amounts to \$96. Find the selling price of the flour per barrel.

4. A fruit broker sold \$680 worth of apples, and, after deducting 5% commission and 20% for freight and other charges, invested the balance in oranges. If he invested \$500.00 in oranges, what rate of commission did he charge for the investment?

5. A farmer in Southern Alberta ships three cars of baled alfalfa, each car containing 15 tons, to a commission merchant in Calgary who sells it for \$20 per ton. He retained \$36.50 to pay charges amounting to \$9.50 and his commission. What rate of commission did he charge?

6. A grain broker buys 15,000 bushels of wheat for his firm at \$1.10 per bushel, charging 1% commission. He then sells it at an advance of 15 cents a bushel, also charging 1% for selling. Find the firm's net profit and his total commission.

7. A real estate agent sold a house on a commission of 5% and sent the owner a cheque for \$3800 as the net proceeds. What was the selling price of the house?

8. An auctioneer's commission for selling a bunch of 40 horses was \$220. The rate of commission charged was 5%. What was the average sale price per head?

9. A commercial traveller for a wholesale house is offered his choice of a salary of \$3000 a year, or a salary of \$2000 a year and a commission of 2% on his year's sales, or a commission of 5% on his year's sales. He accepts the first offer. His year's sales amount to \$75,000. What does he lose by not accepting the second offer? the third offer?

10. A book agent sells a History of the War at \$6.50 each. He receives 40% commission. In two months he earns \$468. How many books did he sell?

11. The total cost of a building, including the architect's commission of \$287.50, was \$6037.50. Find the rate of commission charged by the architect.

EXERCISE

1. An agent receives \$48 as his commission for purchasing goods at 4% commission. What sum must be remitted to him to pay for the goods and his commission?

2. An agent sold a carload of cattle for \$3578.00. He retained \$95.25 to pay charges amounting to \$5.80 and his own commission. At what rate was his commission charged?

3. An agent bought 40,000 pounds of sugar. His commission at $2\frac{1}{2}\%$ was \$62.00. Storage and freight charges were \$58. How much per pound did the sugar cost?

4. A wholesale firm through its agent sold goods which cost \$1250 for \$1750. What per cent profit was made on these goods, if the agent charged 5% commission and the freight and cartage charges amounted to \$37.50?

5. For selling city property a real estate agent charges a commission of 5% on the first \$1000 and $2\frac{1}{2}\%$ on all over \$1000. Find the agent's commission for selling a house and lot for \$6500.

6. A furniture salesman receives a commission of 7% on all sales. In one day his sales were as follows:

2½ dozen dining room chairs	at \$5.75 each
3 buffets	at \$35.00 each
8 library tables	at \$12.50 each
48 sections of bookcases	at \$3.75 per section
6 office desks	at \$28.00 each

Find his total commission on the day's sales.

INSURANCE

Security or indemnity against loss or damage of any kind is called *Insurance*. There are two kinds of insurance, *Property Insurance* and *Personal Insurance*. The more common forms of property insurance are :

(1) *Fire Insurance*, indemnity for loss by fire.

(2) *Marine Insurance*, indemnity for loss or damage of vessels or their cargoes through accidents of navigation.

(3) *Live Stock Insurance*, indemnity for loss of horses, cattle, etc. by lightning or other specified causes.

(4) *Hail Insurance*, indemnity for loss of standing crops by hail.

(5) *Transit Insurance*, indemnity for loss or damage to merchandise during transportation from one place to another.

The principal kinds of personal insurance are *Life*, *Health*, and *Accident*. Personal insurance guarantees to the insured or his heirs a certain specified sum in case of sickness, accident, or death.

Companies guaranteeing an indemnity in case of loss resulting from certain causes are called *Insurance Companies*.

The written contract or agreement between the Insurance Company and the (person protected) insured, is called a *Policy*. It states the conditions under which the indemnity against loss is made, the time the contract is to be in force, the rate, and other essential facts. The amount of indemnity or protection is called the *Face of the Policy*.

The sum paid the Insurance Company for the protection is called the *Premium*.

Insurance rates are stated in per cent, or in cents per \$100.00, or in dollars and cents per \$1000. The rates of

insurance on property vary with the kinds of buildings, their location with reference to other buildings, the efficiency of the fire protection in the community, etc.

Life Insurance is the most important kind of personal insurance. There are many kinds of life insurance policies, but the three most important types of policies are :

(1) *Straight or Ordinary Life.* The straight life policy requires the payment of premiums throughout the whole life. In the case of straight life insurance protection and not investment is most desired. It affords to the insured the greatest amount of permanent protection for his outlay. As the premiums are paid throughout life, they are the lowest that will give genuine protection. The straight life policy is attractive to the poor man, because it enables him to carry an amount of protection which he could not afford at a higher cost.

(2) *Limited Payment Life.* The limited payment life policy is payable at death with premiums spread over a fixed number of years, as 20 years, when the policy is said to be "paid up." This is probably the most popular insurance contract, as it is free from the objection of continuous premium payments and involves a moderate degree of investment. For men in early and middle life the annual premium is not excessive, and it is required only while earning power is at a maximum.

(3) *Endowment.* Endowment insurance is a protection and an investment. The endowment policy is frequently termed a *Savings Bank Insurance*, the reason being that under the endowment the important feature is the compulsory saving that it involves. There is protection but for a fixed term of years only, as for ten, fifteen, or twenty or more years. At the end of this period, the assured him-

self receives the amount of the policy. If death occurs during the term of the endowment, the amount of the policy is paid to the beneficiary or heir of the insured. The amount of the annual premium varies with the length of the endowment term; the shorter the term the higher the premium.

NOTE. — The teacher should familiarize the pupils with the object and principal advantages of each of these types of policies.

The amount of the premium in life insurance depends upon the age of the person insured and the kind of policy. The rate is stated in dollars and cents per \$1000.

EXERCISE

Oral:

1. What is the premium on a \$600 policy at 3%?
2. What is the premium on a \$2000 policy at \$1.25 per \$1000?
3. Find the premium on a brick house insured for \$6000 at 25 cents per \$100.
4. Find the premium on a \$1750 policy at 2%.
5. What must be paid to insure a vessel for \$50,000 at 1%?
6. A house is insured for \$5000 at 35 cents a hundred. What is the premium?

EXERCISE

1. I have my house insured for \$3000 at $\frac{1}{2}$ % and the contents of the house for \$1600 at $\frac{3}{4}$ %. Find the amount of my premium.
2. A merchant insured his stock of goods valued at \$18,000 for $\frac{2}{3}$ of the value at \$1.45 per \$1000. What was the premium?

3. A merchant had 1200 bbls. of flour worth \$5.80 per barrel insured for $\frac{3}{4}$ of its value at $1\frac{1}{2}\%$. Find the premium paid.

4. A vessel is carrying 32,000 bushels of wheat worth \$1.75 per bushel. The wheat is insured for $\frac{3}{4}$ of its value at 65 cents per \$100. Find the amount of the premium. What will be the owner's net loss if the cargo is destroyed? What will be the insurance company's net loss?

5. A farmer insures his growing wheat against damage by hail for \$2400. What premium does he pay at 8% ?

6. My house is insured for \$5000 for 3 years and my premium for this period is \$30. What per cent of the face of the policy is the premium? What is the rate per \$1000? What is the rate per cent per year?

7. A factory building worth \$60,000 is insured for $\frac{3}{4}$ of its value at $1\frac{1}{2}\%$. The machinery and stock worth \$40,000 are insured for $\frac{3}{4}$ of the value at 2% . The building and contents are completely destroyed by fire. Find: (1) the net loss to the insurance company; (2) the net loss to the owner.

8. One insurance company has offered me a three-year policy of \$6500 at $1\frac{1}{2}\%$ on my home, another company offered me an annual policy renewed for the same period at 55 cents on \$100 for a year. Which is the better offer and by how much?

9. I have my motor car, which is valued at \$1800, insured with the London & Lancashire Fire Insurance Company for 90% of its value, against fire, theft, and collision. The fire rate is 1% , the theft rate $\frac{3}{4}\%$, and the collision rate $2\frac{1}{2}\%$. Find the amount of premium paid to this company for my motor insurance.



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10. A farmer insured his wheat crop of 120 acres against damage by hail in each of three different Hail Insurance Companies at \$10 per acre. The rate of premium charged by each company was 10%. What protection per acre against total loss by hail is the farmer guaranteed? Find the total amount of premium paid by the farmer. During the month of August his crop was partially destroyed by hail, the companies' adjusters estimating the damage at 60% over the entire area. Find the total amount of insurance received by the farmer from the three companies. If this crop averaged 15 bushels to the acre when threshed and the wheat is sold at \$1.80 per bushel, find the farmer's net return per acre from the 120 acres.

EXERCISE

1. A man carries a health policy that guarantees him \$25 per week in case of sickness. This insurance cost him \$35 per year. During four years he was sick 5 weeks and drew his full insurance during that time. What was the net cost to him of his protection for the four years?

2. A man at the age of 25 years took out a 20-payment life policy for \$2000, the rate of premium being \$29.50 per \$1000 yearly. What is the amount of his premium for the first five years? If he dies after paying ten premiums, how much more do his beneficiaries receive than was paid to the company in premiums?

3. A grain merchant in Winnipeg ordered his agent at Calgary to buy 10,000 bushels of wheat at \$1.75 per bu., 4000 bushels of oats at 85 cents per bu., and 3200 bu. barley at \$1.10 per bu., paying his agent 2% commission for buying. A policy at $1\frac{1}{2}\%$ was taken out to cover the cost of the grain and commission as protection during transit from Calgary

to Winnipeg. Find the amount of the policy and the premium paid.

4. A grain dealer bought 4000 bu. of wheat and had it insured at $\frac{3}{4}$ of its cost at $2\frac{1}{4}\%$. His premium was \$112.50. What did the wheat cost him per bushel?

5. A merchant paid \$60 for insuring his stock of goods worth \$6000 for $\frac{3}{4}$ of their value. What was the rate of insurance?

6. A shipment of goods was insured for \$6000. This sum covered the value of the goods, \$5930, the premium, and \$2.50 expenses. What was the rate of insurance?

7. At the age of 40 years the annual premium on an ordinary life policy is \$35 for \$1000. Every five years the dividends decrease the premium by 20%. What would it cost to carry \$5000 of such insurance for 10 years?

TAXES

Money is required by the Dominion, Provincial, and Municipal Governments for public purposes. The Provincial and Dominion Governments expend money in public works, in erecting and maintaining public institutions, in paying the salaries of public officials, etc. Municipalities expend money in erecting and maintaining municipal buildings, the building and repairing of roads and streets, maintaining schools and hospitals, providing proper sewerage and sanitary conditions, providing fire and police protection, in paying the salaries of municipal officials, etc. All the above expenses are met by money levied by proper officials on property, on business, or on persons. This money is called a *Tax*.

For purpose of direct taxation, there are two kinds of property, *Real* and *Personal*. Real property comprises

property that is fixed or immovable, such as land, buildings, mines, railroads, etc. Personal property consists of movable property, as money, bonds, merchandise, live stock, household goods, etc. Besides the property tax there are other kinds of tax. In some municipalities a *Poll Tax* of a certain sum is levied on all male persons over twenty-one years of age, without regard to property or income. A tax is also levied on a person according to his income by the Dominion Government and by many municipalities. This is called an *Income Tax*. Usually a certain part of the income is exempt, and only the remaining part of the income is liable to taxation.

When the tax is paid directly by the person who is to bear the burden, it is a *Direct Tax*. The tax levied on articles of merchandise brought into the country or on merchandise made in this country, is called an *Indirect Tax*. This tax is called *indirect* because while paid to the government by the importer or manufacturer, it is added to the selling price of the merchandise and therefore indirectly paid for by the person who buys the goods.

The Township, Town, or City Councils appoint officers called *Assessors* or *Assessment Commissioners*, who estimate the value of all the taxable property in the municipality. Assessors report to the Council the name, address, and estimated value of all property, real and personal, of each resident of the municipality. This report is called the *Assessment Roll*.

When the Municipal Council has decided what the expenditure for the year will be, it proceeds to determine the rate of taxation. This is found by dividing the sum to be raised by the measure of the value of all the taxable property in the municipality. The *Tax Rate* is usually expressed as so many mills on each dollar of valuation or as a per cent of

the valuation. The sum to be paid by each tax-payer is then computed, and an official, called the *Collector*, appointed by the Council, proceeds to receive the taxes.

Goods entering Canada from foreign countries are required to be landed at certain places called *Ports of Entry*.

The Dominion Government has an establishment at each port of entry, called a *Custom House*, with one or more officers attached to it, called *Custom House Officers*. These inspect the goods, examine the invoices, collect the sums levied upon the goods, etc.

An *Invoice* is a statement of the kind and quality of the goods shipped to a purchaser, with their weight or amount, and the cost of each article, made out in the currency and weights and measures of the country from which the goods are imported.

The sums collected on imported goods are called *Customs Duties*.

Certain articles, such as spirituous or malt liquors, snuff, cigars, etc., manufactured in Canada, are required to pay an *Excise Duty*. At each place where these are manufactured there are one or more government officials called *Excise Officers*, whose duty it is to check the quantities manufactured, levy the duty, see that none is disposed of without paying duty, etc.

The duty on some articles is reckoned at a certain rate per cent of their cost in the country from which they are imported. This is called an *Ad Valorem Duty*.

On other articles the duty is levied on the quantity of the goods without regard to their cost. This is called a *Specific Duty*.

On some articles both kinds of duties are levied.

ORAL EXERCISE

(a) Find the tax on the following valuations:

- | | |
|-------------------------|---------------------------------|
| (1) \$2000 at 10 mills. | (4) \$4500 at 2%. |
| (2) \$1500 at 8 mills. | (5) \$8000 at $1\frac{1}{2}$ %. |
| (3) \$6000 at 1%. | (6) \$7500 at 12 mills. |

(b) The rate of taxation is $1\frac{1}{4}$ %, and my property is assessed at \$4000. Find the amount of my tax.

(c) If the tax rate is 15 mills on the dollar, what is the amount of a man's taxes whose property is assessed at \$6000?

(d) The assessed valuation of the property of a town is \$500,000, and \$5000 is to be raised by taxation. Find the rate of taxation.

WRITTEN EXERCISE

1. A man pays as a tax $1\frac{1}{4}$ % of the value of his property, assessed at \$10,000. What is the amount of his tax?

2. If I am taxed $1\frac{1}{4}$ % on real estate assessed at \$8000, what is the amount of my tax?

3. In a town where the assessed valuation of the property is \$1,000,000 a tax of \$25,000 is to be raised. What is the rate of taxation expressed (1) in per cent, (2) in mills on the dollar? What is the amount of J. Brown's tax on property assessed at \$7000?

4. The value of my house is \$6000, and the value of the lot is \$1200. The house is assessed at 25% of the value and the lot at 75% of its value. If the tax rate is 22 mills, find the amount of my taxes.

5. A merchant's building and lot is assessed at \$30,000 and his merchandise at \$15,000. Find the amount of his tax at 18 mills.

6. A man owns \$8500 worth of property which is assessed at 80% of its valuation. He pays a tax of \$136 on this property. Find the rate of taxation.

7. The assessed valuation of the property of a village is \$200,000. \$5000 is required to be raised by taxation. What is the rate of taxation? What will be the amount of my tax, if I own property in this village assessed at \$4000?

EXERCISE

1. A municipality has to build three bridges each costing \$1580. The estimated expenditure for building and repairing roads is \$2020. The assessed valuation of the property in this municipality is \$1,800,000. Find the rate of taxation necessary to meet these expenditures.

2. B lives in a town in which the taxable property is valued at \$1,600,000. A tax of \$25,000 is to be levied. Find B's tax, if he is assessed for \$7640 for real estate and \$2860 for personal property.

3. In a rural school district the rate of taxation for school purposes is 8 cents per acre. Find the amount of the taxes, if the district is four miles by five miles, two sections being exempt from taxation.

4. A land company owns five quarter sections in a school district where the rate of taxation is 6.5 cents per acre. Find the amount of taxes this company pays the school district.

5. In a school district in which there are 12,960 acres of assessable land, the rate of taxation is $6\frac{1}{2}$ cents per acre. Find the amount of taxes collectible, if 5 quarter sections are not taxable.

6. In 1918 the rate of taxation in a school district containing 16 sections of assessable land was $8\frac{1}{2}$ cents per acre. For 1919 the trustees estimated that their expenses would be increased by \$153.60. What rate had to be struck for 1919?

7. The estimated expenditures for a school district for the year 1919 were as follows: Teacher's salary \$960.00, secretary-treasurer's salary \$50.00, caretaking \$60.00, repairing buildings and fence \$80.00, fuel \$96.00, debenture payment \$160.00. The district receives a government grant of \$206.00. If this district is five miles square, what will be the amount of the school tax of a farmer who owns a half section of land in the district?
8. The details of the tax levy in a city for the year 1917 were as follows: municipal rate 5.2 mills, school rate 8.7 mills, hospital rate 1 mill, library rate .18 mill, parks rate .58 mill, debenture rate and other interest charges 10.34 mills. A discount of 10% is allowed on all taxes, if paid before a certain date. Find the amount of money paid by a man in taxes who owns a house and lot in the city, the assessed valuation being \$4000, and who takes advantage of the discount offered. If the total assessment in the city is \$78,000,000, find the city's yearly revenue from taxation.
9. In a town the total assessment amounts to \$2,500,000. In this town a man owning property assessed for \$15,000 pays \$300 taxes. Find the tax rate and the total tax levied in the town.
10. A man receiving a salary of \$3500 pays an income tax of 2% on all over \$2000. Find the amount of his tax. Find his net income.
11. A man receives a salary of \$2500. His net income is \$2471.20, after paying an income tax on all over \$700. Find the rate of taxation.
12. A man paid \$25.60 income tax. If \$800 of his income is exempt from taxation and the rate is 16 mills on the dollar, find his income.

EXERCISE

1. What is the assessed value of property taxed \$37.80 at the rate of $4\frac{1}{2}$ mills on the dollar?
2. If the tax in a town is \$5775 and the rate $17\frac{1}{2}$ mills on the dollar, what is the assessed valuation of the property?
3. At the rate of $15\frac{1}{2}$ mills on the dollar, what must be the assessed value of the property to yield \$9150?
4. An incorporated village allows 5% for collecting its taxes. A sum of \$3610 is needed after paying the collector. This is raised by $12\frac{1}{2}$ mills on the dollar. Find the assessed value of the property.
5. B paid a tax of \$67.50 on property where the rate of taxation was $1\frac{3}{8}$ %. Find the assessed value of his property.
6. A paid a tax of \$109.08. The rate of taxation was $14\frac{1}{2}$ mills on the dollar. His real property was assessed for \$4325. Find the assessed value of his personal property.
7. What is the value per acre of a half section of land on which the tax is \$64.00, if it is assessed for $\frac{2}{3}$ of its value, and the rate of taxation is 8 mills?
8. The total assessment in a town is \$750,000, and the rate of taxation is 20 mills. 10% of the taxes cannot be collected, and it costs 2% for the collection of the remainder. What are the net receipts in taxes?
9. My house valued at \$6000 is rented for \$50 a month. It is assessed for $\frac{2}{3}$ of its value, the rate of taxation being 20 mills. It costs annually \$60 to keep it in repair. Would my income be increased or decreased and by how much, if I sold the house for \$6000 and invested the money at 8%?
10. J. Brown owns property valued at \$7500. He pays annually \$120 taxes, \$50 for repairs, and \$40 for other expenses. What monthly rental must he get for his property in order to make 6% on his investment of \$7500?

EXERCISE

1. What is the duty at \$1.35 a pound on 50 cases of tobacco, each case weighing 160 pounds?
2. Find the duty on an importation of ready-made clothing invoiced for \$1750 at 35%.
3. Find the duty on 8 barrels of sugar, each weighing 800 lbs. gross, at $1\frac{1}{4}$ ¢ per pound, 16% being allowed for tare.
4. Find the duty on 600 cans of coffee valued at \$4.00 a can, each can containing 25 pounds, if the specific duty is 3¢ a pound and the ad valorem duty is 10%.
5. A merchant imported 50 dozen razors valued at \$15.00 a dozen. The duty was 33 $\frac{1}{4}$ % ad valorem. At what price must he mark each razor to make 20%?
6. How many pounds of rice are there in a consignment valued at 4¢ per pound, on which the duty is \$48.00, made up of a specific duty of 2¢ per pound and an ad valorem duty of 10%?
7. The duty on musical instruments is 25%. For what sum must a dealer sell imported pianos on which he paid \$367.50 duty, so as to gain 20%?
8. If goods invoiced at \$875.00 cost \$1265.00 when laid down in the warehouse, the insurance and freight amounting to \$83.75, find the rate of duty.
9. R. Jones and Sons imported 600 boxes of cigars, each box containing 50 cigars and weighing $\frac{1}{4}$ pound, the invoice price per box being \$4.50. If the specific duty on cigars is \$1.75 per pound, and the ad valorem duty 25%, find the amount of duty paid on this shipment.
10. A merchant imported from Paris, France, 250 pieces of silk, each piece containing 100 yards at 5 francs per yard.

He paid 35% ad valorem duty and \$60.00 for shipping charges. He retailed the silk at \$1.50 per yard. Find his gain, the franc being equivalent to 20 cents.

SIMPLE INTEREST

Introductory.

If a man rents a house or farm, he agrees to pay for the use of these a certain sum of money per month, or a certain sum of money per year. When a man borrows or hires money he has also to pay for its use. The money paid for the use of money is called *Interest*.

If I borrow \$500 for 1 year and agree to pay \$5.00 for the use of each \$100, I shall have to pay \$25.00 for the use of the \$500 for 1 year. \$25.00 is the interest on \$500 for 1 year.

The money for the use of which interest is paid, is called the *Principal*.

The number of dollars paid for the use of \$100 for 1 year is called the *Rate of Interest*. The rate of interest is usually expressed as a per cent of the principal for its use for 1 year. Interest at 8% means that a sum equal to 8% of the principal is to be paid each year as interest. The interest on \$500.00 for 1 year at 8% is, therefore, $\$500 \times .08$, or \$40.00.

To find the interest on any sum, at any rate per cent, for a given time.

Example:

To find the interest on \$750.00 for $2\frac{1}{4}$ years at 6%.

The interest for 1 year = $\$750 \times .06 = \45.00 .

The interest for $2\frac{1}{4}$ years = $\$45.00 \times 2\frac{1}{4} = \112.50 .

ORAL EXERCISE

1. What is the interest on \$100.00 for 1 year at 5%? at 7%? at 3%? at $6\frac{1}{2}$ %? at $8\frac{1}{2}$ %? at 10%?

2. What is the interest on \$300.00 for 2 years at 8%? at 6%? at 3½%? at 7¼%? -

3. At 4%, 6%, and 8% find the interest on :

- (a) \$600.00 for 2 years. (c) \$900.00 for 3 years.
 (b) \$1000.00 for 5 years. (d) \$400.00 for 1½ years.

WRITTEN EXERCISE

Find the interest on :

1. \$550 for 2 years at 5%.
2. \$840.00 for 1 year at 6¼%.
3. \$750 for 3 years at 8%.
4. \$3152.16 for 1 year at 7¼%.
5. \$2838.50 for 3 years at 9¼%.
6. \$720.00 for 3½ years at 6¼%.

Find the interest on :

7. \$248.50 for 5 years 6 mo. at 6%.
 8. \$824.25 for 2 years 3 mo. at 8%.
 9. \$1250.00 for 3 years 4 mo. at 4½%.
 10. \$860.00 for 2 years 8 mo. at 9%.
 11. \$2540.00 for 1 year 9 mo. at 4%.
12. A man borrowed \$7200.00 for 1 year, viz.: \$1250 at 7%, \$1340 at 7¼%, \$2360 at 8%, and the remainder at 8½%. How much interest has he to pay at the end of the year?
13. Four brothers have to divide equally at the end of each year the interest on \$25,800 at 7%. How much does each receive each year?
14. A bank pays 3% interest on a deposit of \$6000.00. The bank loans \$4000 of this sum for 3 months at 8%; all of it for 2 months at 6%; and again \$2000 of it for 7 months at 9%. Does the bank gain or lose, and how much?

Example:

A man borrows \$500 on March 11th and agrees to pay back this money on August 15th with interest at 6%. Find the amount of interest.

Time of interest, March, 31 days – 11 days, = 20 days	
April,	30 days
May,	31 days
June,	30 days
July,	31 days
August,	15 days
Total,	<u>157 days</u>

Interest for 1 year = $\$500 \times .06 = \30.00 .

Interest for 157 days = $\frac{157}{365}$ of $\$30.00 = \12.90 .

15. Find the interest on \$500 for 156 days at 7%.

16. Find the interest on \$7500 from May 5th to October 27th at 6%.

17. Find the interest on \$408.80 from July 3rd, 1918, to Feb. 6th, 1919 at 8%.

18. Find the interest on \$2000 at 5% from May 7th, 1917, to March 4th, 1919.

19. Find the interest on \$4500 at 8% from April 6th, 1918, to May 4th, 1919.

The sum of the principal and interest is called the *Amount*.

Example:

If a man borrows \$480.00 for 8 months at 8%, what amount should he pay back at the end of that period?

Interest on \$480.00 for 1 year = $\$480 \times .08 = \38.40 .

Interest on \$480 for 8 mo. = $\frac{2}{3}$ of $\$38.40 = \25.60 .

Interest = \$ 25.60

Principal = \$480.00

Amount = \$505.60

EXERCISE

1. What is the amount of \$1573 for 4 years at 5%?
2. What is the amount of \$840.00 for 10 mo. at 6%?
3. To what sum will \$784 amount in 2 years 9 mo. at 7%?
4. Find the amount of \$942.00 for 3 mo. at 8%.
5. A man borrowed \$250 on March 2nd at 7%. He paid the principal and interest on May 14th. What was the amount of principal and interest?
6. I borrowed \$500 on May 15th at 6% and \$800 on July 7th at 8%. What sum would discharge these debts on November 10th of the same year?
7. A note given on March 13th for \$820 at 5% was paid on December 20th of the same year. What amount of money was required to cancel the note?
8. I have the choice of buying a house for \$4200 or of renting the same house at \$40.00 a month. Which is the better choice, if money is worth 8%, the taxes, insurance, and repairs of the house amounting to \$112 each year?

The principal, interest, and time being given, to find the rate.

Example:

At what rate per cent will \$756 yield \$241.92 interest in 4 years?

Solution. Interest on \$756 for 1 year = $\frac{1}{4}$ of \$241.92
= \$60.48

Interest on \$100 for 1 year = $\frac{60.48 \times 100}{756} = \$8.$

The rate = 8%.

EXERCISE

1. A man pays \$72.00 for the use of \$900 for 1 year. What is the rate of interest?

2. At what rate of interest will \$500 yield \$90 interest in 3 years?

3. The interest on \$500 for 4 years 3 mo. is \$170. Find the rate.

4. A man loaned \$484 for 5 years and received \$181.50 for the interest. What rate of interest did he charge?

5. A house costing \$7500 is rented at \$60 per month. The insurance and taxes amount yearly to \$120. What rate per cent does the money invested in the house yield?

6. A man borrowed \$2500 and agreed to pay the lender \$2600 in eight months. What rate of interest is he charged?

7. The interest on \$870 for 4 yr. 6 mo. is \$274.05. What will be the interest on \$1000 for 3 mo. at the same rate?

8. Seven months after date a note for \$1800 amounted to \$1873.50. What was the rate of interest charged?

9. I deposited \$1800 in a bank, and at the end of 6 months I was credited with \$36.00 interest. What rate of interest did the bank pay?

10. I bought a quarter section of land at \$25 per acre. At the end of the year my net profits from this farm after paying all expenses were \$600. What rate of interest did the investment yield?

