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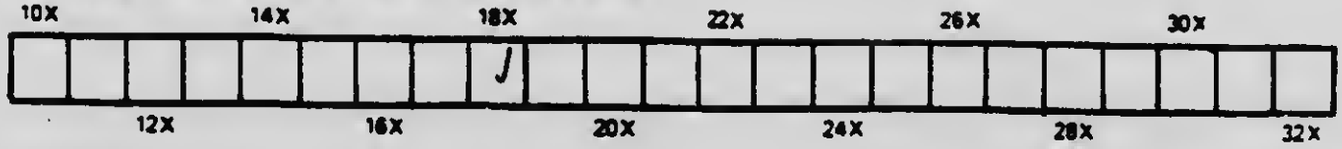

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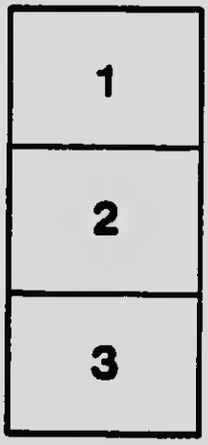

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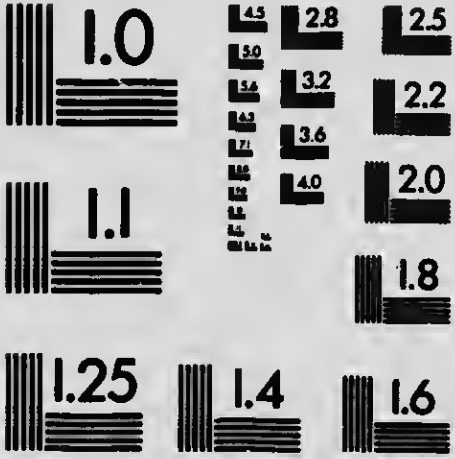

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