The principal, interest, and rate being given, to find the time.

Example:

In what time will the interest on \$600 at 5% amount to \$120?

Solution. The interest on \$600 for 1 year at 5% = \$30.00.

\$30 is interest for 1 year.

\$120 is interest for $(120 \div 30)$ years = 4 years.

EXERCISE

1. In how many years will \$800 yield \$144 interest at 6%?
2. Find the time in which the interest on \$560 at $7\frac{1}{4}\%$ will be \$94.50.
3. Find the time in which \$600 will amount to \$613.75 at $5\frac{1}{4}\%$.
4. Find the time in which \$850 will amount to \$1088 at 8%.
5. A note given for \$250 at 6% remained unpaid until the interest equalled the principal. How long did the note run?
6. In how many years will any sum of money double itself at 5%? at 4%? at 6%? at 10%?
7. A sum of \$600 was loaned on June 10th, 1919, at $7\frac{1}{4}\%$. At what date did it amount to \$664?

The interest, rate, and time being given, to find the principal.

Example:

What principal will yield \$900 interest in 2 years at 6%?

For 2 years the interest is \$900.00.

\$6 is interest for 1 year on a principal of \$100.

\$12 is interest for 2 years on a principal of \$100.

\$900 is interest for 2 years on a principal of

$$\frac{\$100 \times 900}{12} = \$7500.00.$$

EXERCISE

1. What principal will yield an interest of :
 - (a) \$600 in 5 years at 6%?
 - (b) \$375 in 4 years at 5%?
 - (c) \$600 in 3 years at 8%?
 - (d) \$840 in 2 years 4 mo. at 9%?

2. A man borrowed money at 7% and paid \$245 interest a year. How much money did he borrow?

3. A man insures his life for an amount, which, invested at 6%, will give to his wife, after his death, a yearly income of \$1200. For what sum did he insure his life?

4. A man bequeathed his wife \$875.00 a year, his daughter \$770.00 a year and his son \$630.00 a year. What sum must be invested at 7% to produce these sums?

The amount, time, and rate being given, to find the principal.

Example:

What principal will amount to \$496.00 in 1 year 4 mo. at 5%?

The interest on \$100 at 5% for $1\frac{1}{3}$ yr. = \$6 $\frac{2}{3}$

The principal which amounts to \$106 $\frac{2}{3}$ in $1\frac{1}{3}$ yr. = \$100

The principal which amounts to \$496 in $1\frac{1}{3}$ yr. = $\frac{496 \times \$100}{106\frac{2}{3}}$
= \$465.00

EXERCISE

1. Find the principal that amounts to :

- (a) \$382.50 in 1 yr. at 6 $\frac{1}{4}$ %.
- (b) \$694.30 in 1 yr. 6 mo. at 4%.
- (c) \$772.50 in 8 mo. at 4 $\frac{1}{2}$ %.
- (d) \$1881.25 in 225 days at 5%.

2. The amount of a certain principal for 3 $\frac{1}{2}$ years was \$307.20, and for 3 $\frac{3}{4}$ years the amount was \$312.00. Find the principal and the rate.

Sometimes a purchaser buys goods, stock, land, etc., for which he gives in payment a written promise to pay at some future date, which is specified. This written promise to pay

is called a *Promissory Note*. In most cases, the person who gives the note is required to pay interest on the sum stated in the note, for the time specified in the note. Three days additional are allowed for the payment of the note, before payment can be legally enforced. These days are known as *Days of Grace*.

Example:

At a farm sale George Gorman bought from J. A. McGregor, 1 heavy wagon at \$65.00, 2 cows at \$75.00 each, and 1 team of horses at \$475.00. He gave in payment his note for 90 days dated March 10th.

<i>Due</i>	
<i>\$ 690.00</i>	<i>Indian Head, Sask., March 10th, 1919.</i>
<i>Ninety days after date...I...promise to pay to the</i>	
<i>order of.....J. A. McGregor.....at the</i>	
Union Bank, Indian Head, Sask.	
<i>the sum of.....Six Hundred and Ninety.....Dollars.</i>	
<i>with interest at 8% per annum.</i>	
<i>Value received.</i>	
<i>George Gorman</i>	

Date of note, March 10th.

Time note bears interest, 90 days and 3 days' grace.

Date when note is due is June 11th.

Rate of interest, 8% per annum.

Interest on \$690.00 for 93 days at 8% = $\frac{93}{365} \times .08 \times \$690 =$
\$14.06.

Amount required to pay the note, \$690.00 + \$14.06 =
\$704.06.

5.

\$ 720.00

Estevan, Sask., May 4th, 1918.

-----Six months-----after date---I---promise to pay to the
 Cookshutt Company---at the---Dominion Bank, Estevan,
 the sum of ~~~~~Seven Hundred and Twenty~~~~~ Dollars
 with interest at 8% per annum.

Value received.

William Robertson

Find when this note is due. (2) What amount will Robertson have to pay when the note is due?

EXERCISE

1. Find the simple interest on \$275.60 from 18th July, 1911, to 13th September, 1912, at 6% per annum.
2. Find the interest on \$84.25 from April 16th, 1908, to November 4th, 1909, at 7% per annum (year = 365 days).
3. A person borrows money for 6 yr. at $3\frac{1}{2}\%$ and repays at the end of the time as principal and interest, \$847. How much did he borrow?
4. Find the interest on \$387.56 from March 18th to November 19th at 6% per annum.
5. A note of \$360, drawn April 20th, 1911, is paid July 2nd, 1912, with interest at $7\frac{1}{2}\%$ per annum. Find the amount paid.

8. On June 29th, 1909, I borrowed \$16.50 and returned it on April 30th, 1910. With interest at $6\frac{1}{2}\%$, what amount did I then pay?

7. I bought a horse for \$160 and gave in payment my note dated August 15th, 1911, with interest at $7\frac{1}{2}\%$ per annum until paid. On January 8th, 1912, I sold the horse for \$200 cash and paid my note. What was my net gain?

8. What amount will be due July 1st, 1911, on a note of \$80, drawn February 6th, 1911, bearing interest at $5\frac{1}{4}\%$ per annum?

9. On October 15th, 1911, a young man deposited in a savings bank the sum of \$860.75. On May 20th, 1912, he withdrew the principal and simple interest at 4% per annum. What amount did he withdraw?

10. On January 1st, 1910, A borrowed \$1000 from B at 6% per annum. On July 1st, 1911, he paid \$600. How much did A owe B on January 1st, 1914, when he paid the debt, principal and interest?

EXERCISE

1. On May 15th, 1908, a man bought a piano for \$500, agreeing to pay \$125 a year until it was paid for, with interest at 6% per annum.

- (a) Find the dates on which the various payments were due.
- (b) Calculate the amount of each payment.
- (c) When the piano was finally paid for, how much did it cost him?

2. A man borrowed \$1400 from a loan company on Feb. 1st, 1914, agreeing to repay the principal at the rate of \$140.00 at the end of each year, with interest at 8%.

- (a) How many years will it take to repay the loan?
- (b) Calculate the amount of each payment.
- (c) Find the total amount of interest he has paid during the period.

3. A school district on April 1st, 1912, borrowed \$1200 to defray the expenses of building and equipping a school, agreeing to repay the principal in ten equal annual payments, at $5\frac{1}{2}$ %.

- (a) On what dates are the various payments due?
- (b) Calculate the amount of each payment.
- (c) Find the total amount of interest paid during the period.

4. A school district borrowed \$1200, the principal to be repaid in 8 equal annual payments with interest at 6%.

- (a) Find the amount of each payment.
- (b) Find the total amount of interest paid.

5. A school district in Saskatchewan borrowed \$1000, on April 1st, 1913, agreeing to repay it in ten equal annual payments with interest at 6%.

- (a) Make a table showing the dates of payment, principal, interest, and amount due on each date.
- (b) Find the total amount paid during the period.

6. Make a similar table in the case of a loan of \$12,000, made on March 15th, 1913, payable in 15 equal annual payments, interest at 6%.

7. A school board in Saskatchewan received notice on March 1st, 1913, from a Loan Company, that the last payment of principal and interest on the loan of \$1000 to that district would be due on April 15th. If the loan was repayable in 10 equal annual payments with interest at 6%, find :

- (a) The date on which the loan was made.
- (b) The amount of the payment due.

BANKING

To facilitate the transaction of business, there are institutions called *Banks*, which deal in money and credit. They receive money from persons who wish to deposit it where it will be safe and can be obtained when it is needed. If it is the intention of the person not to use the money for a considerable time, it is desirable to deposit it in the *Savings Branch* of the bank, for the bank will pay interest upon sums of money deposited in the savings branch. The interest is usually added to the sum on deposit at the end of each half year. If the money is deposited for safe keeping and also for convenience in doing business, it is placed in a *Current Account*. No interest is paid on money thus deposited. *Cheques* may be drawn against this account. A person is able to make payments by issuing cheques against this account in place of paying with cash.

Some business institutions require all cheques received as payment of an account to be certified by the bank on which the cheque is drawn. This is done by the proper official of the bank stamping the word "accepted" across the face of the cheque, and a sufficient sum is set aside from the account of the man issuing the cheque to insure payment.

Besides the receiving of deposits of money for safe keeping, the banks have other important business to perform. They loan money on good security to business men and others, and also remit money from one place to another for their clients.

In opening an account at a bank, the person fills out a *Deposit Slip* as shown on this page. On this slip the number

THE BANK OF TORONTO CREDIT			
.....			
.....			
.....			
OF.....		101.....	
x	1=		
x	2=		
x	5=		
x	10=		
x	20=		
x	50=		
x	100=		
Silver.....			
Gold.....			
Cheques.....			

DEPOSIT SLIP

of bills of each denomination, the cheques, the silver, etc., to be deposited must be indicated. Occasionally the bank requires references as to a person's reliability and always requires his "legal signature" as a matter of reference. The person receives a pass book in which is entered by the receiving teller, the amount of money left on deposit. When further deposits are made, the pass book is presented each time for the receiving teller to enter in the amount deposited. At the end of each month the pass book is left at the bank for the clerks to enter in it the account of all

cheques paid by the bank for the person, and to calculate the balance of the person's account. The cancelled cheques the bank has cashed are returned to the person. These cheques serve as vouchers or receipts for payments made.

BANK CHEQUE

<div style="border: 1px solid black; width: 80%; height: 80%; margin: auto;"></div>	No. _____ Calgary _____ 19____ <small style="margin-left: 100px;">ALBERTA</small>	<div style="border: 1px solid black; padding: 2px; width: 30px; height: 30px; margin: auto;"> 4 10 </div>
<h2 style="margin: 0;">The Bank of Toronto</h2>		
Pay to _____ or Order _____ <small>00</small> Dollars _____ \$ _____		

EXERCISE

1. A customer enters a bank to deposit 8 one dollar bills, 5 twos, 7 fives, 2 twenties, three cheques for \$24.85, \$32.85, and \$41, and \$8.37 in change. Fill in his deposit slip.
2. David Smith owes Thompson & Co. \$247.89 for work done. Smith draws a cheque on the Imperial Bank for this sum. Write out the cheque, supplying place and date.
3. A farmer having \$258.16 to his credit in a bank on April 30th, deposits \$17.36, \$24.84, \$72.96, and \$36.45 during the month of May, and draws cheques for \$8.75, \$21, \$36.19, and \$11.37. Find his balance on May 31st.
4. Make out a deposit slip for the following: 25 one-dollar bills, 17 twos, 18 fives, 2 fifties, cheques for \$42.50, \$36.85, \$17.28, \$47.50, and silver \$14.25.
5. John Morrison owes the Massey-Harris Company \$275 on account. He draws his cheque on the Bank of Nova Scotia, on May 8th, 1920 for this sum. Write the cheque.

6. A merchant's deposits during the week have been \$125.32, \$117.84, \$203.16, \$175.15, \$204.15, and \$184.25. He has given cheques for \$46.75, \$24.84, \$36.15, and \$29.40. At the beginning of the week his bank balance was overdrawn \$24.36. Find his balance at the end of the week.

7. Draw a cheque on the Union Bank of Canada of Vancouver, B. C., for the payment of one month's rent in advance on your house in favor of the owner (name to be supplied). Your rental is \$45.00 per month. Use present date.

8. A cheque drawn on the Canadian Bank of Commerce, Calgary, Alberta, for \$95.00, made by J. W. Brown to your order is received by you. You wish to transfer this cheque to W. Smith as payment of account. Write the cheque and make the proper endorsement upon it, so that it may be cashed when presented to the bank by Mr. Smith.

9. You wish to draw out \$25 from the Imperial Bank of Canada for personal use. Write the cheque, using the present date.

COMPOUND INTEREST

When the amount of interest on a sum of money accumulated at the end of any interest period is added to the sum, and for the next interest period with the original sum draws interest, and so on, the investor is said to receive *Compound Interest*. In a savings bank the interest is credited to one's account every six months, and thus the banks pay compound interest on deposits in the savings branch.

Example :

A man deposited \$2500 in a savings bank, the interest being added to the principal every 6 months at 4% per

annum. What will be the amount on deposit to his credit at the end of 18 months?

Original deposit	\$2500
Interest for 1st 6 mo.	<u>50</u>
Amount on deposit for 2nd 6 mo.	\$2550
Interest for 2nd 6 mo.	<u>51</u>
Amount on deposit for 3rd 6 mo.	\$2601
Interest for 3rd 6 mo.	<u>52.02</u>
Sum at his credit at the end of 18 months is . .	\$2653.02

The compound interest on \$2500 for 18 mo. at 4% per annum compounded half yearly is $\$50 + \$51 + \$52.02 = \153.02 .

EXERCISE

Find the compound interest and the amount of:

1. \$1000 for 2 yr. at 5%, compounded annually.
2. \$2500 for 3 yr. at 6%, compounded annually.
3. \$2500 for 1½ yr. at 8%, compounded half-yearly.

Find the difference between the simple and the compound interest on the following:

4. \$1000 for 3 yr., at 6% compounded annually.
5. \$2500 for 18 mo., at 4% compounded half-yearly.
6. \$2500 for 1 yr., at 8% compounded quarterly.
7. What is the compound interest on \$650 for 3 years at 6 per cent, interest being compounded annually?
8. Find the difference between the simple and the compound interest on \$350 for 3 years at 8 per cent, interest being compounded annually.
9. A sum of money put out at simple interest for 2 years at 8 per cent amounted to \$464; to what sum would it have amounted had it been loaned at compound interest?

10. The simple interest on a sum of money for 3 years at 8 per cent is \$120; what is the compound interest on the same sum for the same time?

11. A man deposits in the savings bank \$500, on which interest at 4 per cent per annum is to be added to the principal every 6 months. How much money has the man in the bank at the end of two years?

12. A father placed \$100 in the savings bank in his boy's name, when the boy was 8 years old. Every half year the bank added 4% to the deposit for interest, and the father added \$50 every year. What will be the amount on deposit to the boy's credit when he is ten years old?

BANK DISCOUNT

A great part of the money used in business is borrowed money. This borrowed money is usually obtained from banks.

\$ 100.00	Due _____
	Edmonton, Alta., October 5th, 1919
----- Sixty days -----	after date. I promise to pay to
the order of -----	Union Bank of Canada ----- at the
-----	Union Bank of Canada, Edmonton, Alta. -----
the sum of One Thousand -----	00 Dollars
	with interest at the rate of 8 per cent per annum until
	due and 8 per cent per annum after due until paid,
	value received.
No. _____	James Williams
	208 Robert Street

A merchant wishes to obtain a loan of \$1000 for 60 days from the bank with which he has been doing business. The manager or accountant makes out a note in the form given, and the merchant signs it. The bank deducts the interest in advance on \$1000 for 63 days at a certain rate per cent, gives the merchant the balance, and collects the \$1000 from the merchant at the end of the 63 days.

Note. — The three days added to the specified time are called *Days of Grace* which must elapse before payment of the note can be legally enforced.

To make the payment of the note more secure, the banker often requires the signature of other person or persons known as indorser or indorsers, or requires the conveyance of real or personal property to the bank as security for the payment of the note.

The interest in advance deducted by the bank from the amount of the note at maturity is called *Bank Discount*. When a man borrows from a bank, he pays this interest in advance.

The difference between the sum on a note at its maturity and the discount is called the *Proceeds*.

The sum for which the note is drawn is called the *Face of the Note*.

The number of days from the time when a note is discounted to the time when it legally matures is called the *Term of Discount*.

A bank not only discounts notes made by its customers direct to the bank, but it also discounts notes owned by its customers and payable to them. The owner of the note indorses the note, making it payable to the bank. These notes may or may not bear interest.

EXERCISE

Find (1) the date of maturity, (2) the term of discount, (3) the discount, (4) the proceeds of the following notes:

DATE OF NOTE	FACE OF NOTE	TIME	DATE OF DISCOUNT	RATE
1. April 21st, 1919	\$500	3 mo.	May 5th	6%
2. Sept. 15th, 1919	\$400	4 mo.	Sept. 15th	7%
3. Jan. 25th, 1919	\$657	60 days	Feb. 14th	8%
4. May 11th, 1919	\$511	2 mo.	July 31st	6%

5. Write a 90-day note payable by you to some member of your class, at a local bank.

6. I can borrow \$800 on a 60-day note at 8% from a person or from a bank. How does the interest in the one case compare with the discount in the other? What is the advantage of borrowing from the person? If I borrow from the bank, what rate of interest do I actually pay?

7. A note for \$750.00 without interest, due Sept. 15th, is discounted at 6% on June 28. What are the proceeds?

8. I bought a lot for \$1200 cash and sold it at an advance of 12½% on a 90-day note not bearing interest, which I immediately discounted at the bank at 8%. How much did I make?

9. What is the bank discount and net proceeds of a note for \$584 drawn Jan. 8th, 1918, for 10 months, and discounted at the bank on June 6th, at 6%?

10. A 3-months note for \$900 was dated April 8th and discounted May 27th at 8%. Find the proceeds.

FORM OF NOTE BEARING INTEREST

\$ 200 $\frac{00}{100}$

Due _____

Vancouver, B. C., April 15th, 1919

Sixty days after date I promise to pay to the order of
James Ross _____ at the

Bank of Montreal

VANCOUVER, B.C.

the sum of Two Hundred _____ $\frac{00}{100}$ Dollars

for value received, with interest at the rate of 5 per cent per
annum.

No. _____

Robert Turner.

This note is discounted May 10th, at the Bank of Montreal, Vancouver, at 6%.

The date of maturity is June 17th.

The amount or value of the note at maturity will be \$200 + interest on \$200 for 63 days at 5%, which is \$201.73.

The term of discount is the number of days between May 10 and June 17, or 38 days.

The discount on \$201.73 for 38 days at 6% is \$1.26.

The proceeds of the note are \$201.73 - \$1.26 or \$200.47.

EXERCISE

Find the discount and proceeds of each of the following interest bearing notes :

	FACE OF NOTE	DATE	TIME	RATE OF INTEREST	DATE OF DISCOUNT	RATE OF DISCOUNT
1.	\$400	Sept. 10th	90 da.	6%	Nov. 15th	8%
2.	\$250	June 15th	60 da.	5%	July 4th	7%

	FACE OF NOTE	DATE	TIME	RATE OF INTEREST	DATE OF DISCOUNT	RATE OF DISCOUNT
3.	\$750	Mar. 21st	2 mo.	7%	April 10th	8%
4.	\$1000	July 11th	3 mo.	4%	Aug. 15th	6%
5.	\$1200	June 12th	4 mo.	6%	June 12th	8%

Write out the above notes supplying the name of the maker of the note, the name of the person to whom the money has to be paid, the name of the place, and the name of the bank.

6. I bought a quarter section of land for \$25 per acre and on April 8th sold it for \$30 per acre, receiving one-third cash and a six-months note bearing interest at 6% as payment for the balance. I immediately had the note discounted at the bank at 8%. How much did I make out of this investment?

7. A farmer purchases a tractor from the J. I. Case Co., on March 10th, 1919, for \$1200. He paid one-half cash and gave a nine-months note for the balance, bearing interest at 6%. When does this note mature? Find the amount of the note at the date of maturity. How much money does the farmer actually pay for the tractor? If the J. I. Case Co. have this note discounted at the bank on July 20th at 8%, how much money does the company actually receive for the tractor?

Write the above note, supplying the name of the farmer and the name of the bank.

8. Find the face of a 70-day note that discounted at 8% on the day it is made will realize \$787.20 in cash.

9. I bought a team of horses for \$490. To get money to pay for this team I had a 143-day note discounted at the bank at 5%. For what sum was this note drawn?

10. A banker charged me \$30 discount on a note of \$1200 due in 40 days. Find the rate of discount charged.

11. A banker discounts a note of \$250 at 10% and charges \$10 discount. For how long was the discount computed?

12. I bought goods from a wholesale house at the listed price of \$1600, less discounts of 10% and 5%. As payment for the goods, the wholesaler took my 70-day note for an amount such that when it was discounted immediately at 8%, the proceeds paid the bill. What was the face of the note?

13. A hardware merchant sold a farmer \$420 worth of hardware and took in payment the farmer's 90-day note, bearing interest at 6%. Fifteen days later the merchant had this note discounted at his bank at 8%. Find the proceeds of the note.

14. A flour and feed merchant bought \$2400 worth of flour, the freight and cartage amounting to \$100. He sold the flour at an advance of 20% on the total cost, and as payment took a note for 90 days without interest. He immediately discounted this note at 6%. What was his profit?

DRAFTS

James McGuire, a hardware merchant in Edmonton, owes Brown & Co., a wholesale firm in Winnipeg, \$1000. In payment of this account the actual money is not transmitted to Winnipeg, nor is the payment usually made by cheque. The common method of paying a debt in a distant place is by means of the *Bank Draft*. The merchant in Edmonton goes to his bank and purchases a draft of the following form:

2. A merchant placed 75% of his year's profits in a bank. Later he drew out 25% of this deposit, and his bank account still showed a deposit of \$2700. What were his profits for the year?

3. A speculator invested $62\frac{1}{2}\%$ of his estate in a mine and deposited the remainder, \$5400, in the bank. Find the value of his estate. How much did he invest in the mine?

4. A bill of goods on which a discount of 8% was allowed was settled for \$414. Find the amount of the bill.

5. Write a note for the following: I borrow of Fred Thomas \$640, payable in 4 mo. at 8%.

6. When the rate of taxation is reduced from $18\frac{1}{2}$ mills on the dollar to $16\frac{1}{2}$ mills, my taxes are reduced \$9. Find the amount of my assessment.

7. What sum must be paid to discharge a debt of \$1800 due 15 mo. hence and bearing interest at 8% per annum?

8. A dealer sold two motor cars for \$1800 each. On one he lost 25%, and on the other he gained 25%. Did he gain or lose on the sale of the two cars, and how much?

9. A man's barn was damaged by fire to the extent of 40% of its value. He received from the insurance company in which the barn was insured for 90% of its value the sum of \$972. What was the value of the barn?

10. A clerk whose salary was increased 20% is now receiving a salary of \$1800. What was his former salary?

EXERCISE

1. In a town the rate of taxation is 15 mills on the dollar. The assessment is 75% of the real value of the property in the town. What tax does a man pay who owns property in the town valued at \$6400?

2. A tax of \$2,000,000 is raised in a city upon an assessment of \$125,000,000. What is the rate of taxation? Find the amount of taxes paid by the owner of property assessed at \$19,700.

3. A merchant's sales for the year amounted to \$31,378. This amount was $8\frac{1}{2}\%$ more than his sales last year. What was the amount of his sales last year?

4. What single discount is equivalent to 25% and 10% off?

5. An agent sold \$15,800 worth of goods, and his commission amounted to \$395. What rate of commission did he charge?

6. On July 10th, 1919, James Ross of Fredericton bought three teams of horses from Frank Bishop for \$1500. He paid \$900 cash and gave his 60-day note for the balance. The same day Bishop discounted the note at 8%. (a) Write the note. (b) Find the proceeds of the note. How much money did Bishop receive for the teams?

7. A house that cost \$8000 rents for \$60 per month. It is insured for 75% of its value, the rate being 2% for three years' protection. The taxes are 20 mills on the dollar on an assessment of \$5400. Repairs, etc. during the year amounted to \$32. What rate of interest does this house pay on the investment of \$8000?

8. James Brown in the employ of Kent's Real Estate Agency sold for his firm a house and lot for \$12,500. The firm received a commission of \$625 and out of this commission gave Brown \$250. What rate of commission did the firm charge? On what rate of commission is Brown working?

9. The assessed valuation of the property of a village is \$840,000. The estimated expenditures for the year include \$5400 for schools, \$4830 for public works, \$3000 for salaries of officials, and \$210 for other expenditures. What rate of taxation must be levied to meet these expenditures?

10. A horse dealer bought 25 horses at \$120 per head. He sold 8 of them at \$135 per head, 10 of them at \$140 per head, and the remainder at \$145 per head. His expenses in connection with the buying and selling of these horses amounted to \$4.20 per head. What was his per cent profit?

EXERCISE

1. My property was assessed at \$4800, the rate of taxation being 22 mills. I received a discount of 5% for prompt payment. What amount of taxes did I pay?

2. A farmer sells a carload of wheat containing 2000 bushels at \$1.80 per bu. If he had kept his wheat one month longer, he would have received 10¢ per bu. more for it. Reckoning interest at 8%, find how much he would have gained by holding his wheat and selling it at the increased market price.

3. Investigations made in a certain district in Manitoba showed that there was a loss of 20% in the oat crop due to smut. What was the loss to the farmer who harvested 40 bu. to the acre from an 80-acre field, the market price of oats being 75¢ per bu.?

4. A merchant's balance in the bank at the beginning of the week was \$1675.50. During the week he deposited \$327.75, \$263.40, \$415.25, \$200, \$164.80, and \$380.20. He paid by cheque a bill of goods for \$876 less 5% discount, another bill for \$350 less 2% discount, \$185 for wages, and \$275 for store rent. Find his bank balance at the end of the week.

5. A boy deposited in the savings bank \$150 on Jan. 1st, 1917. The bank pays interest at 4% per annum, the interest being added half yearly to the amount on deposit on Jan. 1st and July 1st. On July 2nd, 1918, the boy withdraws from the bank enough money to pay for a bicycle costing \$60, a suit of clothes costing \$25, and a rifle costing \$32. How much money is there still in the bank to the boy's credit?

6. A farmer bought 20 head of cattle for \$900 and kept them three months. During that time he fed them per head, $1\frac{1}{4}$ ton of hay valued at \$16 per ton, 50 bu. of chop valued at 72¢ per bushel, and 1.5 tons of silage valued at \$8.00 per ton. At what price per head must he sell them to realize a profit of 20% on his investment?

7. If wheat loses 20% by weight when ground into flour, how many bushels of wheat are required to make a barrel of flour?

8. An agent collected 75% of a doubtful account and received \$12 for making the collection. If the rate of commission he charges is 5%, find the amount of the account.

9. A merchant failed in business with liabilities amounting to \$30,000. His assets were: merchandise valued at \$10,000, accounts receivable \$3000, and property (real estate) valued at \$3500. How many cents on the dollar will his creditors receive?

10. What per cent does a man make on his money who rents a house that cost him \$7200 for \$600 per year?

EXERCISE

1. A marine insurance company received \$540 for insuring a vessel worth \$90,000 at $\frac{3}{4}$ of its value. What rate of insurance did the company charge?

2. A man, having a family of four children all under the age of 16 years, receives a salary of \$3500. Of this salary \$2000 is exempt from the Federal income tax, and in addition \$200 for each child under 16 years is exempt. Find the amount of Federal income tax this man pays, the rate being 5%.

3. An insurance company, having insured a block for \$200,000 at 75¢ per \$100, reinsured \$50,000 of this risk with another company at $\frac{3}{4}$ %, and \$90,000 with another company at $\frac{1}{4}$ %. What amount of premium did this company receive more than it paid out?

4. A grocer buys 50 barrels of apples, each containing $2\frac{1}{2}$ bushels, at \$4.40 per barrel. If the loss by decay amounts to 20%, at what price per bushel must he sell the remainder to make a profit of $12\frac{1}{2}$ %?

5. A dealer marked the selling price of his goods 25% above the cost. What per cent of their cost would he gain or lose, if he sold them at a special sale 25% below the marked price?

6. A shipment of glassware was invoiced at \$1200 with discounts of 20% and 10% off. For what price must this shipment be sold to yield a net profit of 25%?

7. Write a note in which you promise to pay William Grant \$600 in 3 months with interest at 8%.

8. I sell to a customer a bill of goods amounting to \$250. I am willing to take his 70-day note for this amount, which I will immediately discount at the bank at 8%, or I will give him a discount of 2% for cash. Which is the better settlement from my standpoint?

9. A man pays an annual premium of \$35.60 a thousand on a life insurance policy. If the total annual premium is \$178, what is the face of the policy?

10. A manufacturer sells coal ranges to a hardware merchant at such a price that the hardware merchant can sell them at \$60 each and make a profit of 25%. The manufacturer makes a profit of $33\frac{1}{3}\%$. Find the cost of manufacture per range.

CHAPTER VIII
POWERS AND ROOTS

Powers

Introductory.

1. What is the product of 2×2 ?
2. What is the product of $2 \times 2 \times 2$?
3. What is the product when 2 is used as a factor 4 times ? 5 times?
4. What is the product when 3 is used as a factor twice? 3 times? 4 times?

The product obtained by using the same number two or more times as a factor is called a *Power* of the number.

4, 8, 16, 32, etc. are powers of 2. 9, 27, 81 are powers of 3.
16, 64, 256, etc. are powers of 4. 49 is a power of 7.

The power is known by the number of times the given number is used as a factor. If the number is used *twice* as a factor, the product is the *Square* or the *Second Power* of the number.

4 is the square or second power of 2.

81 is the square or second power of 9.

If the number is used 3 times as a factor, the product is the *Cube* or the *Third Power* of the number.

27 is the cube or the third power of 3.

125 is the cube or the third power of 5.

If the number is used 4 times as a factor, the product is the *Fourth Power* of the number ; if used 5 times the product is the *Fifth Power*, etc.

EXERCISE

1. Find the square or the second power of the following numbers: 6, 8, 11, 25, 9, 17, 50, 40.
2. Find the cube or the third power of the following numbers: 4, 7, 8, 9, 10, 50.
3. Find the fourth power of 3, 5, 10, 20.

The number of times a number is used as a factor to produce a power is indicated by a figure placed at the right of, and a little above the number. This is called the *Exponent* or *Index*.

Examples:

49 is 7^2 . 125 is 5^3 . 64 is 2^6 .

In these examples 2, 3, and 6 are exponents or indices.

The expressions 7^2 , 5^3 , 2^6 are read 7 squared, 5 cubed, and 2 to the sixth power.

EXERCISE

1. Read the following expressions and give the value of each:
 $1^2, 2^2, 3^2, 4^2, 5^2, 6^2, 7^2, 8^2, 9^2, 10^2, 11^2, 12^2$.
2. Read the following expressions and find the value of each:
 $1^3, 2^3, 3^3, 4^3, 5^3, 6^3, 7^3, 8^3, 9^3, 10^3, 11^3, 12^3$.
3. Find the square or second power of the following numbers:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
15	35	27	19	57	49	75	3.5	7.8	9.5	6.52

4. Find the cube or the third power of the following:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
9	17	25	50	100	3.2	4.5	.05	3.05	.002	7.003

In order to find the power of a fraction we reduce the fraction to its lowest terms and find the power of the numerator and the denominator.

Example :

Find the square of $\frac{1}{3}$.

Reduce the fraction to its lowest terms by dividing the numerator and denominator by 3. We have $\frac{1}{3}$.

To find the square of $\frac{1}{3}$, find the square of the numerator and denominator, *i.e.* $\frac{1^2}{3^2}$.

In the same way to find the third or fourth powers of a fraction, find the third and fourth powers of each of the terms of the fraction.

The cube of $\frac{2}{7}$ is $\frac{8}{343}$.

The fourth power of $\frac{1}{2}$ is $\frac{1}{16}$.

EXERCISE

1. Find the square of the following :

$$\frac{1}{2}, \frac{3}{4}, \frac{5}{8}, \frac{7}{8}, \frac{2}{5}, \frac{9}{12}, \frac{35}{12}$$

2. Find the cube or the third power of the following :

$$\frac{2}{3}, \frac{6}{15}, \frac{3}{5}, \frac{1}{3}$$

3. Find the fourth power of the following :

$$\frac{1}{2}, \frac{1}{3}, \frac{2}{7}, \frac{3}{8}$$

EXERCISE

Find the value of the following :

- | | | | |
|------------------------|------------------------|-----------------------|------------------------|
| 1. $4^3 \times 5^2$ | 2. $5^3 \times 2^2$ | 3. $25^2 \times 10^3$ | 4. $4^3 \times 6^2$ |
| 5. $9^2 \times 3^3$ | 6. $15^3 \div 5^2$ | 7. $12^2 \div 6^3$ | 8. $(1.7)^3 \div 17^3$ |
| 9. $37^2 \div (3.7)^2$ | 10. $(2\frac{1}{3})^2$ | | |

EXERCISE

1. Write the squares of the numbers from 13 to 20 inclusive.

2. Find the cubes of the odd numbers from 7 to 15 inclusive.

3. What power of a number is obtained by multiplying together the first power, the third power, and the fifth power? Prove by using 2 as the number.

4. When the second power of a number is multiplied by its third power and then by its fifth power, what is the power of the product? Prove your answer by using 3 as the number.

5. Of what number is 509 one of the two equal factors?

6. Of what number is 3007 one of the two equal factors?

7. Find the number of which one of the three equal factors is 0.7.

8. Find the number of which one of the four equal factors is 0.3.

9. A rectangular field is 54 rods long and 36 rods wide. Find the area of a square field which has the same perimeter as this field.

10. When the seventh power of a number is divided by its fourth power, what power of that number is the quotient? Prove your answer by using the number 2.

Square Root

Introductory.

1. What is the *second power* of 5? of 9? of 12?
2. What number multiplied by itself will give as product :
36? 81? 25? 64? 121?
3. Find the number whose *second power* is 16? 49?
144? 169?

4. Find the *two equal factors* of each of the following :
9, 25, 49, 225, 100.

One of the two equal factors of a number is called the square root of the number.

4 is the square root of 16 ; 9 is the square root of 81.

The *Square Root* of a number is indicated by the sign $\sqrt{\quad}$, placed over the number, the square root of which is to be found.

Example: $\sqrt{64}$ means the square root of 64.

EXERCISE

1. What is the square root of each of the following :
144? 625? 169? 121? 64?
2. Square any whole number or integer of one digit. Examine the product and find the number of figures or digits in the square of a number of one digit.
3. Square several numbers of two digits. Examine the product and find the number of figures or digits in the square of a number of two digits.
4. Square several numbers of three digits. Examine the product and find the number of figures or digits in the square of a number of three digits.
5. The square of a number is 82,369. How many figures or digits are there in the number?
6. How many digits or figures are there in the square root of each of the following numbers :
841? 2304? 9801? 88,804? 6889? 776,161?

7. How many figures are there in the square root of the following numbers :

- a. A number of 3 digits?
- b. A number of 6 digits?
- c. A number of 7 digits?
- d. A number of 4 digits?

8. There are 3 figures in the square root of a number. How many figures are there in the number?

9. There are 4 figures in the square root of a number. How many figures are there in the number?

10. Make a general rule showing the relation between the number of figures in any number and the number of figures in its square root.

Rule. — The number of figures or digits in the square root of a number is the same as the number of periods of two figures or digits each, into which the number can be separated, beginning with the units and marking off periods of two digits each to the left. The last place or period on the left may contain only one figure or digit.

To find the square root of a number by factoring :

Examples: $6 \times 6 = 36$. Then $\sqrt{36} = \sqrt{6 \times 6} = 6$.

Find by factoring, the square root of 400.

The prime factors of 400 are $2 \times 2 \times 2 \times 2 \times 5 \times 5$.

We arrange these in two groups with the same factors in each group, thus: $(2 \times 2 \times 5) \times (2 \times 2 \times 5)$.

Hence the square root of 400 is the same as the square root of $(2 \times 2 \times 5) \times (2 \times 2 \times 5)$ which is $2 \times 2 \times 5$, or 20.

$$\sqrt{400} = 20.$$

EXERCISE

Find by factoring, the square root of the following :

	a	b	c	d	e	f	g	h	i	j
1.	100	81	225	729	361	289	576	625	1296	441

To find the square root of a number.

Introductory.

1. Examine the following method of finding the square or second power of 25.

$$\begin{aligned}
 25 &= 20 + 5 \\
 \underline{25} &= \underline{20 + 5} \\
 125 &= 20 \times 5 + 5^2 \\
 \underline{500} &= \underline{20^2 + 20 \times 5} \\
 625 &= 20^2 + 2 \times 20 \times 5 + 5^2 \\
 &= 20^2 + (2 \times 20 + 5) \times 5
 \end{aligned}$$

2. Find the square of 43 in a similar way and examine the result.

3. Find the square of 56 in a similar way and examine the result.

4. How do we find the square of a number, made up of a number of tens and units?

5. Write down the square or second power of $(40 + 7)$.

6. Find the square root of 2025.

METHOD

$$\begin{array}{r}
 45 \\
 \hline
 20,25 \\
 16 \\
 \hline
 85 \quad 425 \\
 \hline
 425
 \end{array}$$

(1) Beginning with the units, separate the number 2025 into periods of two digits in each.

(2) What is the greatest square equal to or less than the left-hand period? We see the greatest square is 16. Take the square root of this which is 4, for the first figure in the square root. Subtract the square of this from the left-hand period.

(3) To the remainder 4, annex the two digits of the next period, making 425.

(4) Multiply the first figure of the square root by 2, which gives as a trial divisor, 8 tens.

(5) We have in the dividend 42 tens and 5 units to be divided by 8 tens as trial divisor. The quotient is 5. This should be written in the root for the second figure or digit of the square root. It should also be written along with the trial divisor of 8 tens, making the complete divisor 85.

(6) Multiply the complete divisor, 85, by the last figure or digit of the root 5, and subtract the product from the dividend.

7. Find the square root of 4,124,961.

$$\begin{array}{r}
 2 \quad 0 \quad 3 \quad 1 \\
 \hline
 4, \quad 12, \quad 49, \quad 61, \\
 4 \\
 \hline
 403 \quad | \quad 12 \quad 49 \\
 \quad \quad | \quad 12 \quad 09 \\
 \hline
 4061 \quad | \quad 40 \quad 61 \\
 \quad \quad | \quad 40 \quad 61 \\
 \hline
 \end{array}$$

$$\sqrt{4124961} = 2031.$$

8. Find the square root of 225.47856.

$$\begin{array}{r}
 1 \quad 5 \quad . \quad 0 \quad 1 \quad 5 \\
 \hline
 2, \quad 25 \quad . \quad 47, \quad 85, \quad 60 \\
 1 \\
 \hline
 25 \quad | \quad 1 \quad 25 \\
 \quad \quad | \quad 1 \quad 25 \\
 \hline
 3001 \quad | \quad .4785 \\
 \quad \quad | \quad 3001 \\
 \hline
 30025 \quad | \quad 178460 \\
 \quad \quad | \quad 150125 \\
 \hline
 \quad \quad | \quad 28335
 \end{array}$$

$$\sqrt{225.47856} = 15.015.$$

In finding the square root of a number containing a decimal, beginning with the decimal point, mark off the integral part into periods with two digits, and in the same way, beginning with the decimal point, mark off the decimal part into periods containing two digits. Zeros may be annexed at the end of the decimal part.

Proceed as in the former examples.

Note. — Where a number is not a perfect square, it is not necessary to continue the work beyond the second or third decimal place.

EXERCISE

Find the square root of each of the following :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1.	289	625	361	256
2.	576	1296	5625	729
3.	9025	2401	4096	104976
4.	1369	2209	3136	98596
5.	5184	4225	7225	62500

EXERCISE

Find the square root of the following numbers. Where the number is not a perfect square the work should be carried to *three* places of decimals.

	<i>a</i>	<i>b</i>	<i>c</i>
1.	390625	262144	117649
2.	499849	820836	522729
3.	734449	390625	492804
4.	445.02241	45.1584	3003.04
5.	27.5625	66.2596	345.00

EXERCISE

1. A man has a square field containing 10 acres. Find the length of the fence about the field.

2. A man owns a section of land which is in the form of a square. Find the number of rods of fencing required to fence the farm.

3. A garden is 3 times as long as it is wide. If it contains 1452 square yards, what is the length of the fence required to fence it?

4. A man owns a ranch containing 320 acres. The ranch is twice as long as it is wide. Find the cost of fencing the ranch at 75 cents per rod of fence.

5. A field is 330 feet long and 160 feet wide. What will be the length of a square field which has the same area as this field?

6. A rectangular field is twice as long as it is wide. If the field contains 7.2 acres, find the cost of fencing the field at 17 cents a yard.

7. What is one of the equal factors of 2,137,444?

8. A public hall contains 2646 square feet of floor space. Its length is $1\frac{1}{2}$ times its width. If the height of the hall is 15 feet, find the cost of painting the walls and ceiling of the hall at thirty-five cents per square yard.

CHAPTER IX

MENSURATION

Lines and Angles

Introductory.

Examine the following lines :



What differences are noticeable?

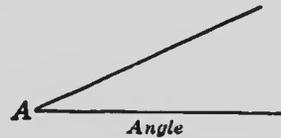
Line *A* is a straight line.

Line *B* is a curved line.

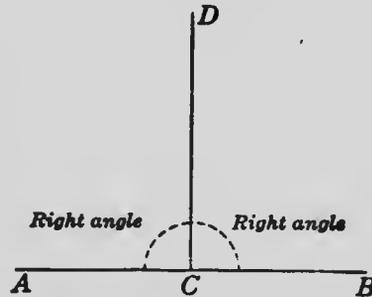
Line *C* is a broken line.

Draw two straight lines that meet at a point but are not in the same straight line.

The difference in direction of two straight lines that meet at a point is called an *Angle*.

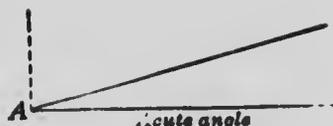


An angle formed when one straight line meets another straight line so as to make the adjacent angles equal is called a *Right Angle*.

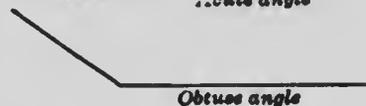


The lines *AB* and *CD* forming the right angles are said to be *Perpendicular* to each other.

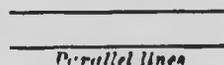
An angle less than a right angle is called an *Acute Angle*.



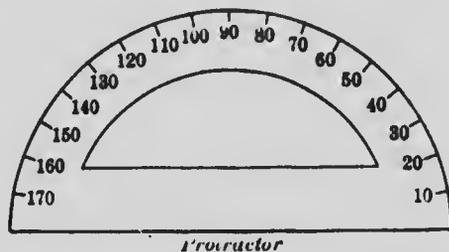
An angle greater than a right angle is called an *Obtuse Angle*.



Parallel Lines are lines which have the same direction and are equally distant at all points.



Draw this figure on cardboard and cut it out. It is called a *Protractor*. Measure an angle of 60° ; of 90° ; of 75° ; of 120° ; of 10° ; of 45° .



Draw two lines, one due east, and from one end of this line another due north. What kind of an angle do they form? How many degrees are there in this angle?

Quadrilaterals

A *Plane Surface* or plane figure is a surface such that a straight line joining any two points on it lies wholly in that surface. If a straight edge is placed in any direction on a plane surface, all parts of the straight edge will touch the plane surface. A plane surface has two dimensions, length and breadth.

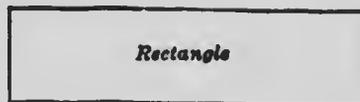
A *Quadrilateral* is a plane figure having four straight sides.



A *Parallelogram* is a quadrilateral whose opposite sides are parallel.



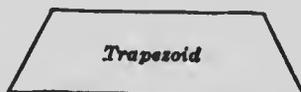
A *Rectangle* is a parallelogram whose angles are all right angles.



A *Square* is a rectangle whose sides are equal.



A *Trapezoid* is a quadrilateral having only two sides parallel.



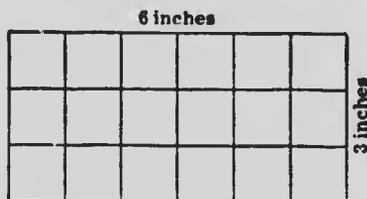
Any straight line drawn perpendicular to and joining the parallel sides of a parallelogram or trapezoid is called the *Altitude*.

The straight line joining the opposite corners of a quadrilateral is called the *Diagonal*.

Rectangle

The rectangle is the only plane figure whose area may be directly found by applying the unit of measure (a square) and then counting the number of times it is applied.

To find the area of a rectangle 6 in. long and 3 in. wide. The square unit used in finding the area is a square whose sides are one inch long.



 The square unit
or square inch

How many square units are there in one row?

How many square units are there in the three rows?

How many square inches are there in the three rows?

What is the area of the rectangle?

$$\text{Area} = 6 \times 3 \times 1 \text{ square inch} = 18 \text{ square inches.}$$

EXERCISE

1. Show by a drawing that a rectangle 7 in. long and 4 in. wide contains 28 sq. in.
2. Draw a rectangle 5 in. long containing 20 sq. in. How wide is the rectangle?
3. Show that a rectangle containing 72 sq. in. and 9 in. long is 8 in. wide.

ORAL EXERCISES

1. Find the area of the floor of a room 15 feet long and 8 feet wide.
2. A book is 14 inches long and 6 inches wide. Find the area of the cover.
3. The area of a flower bed is 112 square feet. The bed is 8 feet wide. What is its length?
4. A garden contains 2400 square feet. If the garden is 60 feet long, what is its width?

EXERCISE

1. How much more floor surface has a room 16 ft. long and 12 ft. wide than a room 18 ft. long and 9 ft. wide?
2. A city lot with a frontage of 50 ft. and a depth of 120 ft. is valued at \$30 per foot frontage. What is the value of the lot per square foot?
3. Find the cost of building a cement sidewalk 8 ft. wide and 30 rd. long at 90¢ per square yard.
4. A contractor lays a sidewalk 8 ft. wide on both sides of a street one-quarter of a mile long. The 2 in. plank used is supported by three continuous lines of scantling 4 in. by 4 in. Find the cost of the lumber at \$30 per M.
5. Trees are planted 12 ft. apart around the sides of a rectangular field 40 rd. long and containing 2 acres. Find the number of trees required.

6. How many blocks 12 in. by 18 in. will be required to pave a street $\frac{1}{8}$ mi. long and 45 ft. wide?
7. A farmer estimates 9.75 tons of green feed to the acre from a field of oats. If the field is 40 rd. long and 32 rd. wide, how many tons does he expect?
8. A farmer sows 12 oz. of wheat to a sq. rd. of his farm. How many bushels will he require to seed a section?
9. A field whose length is four times its width contains 10 acres. Find its dimensions.
10. A map is drawn to the scale of $\frac{1}{2}$ inch to a mile. How many acres are represented by a square inch on the map?
11. At 45¢ per rod it costs \$79.20 to fence a rectangular field. The field is 220 yd. wide. Find its area expressed in acres.

EXERCISE

1. A room is twice as long as it is wide, and its floor area is $76\frac{1}{8}$ sq. yd. Find its length and width.
2. At 30¢ per roll of 8 yd., what will be the cost of paper for the walls and ceiling of a room, the paper being 18 in. wide, the room being 24 ft. long, 21 ft. wide, and 12 ft. high, and no deductions being allowed for openings?
3. A railing encloses a rectangular field of 15 A. The length of the field is to its breadth as 3 to 2. Find the length of the railing.
4. In what time would a field 80 rd. \times 60 rd. pay for underdraining lengthwise at 2¢ per foot, if the field yields 2 bu. at 66¢ per acre more than before draining? The drains are 4 rd. apart, and the first drain runs down the centre of the field.
5. I bought a bush farm 180 rd. long by 96 rd. wide at \$12.50 per acre. I paid \$14.75 per acre for clearing and

\$1.35 per rod for enclosing the whole farm with wire fencing. Taking into account that I sold the wood for \$1160, how much has the improved farm cost me per acre?

6. A map measures 4 ft. 6 in. by 3 ft. 3 in. and is drawn on the scale of $\frac{1}{4}$ in. to a mile. How many acres does the map represent?

7. On a map drawn to the scale of $\frac{1}{4}$ in. to a mile, a township measures $3\frac{1}{4}$ in. long by $1\frac{1}{4}$ in. wide. How many acres are there in it?

8. A four-foot sidewalk of 2-in. planks is to be laid round a square field containing 10 A. The inner edge of the sidewalk is to be two feet out from the boundary of the field. Find the cost of the planking in the sidewalk at \$15 per M.

9. Find the cost of fencing a square lot containing $2\frac{1}{4}$ A. with wire fencing five wires high at 2¢ per foot.

10. Find the cost of covering the floor of a hall $54\frac{1}{2}$ ft. long and 16 ft. 8 in. wide with linoleum at \$.96 per square yard.

The Parallelogram

Cut from paper or cardboard a parallelogram of some convenient size. Fig. 1.

Draw a perpendicular from C to AB . CR is the altitude of the parallelogram.

Cut off the shaded part CRB and place it in the position ADS .

The plane figure $DSRC$ is made up of the same parts as the original par-

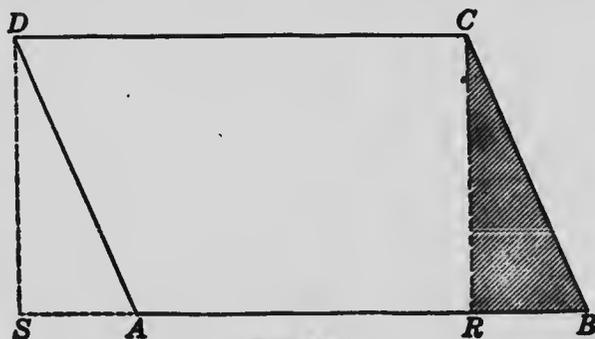


FIGURE 1

allelogram $ABCD$. Compare the areas of these two plane figures. What name do you give to the plane figure $DSRC$? Name its base. Compare the length of its base with that of the parallelogram. Compare its altitude with that of the parallelogram. How do you find its area?

The area of a parallelogram is equal to that of a rectangle whose length is equal to the base of the parallelogram and whose width is the altitude of the parallelogram. Hence the number of square units in the area of a parallelogram is the product of the number of units of length in its base, and the number of units of length in its altitude.

EXERCISE

1. Find the area of the following parallelograms :
 - (a) Base, 3 ft. 4 in., altitude, 2 ft. 6 in.
 - (b) Base, 24 ch. 61 links., altitude, 16 ch. 25 links.
 - (c) Base, 40 rd. 4 yd., altitude, 24 rd. 5 yd.

2. A strip of land in the form of a parallelogram is 80 rd. long and 36 rd. wide. Find its area expressed in acres.

3. How many rectangles, each having a base 12 ft. long, and an altitude of 8 ft., would be required to have the same area as a parallelogram 48 ft. long with an altitude of 12 ft.?

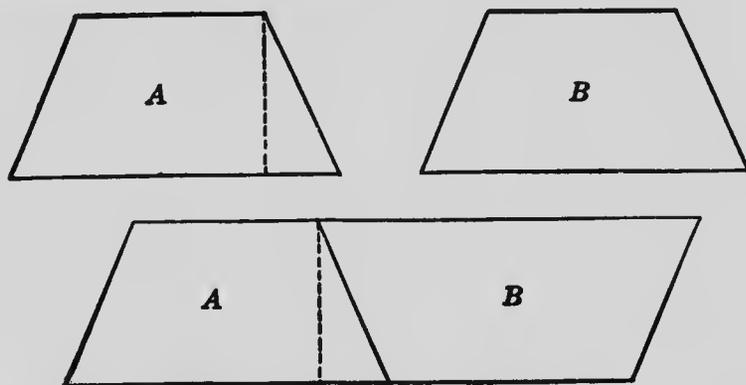
4. The area of a parallelogram is 576 sq. ft., and its altitude is 18 ft. Find its length.

5. The base of a parallelogram is 27 in., and its area is 3 sq. ft. Find its altitude.

The Trapezoid

Cut out of paper two trapezoids *A* and *B* of convenient size and exactly alike.

Place them end to end as in figure formed by *A* and *B*. Of what form is this figure?



It is evident that the length of the base of this parallelogram is equal to the sum of the lengths of the two parallel sides of the trapezoid, and its altitude is equal to the altitude of the trapezoid. Its area is also equal to twice the area of the trapezoid.

Hence, the number of square units in the area of a trapezoid is equal to one-half of the product of the sum of the linear units in its parallel sides and the number of linear units in its altitude.

EXERCISE

1. Find the area of a trapezoid whose parallel sides are 10 in. and 12 in. in length and whose altitude is 8 in.
2. A field is in the form of a trapezoid. The parallel sides are 85 rd. and 75 rd. long, and the width of the field is 60 rd. How many acres are there in the field?

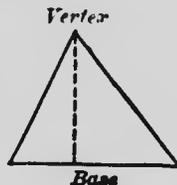
3. A 2 in. plank 18 ft. long is 10 in. wide at one end and 12 in. wide at the other. How many board feet are there in this plank?

4. The city bought a plot of land in the form of a trapezoid for a public playground. The parallel sides of this plot are 360 ft. and 420 ft. long, and its width is 242 ft. Find the cost of this plot of land at \$450 per acre.

Triangles

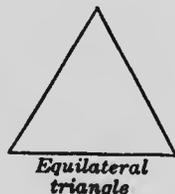
A *Triangle* is a plane figure having three straight sides and three angles.

The side on which the triangle stands is the *Base*, and the opposite corner, the *Vertex*.



The perpendicular dropped from the vertex on the base is the *Altitude*.

A triangle that has three equal sides is called an *Equilateral Triangle*.



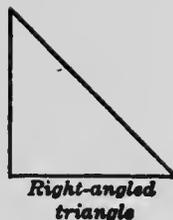
A triangle that has two equal sides is called an *Isosceles Triangle*.



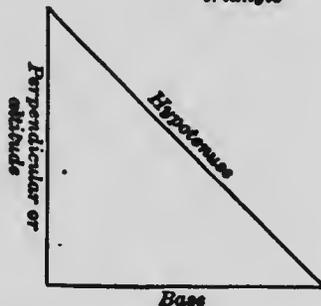
A triangle having no two sides equal is called a *Scalene Triangle*.



A triangle having one of its angles a right angle is called a *Right-angled Triangle*.



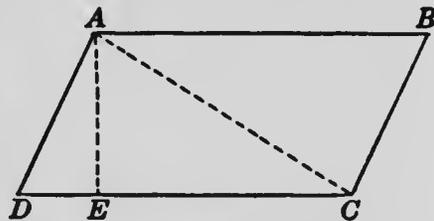
The side opposite the right angle is called the *Hypotenuse* and the other sides, the *Base* and the *Perpendicular*.



Triangles are also classified as *Acute-angled* or *Obtuse-angled*, depending upon the size of the largest angle.

To find the area of a triangle

Draw a parallelogram $ABCD$. Mark the diagonal AC . Into how many triangles does AC divide the parallelogram? Mark the altitude AE of the parallelogram. Divide the parallelogram into two triangles by cutting along the line AC . Apply one triangle to the other. Are their areas equal?



What part of the parallelogram is the triangle ADC ?

The area of the parallelogram is $DC \times AE$; the area of the triangle ADC is $\frac{1}{2} DC \times AE$.

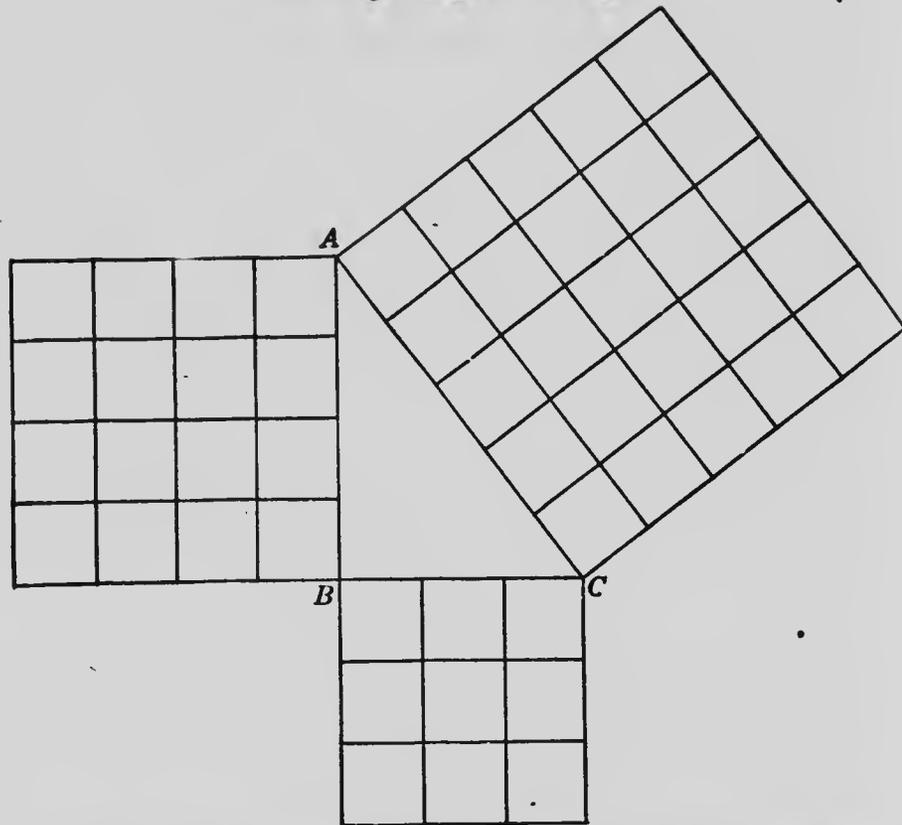
Hence the area of the triangle is one-half the product of the number of linear units in its base and the number of linear units in its altitude.

Show how to find the area of a right-angled triangle.

EXERCISE

1. Find the area of a triangle whose base is 14 in. and altitude 9 in.
2. The length of one side of a triangular field is 72 rd., and the perpendicular distance from this side to the opposite corner is 40 rd. How many acres does this field contain?
3. The area of a triangle is 72 sq. in. The altitude is 16 in. Find the length of the base.
4. A triangular field contains 10 acres. The base of the field is 64 rd. long. Find its altitude.
5. A rectangle is 16 in. long and 10 in. wide, and a triangle has a base 8 in. long and an altitude of 10 in. How many times greater is the rectangle than the triangle?
6. Find the area of the following right-angled triangles :
 - (a) Base $6\frac{1}{2}$ yd., perpendicular side 13 yd.
 - (b) Base 10 yd. 2 ft., perpendicular side 10 yd. 2 ft.
 - (c) Base 3 chains, perpendicular side 40 yd. 1 ft.
7. Find the perpendicular or base of the following right-angled triangles :
 - (a) Area 195 sq. ft., base 26 ft.
 - (b) Area $2\frac{1}{2}$ acres, perpendicular 110 yds.
 - (c) Area $76\frac{1}{2}$ acres, perpendicular 7200 links.

The Right-angled Triangle



Construct a right-angled triangle having the base BC 3 in. long and the perpendicular side AB 4 in. long. On the base, on the perpendicular, and on the hypotenuse of this triangle construct squares. Measure the length of the hypotenuse. Divide these squares into units of one square inch. Count the number of unit squares in each of the large squares. Compare the number of unit squares on the hypotenuse with the sum of the unit squares on the base and the perpendicular. How does the area of the square on the hypotenuse compare with the sum of the areas of the squares on the other two sides?

The area of the square on the hypotenuse of a right-angled triangle is equal to the sum of the areas of the squares on the other two sides. -

EXERCISE

1. Draw right-angled triangles with the following dimensions :

- (a) Base 6 in., perpendicular 8 in.
- (b) Base 12 in., perpendicular 5 in.
- (c) Base 9 in., perpendicular 12 in.

Measure the length of the hypotenuse in each case.

What is the area of the square on the hypotenuse in each case?

Compare the area of the square on the hypotenuse with the sum of the areas of the squares on the other two sides in Exs. (a), (b), (c).

Given the length of any two sides of right-angled triangle, to find the length of the third side :

Example: The perpendicular is 6 in. and the base 8 in. in length, to find the length of the hypotenuse.

$$\begin{aligned} \text{Area of square on perpendicular} &= 36 \text{ sq. in.} \\ \text{Area of square on base} &= 64 \text{ sq. in.} \\ \therefore \text{area of square on hypotenuse} &= \underline{100} \text{ sq. in.} \\ \therefore \text{the length of hypotenuse} &= \sqrt{100} \text{ in.} \\ &= 10 \text{ in.} \end{aligned}$$

Example: The base is 12 in. and the hypotenuse is 13 in. in length, to find the length of the perpendicular.

$$\begin{aligned} \text{Area of square on hypotenuse} &= 169 \text{ sq. in.} \\ \text{Area of square on base} &= \underline{144} \text{ sq. in.} \\ \therefore \text{area of square on perpendicular} &= \underline{25} \text{ sq. in.} \\ \therefore \text{length of perpendicular} &= \sqrt{25} \text{ in.} \\ &= 5 \text{ in.} \end{aligned}$$

EXERCISE

Find the hypotenuse of each of the following right-angled triangles, whose base and perpendicular are, respectively :

1. 35 ft. and 12 ft.
2. 31 ft. 6 in. and 56 ft. 8 in.
3. 408 ft. and 506 ft.

Find the base of each of the following right-angled triangles, whose perpendicular and hypotenuse are :

4. 36 in. and 85 in.
5. 117 ft. and 125 ft.
6. 24 chains and 74 chains.
7. 1 ft. 2 in. and 4 ft. 2 in.

Find the perpendicular of the following right-angled triangles, whose base and hypotenuse are, respectively :

8. 56 yd. and 394 yd.
9. 2 rd. and 3 rd. 5 yd. 6 in.
10. 1 chain 40 links and 5 chains.
11. Find the area of the following figure :

$$AC = 1.26 \text{ in.}$$

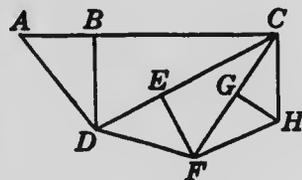
$$CD = .95 \text{ in.}$$

$$CF = .71 \text{ in.}$$

$$BD = .55 \text{ in.}$$

$$EF = .4 \text{ in.}$$

$$GH = .21 \text{ in.}$$



EXERCISE

1. If the gable end of a house 64 ft. wide is 24 ft. high, what is the length of the rafters?
2. Find the width of a house whose rafters are 12 ft. and 16 ft., respectively, and form a right angle where they meet.
3. A ladder 85 ft. long stands close against a building. How far must it be drawn out at the foot that the top may be lowered 1 ft.?

4. A tree was broken 51 ft. from the top and fell so that the end struck 24 ft. from the foot. What was the length of the tree?

5. A owns a rectangular lot 168 ft. by 95 ft. What is the distance through it from opposite corners?

6. A rope 190 ft. long will reach from the top of a pole to a point on the opposite bank of a river whose width is 152 ft. Find the height of the pole.

7. A ladder 34 ft. long stands upright against a wall. If it is pulled out 16 ft. at the bottom, how far will the top be lowered?

8. Two towers 94 ft. and 78 ft. high are on opposite banks of a stream 30 ft. broad. What is the length of the shortest line connecting the tops of the towers?

9. A field in the form of a right-angled triangle has a base of 720 feet and a hypotenuse of 962 ft. Find the cost of fencing it at 21¢ per foot.

10. What is the shortest distance between the lower corner and the upper opposite corner of a room 60 ft. long, 32 ft. wide, and 51 ft. high?

11. What is the length of the longest straight rod which, without bending, can be put into a box 5 ft. long, 1 yd. wide, and $\frac{1}{4}$ yd. deep?

The Circle

With a pair of compasses, or a pencil and string, describe a circle.

Point out the centre, the radius, the diameter, the circumference.

What relation does the radius bear to the diameter?

Every point in the circumference is at what distance from the centre?

A plane figure bounded by a curved line such that every point in this curved line (the circumference) is at the same distance from the centre, is a circle.

Procure a round ruler 1 in. in diameter and find what length of string will just reach round it.

Measure a cylinder 7 in. in diameter to find what length of string will just reach round it.

Measure the circumference and diameter of a stove pipe and compare the length of the circumference with that of the diameter.

It is found that the circumference of a circle divided by the diameter = 3.1416, which is usually denoted by the Greek letter π . For practical purposes $\pi = 3\frac{1}{2}$.

EXERCISE

Find the circumferences of circles whose diameters are :

- | | | |
|----------------|-----------------------|-----------------------|
| 1. 35 ft. | 4. 1 rd. 5 yd. | 7. 20 ft. |
| 2. 91 chains. | 5. 3 chains 50 links. | 8. 4 chains 76 links. |
| 3. 4 yd. 2 ft. | 6. 7 chains 84 links. | 9. 5 yd. 1 ft. 4 in. |

Find the diameter of circles whose circumferences are :

- | | | |
|------------------|--------------|------------------------|
| 10. 44 in. | 13. 264 in. | 16. 64 rd. |
| 11. 10 ft. 1 in. | 14. 3520 ft. | 17. 5 chains 39 links. |
| 12. 3 yd. 2 in. | 15. 15.4 mi. | 18. 73 yd. 1 ft. |

19. The radius of a circle is 24 in. Find its circumference.

20. A wire may be so bent as to enclose a square whose area is 484 sq. in. If this wire were bent into the form of a circle, what would be its radius?

21. The radius of a fountain is 21 ft. Find the cost of enclosing it with an iron railing at \$3.60 per yard.

22. A locomotive is travelling at the rate of 60 mi. per hour, and the diameter of its driving wheel is 3 ft. 6 in. How many times does it turn in a second?

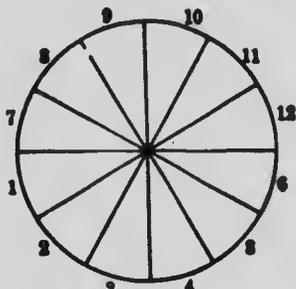


FIGURE 2

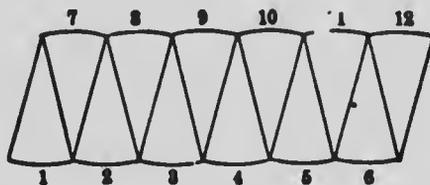


FIGURE 3

From a piece of leather or tough paper make a circle and divide it into triangles as in Fig. 2. Change the circle into the form of Fig. 3. Into what shape, nearly, has the circle been changed?

If the circle had been cut into twice as many equal parts and arranged as in Fig. 3, it would still more nearly resemble the shape of what figure?

What is the length of Fig. 3 in terms of the circumference?

What is the width of the figure in terms of the radius?

Compare the area of Fig. 3, with that of the circle in Fig. 2.

The area of a circle is the same as that of a rectangle having a base equal to one-half the circumference and altitude equal to the radius.

Hence, the number of square units in the area of a circle is equal to one-half the product of the number of linear units in its circumference and the number of linear units in its radius.

If Fig. 3 is 22 in. long and 7 in. wide, what is its area?

What is the area of a circle 7 in. in radius?

What is the area of a circle 14 in. in radius?

EXERCISE

Find the area of circles with the following diameters :

- | | | |
|-----------|------------|---------------|
| 1. 84 in. | 3. 525 ft. | 5. 483 links. |
| 2. 98 yd. | 4. 133 ft. | 6. 126 ft. |

Find the area of circles with the following circumferences :

- | | | |
|-----------------|------------|----------------|
| 7. 77 in. | 9. 220 yd. | 11. 473 links. |
| 8. 90.2 chains. | 10. 3 rd. | 12. 1 mi. |

Find the area of circles with the following radii :

- | | | |
|-----------------|---------------|-----------------|
| 13. 3 ft. 6 in. | 15. 7 chains. | 17. 1 rd. 5 yd. |
| 14. 7 ft. 7 in. | 16. 1.75 rd. | 18. 35 chains. |

EXERCISE

1. How many square yards of cement would be required to cover a circular hall, 45 ft. in diameter ?

2. The circumference of a race track is 1 mi. What is its area ?

3. How many feet of iron must a blacksmith buy for the tires of 12 wheels 4 ft. in diameter ?

4. What space would the driving wheel of a locomotive 5 ft. 3 in. in diameter pass over in making 25 revolutions ?

5. Find the radius of a circle equal in area to the sum of three circles whose radii are 8 in., 9 in., and 12 in.

6. A circular lawn, 220 yd. in diameter, is surrounded by a gravel path 12 ft. wide. Find the cost of making the path at 36¢ per square yard.

7. Two circles, the radii of which are $3\frac{1}{2}$ in., are placed upon one whose diameter is 14 in. Find the area of the surface not covered.

8. The diameter of a circle is 126 in. Find the length of an arc of 50° ; of 65° ; of 80° ; of 90° .

9. A circular lawn contains $2\frac{1}{2}$ A. Find its radius.
10. A circle 5 ft. 2 in. in diameter has another 2 ft. 4 in. in radius inscribed within it. Find the area of the part of the large circle without the smaller one.
11. The diagonal of a square is $5\frac{1}{2}$ ft. Find the circumference of a circle circumscribed about the square.

Rectangular Solids

Fig. A is a rectangular solid of which $abcd$ is its upper surface. As in rectangle, page 235, lines are drawn dividing the side into equal squares. The number of cubic units of

measure which can be placed on the line bc corresponds to the number of linear units of measure in that line; and the number that can be placed on the surface $abcd$ is the number on bc multiplied by the number of linear units

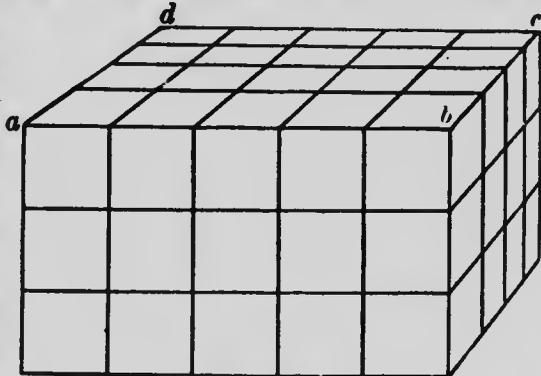


FIGURE A

of measure in the adjacent side ab . If the number of cubic units of measure on $abcd$ be multiplied by the number of linear units of measure corresponding to the height of the solid, the product will evidently be the number of cubic units of measure in the whole solid.

Hence, to find the number of cubic units of measure in a rectangular solid, multiply the number of linear units of measure that can be placed on a line called the breadth, by the number of linear units of measure in the length, and this product by the number of linear units of measure in the height.

EXERCISE

1. Find (a) the surface area and (b) the volume of a cube whose edge is $4\frac{1}{2}$ in. long.

Find (a) the surface area and (b) the volume of the following covered boxes :

2. Length 6 ft., width $2\frac{1}{2}$ ft., depth $3\frac{1}{2}$ ft.

3. Length 9 in., width $4\frac{1}{2}$ in., depth $2\frac{1}{2}$ in.

4. How many 2-in. cubes will be required to build a cube with an edge 12 in. long?

5. How much does the surface area of the small cubes in Question 4 exceed that of the large one?

6. A schoolroom 34 ft. by 25 ft. is intended to accommodate 50 pupils. What must be its height to allow 250 cu. ft. of air-space for each pupil?

7. Find the volume of a cube, the area of whose entire surface is 7 sq. ft., 6 sq. in.

8. A piece of copper 1 ft. long, 9 in. wide and $\frac{3}{8}$ in. thick is rolled into a plate 6 ft. long and 4 ft. wide. How thick will the plate be?

9. A log of square timber is 18 ft. long, 18 in. broad, and 15 in. thick. If $2\frac{1}{2}$ solid feet are cut off the end of it, what length is left?

10. A cistern is partly full of water and has 250 gal. in it. If the length of the cistern be $6\frac{1}{2}$ ft. and the breadth $3\frac{1}{2}$ ft., find the depth of the water.

11. A cistern is $12\frac{1}{2}$ ft. long and 8 ft. wide. If, when it is full of water, 1500 gal. are drawn off, how much will the surface of the water sink?

EXERCISE

1. A rectangular room 15 ft. high, whose length is one-half more than its width, contains 12,960 cu. ft. of air space. Find its length.

2. A rectangular tank holds $12\frac{1}{2}$ T. of water. If it is 16 ft. long and 4 ft. wide, how deep is it, supposing 1 cu. ft. of water to weigh 1000 oz.?

3. A closed tank made of plank 2 in. thick, is 10 ft. long, 4 ft. wide, and 5 ft. 4 in. deep, external measurement. How many gallons of water will it hold, a gallon of water being $\frac{4}{15}$ of a cubic foot?

4. The surface area of a rectangular solid 1 ft. 3 in. long and 14 in. wide is 1000 sq. in. Find its depth.

5. A brick with mortar occupies a space 9 in. long, $4\frac{1}{2}$ in. wide, and 3 in. deep. How many bricks will be required for a wall 90 ft. long, $13\frac{1}{4}$ in. thick, and 6 ft. high?

6. A rectangular block of wood measures 20 ft. by 1 ft. 10 in. by 1 ft. 3 in. What length must be cut off it to contain 11 cu. ft.?

7. A rectangular cistern 8 ft. long and $6\frac{1}{4}$ ft. wide is full of water. How much will the water sink when 1000 gal. are drawn off?

8. It costs \$584.50 to excavate the basement of a rectangular building $125\frac{1}{4}$ ft. long and 28 ft. wide, at 25¢ per cubic yard. How deep is the excavation?

9. A cubic foot of copper is rolled into a sheet 48 ft. long and 4 ft. wide. How thick is the sheet?

10. A rectangular cistern 4 ft. long and $3\frac{1}{2}$ ft. wide has 500 gal. of water in it. How deep is the water?

11. A cubic foot of swamp oak weighs 43 lb. Find the weight of 15 planks, each 24 ft. long, 14 in. wide, and 3 in. thick.

12. Water in freezing expands 10%. How many loads of ice of 2 tons each will be required to fill an ice house 44 ft. long, 40 ft. wide, to a height of 20 ft., assuming that a cubic foot of water weighs 1000 oz.?

The Cylinder

1. Examine a cylinder.
 - (a) How many parts are there in its surface?
 - (b) What is the shape of each end face?
 - (c) Compare the areas of the end faces.
 - (d) Imagine a straight line joining the centres of the two end faces; at what distance from this line is every part of the curved face?
2. Describe a cylinder.
3. (a) Fit a sheet of paper over the curved face of a cylinder.
 - (b) Examine the shape of this sheet.
 - (c) Compare the area of the sheet with the area of the curved face.
 - (d) State the dimensions of the sheet of paper in terms of the dimensions of the cylinder.
 - (e) How is the area of the sheet of paper found?
 - (f) How is the area of the curved face of a cylinder found?
4. (a) A cylinder is 7 in. in radius and 12 in. long. Find the area of its surface.
 - (b) What is the area of one end? Of the two ends?
 - (c) What is the length of the circumference of the cylinder?
 - (d) What is the area of the curved face?
 - (e) What is the area of the entire surface?



EXERCISE

Find the surface of each of the cylinders whose diameter and height are, respectively :

- | | |
|----------------------------------|--------------------------|
| 1. 42 in. and 40 in. | 4. 126 in. and 20 ft. |
| 2. $3\frac{1}{2}$ in. and 10 in. | 5. 21 ft. and 4 ft. |
| 3. 14 ft. and 5 ft. | 6. 8 ft. 2 in. and 4 ft. |

Find the volume of each of the cylinders whose diameter and height are, respectively :

- | | |
|----------------------------------|------------------------|
| 7. 14 in. and 1 ft. | 10. 14 ft. and 5 ft. |
| 8. 42 in. and $3\frac{1}{2}$ ft. | 11. 21 ft. and 6 ft. |
| 9. 3 ft. 6 in. and 15 in. | 12. 105 in. and 16 ft. |

Find the diameter of each of the cylinders whose solid content and height are, respectively :

- | | |
|-----------------------------|-----------------------------------------|
| 13. 308 cu. in. and 8 in. | 16. $115\frac{1}{2}$ cu. ft. and 12 ft. |
| 14. 1331 cu. in. and 14 in. | 17. 2079 cu. ft. and 24 ft. |
| 15. 385 cu. ft. and 10 ft. | 18. $513\frac{1}{2}$ cu. ft. and 40 in. |

EXERCISE

- The area of the curved face of a cylinder is 440 sq. in. It is 5 in. in radius. Find its height.
- A roller is 6 ft. long and 3 ft. 6 in. in diameter. How much ground is rolled in 1000 revolutions?
- How often would the roller in the last example turn in rolling a 10-acre field?
- Find the cost, at 25¢ per square foot, of decorating the curved face of a pillar 21 ft. high and 18 in. in diameter.
- It cost \$31.68 to decorate the curved face of a pillar 21 ft. high at 36¢ per square foot. Find the diameter of the pillar.
- A cylinder of copper 1 ft. high and 7 in. in diameter is rolled out into a plate 8 in. wide and $\frac{1}{8}$ in. thick. How long is the plate?
- The cent is an inch in diameter and $\frac{1}{16}$ in. thick. How many cents can be coined from a cylinder of copper 6 in. in diameter and 1 ft. high?
- Find the cost, at \$1.75 per cubic yard, of sinking a shaft 120 ft. deep and 6 ft. in diameter.

9. If a cubic foot of iron weighs 488 lbs., find the weight of a solid iron pillar 14 ft. long and 9 in. in diameter.
10. How many cubic feet of earth must be taken out in digging a well 30 ft. deep and 6 ft. in diameter?

REVIEW EXERCISE

1. Find the area of a board 5 ft. long, 12 in. wide at one end and 6 in. at the other.
2. Draw on paper a figure with two parallel sides 3 in. and 4 in. long and altitude 2 in. Find its area.
3. If a ton of coal is equal to 36 cu. ft., how many tons can be put into a bin $8\frac{1}{4}$ ft. wide, $8\frac{1}{4}$ ft. deep, and 18 ft. long?
4. Find the volume of a cylindrical column 40 ft. high and 3 ft. in diameter.
5. A circular pond 5 ch. in diameter is covered with ice 8 in. thick. How many cubic feet of ice are there on the pond?
6. An ice dealer stored the ice from 5 A. of a lake. The ice was of an average thickness of 2 ft. Find the weight of the ice, each cubic foot weighing $56\frac{1}{2}$ lbs.
7. Find the cost of slating a roof 50 ft. 6 in. long at \$12.50 a square, each side of the roof being 24 ft. (A square = 100 sq. ft.)
8. A bushel contains 2218.2 cu. in. How many bushels will a bin 8 ft. long, 5 ft. wide, and 6 ft. deep contain?
9. A reservoir in the form of a cylinder is 350 ft. in diameter. How many gallons does it contain when filled to the depth of 20 ft.? (1 cubic ft. = $6\frac{1}{4}$ gal.)
10. The area of a triangle is 250 sq. ft.; its altitude is $6\frac{1}{4}$ ft. Find its base.

11. Find the area of a triangle with two equal sides, each of which is 50 rd. long, and the base 40 rd. long.

12. How far from the bottom of a building 70 ft. high must the foot of a ladder 72 ft. long be placed, so that it may just reach to the top of the building?

13. The sides of a rectangle are to each other as 4 to 3. The diagonal is 55 ft. long. Find its area.

14. Find the side of the largest square that can be inscribed in a circle 10 ft. in diameter.

15. Find the distance from a lower corner to the opposite upper corner of a rectangular room 32 ft. long, 24 ft. wide, and 16 ft. high.

16. At \$2.25 a rod, how much less will it cost to fence a field 80 rd. square than a field of the same area one-fourth longer?

17. A roof is 36 ft. long, and each side is 24 ft. wide. Slates are 16 in. by 12 in. and lap 10 in. How many slates will it take?

18. How many board feet are there in 84 boards, each 7 ft. long and 10 in. wide?

19. Estimate the number of gallons of water in a well $4\frac{1}{2}$ ft. in diameter when the water is 9 ft. deep.

20. A lot was bounded as follows: beginning at the north-east corner the line ran west 40 ft., thence south 75 ft., thence east 100 ft., thence to the north-east corner. Find the cost of sodding this lot at 15¢ per square yard.

21. A room is heated by 350 feet of steam pipe 2 in. in diameter. Find the area of the curved surface which radiates the heat.

22. How many gallons of water are there in a cylindrical tank 35 ft. high and 21 ft. in diameter when the tank is full? (1 cubic ft. = $6\frac{1}{4}$ gal.)

23. The globe in school is 12 in. in diameter. Find the length of the equator and of a degree of latitude at the equator.

24. At 84¢ per sq. yd. it cost \$26.88 to pave a triangular court, the base of which was 32 ft. Find the altitude of the court.

25. The perimeter of a square and the circumference of a circle are each 44 ft. Which has the greater area and by how much?

26. Find the cost of concreting the bottom of a circular fountain 63 ft. in diameter at \$1.50 per square yard.

27. Two vessels sail from the same port. One sails due north at the rate of 13 mi. per hr. and the other due west at the rate of 14 mi. per hr. How far apart are they at the end of 12 hr.?

28. Find the cost of material for a 4-ft. sidewalk 240 feet long of 2-in. plank resting on two rows of 2"×6" scantling, if lumber is worth \$26 per M.

29. The cost of building a sidewalk 120 feet long of 2-inch plank, supported on two lines of 2"×6" scantling at \$25 per M., was \$48. Find the width of the sidewalk.

30. A sidewalk 3 ft. wide of 2-inch plank, supported by two rows of 2"×5" scantling, is built the full length of a block 500 ft. long. How much more would the sidewalk have cost had it been 5 ft. wide, lumber being worth \$28 per M.?

31. How many sq. yds. of oilcloth are needed for a kitchen 15 ft.×21 ft., allowing 5 per cent more than the area for matching?

32. A farmer, who has a section of wheat, makes the first cut around it with a binder having a 5½ ft. cutting-bar.

(a) How long will it take to make the first round, if the horses travel at the rate of 3 miles an hour?

(b) How many acres does he cut the first round?

(c) If four binders, each with a $5\frac{1}{2}$ ft. cutting-bar, are set to work, how many acres remain uncut after each machine has made 18 rounds?

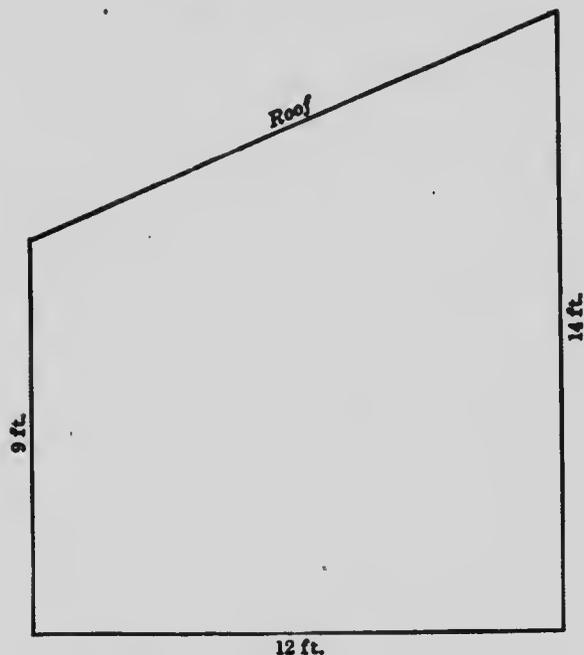
33. Find the cost of laying a granolithic sidewalk 120 ft. long and 4 ft. wide, at 45¢ per sq. yd.

34. Find the cost of cementing the floor of a cellar 18 ft. \times 15 ft., if it requires one cubic yard of gravel at \$1.50 a yard and 2 sacks of cement worth 90¢ a sack for every 3 square yards.

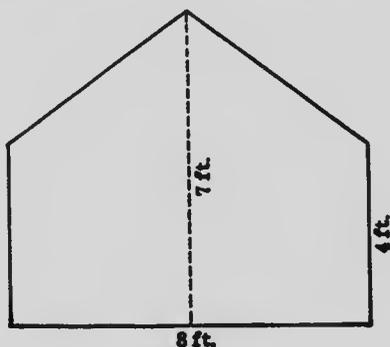
35. In Question 28, had a granolithic walk been laid, what would the cost have been, (a) if the cost of laying it was 5 cents a square foot; (b) if it had cost 24 cents a running foot?

36. A close board fence 4 ft. high is built around a block of land 500 ft. long and 270 ft. wide. The boards are nailed to two lines 2" \times 4" scantling. Posts are placed 10 feet apart and cost 22¢ each. Find the entire cost of the fence, if lumber is worth \$27 per M.

37. A man who owns a corner lot 33 ft. by 132 ft. decides to build a picket fence on the street sides and a close board fence 4 ft. high on the inside of the lot. The posts cost 25 cents each and are placed 8 ft. 3 in. apart. The pickets, $2\frac{1}{2}$ " wide, are placed 2" apart and cost \$4.40 per 100. Two rows of scantling 2" \times 4" support the pickets and the boards. In the case of the picket fence a base board 12" wide is used, while a rain board costing 3 cents a foot is placed below the pickets. If lumber is worth \$27 per M., find the entire cost of the material, allowing \$2.75 for nails.



38. The above figure represents the end of a shed 20 ft. long, and other dimensions as shown. Find the number of feet of inch lumber required to enclose it.

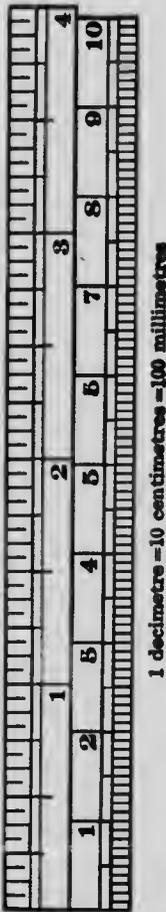


39. The above diagram represents the end of a canvas tent 10 ft. long and other dimensions as shown. Find the number of square feet of canvas required to make this tent.

CHAPTER X

THE METRIC SYSTEM OF WEIGHTS AND MEASURES

1. In 1795, France adopted a system of weights and measures called the *Metric System*, based upon the decimal system of notation, all the divisions and multiples being by 10. It has since been adopted by most of the nations of Europe and is in partial use in Canada and the United States.



2. *Unit of Length.* The metric standard for measurement of distance is the *Metre*, which is 39.37 inches long, or almost 3 ft. 3 $\frac{3}{8}$ in.

From the metre all other measures of this system are derived, hence the name *Metric System*.

The metre was defined by a law of the French Republic to be the distance between the ends of a rod of platinum made by Borda, the temperature being that of melting ice. It was supposed that this rod represented one ten-millionth part of the distance from the earth's equator to the pole. It has since been found that this is not exactly the case, and thus the metric standard is not the terrestrial globe but Borda's platinum rod.

The annexed diagram represents one-tenth of a metre in length and is called *Decimetre*. It is subdivided into ten equal parts, each of which is called a *Centimetre*, and each of these again into ten equal parts, each of which is called a *Millimetre*.

3. *Unit of Volume.* The unit of volume depends directly on the unit of length. The capacity of a box one-tenth of a metre (a decimetre) long, wide, and deep is the standard unit of measure. Such a measure is called a *Litre*, and is equal to 1761 pints (imperial).

4. *Unit of Weight.* The weight of so much distilled water at a temperature of 4° C. as would fill a measure one-hundredth of a metre (a centimetre) long, wide, and deep is the standard unit of weight and is called a *Gram*.

5 By using Latin and Greek prefixes, denominations higher and lower than the standard, units are formed, the Greek numerals indicating multiples and the Latin ordinals indicating decimal divisions, thus:

Deca stands for 10	}	times the unit.
Hecto stands for 100		
Kilo stands for 1000		
Deci stands for 10th	}	part of the unit.
Centi stands for 100th		
Milli stands for 1000th		

METRIC TABLES

Measures of Length

The unit is the metre.

10 millimetres (mm.)	= 1 centimetre	=	.01 metre
10 centimetres (cm.)	= 1 decimetre	=	.1 metre
10 decimetres (dm.)	= 1 metre	=	1. metre
10 metres (m.)	= 1 decametre	=	10. metres
10 decametres (Dm.)	= 1 hectometre	=	100. metres
10 hectometres (Hm.)	= 1 kilometre	=	1000. metres
10 kilometres (Km.)	= 1 myriametre	=	10000. metres

Note. — Metre = 39 $\frac{3}{8}$ in., nearly; 64 metres = 70 yd., nearly; 1 kilometre = 1100 yd., nearly; 8 Km. = 5 mi., nearly.

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Cloth, etc., is measured by the metre; very small distances by the millimetre; great distances by the kilometre.

A rough rule for converting metres into English yards is to add 10 per cent to them; thus, 40 metres are equal to 44 yards.

The centimetre is nearly equal to $\frac{1}{25}$ in.; hence to convert centimetres to inches, multiply by 4 and point off the last figure.

To convert millimetres to inches or decimals of the inch, multiply by 4 and point off the last two figures.

EXERCISES

1. How many metres in a decimetre? In a hectometre? In a kilometre? How many decimetres in a hectometre? In a kilometre?

2. What part of a metre is a decimetre? A centimetre? A millimetre?

3. With a metre-stick, or a string one metre in length, measure the height of your desk, the length and width of the schoolroom, the length and width of the platform, the width of the nearest street. Measure the foregoing with a yard measure. Convert the metric measures into feet and inches, approximately, and compare with the actual measurement by these units.

4. Find the value of each of the following expressions in metres:

- (a) $.435 \text{ m.} + 825 \text{ cm.} + 4263 \text{ mm.} + 1595 \text{ Km.}$
- (b) $.927 \text{ Km.} - 6495 \text{ cm.}; 4.37 \text{ cm.} - 42.87 \text{ mm.}$
- (c) $8 \times .0457 \text{ Km.}; 38,019 \text{ mm.} \div .097.$

5. Find the cost of 83.75 m. of cloth at \$3.25 per metre.

6. The expense of building a certain railroad is \$25,000 per kilometre. What is the whole cost of the road, if its length is 72 Km. and 53 m. ?

7. The length of the tunnel through Mont Cenis is about 12.22 Km. What is this length in miles, very nearly ?

8. The width of the Atlantic is about 3000 mi. What is its width in kilometres ?

9. A train is running at the rate of 48 Km. an hour. How many metres does it travel in a second ?

10. Reduce 27 m. to the fraction of 36 Km.

11. Take 31 Km. 3 Hm. 9 m. from 115 Km. 2 Dm. 8 dm.

12. Find the total cost of 75 cm. at 4 francs per metre, 625 mm. at 8 francs per metre, 60 dm. at 12 francs per metre, and 7 m. 8 cm. at 25 francs per metre.

Measures of Surface, or Square Measure

100 sq. millimetres (sq. mm.)	= 1 sq. centimetre = .0001 sq. metre
100 sq. centimetres (sq. cm.)	= 1 sq. decimetre = .01 sq. metre
100 sq. decimetres (sq. dm.)	= 1 sq. metre = 1 sq. metre = 1 centare
100 sq. metres (sq. m.)	= 1 sq. decametre = 100. sq. metres = 1 are
100 sq. decametres (sq. Dm.)	= 1 sq. hectometre = 10000 sq. metres = 1 hectare
100 sq. hectometres (sq. Hm.)	= 1 sq. kilometre = 1000000 sq. metres

Note. — The are, centare, and hectare are used only in land measure.

The "are" is slightly less than 4 sq. rd.

The "hectare" is slightly less than $2\frac{1}{2}$ A.

Since the scale is 100 (10×10), there are two places for each denomination. Thus 5 hectares, 2 ares, 5 centares is written 5.0205 hectares, or 50,205 square metres.

EXERCISE

1. Write 12 square kilometres as square metres.
2. Write 8 square metres and 35 square decimetres as square metres.
3. A farmer had 5 hectares 5 ares 9 centares of land, and sold first .5 of it, then .3 of it for \$384 an are. What did he get for what he sold? How much had he left?
4. Find in square metres the area of a room 4.53 m. long and 2.75 m. wide.
5. Divide 73 sq. m. by 25.
6. How many square millimetres are there in one square metre?
7. Find the area in square metres of a lot 485 decimetres square.
8. Find the area of a floor 15 m. 68 cm. long and 7 m. 8 cm. 5 mm. wide.
9. Find the cost of carpeting a rectangular room 16 m. 2 dm. 4 cm. long, 7 m. 8 dm. 5 cm. wide with carpet 6 dm. 2 cm. 8 mm. wide at \$5 per metre.
10. A rectangular field has an area of 43 ares 20 centares; its length is 150 m. What is its breadth in metres?
11. A rectangular surface measures 1 sq. m.; it is 1 cm. wide. Find its length.
12. How many bricks each 16 cm. long and 8 cm. wide will be required to pave a walk 24.8 Km. long and 2.4 m. wide?

Measures of Capacity

$$\begin{aligned}
 1000 \text{ cu. millimetres (c. mm.)} &= 1 \text{ cu. centimetre} \\
 &= .000001 \text{ cu. metre} \\
 1000 \text{ cu. centimetres (c. cm.)} &= 1 \text{ cu. decimetre} \\
 &= .001 \text{ cu. metre} = 1 \text{ litre} \\
 1000 \text{ cu. decimetres (c. dm.)} &= 1 \text{ cu. metre} \\
 &= 1 \text{ cu. metre} = 1 \text{ stere}
 \end{aligned}$$

Note. — In measuring wood a cubic metre, called a stere, (St.) is used. $3\frac{1}{10}$ steres = 1 cord, nearly.

In measuring liquids the cubic decimetre, called a *Litre*, is used. Four litres = seven pints, very nearly.

In measuring grains, fruits, etc., the hectolitre is used.

The numeral prefixes are used with the litre as with the metre.

EXERCISE

1. Write 5.14 cubic decimeters as cubic metres.
2. Write 8,765,345 cubic centimetres as cubic metres.
3. Add 3 cu. m., 18 cu. dm., 207 cu. cm., 385 cu. m., 230 cu. dm., 895 cu. cm., 10 cu. mm., 831 cu. m., 300 cu. cm. Express the sum in cu. m., then in cu. dm.
4. How many steres of wood are there in a pile 26 m. long, 2.25 m. wide, and 3 m. high?
5. Find the cost of 27.5 Hl. of wheat at \$0.13 per decalitre.
6. How many litres will a rectangular box 1.5 m. long, .72 m. wide, and .84 m. deep hold?
7. How many litres are there in 75 decalitres?
8. A family consumes 2 l. 4 dl. of milk daily. Find the weekly cost at 6¢ per litre.

9. What is the volume of rectangular stone 2 m. long, 8 dm. broad, and 5 dm. 6 mm. thick?

10. How many phials, each holding 2.5 centilitres, may be filled from a vessel containing $2\frac{1}{4}$ litres?

EXERCISE

1. Write in full the table of Dry, or Liquid Measure.
2. Write 4 litres and 8 decalitres as litres.
3. Write 175.4 decalitres as litres.
4. At \$2.00 a litre, what is the price of a centilitre?
5. How much must I pay for 56.25 litres of coal oil at $18\frac{1}{4}$ ¢ a litre?
6. How many litres are there in a cubic metre?
7. How many gallons are there in 20 litres?
8. A merchant bought 10 hectolitres of potatoes at \$1 per hectolitre, and sold them at 50¢ a bushel. Did he gain or lose, and how much?
9. How many litres are there in a rectangular tank 3.5 m. long, 2.6 m. wide, and 3.1 m. deep?
10. Taking a pint equivalent to .468 l., how many hectolitres correspond to 3125 bu.?

Measures of Weights

10 milligrams (mg.)	= 1 centigram	=	.01 gram
10 centigrams (cg.)	= 1 decigram	=	.1 gram
10 decigrams (dg.)	= 1 gram	=	1. gram
10 grams (g.)	= 1 decagram	=	10. grams
10 decagrams (Dg.)	= 1 hectogram	=	100. grams
10 hectograms (Hg.)	= 1 kilogram	=	1000. grams

Note. — A cubic centimetre of water at its greatest density weighs one gram. This is the unit of weight.

A gram = $15\frac{1}{2}$ grains, nearly; 28 grams = 1 oz. Avoir., nearly.

The gram is used in weighing letters, mixing and compounding medicines, and in weighing all light articles.

The kilogram equals about $2\frac{1}{2}$ lbs. Avoirdupois. It is the ordinary unit of weight.

In weighing heavy articles two other weights, the quintal (100 kilograms) and the tonneau or ton (1000 kilograms), are used. The ton is a little less than 2205 lbs.

A litre of water weighs 1 kilogram.

A cubic metre of water weighs 1000 kilograms.

EXERCISE

1. Write 7 kilograms and 18 grams as grams.
2. Write 277 centigrams as grams.
3. Write 12 grams, 2 centigrams and 1 milligram as grams.
4. At \$6 a ton for coal, what will it cost to heat a building 30 days if it takes 400 kilograms of coal a day?
5. How many grains are there in two grams?
6. How many pounds Avoirdupois are there in 976.25 grams?
7. How many grams are there in 12 lbs. Troy? In 12 lbs. Avoir.?
8. The French post-office allows 7.5 grams for a single postage; the Canadian 1 oz. Avoir. By how many grains does the Canadian exceed the French allowance?
9. The pressure of the atmosphere on a certain day was $14\frac{3}{4}$ lbs. Avoir. to the square inch. What would be the corresponding pressure in kilograms to the square centimetre?

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10. Each soldier in a garrison consumes daily 8.5 Hg. of bread. In 25 da. the entire garrison consumes 53,125 Kg. How many soldiers are there in the garrison?

REVIEW

1. In a 3-metre square there are how many square decimetres?

2. How many square centimetres are there in an oblong 5 dm. by 6 dm.?

3. The base of a triangle is 9 dm. and the altitude is 64 dm. Find the area.

4. The perimeter of a rectangle is 60 m. and the length is to the breadth as 3 to 2. Find the length, breadth, and area.

5. How many acres are there in a field 72.5 m. by 62.8 m.?

6. A boy rode on his bicycle 2645 m. in 5 min. At this rate how far would he ride in $1\frac{1}{4}$ hr.? Express the answer in kilometres.

7. Divide 16 Hl. of wheat equally among 20 persons. Express the answer in litres.

8. In a right-angled triangle the base and perpendicular are, respectively, 24 dm. and 70 dm. long. Find the hypotenuse.

9. A bin is 12 m. long and 8 m. wide. How deep must it be to hold 1080 Hl. of wheat?

10. Write the following as cubic metres :

(a) 47 cu. m., 7 cu. dm., 8 cu. cm.

(b) 57 cu. m., 19 cu. dm., 84 cu. cm.

(c) 758 cu. m., 78 cu. cm.

11. The total surface of a cube is 2400 sq. m. Find its volume.

12. How many dekalitres of water will weigh 18.05 Kg.?

EXERCISE

1. Find in miles the length of 10 Km., a metre being 39.37 in.
2. How much is a pile of wood 8 m. long, 4.5 m. wide, and 3.4 m. high worth at \$1.25 a stere?
3. Find the cost of 36.8 a. of land when \$750 is paid for 4.25 Ha.
4. The circumference of a wheel is 4.5 m. in length. How many revolutions will this wheel make going 278.1 Km.?
5. How deep must a rectangular box be to hold 30 l. if it is 45 cm. long and 24 cm. wide?
6. What weight of water will fill a vat 96 dm. long, 48 dm. wide, and 42 dm. deep?
If alcohol is 80% as heavy as water, find the weight of alcohol in a rectangular vessel 5 dm. by 4 dm. by 24 cm.
8. The circumference of a hoop is 3.8 m. How many times will it turn in rolling a distance of 66.5 dm.?
9. A nickel 5-cent piece weighs 5 g. How many nickels can be made from a bar of coin metal weighing 7 Kg.?
10. How many cubic metres of earth must be removed in excavating a cellar 8.5 m. long, 6.4 m. wide, and 2.2 m. deep?

EXERCISE

1. Compare the area of a rectangular field whose length is three times its breadth, and perimeter 1200 m., with the area of a square field whose perimeter is 1000 m.
2. How many acres are there in one rectangular field 75 m. by 66 m.?
3. The diameter of a circle is 371 cm. long. Find its circumference and its area.

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4. How much will it cost to paint the curved surface of a standpipe 20 m. high and 8 m. in diameter at 25¢ per square metre?
5. Reduce the following :
- (a) 24.7 cu. m. to cubic decimetres.
 - (b) 1,847,689 cm. to metres.
 - (c) 87 Hg. to decigrams.
 - (d) 84 A. to sq. metres.
 - (e) 5.8 Kg. to centigrams.
 - (f) 49 sq. m. to sq. centimetres.
6. How many litres will a box hold which is 82 cm. long, 16 cm. wide, and 15 cm. deep?
7. An empty jug weighs 1.04 Kg., full of water it weighs 3.8 Kg. Find the capacity of the jug in litres.
8. Into how many lots of 4.25 a. may 8 Ha. 5 a. be divided?
9. Find the weight of a bar of iron 50 cm. long, 4 cm. wide, and 2.5 cm. thick, iron weighing 7.8 times as much as an equal volume of water.
10. Express in kilograms the weight of .375 cu. m. of water at its greatest density.
11. A ditch 90 m. long, 75 dm. wide, and 50 dm. deep is full of water. Find its weight.

CHAPTER XI

REVIEW

Problems Based on Agriculture, Industry, and Commerce Miscellaneous Problems

EXERCISE

1. Approximately 75% by weight of potatoes is water; the remainder is made up of solid substances. Find the weight of solid substances in a shipment of 5640 bushels.

2. Air weighs .0012 times as much as water. Find the weight of the air in a room 70 ft. long, 35 ft. wide, and 16 ft. high.

3. A schoolroom is 32 ft. long and 28 ft. wide. It has 4 windows, each containing 12 panes of glass 30 inches long and 22 inches wide. Find the ratio of the window area to the floor area.

4. Find the cubic contents of a cubical box, if the area of all its faces is 24,576 square inches.

5. Two men, A and B, hired a pasture field for \$150.00. A put in 75 sheep for 6 months, and B 90 sheep for 5 months. How much of the rent should each pay?

6. A mill was insured for $\frac{3}{4}$ of its value at a premium costing $\frac{5}{8}\%$. If the premium paid was \$77.50, find the value of the mill.

7. A merchant sold flour at \$8.10 per barrel, losing 10%. What would be his gain per cent if he sold the flour at \$9.75 per barrel?

8. I have \$12,000 which I wish to invest. I have two choices: first, investing in Victory Bonds, which pay $5\frac{1}{4}\%$ interest and are exempt from taxation; second, investing in a mortgage which pays 7% interest, the income from which is subject to an income tax of 4% . Which will give the larger yearly income and by how much?
9. A farmer has 83.75 acres of oats, 128.25 acres of wheat, and 45.35 acres of barley. The yields were as follows: oats, 73.5 bushels per acre; wheat, 35.25 bushels per acre; barley, 42.75 bushels per acre. The crop was sold at the following prices: oats, 63 cents per bushel; wheat, \$1.87 per bushel; barley, 98 cents per bushel. Find the total gross returns from the grain.
10. A bankrupt firm makes an assignment with assets of \$36,384.00 and liabilities of \$72,560.00. The cost of settlement is \$3240.00. How much will be paid on the dollar to the creditors?
11. A farmer sold two horses for the same price, \$189 each. On the first horse he gained $12\frac{1}{4}\%$, and on the second he lost $12\frac{1}{4}\%$. Find his net gain or loss.
12. A hardware firm purchased goods listed at \$5460.00 subject to discounts of 25% , 5% , and 2% . Find the net cash price of the goods.
13. I wish to obtain \$500 from the Bank of Commerce. For what sum must I give a note drawn for 90 days, if the bank charges 8% per annum?
14. There are two square pasture fields. The first is 60 rods square, and the area of the first bears the same relation to the area of the second as 1 bears to 4. Find the length of the fence enclosing the second field.

15. A vacant corner lot is 160 ft. long and 120 ft. wide. What distance is cut off by a boy who takes a short cut across the lot from corner to corner rather than walk around both sides?

16. A man insured his house for \$3500, his barn and granaries for \$1250, and his personal property for \$850. The following rates of insurance were paid: On the house and personal property $2\frac{1}{4}\%$, on the barn and granaries $2\frac{1}{2}\%$. Find the total amount of the premium paid.

17. I bought a half section of land, paying for it \$45 per acre. I sowed 120 acres in wheat which cost me the following expenditures: seed, 75 lbs. of wheat per acre at \$2.20 per bushel; putting in the crop, \$4.00 per acre; cutting and stooking, \$3.75 per acre; threshing, 12¢ per bushel; marketing grain, 8¢ per bushel. The yield of wheat was 37 bushels per acre, which I sold for \$1.75 per bushel. The total cost of labor for the season was \$1600. If the money I invested in the land is worth 8% per annum, find my total profit over all expenses, wages, and interest charges.

18. A note drawn for three months for \$850 bearing interest at 9% per annum is made on June 16th, 1919. The note was discounted at the bank on July 8th at 8%. Find (a) date when note is due, (b) proceeds of the note.

19. An ice house is 120 ft. long, 60 ft. wide, and 20 ft. high. Allowing $12\frac{1}{2}\%$ of the total space for sawdust for packing the ice, find the number of tons of ice that may be stored in the building. Water expands 10% in freezing, and 1 cu. ft. of water weighs $62\frac{1}{2}$ lbs.

20. A man bought a house for \$6500. The annual expenditures are: repairs, \$120; taxes, \$72.40; insurance, \$13.60. The house is rented for \$83 per month. What rate of interest does the owner make on his investment of \$6500?

EXERCISE

1. It has been found that a man who has not received a high school education is able to earn an average of \$748.00 a year over a period of 40 years. A man who has received a four-years' high school training is able to earn on an average of \$1245 per year over a period of 40 years. If the high school term is 180 days a year, find the value in increased earning power of each day spent in high school.

2. The price of gas for domestic use is 35 cents per thousand cubic feet, with a discount for cash of 10%. The reading of the metre on March 1st was 57,400 cubic feet; on April 1st the reading was 63,200 cubic feet. Find the amount I shall have to pay, if I take the discount for cash.

3. I bought a stock of hardware, the list price of which was \$15,000. I secured on this two discounts of $33\frac{1}{4}\%$ and 15%. I sold the goods at an advance of 10% on the list price. If the cost of handling the goods was 5% of the net cost, what per cent gain did I make on the stock?

4. A man sold some horses and cattle. He was offered \$2400 cash or \$2650 on a note due in 6 months without interest. He accepted the second offer and immediately discounted the note at the bank at 8% discount. How much more in cash did he receive by accepting the second offer?

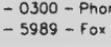
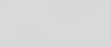
5. On November 3rd I borrowed from the bank \$750, giving to the bank my note for 90 days. The bank charged interest at the rate of 8% per annum and deducted the interest in advance from the amount borrowed. What amount of money does the bank give me on the note?

6. A boy deposits in the savings bank on January 1st, 1918, the sum of \$25; on July 1st, he deposits another amount of \$25; on January 1st, 1919, he again deposits



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\$25. The bank adds interest to what he has on deposit on June 30th and December 31st at the rate of 4% per annum. How much has he to his credit on July 1st, 1919?

7. A silo which is in the shape of a cylinder is 14 feet in diameter and 35 feet high. Find the number of acres of green oats and peas required to fill the silo, allowing 40 lbs. to the cubic foot, the yield of green feed being 14 tons per acre.

8. A water tank is 12 feet long, 2 feet wide, and 3 feet deep. Find the cost of lining the inside of the tank with zinc which is worth 19 cents per lb., if 1 lb. of zinc is allowed to every 2 square feet.

9. A farmer has 15 dairy cows which produce an average of 27 lbs. of milk daily during the months of June, July, and August. He sells the milk to a dairy which pays him 49 cents per lb. butter fat. If the milk tests 3.95% butter fat, find the total amount of money he received from the milk during the three months.

10. A man bought a house, paying for it \$5600. The taxes on the house are \$65 per year, insurance \$15 per year, repairs \$150 per year. What rate of interest does the owner make on his investment of \$5600, if he rents the house for \$45 per month?

11. Three men form a partnership in a hardware store. The first man invests \$2500 in the business, the second man \$3500, and the third \$3000. At the end of the year the profits amount to \$2700. How much should each receive?

12. A commission merchant received \$375 as his commission for purchasing 2500 barrels of flour. If his rate of commission is $2\frac{1}{2}\%$, find the price paid per barrel for the flour.

13. A man owns a herd of 28 dairy cattle. He feeds them ensilage for 150 days at the rate of 40 lbs. per day per cow. If 1 ton of ensilage requires 44 cubic feet of space, find what must be the height of a silo whose diameter is 14 feet which will be required to store the feed.

14. A park 360 feet wide and 600 feet long is prepared for grass. It is filled in with earth to a depth of 10 inches, and a dressing of black earth to a depth of $2\frac{3}{4}$ inches is put on the top. Find the cost of preparing the lawn, if the earth is worth 75 cents a load and the black earth for dressing is worth \$1.35 per load. A load of earth contains 1 cubic yard.

15. A water tank, which is in the form of a cylinder with a diameter of 12 feet, is filled at the rate of 180 gallons per minute. What will be the depth of the water in the tank at the end of 45 minutes? 1 cubic foot of water contains $6\frac{1}{4}$ gallons.

16. Find the net return per acre from a field of wheat, using the following data :

- (1) Interest on money invested in the land at 8%. Cost of the land \$40 per acre.
- (2) Preparation of the land for crop at \$7.50 per acre.
- (3) Seed at \$2.20 per bushel, using 75 lbs. per acre.
- (4) Cutting grain at \$1.35 per acre.
- (5) Stooking the grain at \$0.75 per acre.
- (6) Twine, $2\frac{1}{4}$ lbs. to the acre, at 16 cents per lb.
- (7) Threshing at 12 cents per bushel.
- (8) Hauling grain to the elevator at 6 cents per bushel.
- (9) Freight to Fort William at 25 cents per cwt.
- (10) Commission for selling the wheat 1 cent a bushel.
- (11) Selling price of the wheat at Fort William \$2.15 per bushel.
- (12) Average yield per acre 27 bushels.

17. A stream of water is 40 rods wide and flows at the rate of 5 miles per hour. If the average depth of the stream is 4 ft., find the number of gallons of water that may be withdrawn from the stream per minute, if only $\frac{1}{4}$ of the water may be taken from the stream. 1 cubic foot of water contains $6\frac{1}{4}$ gallons.

18. A farmer has 168 acres in wheat. He expects a yield of 40 bushels per acre. How many bins each 15 feet long, 10 feet wide, and 7 feet high must be built to store the grain, allowing $1\frac{1}{4}$ cubic feet of space per bushel?

19. A man owns 4 square lots which adjoin each other, all facing on the same street. If the area of one lot is 2209 square yards, find the cost of fencing the outside of the 4 lots at 35 cents a foot.

20. A man shipped 2 carloads of stock to the Winnipeg stockyards. In the first car were 18 head which averaged in weight 1120.62 lbs. In the second car were 24 head which averaged in weight 1098.76 lbs. The cattle were sold at \$7.75 per cwt. Find the total amount received for the cattle. If a commission of 1% were paid for selling the cattle, find the net amount received on the shipment.

EXERCISE

1. How many acres of green feed will produce the silage to feed 16 cows, 30 pounds each of silage per day during the months of Jan., Feb., and Mar., if each acre yields 12 tons of silage?

2. A farmer, using a plow which turns two furrows each 14 inches wide, plows 16 rounds per day in a field 160 rd. long. If he receives \$4.50 per acre, how much does he earn during the 50 days he worked in June and July?

3. A courtyard is 5.5 metres wide and 6.3 metres long. How many bricks each 21 cm. long and 11 cm. wide will be required to pave it?

4. A farmer had a field of wheat 320 rd. long and 160 rd. wide. The average yield was 35 bushels per acre. It cost \$4.80 per acre to work the land, \$3.50 per acre for seed wheat, \$2.25 per acre to harvest, and 11¢ per bushel to thresh and market. Find the farmer's profit from the field of wheat, if he sold the wheat at \$1.85 per bushel.

5. A body of British soldiers dug a trench $2\frac{1}{4}$ miles long. The trench had an average depth of 5 ft. 4 in. and an average width of 3 ft. 6 in. How many cubic yards of earth were removed?

6. In a town a cylindrical water tank 42 ft. in diameter is lowered 6 ft. in $4\frac{1}{4}$ hours when no water is being pumped into it. How many gallons of water are used in this town per hour?

7. A wagon wheel is 14 ft. 6 in. in circumference. How many revolutions will it make in going 9 miles?

8. How many cubic feet of concrete are there in a retaining wall 75 ft. long, 12 ft. high, 4 ft. wide at the bottom and 2 ft. wide at the top?

9. A lead pencil is 8 inches long and $\frac{1}{4}$ of an inch in diameter. The lead in the pencil is $\frac{1}{8}$ of an inch in diameter. Find the number of cubic inches of wood in the pencil.

10. A fence around a square field costs \$84 at 35¢ per rd. What would be the cost of the fence, if this field had been rectangular in shape with a width of 40 rd.?

11. A room is 18 ft. long, 12 ft. wide, and 10 ft. high. What will it cost to plaster the room at 30¢ per sq. yard, making deductions for two doors each 7 ft. high and 4 ft. wide, and 3 windows each 6 ft. high and 3 ft. wide, and an 8-inch baseboard?

12. A board $2\frac{1}{2}$ inches wide, when tongued and grooved, covers 2 inches of floor space. In estimating the number of feet of flooring required for a room, what part of the area of the floor space must you add to the floor space in order to get the correct estimate of the number of feet of flooring required?

13. A man can buy for \$75 a grade cow that gives 32 lbs. of milk per day, or for \$125 a Jersey cow that gives 27 lbs. of milk daily. The grade cow's milk tests 3.75% butter fat and the Jersey's 5% butter fat. If the market price of butter averages 40¢ a pound during the year, which is the better investment? What per cent profit would each cow yield on the investment?

14. If a clean field of oats yields 70 bushels per acre, and a weedy field yields only 50 bushels per acre, what is the loss per cent caused by weeds, when the market price of oats is 60¢ a bushel?

15. Two boys leave the public school, one to work as an unskilled laborer at \$2.50 per day; the other borrows \$600 which he pays back at the end of 4 years with interest at 6%, and goes away to a trade school for 3 years. He learns a trade by means of which he can earn \$8.00 per day. Each boy is able to average 275 working days a year. At the end of 10 years from the time they leave the public school, how much money has the first boy earned, and how much has the second boy earned over and above the amount borrowed with interest which he paid out of his earnings?

16. If 10 inches of snow make one inch of water, and the average depth of snow on a section of land is 18 inches, find the number of cubic feet of water on the section.

17. A man bought a farm 3 Km. long and 2.5 Km. wide. Find the cost of fencing the farm at 10¢ per metre.

18. A farmer insured his house for \$2700 at a premium of $1\frac{1}{4}\%$, his barn for \$1200 at a premium of $\frac{1}{8}\%$, and 6400 bushels of wheat at \$2.25 per bushel at a premium of 1%. Find the amount of premiums paid by the farmer for this insurance.

19. A tea importer buys 3 tons of tea at \$26 per cwt. The duty on the tea is $33\frac{1}{3}\%$. Freight and other charges are \$120. He sells the tea at 55¢ per lb. Find his gain per cent.

20. A merchant bought paper at \$3 per ream and sold it at 25¢ per quire. What per cent profit did he make?

EXERCISE

1. A fruit-grower shipped 200 dozen ten-pound boxes of cherries to Vancouver, where they were sold by a commission agent at \$1.20 per box. Picking and packing the fruit cost $1\frac{1}{2}$ cents per lb., freight and shipment charges were \$35.00, and the agent's commission was 4%. Find the net amount received by the fruit grower.

2. Find the cost of sending the following telegrams at 25 cents for the first 10 words and 1 cent for each additional word :

(a) 22 words. (b) 45 words. (c) 68 words.

3. What will be the charge for using a long distance telephone, if the telephone charges are 45 cents for the first 3 minutes and 10 cents for each additional minute :

(a) Conversation for 7 minutes?

(b) Conversation for 11 minutes?

(c) Conversation for 14 minutes?

4. A coal bin 10 feet long and $7\frac{1}{2}$ feet wide has 15 tons of coal stored in it. If 1 ton of coal requires 35 cubic feet of space, find the height of the coal in the bin.

5. Mark the following goods which cost as indicated, so that there will be a profit of $33\frac{1}{2}\%$ after giving the indicated discount :

- (a) Cost \$288, discount off marked price 10%.
- (b) Cost \$378, discount off marked price 20%.
- (c) Cost \$960, discount off marked price $16\frac{1}{2}\%$.

6. A farmer bought a farm 1 mile long and $\frac{1}{4}$ of a mile wide at \$47.50 per acre. He broke all the land and sowed it in wheat, using 75 lbs. of seed to the acre. The following were his expenses: preparing the ground for crop, \$3.00 per acre; seed, \$2.20 per bushel; cutting and stooking, \$1.75 per acre; binder twine, \$125.00; threshing, 12 cents per bushel; hauling to elevator, 6 cents per bushel. The crop averaged 28.75 bushels per acre, which was sold at \$1.65 per bushel. If money is worth 8% per annum, and the farmer had his money invested in the farm for two years before securing a crop, find the average net profit per year for the two years.

7. A farmer, by feeding his cows \$3.50 worth of bran more per day than he had been feeding, increased the percentage of butter fat from 3.5% to 3.69% and increased the daily yield from 2325 lbs. to 2475 lbs. If he sells the milk at 52 cents per lb. butter fat, how much did he gain per day by the increased feeding?

8. Find the square root of each of the following numbers :

- (a) 9456.76 (b) 32.7184 (c) 192.16834

9. Find the cost of carpeting a room 18 feet long, 14 feet 6 inches wide, with carpet 18 inches wide at \$3.25 per yard,

allowing 7 inches additional length on each strip but the first for matching the pattern. The carpet is laid lengthwise in the room.

10. A man borrows a sum of money from the Standard Bank and gives in payment his note for \$650 due in 90 days. If the bank charges in advance 8% per annum for money loaned, find the amount received by the man from the bank.

11.

\$ 435.00	Portage La Prairie, Manitoba, March 7th, 1919
.....Six months.....after date,---I---promise to pay to the Massey Harris Co. Ltd., .....at the.....Union Bank of Canada, Portage La Prairie..... the sum of Four Hundred and Thirty-Five $\frac{00}{100}$ Dollars with interest at 9% per annum.	
Value received.	
Robert Jones.	

This note was discounted at the bank on April 15th, the discount rate being 8% per annum. Find (1) the date when this note is due, (2) the proceeds of the note on April 15th.

12. The area of the floor of a schoolroom, the length and width of which are the same, is 841 square feet. Find the number of square feet of blackboard space required for a blackboard along 2 sides of the room, the blackboard being 4 feet high.

13. A school district borrowed on debentures \$1200, agreeing to pay back the principal in 5 equal annual payments, together with interest at $6\frac{1}{2}\%$ per annum. Find the amount of each of the 5 annual payments of principal and accrued interest.
14. A hardware salesman is paid \$125 a month and a commission of $2\frac{1}{4}\%$ of his sales. Find what his yearly income will be, if his sales for the year amounted to \$98,500.
15. A merchant sold flour which cost him \$2400 at a profit of 18% ; he sold sugar which cost him \$3550 at a profit of 20% ; rice which cost \$1800 he sold at a profit of 16% ; and soap which cost \$3200 at a profit of 7% . What was his gain per cent on the sale of all these articles?
16. A firm insures its property in three companies; in the first for \$5000, in the second for \$7500, and in the third for \$6000. A fire occurs, and the loss is \$4200. What amount of the loss should each company pay?
17. The regulations of a city require all milk sold by dairies to test 4.556% butter fat. A dairy which distributes 250 gallons of milk in the city has shipped to it two consignments of milk testing respectively 3.75% butter fat and 5.3% butter fat. How much of each of these shipments can be used in a mixture by the dairy to supply 250 gallons at the legal test of 4.556% butter fat?
18. A dealer imports the following goods from the United States: 3 dozen ladies' shoes listed at \$85 per dozen, 5 dozen men's shoes listed at \$78 per dozen, and 2 dozen leather travelling bags listed at \$12 each. The duty on these goods is $33\frac{1}{3}\%$. If freight charges are \$35, find the cost of the goods to the dealer.

19. In 1917, Ontario produced 3,495,000 lbs. of tobacco from 2930 acres. In 1918, 6,649,500 lbs. were grown from 6500 acres. (a) Find the average yield per acre for each year. (b) Find the increase per cent of the total tobacco production of 1918 over the year 1917.

20. A man sold his farm for \$18,400. He paid the real estate firm for selling the farm a commission of 5% on \$5000 of the sale, and 1% on the remainder. The man invests the proceeds from the farm in mortgages which pay 9% interest per annum. If he pays an income tax of 4% on the interest from the mortgage, find his net yearly income.

EXERCISE

1. The average temperatures of the Province of Ontario in 1918 were as follows: January, 15.2° ; February, 13.6° ; March, 27.8° ; April, 41.5° ; May, 53.2° ; June, 61.4° ; July, 68.8° ; August, 68.4° ; September, 59.8° ; October, 47.7° ; November, 33.6° ; December, 28.3° . (a) Find the average temperature for the year. (b) Find the average temperature for the summer months, June, July, and August.

2. The assessed value of the property of a town is \$2,496,000. The estimated expenditures for the year are as follows: streets and public works, \$8600; schools, \$6400; hospitals, \$2500; miscellaneous, \$2452. (a) Find the mill rate that will be required to be levied to meet these expenditures. (b) W. H. Brown is assessed on land for \$2200 and on a building for \$6550. Find the amount of his taxes.

3. The diameter of a bicycle wheel is 28 inches. Find the number of revolutions it makes in going 1 mile.

4. A baseball diamond is 90 ft. square. Find the distance between two diagonally opposite corners.

5. Construct an isosceles triangle with a base 8 inches long and each of the equal angles at the base 60° . Find the area of this triangle.

6. Find the area of the curved surface of a cylindrical standpipe which is 28 ft. in diameter and 60 ft. high.

7. A man's yearly income is obtained from the following sources: salary, \$2700; interest from mortgages, \$375; interest on Victory Bonds exempt from taxation, \$500; rent from house, \$225. He pays a Federal Income Tax of 4% on all his income over \$2000, with the exception of his income from Victory Bonds. Find the amount of his net income.

8. At a sale a man bought \$375 worth of stock. He has the option of paying cash and receiving a discount of 5%, or giving his note due in six months bearing interest at 8% per annum. If the man can make 8% on his money, which is the better settlement for him to make, and by how much?

9. Five men form a company investing the following amounts: A, \$3500; B, \$4200; C, \$3600; D, \$4000; and E, \$4500. If the profits for the year were \$4200, find the share of each man.

At the end of the first year A bought out the shares of D and E. The second year the business paid a profit of 25% of the capital invested. Find the amount each person should receive at the end of the second year.

10. A school district is 5 miles long and $4\frac{1}{2}$ miles wide. The expenditures were estimated as follows: debenture payment, \$529; teacher's salary, \$1200; salary of the secretary-treasurer, \$75; fuel and supplies, \$160. The

government grant is \$200 per year. Find the rate of taxation in cents per acre which must be levied to meet the expenses of the district.

11. Simplify :
$$\frac{36\frac{1}{2} - 2\frac{3}{4}}{\frac{1}{2} + 2\frac{1}{2} - \frac{1}{2} \text{ of } \frac{17.5}{12} \text{ of } \frac{1}{2} - 2\frac{1}{2}}$$

12. A school rink is 160 ft. long and 104 ft. wide. The ice is 8 inches thick. If water expands $\frac{1}{10}$ of its volume in freezing, find the number of gallons of water required for the rink. (1 cu. ft. of water contains 6.25 gallons.)

13. A real estate agent charges the following commissions : Farm lands, 4% of total sales ; city property, 5% on \$1000, and 2½% on all sums over that amount. The sales for one week were as follows : 1 quarter section of land at \$37.50 per acre, 1 house and lot in Regina at \$6400, 1 section of wheat land at \$65 per acre, 1 half section of land at \$21.50 per acre, 1 house and lot in Moose Jaw at \$4500. Find the total commissions for the week.

14. A man buys a threshing outfit, making the following investments : separator, \$1830 ; engine, \$4200 ; tank and wagon, \$180 ; cook car, \$160. He hires the following help : 4 men with teams at \$8 each per day, 1 tank man at \$7 per day, 1 separator man at \$8.50 per day, 1 engineer at \$8.00 per day, 1 cook at \$6.00 per day. He had a run of 30 days during which he threshed 26,231 bushels of wheat, charging 12¢ per bushel ; 24,319 bushels of oats, charging 7¢ per bushel ; 14,994 bushels of barley, charging 9¢ per bushel. He uses 1½ tons of coal per day for which he pays \$6.50 per ton. It costs him \$12 per day to pay for the food of his men. He allows 20% of the cost of his equipment for the year's depreciation. If he charges against the returns, the depreciation charges and a year's interest at the rate of

8% on his original investment, find how much he has made on the season's threshing.

15. A man wishes to set out an orchard of 1521 fruit trees, so that the number of trees in the length and breadth of the orchard will be the same. The trees are placed 25 ft. apart. How many acres of land will be required for the orchard?

16. A man bought 320 acres of land at \$65 per acre. He paid \$5400 cash and arranged to pay the balance in *four* equal annual payments together with interest at 6% per annum. Calculate the amount of each of the *four* annual payments.

17. The capital invested in the building and equipment of a furniture factory is \$250,000. The profits for one year are \$175,025. The amount paid to employees in wages is \$375,250. From the profits an amount equal to 15% of the capital invested in building and equipment is set aside to pay depreciation. The shareholders are paid at the rate of 40% per annum on the capital invested, and the balance of the profits are distributed among the employees in proportion to the amount of the wages. (a) Find by what per cent the wages are increased from sharing in the profits. (b) Find the share of profits received by a man whose wages are \$13.75 per year.

18. A 60-day note for \$450.00 was discounted at 8% on April 18th. The proceeds amounted to \$446.23. Find (a) in how many days from April 18th, the note would be due; (b) the date when the note is due; (c) on what date the note was drawn.

19. A commission agent received a consignment of 2400 barrels of flour which he sells at \$8.75 per barrel on a commission of 4%. Freight charges amounting to \$325 and storage charges of \$75 are deducted, and the balance is

remitted to the shipper. How much did the agent remit from the sale of the flour?

20. An importer of Montreal bought in England cotton goods invoiced at \$12,345.00. The duty on these goods is $27\frac{1}{2}\%$. Shipment charges were \$228.00. At what price must the goods be sold to realize a profit of 25% on the entire cost of the goods?

APPENDIX

TABLES OF WEIGHTS AND MEASURES FOR REFERENCE

Avoirdupois Weight

16 drams (dr.)	= 1 ounce	or 1 oz.
16 ounces	= 1 pound	or 1 lb.
100 pounds	= 1 hundredweight, 1 cental	or 1 cwt.,
20 hundredweight	= 1 ton	or 1 T.

Note. — In Great Britain 112 lbs. make a hundredweight, and 2240 lbs. make a ton, called the long ton.

Fluid Measure — Medicine

60 drops	= 1 dram
8 drams	= 1 fluid ounce
20 ounces	= 1 pint
8 pints	= 1 gallon
1 dram	= 1 teaspoonful
2 drams	= 1 dessertspoonful
4 drams	= 1 tablespoonful

Long Measure

12 inches (in.)	= 1 foot	or 1 ft.
3 feet	= 1 yard	or 1 yd.
50 yards	= 1 rod	or 1 rd.
40 rods	= 1 furlong	or 1 fur.
8 furlongs	= 1 mile	or 1 mi.
1 mi.	= 320 rd. = 1760 yd. = 5280 ft. = 80 chains	

Note. — Gunter's chain is used in measuring land. It is 22 yards in length, and is divided into 100 links, each link being 7.92 inches long.

Note. — 6 feet 1 fathom
 120 fathoms 1 cable length
 880 fathoms 1 mile

Note. — The hand (the breadth of the hand and thumb) used in measuring the height of horses at the shoulder is 4 inches.

Surface Measure

144 square inches (sq. in.) = 1 square foot or 1 sq. ft.
 9 square feet = 1 square yard or 1 sq. yd.
 300 square yards = 1 square rod or 1 sq. rd.
 160 square rods = 1 acre or 1 A.
 640 acres = 1 square mile or 1 sq. mi.

Note. — 10,000 square links = 1 square chain
 10 square chains = 4840 sq. yds. = 1 acre

160 A. = a quarter-section land | 640 A. = a whole section land
 320 A. = a half-section land | or 1 sq. mi.
 36 sections = 1 township (tp.)

Cubic, or Solid Measure

1728 cubic inches (cu. in.) = 1 cubic foot or 1 cu. ft.
 27 cubic feet = 1 cubic yard or 1 cu. yd.
 128 cubic feet = 1 cord or 1 cd.

Measure of Capacity

2 pints (pt.)	= 1 quart	or 1 qt.
4 quarts	= 1 gallon	or 1 gal.
2 gallons	= 1 peck	or 1 pk.
4 pecks	= 1 bushel	or 1 bu.

1 cu. ft. of water weighs 1000 oz. and contains $6\frac{1}{4}$ gal.

The following table shows the weight of a bushel of the article named :

Lime	80 lbs.	Rye	56 lbs.
Bituminous coal	70 lbs.	Flax seed	56 lbs.
Beans	60 lbs.	Onions	50 lbs.
Clover seed	60 lbs.	Barley	48 lbs.
Peas	60 lbs.	Buckwheat	48 lbs.
Potatoes	60 lbs.	Timothy seed	48 lbs.
Turnips	60 lbs.	Hemp seed	44 lbs.
Carrots	60 lbs.	Castor beans	40 lbs.
Parsnips	60 lbs.	Malt	36 lbs.
Beets	60 lbs.	Oats	34 lbs.
Wheat	60 lbs.	Blue grass seed	14 lbs.
Indian corn	56 lbs.		

Measure of Time

60 seconds (sec.)	= 1 minute	or 1 min.
60 minutes	= 1 hour	or 1 hr.
24 hours	= 1 day	or 1 da.
7 days	= 1 week	or 1 wk.
12 calendar months or 365 days	= 1 year	or 1 yr.
366 days	= 1 leap year	

Circular or Angular Measure

60 seconds (")	= 1 minute or 1'
60 minutes	= 1 degree or 1°
360 degrees	= 1 circumference or 1 C.

English or Sterling Money

4 farthings (far.)	= 1 penny	or 1d.
12 pence	= 1 shilling	or 1s.
20 shillings	= 1 pound	or £1

Note. — £1 sterling = \$4.86 $\frac{2}{3}$, and 1s. = 24 $\frac{1}{3}$ cents.
1 guinea = 21 shillings

Miscellaneous Table

12 units	= 1 dozen	or 1 doz.
12 dozen	= 1 gross	or 1 gro.
12 gross	= 1 great gross	
20 units	= 1 score	or 1 sco.
24 sheets	= 1 quire	or 1 qr.
20 quires	= 1 ream	or 1 rm.
196 lbs. flour	= 1 barrel	or 1 bbl.
200 lbs. pork	= 1 barrel	or 1 bbl.

Freezing point of water, on Fahrenheit scale, 32° above zero.

Boiling point of water, under a pressure of 760 mm., 212 F.

A board foot is 12 in. × 12 in. × 1 in.

A bunch of shingles contains 250. A thousand shingles are reckoned to cover 100 sq. ft.

Light travels at the rate of 186,000 mi. a second.

Sound travels in the air at the rate of 1100 ft. a second.

An imperial gallon contains 277.274 cu. in.

The wine gallon contains 231 cu. in. 6 wine gallons = 5 standard gallons.

A bushel contains 8 imperial gallons.

The long ton is used in the United States custom houses and in wholesale transactions in iron and coal.

Atmospheric pressure. At the level of the sea the pressure of the atmosphere is about 14.7 lbs. per square inch.

The barometer. The column of mercury falls about an inch for each 1000 ft. of ascent.

A brick is 8 in. long, 4 in. wide, and 2 in. thick. About 22 bricks and the mortar will fill 1 cu. ft.

A lath is 4 ft. long and $1\frac{1}{2}$ in. wide. They are usually left $\frac{3}{8}$ in. apart when nailed. There are 50 laths in a bunch. A bunch will cover 3 sq. yd. of surface.

Wall paper in America is 18 in. wide and is put up in double rolls 16 yds. long. English wall paper is usually 21 in. wide.

ANSWERS

Exercise. Page 9

- | | |
|-------------------------------------|-------------------------------------------|
| 9. \$14,158 | 14. \$3,173.52 |
| 10. (1) By Rail 31,653, 614 bushels | 15. \$133,493.91 |
| (2) By Vessel 126,189,621 bushels | 16. 26,186,000 acres; 735,798,000 bushels |
| (3) Total 157,843,235 bushels | 17. (1) 695,221 boys |
| 11. 38,192 miles | (2) 691,501 girls |
| 12. 121,877,128 tons | (3) Total 1,386,722 |
| 13. 14,015,588 tons | |

Exercise. Page 14

- | | | |
|--------------|---------------------|-----------------|
| 5. \$2040.14 | 6. 2,447,820 cattle | 7. \$18,519,024 |
|--------------|---------------------|-----------------|

Exercise. Page 19

- | | |
|----------------------------|-----------------------------------------------------------------|
| 1. Manitoba \$76,744,239 | 7. (1) \$2304 (2) \$10360 (3) \$8056 |
| Saskatchewan \$220,512,831 | (4) \$50.35 |
| Alberta \$99,095,227 | 8. \$52.75 |
| Total \$396,352,297 | 9. \$48,283,315.00 |
| 2. \$19,250,000 | 10. (1) Ontario \$70.68, Quebec |
| 3. \$6,592,560.73 | \$81.95, N. S. \$81.78, N. B. |
| 4. \$124.97 | \$92.16, P. E. I. \$52.44, Man. |
| 5. Gain \$315 | \$55.04, Sask. \$74.80, Alta. |
| 6. Gain \$2318.75 | \$62.48, B. C. \$111.15; (2) 136½ bush.; (3) 57½¢; (4) \$75.83½ |

Exercise. Page 21

- | | |
|-------------------------|---------------|
| 8. 198 yds. 2 ft. 3 in. | 11. 49½ lots |
| 9. 24 ft. 10 in. | 12. 600 poles |
| 10. 3168 steps | |

Review Exercises. Page 23

- | | |
|------------------------|-------------------------|
| 6. 24 quarter sections | 9. 20 sq. yds.; \$30.00 |
| 7. 11,520 acres | 10. Length 80 rods |
| 8. 18,000 sheets | |

Exercise. Page 23

- | | |
|------------------------------------|---------------------------|
| 5. 216 bd. ft. | 8. 3000 bd. ft.; \$525.00 |
| 6. 40 planks; 400 bd. ft.; \$12.00 | 9. 90,000 bd. ft.; \$2520 |
| 7. 780 bd. ft. | |

Review Exercises. Page 25 (top of page)

- | | |
|-----------------|---------------------------------|
| 7. 4500 gallons | 9. $1\frac{1}{2}$ cords; \$8.40 |
| 8. 196 loads | 10. 3 tons |

Review Exercises. Page 26

- | | |
|-------------------|--------------|
| 6. 144 bottles | 9. \$56.70 |
| 7. \$57.60 | 10. \$196.56 |
| 8. 13,500 gallons | |

Review Exercises. Page 27

- | | |
|---------------------------|--------------|
| 4. 64 tons 1024 lbs. | 7. \$298.94 |
| 5. 11,343 tons 15 cwt. | 8. \$2887.50 |
| 6. \$410.15 $\frac{1}{4}$ | |

Review Exercises. Page 28

- | | |
|------------------------------------|-----------------------|
| 1. \$309.72 | bush.; beans 98 bush. |
| 2. \$486.45 | 4. \$330.45 |
| 3. Potatoes 117 bush.; turnips 123 | 5. 75,000 tons |

Review Exercises. Page 29

- | | |
|-------------------------|------------------------|
| 1. 166 days | 4. 94 days |
| 2. 248 days | 5. 5 hours 40 minutes |
| 3. 1232 hours; \$800.80 | 6. 28 hours 45 minutes |

Review Exercises. Page 30

- | | |
|---------------------------------|--------------------------|
| 1. 2 quires; 6 quires; 9 quires | 5. \$2.70 |
| 2. 2160 pencils | 6. \$12.00 |
| 3. 4320 eggs | 7. \$7.90 |
| 4. 5 oranges | 8. \$31.66 $\frac{2}{3}$ |

Exercise. Page 32

- | | |
|-------------|---------------------------|
| 1. \$41.42 | 5. \$785.20 |
| 2. \$591.24 | 6. \$3345 |
| 3. \$27.15 | 7. \$159.83 $\frac{1}{2}$ |
| 4. \$268.00 | 8. \$6553.50 |

ANSWERS

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Exercise. Page 34

- | | |
|-------------------------|--------------------------|
| 1. Balance due \$185.70 | 4. Balance due \$39.59 |
| 2. Balance due \$1.95 | 5. Balance due \$1553.93 |
| 3. Balance due \$33.80 | |

Exercise. Page 36

- | | |
|------------------------------------------------------|----------------------|
| 1. 32 miles 1280 yds. per hour | 6. \$56.26 |
| 2. \$18,400.50 | 7. \$43.75; \$100.00 |
| 3. $22\frac{1}{4}$ board feet; contents 10648 cu.in. | 8. \$472 |
| 4. 495 miles | 9. \$2303.43 |
| 5. \$10461.42 | 10. \$20.46 |

Exercise. Page 38

- | | |
|-----------------------------------------------|---------------------------------|
| 1. \$674,325.00 | 5. 7 days |
| 2. \$2106.00 | 6. \$1323.03 |
| 3. \$43.87 | 7. \$73.70 |
| 4. 1st boy \$645; 2nd boy \$1346.67; \$175.42 | 8. By carload cheaper by \$8.64 |

Exercise. Page 40

- | | |
|---------------------------------------|-----------------------|
| 1. 38 lbs. $3\frac{1}{2}$ oz. | 6. 11 ft. |
| 2. 224 cu. ft. of air space | 7. 150 bush. per acre |
| 3. \$46.07 $\frac{1}{2}$ | 8. \$137,871,757.12 |
| 4. \$309.67 | 9. \$40.98 |
| 5. Area of floor 288 sq. ft.; \$72.00 | |

Exercise. Page 41

- | | |
|--------------------------------------------------------------------------------------------------|---------------------------------|
| 1. (a) $238\frac{1}{2}$ yds.; (b) $831\frac{1}{2}$ yds.; (c) 1926 yds. 2 ft. (d) 5093 yds. 1 ft. | (b) 10 ac. 70 sq. rds. |
| 2. (a) 1016 rds. 5 yds. 1 ft. (b) 880 rds. | 5. (a) 5940 yds.; (b) \$1247.40 |
| 3. 5 mi. 96 rds. 5 yds. 1 ft. | 6. 960 bushels |
| 4. (a) 15 ac. 140 sq. rds. 5 sq. yds.; | 7. 4537 tons 10 cwt. |
| | 8. \$103.40 |
| | 9. $27\frac{1}{2}$ miles |
| | 10. 170 days |

Exercise. Page 42 (near bottom of p. 25)

- | | |
|---------------------|---------------------|
| 1. 119,790 cub. ft. | 6. \$49.00 |
| 2. \$16,100 | 7. \$142.20 |
| 3. \$1320 | 8. 1 mile 3680 feet |
| 4. \$378 | 9. \$14.28 |
| 5. \$118.75 | 10. \$84.90 |

Exercise. Page 49

- | | |
|------------------------------------------------|----------------------------|
| 1. 6 acres | 3. 12 inches |
| 2. 60 feet: A 10 lots; B 12 lots;
C 15 lots | 4. A 7 horses; B 12 horses |
| | 5. 7 feet |

Exercise. Page 51

- | | |
|--------------------|---------------------------|
| 5. 8 | 10. 5 tubs |
| 6. \$3.60 per bbl. | 11. $28\frac{1}{2}$ cents |
| 7. 42 cents | 12. 20,160 |
| 8. \$15.00 | 13. 3360 bush. |
| 9. \$2.88 | |

Exercise. Page 54

- | | |
|-----------------------------------|-----------------|
| 19. Length 24 feet, width 12 feet | 22. 147,071 |
| 20. \$36; \$24 | 23. 2976 boards |
| 21. 72 times | |

Exercise. Page 55

- | | |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 1. A \$8; B \$12 | 11. 2976 rails |
| 2. 1, 5, 7, 11, 13 | 12. H. C. F. 20; L. C. M. 36,901,200 |
| 3. Length 18 ft., width 9 ft. | 13. $7\frac{1}{2}$ lbs. |
| 4. 1, 2, 4, 5, 7, 8, 10, 14, 20, 28, 35,
40, 56, 70, 140, 280 | 14. 1938 tiles |
| 5. 9 | 15. 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15,
18, 20, 24, 30, 36, 40, 45, 60,
72, 90, 120, 180 |
| 6. 33 | 16. a. 1, 2, 3, 4, 6, 12 |
| 7. 309 | b. 12 |
| 8. 165 cu. ft. | c. 1,151,208 |
| 9. \$109.80 | |
| 10. 825,371 | |

Exercise. Page 57

- | | |
|------------------------------|------------|
| 17. 336 cu. ft.; 10,080 lbs. | 19. \$3.12 |
| 18. 6 ft. 8 in. | 20. \$25 |

Exercise. Page 71

- | | |
|-------------------------|--------------------------------|
| 1. $\$1\frac{1}{2}$ | 7. $55\frac{1}{2}$ bu. |
| 2. $\$1\frac{1}{2}$ | 8. $18\frac{1}{2}$ ft., 13 ft. |
| 3. 9 | 9. $714\frac{1}{2}$ rd. |
| 4. 13 eighths | 10. 440 |
| 5. $16\frac{1}{2}$ gal. | 11. $46\frac{1}{2}$ |
| 6. 65 mi. | 12. $33\frac{1}{2}$ hr., 4 |

ANSWERS

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Exercise. Page 75

- | | |
|--------------------|---------------------------|
| 1. $19\frac{1}{2}$ | 8. $69\frac{1}{2}$ |
| 2. $39\frac{1}{2}$ | 9. $81\frac{1}{2}$ mi. |
| 3. $53\frac{1}{2}$ | 10. $1834\frac{1}{2}$ bu. |

Exercise. Page 76

- | | |
|-------------------------|---------------------------|
| 1. $18\frac{1}{2}$ | 6. $220\frac{1}{2}$ acres |
| 2. $14\frac{1}{2}$ gal. | 7. $29\frac{1}{2}$ mi. |
| 3. $\frac{1}{2}$ | 8. $\$138\frac{1}{2}$ |
| 4. $7\frac{1}{2}$ yd. | 9. $175\frac{1}{2}$ mi. |
| 5. $84\frac{1}{2}$ | 10. $9\frac{1}{2}$ T. |

Exercise. Page 77

- | | |
|--------------------------------------------------------|--------------------------|
| 1. 16 oz. | 6. $39\frac{1}{2}$ T. |
| 2. $3\frac{1}{2}$ yd. | 7. $13\frac{1}{2}$ in. |
| 3. 1320 yd., $1906\frac{1}{2}$ yd. $36\frac{1}{2}$ yd. | 8. $41\frac{1}{2}$ mi. |
| 4. $2\frac{1}{2}$ A. | 9. $122\frac{1}{2}$ lb. |
| 5. $38\frac{1}{2}$ sec. | 10. $401\frac{1}{2}$ mi. |

Exercise. Page 78

- | | |
|--------------------------------------------|------------------------------------------------|
| 1. $\frac{1}{2}$ | 11. $295\frac{1}{2}$ A. |
| 2. $3\frac{1}{2}$ T. | 12. $1113\frac{1}{2}$ yd. |
| 3. $\frac{1}{2}$ | 13. $87\frac{1}{2}$ T. |
| 4. $21\frac{1}{2}$ gal. | 14. $26\frac{1}{2}$ lbs. |
| 5. $89\frac{1}{2}$ mi., $5\frac{1}{2}$ mi. | 15. $23\frac{1}{2}$ sec., $36\frac{1}{2}$ sec. |
| 6. $81\frac{1}{2}$ ft., $5\frac{1}{2}$ ft. | 16. $4\frac{1}{2}$ ft. |
| 7. $110\frac{1}{2}$ lbs. | 17. $18\frac{1}{2}$ in. |
| 8. $68\frac{1}{2}$ | 18. $555\frac{1}{2}$ T. |
| 9. $71\frac{1}{2}$ mi. | 19. 73, $88\frac{1}{2}$, $117\frac{1}{2}$ |
| 10. $5371\frac{1}{2}$ bu. | 20. $764\frac{1}{2}$ A. |

Exercise. Page 89

- | | |
|---------------------------|-------------------------------------|
| 1. 240 | 11. $1066\frac{1}{2}$ |
| 2. 384 | 12. 340 |
| 3. $\$41.66\frac{1}{2}$ | 13. 18 |
| 4. $1\frac{1}{2}$ days | 14. 100 towels; $9\frac{1}{2}$ cts. |
| 5. $147\frac{1}{2}$ yds. | 15. $\$33,075$ |
| 6. $34\frac{1}{2}$ ft. | 16. $11,739\frac{1}{2}$ lbs. |
| 7. $2732\frac{1}{2}$ bus. | 17. 144 days |
| 8. $41\frac{1}{2}$ miles | 18. $4\frac{1}{2}$ hrs. |
| 9. $29\frac{1}{2}$ bus. | 19. $\$63.25$ |
| 10. $39\frac{1}{2}$ lbs. | 20. $2395\frac{1}{2}$ miles |

Exercise. Page 92

- | | |
|-------------------------------------------------------------------------------------------------|---------------------|
| 1. $\frac{1}{2}, \frac{1}{3}, 2\frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}$ | 16. $1\frac{1}{10}$ |
| 2. $\frac{1}{2}, \frac{1}{3}, 1\frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}$ | 17. $\frac{1}{3}$ |
| 3. 16 | 18. $\frac{1}{11}$ |
| 4. $\frac{1}{2}$ | 19. $\frac{1}{11}$ |
| 5. $\frac{1}{2}$ | 20. $\frac{1}{11}$ |
| 6. $\frac{1}{2}$ | 21. $1\frac{1}{11}$ |
| 7. $1\frac{1}{2}$ | 22. $\frac{1}{11}$ |
| 8. $\frac{1}{11}$ | 23. $\frac{1}{11}$ |
| 9. $4\frac{1}{11}$ | 24. 12 |
| 10. $\frac{1}{11}$ | 25. $1\frac{1}{11}$ |
| 11. $\frac{1}{11}$ | 26. $\frac{1}{11}$ |
| 12. 2 | 27. $2\frac{1}{11}$ |
| 13. $2\frac{1}{11}$ | 28. 1 |
| 14. $2\frac{1}{11}$ | 29. $\frac{1}{11}$ |
| 15. $1\frac{1}{11}$ | 30. $\frac{1}{11}$ |

Exercise. Page 93

- | | |
|--------------|-----------------------------|
| 1. 792 miles | 4. 24 ft. long, 18 ft. wide |
| 2. \$2070 | 5. 253 lbs. |
| 3. 990 | |

Exercise. Page 94

- | | |
|-------------|--------------------------|
| 1. 360 | 6. \$8000 |
| 2. \$21,908 | 7. \$3150 |
| 3. \$126.80 | 8. \$15.50 |
| 4. 35 days | 9. \$16.86 $\frac{1}{3}$ |
| 5. \$8450 | 10. $1\frac{1}{3}$ miles |

Exercise. Page 95

- | | |
|--------------------|--------------------|
| 1. $\frac{1}{10}$ | 7. $1\frac{1}{4}$ |
| 2. $23\frac{1}{2}$ | 8. $1\frac{1}{10}$ |
| 3. $3\frac{1}{2}$ | 9. 19 |
| 4. $21\frac{1}{2}$ | 10. 7 |
| 5. $2\frac{1}{2}$ | 11. $\frac{1}{2}$ |
| 6. 0 | 12. $1\frac{1}{2}$ |

Exercise. Page 95

- | | |
|-----------------------------------|---------------------------------------------|
| 1. \$13.50 | 5. \$4000 |
| 2. \$29.30 $\frac{1}{2}$ | 6. \$278.88 $\frac{1}{2}$ |
| 3. Wife \$17,600, daughter \$5500 | 7. 202 $\frac{1}{2}$ ac.; 135 ac. wheat; 90 |
| 4. \$1667.25 | acres barley; 30 ac. oats |

- | | |
|---------------------------------------------------------------------------------------------------|------------------------------------------|
| 8. \$16.24 | 12. $\frac{1}{2}$, \$306.25 |
| 9. \$5.38 | 13. \$520 $\frac{1}{2}$ |
| 10. \$3822.62 $\frac{1}{2}$ | 14. 18 $\frac{1}{2}$ $\frac{1}{2}$ miles |
| 11. Seed cost \$104 $\frac{1}{2}$, crop worth \$1512 $\frac{1}{2}$, profit \$1468 $\frac{1}{2}$ | 15. \$2000 |

Exercise. Page 97

- | | |
|----------------------------------------------------|---------------------------------------------------------------------------|
| 1. 82944 lbs.; \$2460.67 | 6. \$255 |
| 2. 3055 $\frac{1}{2}$ lbs.; \$333.33 $\frac{1}{2}$ | 7. \$1196.80 |
| 3. 90,000 gallons | 8. 238 $\frac{1}{2}$ yds.; 132 $\frac{1}{2}$ yds.; 105 $\frac{1}{2}$ yds. |
| 4. \$36.75 | 9. 40 $\frac{1}{2}$ tons; \$688.50 |
| 5. 160 acres | 10. \$15,733 |

Exercise. Page 110

- | | |
|-------------|--------------|
| 1. 50.833 | 6. 10378.339 |
| 2. 118.617 | 7. 7184.736 |
| 3. 113.871 | 8. 7935.321 |
| 4. 1137.784 | 9. 4191.149 |
| 5. 1112.461 | 10. 5320.447 |

Exercise. Pages 73-74

- | | |
|----------------|-----------------|
| 1. 1567.67178 | 16. 13826.336 |
| 2. 1738.0814 | 17. 49370.521 |
| 3. 9524.8892 | 18. 9325.385 |
| 4. 1333.23887 | 19. 1097.509815 |
| 5. 1418.126 | 20. 12188507 |
| 6. \$1648.88 | 21. 717.12935 |
| 7. \$1450.04 | 22. 547.56122 |
| 8. \$1579.34 | 23. 6383.186 |
| 9. \$2063.69 | 24. 740.4841 |
| 10. \$2562 | 25. 1212.8426 |
| 11. 3402.95 | 26. 484.026 |
| 12. 3218.135 | 27. 1226.0624 |
| 13. 613.8254 | 28. 797 3094 |
| 14. 1767.324 | 29. 697 .5556 |
| 15. 104859.101 | 30. 575.501 |

Exercise. Page 112

- | | |
|------------|--------------|
| 1. 501.859 | 6. 584.9819 |
| 2. 750.1 | 7. 4718.313 |
| 3. 724.639 | 8. 522.816 |
| 4. 1419.79 | 9. 511.06656 |
| 5. 498.491 | 10. 1323.638 |

Exercise. Page 112

- | | |
|------------------|--------------------|
| 1. 802.6 miles | 6. 3097.71 bushels |
| 2. 608.56 miles | 7. 40.85 tons |
| 3. 2020.4 miles | 8. 1709.48 acres |
| 4. 56.12 inches | 9. 193.76 tons |
| 5. 13.877 inches | 10. 215.36 lbs. |

Exercise. Page 114

- | | |
|------------|-------------|
| 1. 38.489 | 11. .7647 |
| 2. 362.015 | 12. 4.7796 |
| 3. 26.9779 | 13. .16687 |
| 4. 1.2632 | 14. 1.9565 |
| 5. 58.1088 | 15. 51.522 |
| 6. 31.045 | 16. 459.88 |
| 7. 47.7422 | 17. 5.56285 |
| 8. 45097 | 18. 67.009 |
| 9. 48.638 | 19. 86.5497 |
| 10. 2.627 | 20. 47.556 |

Exercise. Page 115

- | | |
|-----------------|-------------------------------------------------|
| 1. 24.4 degrees | 9. Jersey gave 1.453 lbs. more than
Ayrshire |
| 2. 27.55 tons | Ayrshire gave 1.213 lbs. more
than Holstein |
| 3. 10.73 inches | Holstein gave 0.24 lbs. more
than Ayrshire |
| 4. 40.3 inches | 10. 24.8 lbs. |
| 5. 2.67 inches | |
| 6. 832.94 miles | |
| 7. 479.8 miles | |
| 8. 1411.6 miles | |

Exercise. Page 116

- | | |
|-------------|---------------------------------|
| 1. 47.575 | 6. 431 acres |
| 2. 1006.754 | 7. 111.95 tons |
| 3. 369.9528 | 8. 10.09 miles |
| 4. 86.1942 | 9. 77.042 miles |
| 5. 457.7493 | 10. 1.2 inches more in Edmonton |

Exercise. Page 119

- | | |
|-----------|------------|
| 1. 26.748 | 3. 222.272 |
| 2. .5642 | 4. 1.6072 |

- | | |
|---------------|----------------|
| 5. 457.46319 | 13. 303.6285 |
| 6. .2652 | 14. 95.1678 |
| 7. 32.92076 | 15. .0063802 |
| 8. -4.68546 | 16. .0020412 |
| 9. 785.8872 | 17. 254.6022 |
| 10. 38.128236 | 18. 161.496921 |
| 11. 5.162956 | 19. 1.8851742 |
| 12. 60.3694 | 20. 22.179156 |

Exercise. Page 120

- | | |
|--------------|---------------|
| 1. 1991.5608 | 9. 69.42234 |
| 2. 3.136152 | 10. 54.113238 |
| 3. 5.63586 | 11. 449.506 |
| 4. 43.04083 | 12. 34401.15 |
| 5. .0726376 | 13. 24.487021 |
| 6. 2.41162 | 14. .0612718 |
| 7. 173.9282 | 15. .1373085 |
| 8. 2.4552141 | |

Exercise. Page 120

- | | |
|----------------|--------------|
| 1. 593.028 | 9. 101245.05 |
| 2. .23450 | 10. 451.752 |
| 3. 17922.88 | 11. 18364.32 |
| 4. 2802.6 | 12. 2102.517 |
| 5. 17206.53 | 13. 272.49 |
| 6. 2368.614021 | 14. 345.67 |
| 7. 4.698 | 15. 21.12941 |
| 8. 1968 | |

Exercise. Page 120

- | | |
|-------------------|---------------------------------|
| 1. 704.718 miles | 6. 382.5498 lbs. ; \$202.751394 |
| 2. 875.875 miles | 7. \$157.4305 |
| 3. 29.0598 ft. | 8. \$2113.3115 |
| 4. 8000 lbs. | 9. \$21386.007 |
| 5. 242.1875 miles | 10. 126 tons ; \$2992.50 |

Exercise. Page 123

- | | |
|-----------|-----------|
| 1. 3.509 | 6. .007 |
| 2. 22.571 | 7. 1.0002 |
| 3. 50.806 | 8. 69 |
| 4. 46.703 | 9. .618 |
| 5. .201 | |

Exercise. Page 123

	A	B	C		A	B	C
1.	11.342	56.78	309.8345	6.	.9201	86.52	2.961
2.	75.943	6.38	6.738	7.	9.832	90.083	.757
3.	523.469	26.47	7.863	8.	.0000624	.4162	.537
4.	3.0478	72.039	106.965	9.	.00582	.2999	.000074
5.	.00057	.0476	.0897	10.	.05123	4.3218	2.698

Exercise. Page 85

	A	B	C
1.	113.566	747.61	72.849
2.	93.586	63.584	3.8465
3.	1472.3	5.8304	5.976
4.	463	5.46	2.736
5.	.097	12.82	.00154
6.	56.8	.206	.46215
7.	.00426	2900	.000268
8.	.00293	36.125	.04066
9.	28.37	.0879	5.839
10.	754.755	.03487	82.73

Exercise. Page 128

	A	B	C
1.	.0676	5.5824	.1424
2.	.8489	4.8865	3
3.	85.1063	39.7740	1070.3363
4.	858.8235	668.5714	11111.1111
5.	.5081	800	.1324
6.	1240	.0033	.002064
7.	10684.2105	2198.7027	.1311
8.	7.7390	.0346	11.8254
9.	9.1767	391.9372	.6576
10.	.0298	962.5668	615.9895

Exercise. Page 128

- | | | | |
|----|---------------|-----|--------------|
| 1. | 1.315 inches | 7. | 3870 bus. |
| 2. | 14.146 inches | 8. | 128 miles |
| 3. | 955.94 miles | 9. | 3508000 |
| 4. | 25.995 lbs. | 10. | 85100 |
| 5. | 4.128 lbs. | 11. | 4133.64 bus. |
| 6. | 2635 bushels | 12. | 555.775 |

Exercise. Page 130

- | | |
|-------------------------------|--------------------|
| 1. 40 rods | 6. \$28.18 |
| 2. 1218.75 lbs. | 7. 918 gallons |
| 3. 1396.648 bus. | 8. 3.46 lbs. |
| 4. 9.43 hours | 9. 9.689 miles |
| 5. 428.509 lbs.; \$201.399606 | 10. 9221.4 bushels |

Exercise. Page 131

- | | |
|------------------------------------------|---------------------------------------------------|
| 1. 1675 bus. wheat, 3600 bushels
oats | 6. 21.8375 miles per hr.; 18.96
knots per hour |
| 2. 110 yards | 7. \$155.76 |
| 3. 0.109 | 8. 9 mls. per hr. |
| 4. 8.947 hours | 9. 3.23 tons per acre |
| 5. 3.433 lbs. | 10. \$513.31½ |

Exercise. Page 132

- | | |
|------------------------|-------------------------|
| 1. \$96.90415 | 6. 27.3 miles per hr. |
| 2. \$4.40703 | 7. \$112.4705 |
| 3. \$2.54127 | 8. \$571.952 |
| 4. \$109.84248 | 9. 48.4 miles; \$1.6698 |
| 5. 4.75 cents per mile | 10. 1577.5425 |

Exercise. Page 134

- | | |
|----------------------------------|-------------------------------------|
| 1. \$181.05 | 42.9; N. S. 22.9; N. B. 12.5; |
| 2. 4.44 inches | Que. 5.66; Ont. 9.67; Man. |
| 3. \$1028.24 | 6.18; Sask. 1.95; Alta. 1.46; |
| 4. Taking 52 weeks in yr. 1910 — | B. C. 1.12; Yukon 0.041; |
| \$581.308; 1917 — \$814.996 | N. W. T. 0.0096; (d) 1.91 |
| Taking 365 days in yr. 1910 — | 6. (a) 1742.7 miles; (b) \$60.12315 |
| \$582.905; 1917 — \$817.235 | 7. \$9.853704 |
| Differences \$233.688; \$234.33 | 8. 6261.75 tons |
| 5. (a) 3,729,494.9 sq. miles; | 9. 302 hours 42½ min. |
| (b) 7,206,643; (c) P. E. I. | 10. 17 days 18.17 h.s. |

Exercise. Page 141

- | | |
|---------------------------------|---------------------------------------------------|
| 1. 1125 bu. | 6. Wh. 216, bar. 96, rye 72, oats 96,
oats 20% |
| 2. 15 problems | 7. For. 73,350, Can. 39,120, Br.
9780 |
| 3. 105 stockers | |
| 4. \$1020 | |
| 5. 240 ac., 32 ac., 48 ac., 15% | |

C
961
757
537
.0000746
698

Page 141—Continued

8. Br. 148,888, U. S. 136,816, others 116,696
 9. Br. \$748,394,249.20,
 U. S. \$276,330,184.32,
 Others \$126,651,334.48
10. B. C. \$21,447,938.04, N. 14,647,372.32, N. B. \$6,274.28. Others \$9,939,288.32

Exercise. Page 145

1. $33\frac{1}{2}\%$
 2. $66\frac{1}{2}\%$
 3. 87%
 4. 4.35%
 5. 28%
 6. $29.31 - \%$
7. $27.80 - \%$
 8. country $54.47 - \%$, city $45.52 - \%$
 9. $40.90 - \%$
 10. (1) $55.28 - \%$, (2) $9.73 - \%$
 (3) $8.18 - \%$

Exercise. Page 146

1. \$16144
 2. $14.83 - \%$
 3. Rur. 48.367% , Graded $51.33 - \%$
 4. $81.71 - \%$
 5. (a) \$50.10, (b) \$18.78 $\frac{1}{2}$,
 (c) \$31.31 $\frac{1}{2}$, (d) \$25.05
 6. 38.46%
7. (a) $98.97 - \%$, (b) $.26\%$, (c) 76%
 8. Can. 10.42% , U. S. 29.02%
 India 16.92%
 9. Man. 10.92% , Sask. 10.04%
 Alta. 8.33% , B. C. 24.24%
 10. $8.26 - \%$

Exercise. Page 148

1. (1) 2973.9381 lbs., (2) \$1457.23
 2. \$13,625.28
 3. (1) 18.75% , (2) 32.5% ,
 (3) 10.41% , (4) 25%
 4. N. 10867.2 lbs., Ph. 4075.2 lbs.,
 Pot. 2716.8 lbs.
 5. (1) \$720.45, (2) \$886.78,
 (3) 23.08%
 6. (1) 1916, 388,387; (2) 1917,
 413,323; (3) Man. 2.68%
- (4) Sask. 10.46% ; (5) Alta. 8.59% ; (6) B. C. 79%
 (7) 6.42%
 7. Br. 32.81% , U. S. 29.48%
 Fr. 244% , Jap. 2.48% , Nor. 13.89% , S. Am. 9.57%
 8. 55.81%
 9. Gold 7.73% , silver 6.12% , cop. 43.33% , coal 28.88%
 10. 1918, 3000 bu. 1919, 3750 bu.

Exercise. Page 151

1. 72, 126
 2. 55, 66, 77
 3. 684, 576
 4. \$125, \$225, \$150
 5. \$150, \$200, \$250
 6. 120, 140, 280
7. 61, 122, 183, 244, 305
 8. 450, 600, 765
 9. 153 bu., 170 bu., 187 bu.
 10. 525 bu., 350 bu.
 11. 36 boys

ANSWERS

307

Exercise. Page 152

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1. A 750, B 500 2. A \$60, B \$144, C \$96 3. S. \$3900, w. \$4800, d. \$3300 4. A \$1440, B \$960 5. A \$630, B \$525, C \$420 6. A \$10,920, B \$5460 7. A \$1080, B \$1260, C \$1440,
D \$1620 8. \$13,275 | <ol style="list-style-type: none"> 9. \$1765 10. B's Prof. \$87, C invests \$320 11. A 350, B \$210, C \$280 12. A \2333\frac{1}{3}$, B \$2500, C \2666\frac{2}{3}$ 13. Wine 288 gals, water 72 gals. 14. A 2662, B 2420, C 2200, D 2000 15. A 540, B 360, C 485 16. A 33$\frac{1}{3}$% 17. A \$15.60, B \$14.40, C \$8 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Exercise. Page 154

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1. A \$369.20, B \$563.80, C \$184.60 2. A 80 yds, B 15 yds., C 60 yds. 3. (1) 12, (2) 16, (3) 9 4. Silk 63 yds., tweed 82 yds. 5. Wheat 69¢ bu. | <ol style="list-style-type: none"> 6. 14 ten ¢, 12 five ¢ 7. 12 men 8. $\frac{112\frac{1}{2}}{7}$, $\frac{337\frac{1}{2}}{10}$, $\frac{562\frac{1}{2}}{12}$ 9. 30 cows 10. A 26 bu., B 19$\frac{1}{2}$ bu. |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Exercise. Page 155

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1. (a) 1478, 295$\frac{1}{2}$, (b) 28$\frac{1}{8}$, 5$\frac{1}{16}$,
(c) 31.30, 6.26 2. 34 3. (a) 3010 ft, (b) 3656$\frac{1}{2}$ ft.,
(c) 1408$\frac{1}{4}$ ft. 4. 28.72 5. 73.5 6. 14$\frac{1}{2}$ lbs. 7. 111 lbs. 8. 14 ft. 10 in. | <ol style="list-style-type: none"> 9. 1608$\frac{1}{2}$ lbs. 10. 8.8 11. 15,602 ft. 12. 65¢ 13. \2.06\frac{1}{2}$ 14. 43.9925° 15. 27 ft. 6 in.; 4 ft. 7 in. 16. 33$\frac{1}{2}$ gal. 19. \$12 per acre 20. \$42.0693 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Exercise. Page 160

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1. 375 lbs. 2. 44.625 ft. 3. 273 bu. 4. \$16 5. \$720 5. \$70 7. 3$\frac{1}{2}$ days. | <ol style="list-style-type: none"> 8. \1\frac{3}{4}$ 9. 150 men 10. \$12187.50 11. 288 mi. 12. 34 lbs. 13. \$25 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Exercise. Page 161

- | | |
|---------------------------|----------------------------------------|
| 1. $25\frac{117}{177}\%$ | 8. $\frac{1}{4}$ |
| 2. $8\frac{1}{4}$ days | 9. $\$6.37\frac{1}{4}$ |
| 3. 20, 40, 60 | 10. 999.99475 |
| 4. $31\frac{1}{4}$ days | 11. $\$29\frac{1}{4}, \$33\frac{1}{4}$ |
| 5. 2880 bd. ft. | 12. 87357 |
| 6. 379,540 | 13. $5\frac{1}{3}$ |
| 7. $\$5484.37\frac{1}{4}$ | |

Exercise. Page 165

- | | |
|-----------------------------|-------------------|
| 1. (a) $\$405$, (b) $\$93$ | 4. First by $\$6$ |
| 2. $\$380$ | 5. $\$12.75$ |
| 3. $\$1026$ | |

Exercise. Page 167

- | | |
|------------------------|----------------|
| 1. $32\frac{1}{4}\%$ | 8. $\$85$ |
| 2. $\$25$ | 9. $\$12.50$ |
| 3. $\$2700$, $\$2565$ | 10. $\$855$ |
| 4. $28\frac{1}{4}\%$ | 11. $\$250$ |
| 5. $35\frac{1}{4}\%$ | 12. No profits |
| 6. 25% | 13. $\$720$ |
| 7. $\$250$ | 14. $\$173.25$ |

Exercise. Page 169

- | | |
|----------------------|-----------------------|
| 1. $33\frac{1}{4}\%$ | 7. $11\frac{1}{4}\%$ |
| 2. 125% | 8. $41\frac{1}{17}\%$ |
| 3. $\$90$ | 9. $45¢$ |
| 4. $\$7\frac{1}{4}$ | 10. $33\frac{1}{4}\%$ |
| 5. $\$2885$ | 11. 12% |
| 6. $3\frac{1}{4}\%$ | 12. 60% |

Exercise. Page 172

- | | |
|-----------------------|-----------------|
| 1. $\$20$, 40% | 7. $\$7$ |
| 2. $\$9.90$ | 8. $\$2000$ |
| 3. $\$5$ | 9. $\$49087.50$ |
| 4. $\$128\frac{1}{4}$ | 10. 26% |
| 5. $\$24$ | 11. $\$4500$ |
| 6. $\$10$ | |

Exercise. Page 174

- | | |
|-----------------------|----------------|
| 1. $\$600$, $\$3400$ | 5. $\$20.25$ |
| 2. $\$148.75$ | 6. $\$7987.50$ |
| 3. $\$120$ | 7. $\$3264.57$ |
| 4. $\$750$ | 8. $\$750$ |

ANSWERS

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Exercise. Page 175

- | | |
|------------------------|-----------------|
| 1. 5% | 7. \$4000 |
| 2. 6% | 8. \$110 |
| 3. \$4 | 9. \$500, \$750 |
| 4. 2% | 10. 180 |
| 5. 3% | 11. 5% |
| 6. \$1687.50, \$562.50 | |

Exercise. Page 177

- | | |
|---------|-------------|
| 1. 1248 | 4. 30% |
| 2. 2½% | 5. \$187.50 |
| 3. 6½¢ | |

Exercise. Page 180

- | | |
|------------------------------------|-------------------------------|
| 1. \$36 | 6. ⅓%; 6%; ⅓% |
| 2. \$21.75 | 7. \$78,670; \$21,330 |
| 3. \$69.60 | 8. The first offer by \$9.75 |
| 4. \$318.50; \$7318.50; \$48681.50 | 9. \$68.85 |
| 5. \$192 | 10. \$30; \$360; \$2160; \$45 |

Exercise. Page 182

- | | |
|---------------------------|-----------|
| 1. \$15 | 5. 1½% |
| 2. \$295; \$1410 | 6. 1¼% |
| 3. \$24,908.40; \$373.626 | 7. \$1575 |
| 4. \$1.50 | |

Exercise. Page 186

- | | |
|-------------------------|---------------|
| 1. \$125 | 5. \$810 |
| 2. \$120 | 6. 2% |
| 3. 2½%, 25 mills, \$175 | 7. 2½%, \$100 |
| 4. \$52.80 | |

Exercise. Page 187

- | | |
|--------------|-------------------------|
| 1. 3¼ mills | 7. \$24.00 |
| 2. \$164.06¼ | 8. \$93.60; \$2,028,000 |
| 3. \$921.60 | 9. 2%, \$50,000 |
| 4. \$52 | 10. \$30, \$3470 |
| 5. \$790.40 | 11. 1½% |
| 6. 10 cents | 12. \$2400 |

Exercise. Page 189

- | | |
|--------------|------------------|
| 1. \$840,000 | 6. \$325,000 |
| 2. \$330,000 | 7. \$30 |
| 3. \$600,000 | 8. \$13,230 |
| 4. \$304,000 | 9. \$40 increase |
| 5. \$421,875 | 10. \$55 a month |

Exercise. Page 190

- | | |
|-------------|--------------|
| 1. \$10,800 | 6. 2000 lbs. |
| 2. \$612.50 | 7. \$2205 |
| 3. \$73.92 | 8. 35% |
| 4. \$690 | 9. \$1200 |
| 5. \$2 | 10. \$3690 |

Exercise. Page 192

- | | |
|--------------|---------------------|
| 1. \$55 | 11. \$177.80 |
| 2. \$54.60 | 12. \$568.05 |
| 3. \$180 | 13. \$451.50 |
| 4. \$78.804 | 14. Bank gains \$65 |
| 5. \$766.395 | 15. \$14.95 |
| 6. \$163.80 | 16. \$215.75 |
| 7. \$82 | 17. \$19.53 |
| 8. \$148.36 | 18. \$182.46 — |
| 9. \$187.50 | 19. \$387.62 — |
| 10. \$206.40 | |

Exercise. Page 194

- | | |
|--------------|-----------------------------|
| 1. \$1887.60 | 5. \$253.50 |
| 2. \$882 | 6. \$1336.80 |
| 3. \$934.92 | 7. \$851.67 |
| 4. \$960.84 | 8. Buying the house by \$32 |

Exercise. Page 194

- | | |
|--------|------------|
| 1. 8% | 6. 6% |
| 2. 6% | 7. \$17.50 |
| 3. 8% | 8. 7% |
| 4. 7½% | 9. 4% |
| 5. 8% | 10. 15% |

Exercise. Page 196

- | | |
|-------------|---------------------------|
| 1. 3 yrs. | 5. 16 yrs. 8 mos. |
| 2. 2½ yrs. | 6. (20; 25; 16½; 10) yrs. |
| 3. 5 months | 7. November 11th |
| 4. 3½ yrs. | |

ANSWERS

Exercise. Page 196

- | | |
|------------------|----------------|
| 1. (a) \$2000.00 | 2. \$3500.00 |
| (b) \$1875.00 | 3. \$20,000.00 |
| (c) \$2500.00 | 4. \$32,500.00 |
| (d) \$4000.00 | |

Exercise. Page 197

- | | |
|-----------------|-------------------|
| 1. (a) \$360.00 | 2. Prin. \$240.00 |
| (b) \$655.00 | Rate 8% |
| (c) \$750.00 | |
| (d) \$1,825.00 | |

Exercise. Page 199

- | | |
|------------------------|-----------------------|
| 1. \$685.49; June 5th | 4. Dec. 6th; \$407.17 |
| 2. Dec. 9th; \$977.31 | 5. Nov. 7th; \$749.51 |
| 3. Oct. 28th; \$662.76 | |

Exercise. Page 200

- | | |
|-------------|----------------------------|
| 1. \$280.92 | 6. \$17.40 |
| 2. \$93.41 | 7. \$35.20 |
| 3. \$700.00 | 8. \$81.67 |
| 4. \$403.23 | 9. \$881.31 |
| 5. \$392.47 | 10. \$513.92, 1 day = (7¢) |

Exercise. Page 201

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1. (a) May 16th (1909, '10, '11, '12)</p> <p>(b) \$155.00; \$147.50; \$140.00;
\$132.50</p> <p>(c) \$575.00</p> <p>2. (a) 10 years</p> <p>(b) (1) \$25.90</p> <p>(2) \$240.80</p> <p style="padding-left: 100px;">.25 }</p> <p>(3) \$229.60 }</p> <p>(4) \$218.40 }</p> <p>(5) \$207.20 }</p> <p>(6) \$196.00 }</p> <p style="padding-left: 100px;">.12 }</p> <p>(7) \$184.80 }</p> <p>(8) \$173.60 }</p> <p>(9) \$162.40 }</p> <p>(10) \$151.20</p> <p style="padding-left: 100px;">.37 }</p> <p>(c) \$616.00 }</p> | <p>3. (a) April 2nd (1913, '14, '15,
'16, '17, '18, '19, '20, '21,
'22)</p> <p>(b) \$186.00; \$179.40; \$172.80;</p> <p style="padding-left: 100px;">.13 }</p> <p>\$166.20 } ; \$159.60;</p> <p>\$153.00 ; \$146.40;</p> <p style="padding-left: 100px;">.05 }</p> <p>\$139.80 } ; \$133.20;</p> <p>\$126.60</p> <p style="padding-left: 100px;">.18 }</p> <p>(c) \$363.00 }</p> <p>4. (a) \$246.00; \$234.00; \$222.00;</p> <p>\$210.00; \$198.00;</p> <p>\$186.00; \$174.00; \$162.00</p> <p>(b) \$432.00</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Page 201 — Continued

Date of Payment	Principal	Interest	Amount
5. (a) April 2, 1914.	\$100	+ \$100	= \$200
" " 1915.	\$100	+ \$90	= \$190
" " 1916.	\$100	+ \$80	= \$180
" " 1917.	\$100	+ \$70	= \$170
" " 1918.	\$100	+ \$60	= \$160
" " 1919.	\$100	+ \$50	= \$150
" " 1920.	\$100	+ \$40	= \$140
" " 1921.	\$100	+ \$30	= \$130
" " 1922.	\$100	+ \$20	= \$120
" " 1923.	\$100	+ \$10	= \$110
(b)	\$1000 + \$550		= \$1550
Date of payment.	Principal	+ Interest	= Amount
6. (a) March 16, 1914.	\$800	+ \$720	= \$1520
" " 1915.	\$800	+ \$672	= \$1472
" " 1916.	\$800	+ \$624	= \$1424
" " 1917.	\$800	+ \$576	= \$1376
" " 1918.	\$800	+ \$528	= \$1328
" " 1919.	\$800	+ \$480	= \$1280
" " 1920.	\$800	+ \$432	= \$1232
" " 1921.	\$800	+ \$384	= \$1184
" " 1922.	\$800	+ \$336	= \$1136
" " 1923.	\$800	+ \$288	= \$1088
" " 1924.	\$800	+ \$240	= \$1040
" " 1925.	\$800	+ \$192	= \$ 992
" " 1926.	\$800	+ \$144	= \$ 944
" " 1927.	\$800	+ \$ 96	= \$ 896
" " 1928.	\$800	+ \$ 48	= \$ 848
(b)			\$17760
7. (a) April 14, 1903	\$795.00		

Exercise. Page 205

1. \$200.07

4. \$407.38

3. \$332.46

6. \$897.09

Exercise. Page 207

1. Int. \$102.50 Amt. \$1102.50

4. Dif. \$11.02

2. " \$191.02 " \$1191.02

5. " \$3.02

3. " \$312.16 " \$2812.16

6. " \$6.08

- | | |
|------------------|-------------------|
| 7. Amt. \$7.16 | 10. Amt. \$129.86 |
| 8. Diff. \$6.00 | 11. " \$541.22 |
| 9. Amt. \$466.56 | 12. " \$314.32 |

Exercise. Page 211

Date of Maturity	Term of Disc't.	Discount	Proceeds of Note
1. July 24, 1919	80 days	\$6.58	\$493.42
2. Jan. 18, 1920	125 "	\$9.59	\$390.41
3. March 28, 1919	43 "	\$6.19	\$650.81
4. July 14, 1919	17 days overdue	None	
6. They are equal; Lower rate of Int.; $8\frac{1}{4}\%$; Int. \$1.43, \$512.43			
7. \$740.26		9. \$10.84; \$573.16	
8. \$1322.48		10. \$891.12	

Exercise. Page 212

Discount	Proceeds	Discount
1. \$2.40	\$403.72	8. \$800
2. \$2.13	\$250.03	9. \$500
3. \$7.32	\$751.89	10. $22\frac{1}{4}\%$
4. \$4.05	\$1006.36	11. 146 days
5. \$33.55	\$1191.11	12. \$1390.25
6. \$769.84		13. \$419.13
7. Dec. 13, 1919; \$627.42;		14. \$454.14
\$1227.42; \$1207.34		

Exercise. Page 216

1. Exchange = \$3.75

Exercise. Page 216

- | | |
|------------------------------------------------------|------------------|
| 1. $\frac{4}{10}$ or $31\frac{1}{2}\%$; \$22,000.00 | 6. \$4000 |
| 2. \$4800 | 7. \$1980 |
| 3. \$14,400; \$8000 | 8. Lost \$240.00 |
| 4. \$450 | 9. \$2700 |
| 5. | 10. \$1500.00 |

Exercise. Page 217

- | | |
|--------------------------------|------------------------|
| 1. \$72.00 | 6. \$591.72; \$1491.72 |
| 2. 8 mills on the \$; \$156.60 | 7. $6\frac{1}{4}\%$ |
| 3. \$29,000 | 8. 5% ; 2% |
| 4. $32\frac{1}{2}\%$ | 9. 16 mills on the \$ |
| 5. $2\frac{1}{2}\%$ | 10. 13% |

Exercise. Page 219

- | | |
|--------------|--------------------------------------------------------|
| 1. \$101.32 | 6. \$58.08 (\$57.40) |
| 2. \$176.00 | 7. $4\frac{1}{2}$ bush. or 4 bush. $7\frac{1}{2}$ lbs. |
| 3. \$600 | 8. \$320.00 |
| 4. \$1791.70 | 9. 55¢ |
| 5. \$42.17 | 10. $8\frac{1}{2}\%$ |

Exercise. Page 220

- | | |
|--------------------------|--------------------|
| 1. $1\frac{1}{2}\%$ | 6. \$1080.00 |
| 2. \$35.00 | 7. |
| 3. \$862.50 | 8. The 70-day note |
| 4. \$2.47 $\frac{1}{2}$ | 9. \$5000.00 |
| 5. Loss $6\frac{1}{2}\%$ | 10. \$36.00 |

Exercise. Page 233

- | | |
|------------------|-----------------------------|
| 1. 30 sq. ft. | 7. 78 tons |
| 2. \$.25 | 8. 1280 bushels |
| 3. \$396 | 9. 80 rds. \times 20 rds. |
| 4. \$1584 | 10. 2560 acres |
| 5. 132 trees | 11. 12 acres |
| 6. 19,800 blocks | |

Exercise. Page 237

- | | |
|----------------------------------------|---------------------------|
| 1. $18\frac{1}{2}$ ft. \times 37 ft. | 6. 12,130,560 acres |
| 2. \$13.20 | 7. 15,360 acres |
| 3. 200 rds. | 8. \$320.64 |
| 4. 10 yrs. | 9. \$132 |
| 5. \$23.409 | 10. \$96.88 $\frac{1}{2}$ |

Exercise. Page 239

- | | |
|---------------------------------------------------------------------------|------------|
| 1. $8\frac{1}{2}$ sq. ft.; 399.9125 sq. chs.;
840 sq. rds. 14 sq. yds. | 3. 6 |
| 2. 18 acres | 4. 32 ft. |
| | 5. 16 ins. |

Exercise. Page 240

- | | |
|----------------|--------------|
| 1. 88 sq. ins. | 3. 33 B. ft. |
| 2. 30 acres | 4. \$975 |

Exercise. Page 243

- | | |
|----------------|------------------------------------------------------------------------------------|
| 1. 63 sq. ins. | 5. 4 |
| 2. 9 acres | 6. $42\frac{1}{2}$ sq. yds.; $113\frac{7}{8}$ sq. yds.;
$2\frac{3}{4}$ sq. chs. |
| 3. 9 ins. | 7. 15 ft.; 220 yds.; 2125 links |
| 4. 50 rds. | |

ANSWERS

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Exercise. Page 246

- | | |
|-------------------|-------------------------|
| 1. 37 ft. | 7. 4 ft. |
| 2. 64 ft. 10 ins. | 8. 390 yds. |
| 3. 650 ft. | 9. 3 rds. 2 yds. 6 ins. |
| 4. 77 ft. | 10. 4 chs. 80 links |
| 5. 44 ft. | 11. .61105 sq. in. |
| 6. 70 chs. | |

Exercise. Page 246

- | | |
|------------|-------------------|
| 1. 40 ft. | 7. 4 ft. |
| 2. 20 ft. | 8. 34 ft. |
| 3. 13 ft. | 9. \$487.20 |
| 4. 96 ft. | 10. 85 ft. |
| 5. 193 ft. | 11. 2 yds. 3 ins. |
| 6. 114 ft. | |

Exercise. Page 248

- | | |
|-------------------------------|---------------------------|
| 1. 110 ft. | 12. 2 ft. 11 ins. |
| 2. 286 chs. | 13. 7 ft. |
| 3. 14 yds. 2 ft. | 14. 1120 ft. |
| 4. 6 rds. | 15. 4.9 mi. |
| 5. 11 chs. | 16. 20 rds. 4 yds. |
| 6. 24 chs. 64 links | 17. 1 ch. 71.5 links |
| 7. $62\frac{1}{2}$ ft. | 18. 25 yds. 1 ft. |
| 8. 14 chs. 96 links | 19. $150\frac{1}{2}$ ins. |
| 9. 17 yds. 4 ins. | 20. 14 ins. |
| 10. 14 ins. | 21. \$158.40 |
| 11. 3 ft. $2\frac{1}{2}$ ins. | 22. 8 |

Exercise. Page 250

- | | |
|------------------------------|-------------------------------------------------------|
| 1. 5544 sq. ins. | 11. $17.796\frac{1}{2}$ sq. links |
| 2. 7546 sq. yds. | 12. $50\frac{1}{4}$ acres |
| 3. 24062.5 sq. yds. | 13. 38.5 sq. ft. |
| 4. 13898.5 sq. yds. | 14. 180 sq. ft. 106 sq. ins. |
| 5. 18.32985 sq. chs. | 15. 1.54 acres |
| 6. 1386 sq. yds. | 16. 9.625 sq. rds. |
| 7. $471\frac{1}{2}$ sq. ins. | 17. 11 sq. rds. 13 sq. yds. 6 sq. ft.
108 sq. ins. |
| 8. 647.185 sq. chs. | 18. 385 acres |
| 9. 3850 sq. yds. | |
| 10. $21\frac{1}{4}$ sq. yds. | |

Exercise. Page 250

- | | |
|------------------------------|---------------------------------|
| 1. $176\frac{1}{4}$ sq. yds. | 7. 77 sq. ins. |
| 2. $50\frac{1}{4}$ acres | 8. 55 ins.; 71.5 ins.; 88 ins.; |
| 3. $150\frac{1}{2}$ ft. | 99 ins. |
| 4. 25 rds. | 9. 62.04 yds. |
| 5. 17 ins. | 10. 3.863 sq. ft. |
| 6. \$1013.76. | 11. 16.5 ft. |

Exercise. Page 252

- | | |
|---------------------------------------------|---------------------------|
| 1. 121.5 sq. ins.; $91\frac{1}{2}$ cu. ins. | 7. 1 cu. ft. 469 cu. ins. |
| 2. 89.5 sq. ins.; 52.5 cu. ins. | 8. $2\frac{1}{2}$ ins. |
| 3. 138 sq. ins.; 87.75 cu. ins. | 9. 16 ft. 9.6 ins. |
| 4. 216 | 10. 1 ft. 9.9 ins. |
| 5. 4320 sq. ins. | 11. 2.4 ft. |
| 6. 14 ft. 8.4 ins. | |

Exercise. Page 252

- | | |
|----------------------------|------------------------|
| 1. 36 ft. | 7. $3\frac{1}{2}$ ft. |
| 2. $6\frac{1}{2}$ ft. | 8. 18 ft. |
| 3. $1222\frac{3}{4}$ gals. | 9. $\frac{1}{8}$ ins. |
| 4. 10 ins. | 10. $5\frac{1}{2}$ ft. |
| 5. 8640 | 11. 2.2575 tons |
| 6. $4\frac{1}{2}$ ft. | 12. 500 loads |

Exercise. Page 255

- | | |
|-----------------------------|---------------------------------------|
| 1. $7\frac{1}{2}$ sq. ft. | 18. 490 B. ft. |
| 2. 7 sq. ins. | 19. 894.97 gals. |
| 3. $35\frac{1}{8}$ tons | 20. \$87.50 |
| 4. $282\frac{1}{2}$ cu. ft. | 21. $183\frac{1}{2}$ sq. ft. |
| 5. 57042.857 cu. ft. | 22. 75796 $\frac{1}{2}$ gals. |
| 6. 12306.7 tons | 23. $34\frac{1}{2}$ ins.; .0968 ins. |
| 7. \$303 | 24. 18 ft. |
| 8. 186.962 bushels | 25. circle by $30\frac{1}{4}$ sq. ft. |
| 9. 12,031,250 gals. | 26. \$519.75 |
| 10. 80 ft. | 27. 229.259 mi. |
| 11. 916.5 sq. ft. | 28. \$62.40 |
| 12. 16.85 ft. | 29. 4 ft. |
| 13. 1452 sq. ft. | 30. \$56 |
| 14. 7.071 ft. | 31. $36\frac{1}{2}$ sq. yds. |
| 15. 43.08 ft. | 32. 1 hr. 20 mins.; 2.663 acres; |
| 16. \$18 | 462.4 acres |
| 17. 3456 | 33. \$24 |

- | | |
|-------------------|-----------------|
| 34. \$19.50 | 37. \$71.215 |
| 35. \$48, \$57.60 | 38. 996 B. ft. |
| 36. \$255.64 | 39. 268 sq. ft. |

Exercise. Pages 263-264

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|------------------------------------------------------------------------------|-----------------------------------|
| 4. (a) 1595012.948 m., (b) 802.0 m.;
0.00083 m., (c) 365 ^o m.; | 8. 4800 km. |
| 391.94 m. | 9. 13½ m. |
| 5. \$272.1875 | 10. १००० |
| 6. \$180325 | 11. 83 Km. 7 Hm. 1 Dm. 1 m. 8 dm. |
| 7. 7.6375 miles | 12. 257 francs |

Exercise. Page 265

- | | |
|---------------------------------------------|--------------------|
| 3. \$155163.648; 1 H. A., 1 A.,
1.8 c A. | 8. 111.7978 sq. m. |
| 4. 12.4575 sq. mi. | 9. \$1055.60 |
| 5. 2.92 sq. m. | 10. 28.8 metres |
| 7. 23.5225 sq. m. | 12. 4650000 |

Exercise. Pages 266-267

- | | |
|----------------------------------------------------|------------------|
| 3. 1219.24940201 cu. m. ;
1219249.40201 cu. dm. | 6. 867.2 litres |
| 4. 175½ steres | 8. \$1.008 |
| 5. \$35.75 | 9. 0.8096 cu. m. |
| | 10. 100 |

Exercise. Page 270

- | | |
|---------------|-------------------|
| 1. 6.21 miles | 6. 302400 kgms. |
| 2. \$153 | 7. 38.4 kgms. |
| 3. \$649.41 | 8. 1.75 |
| 4. 16800 | 9. 1400 |
| 5. 27½ cm. | 10. 119.68 cu. m. |

Exercise. Page 270

- | | |
|-------------------------------|-------------------|
| 1. 27 to 25 | 7. 2.76 litres |
| 2. 49.5 ares | 8. 189.4 |
| 3. 1166 cm. ; 108171½ sq. cm. | 9. 3.9 kgms. |
| 4. \$125.71 | 10. 0.000375 kgm. |
| 6. 19.68 litres | 11. 337500 kgms. |

Exercise. Page 272

- | | |
|-----------------------------|--------------------------------|
| 1. 42.3 Γ . | 11. \$16 gain |
| 2. 3940 lbs. | 12. \$3812.44 |
| 3. $\frac{11}{14}$ | 13. 510.40 |
| 4. $151\frac{1}{4}$ cu. ft. | 14. 480 rd. |
| 5. \$75 each | 15. 80 ft. |
| 6. \$18,600 | 16. \$130.69 |
| 7. $8\frac{1}{2}\%$ | 17. \$12,240 |
| 8. 2d invest., \$146.40 | 18. (a) Sept. 19, (b) \$855.99 |
| 9. \$14,231.90 | 19. $3579\frac{1}{11}$ T. |
| 10. 45.6¢ | 20. $9\frac{1}{11}\%$ |

Exercise. Page 275

- | | |
|-----------------------|--------------------------|
| 1. \$27.61 | 11. \$750, \$1050, \$900 |
| 2. \$1.83 | 12. \$6 |
| 3. $89\frac{2}{7}\%$ | 13. 24 ft. |
| 4. \$144 | 14. \$7475 |
| 5. 734.72 | 15. $11\frac{1}{11}$ ft. |
| 6. \$78.04 | 16. \$32.92 |
| 7. 7.7 acres | 17. 1,815,000 gal. |
| 8. \$7.98 | 18. 8 |
| 9. \$721.17 | 19. \$451.50 |
| 10. $5\frac{1}{11}\%$ | 20. \$3606.95, \$3570.88 |

Exercise. Page 278

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|-----------------|---------------------------------------|
| 1. 1.8 a. | 11. \$15 |
| 2. \$1018.18 | 12. $\frac{1}{2}$ |
| 3. 1500 | 13. 1st .73% daily, 2d .116% daily |
| 4. 16112 | 14. $28\frac{1}{2}\%$ |
| 5. 9125.92 | 15. 1st boy, \$6875; 2d boy, \$12,456 |
| 6. 11,550 gal. | 16. 4,181,760 cu. ft. |
| 7. 3277.24 | 17. \$1100 |
| 8. 2700 cu. ft. | 18. \$188.25 |
| 9. .368 cu. in. | 19. 50% |
| 10. \$91.00 | 20. $66\frac{2}{3}\%$ |

Exercise. Page 281

- | | |
|------------------------|--------------------------------------------------|
| 1. \$2693.80 | 5. \$426.666 $\frac{2}{3}$, \$630.00, \$1536.00 |
| 2. 37¢, 60¢, 83¢ | 6. \$5370.00 |
| 3. 85¢, \$1.25, \$1.55 | 7. \$11.32 |
| 4. 7 ft. | 10. \$636.75 |

ANSWERS

319

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|-----------------------------------|-------------------------------------|
| 11. \$440.50 | 16. \$1135.14, \$1702.70, \$1362.16 |
| 12. 232 sq. ft. | 17. 120, 130 |
| 13. \$318.00, \$302.40, \$286.80, | 18. \$1279 |
| \$271.20, \$255.60 | 19. 1192.83, 1023, 90.25% |
| 14. \$3962.50 | 20. \$1556.58 |
| 15. 15.1% | |

Exercise. Page 285

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|----------------------------------|------------------------------------|
| 1. 43.275° , 66.2° | 10. $12\frac{1}{4}$ |
| 2. 7.99, \$69.61 | 12. 3151.51 gal. |
| 3. 720 | 13. \$2501.70 |
| 4. 127.2 ft. | 14. \$25; 0.91 |
| 5. 22.627 sq. in. | 15. 21.823 a. |
| 6. 5280 sq. ft. | 16. \$4774, \$4543, \$4312, \$4081 |
| 7. \$3748 | 17. 10%, \$132.50 |
| 8. Cash, \$21.58 | 18. 38 da., May 26, Mar. 24 |
| 9. A \$742.42; B \$890.91; | 19. \$19.760 |
| C \$765.63; D \$848.49; | 20. \$19959.83 |
| E \$954.55. A \$3000; | |
| B \$1050; C \$900 | |

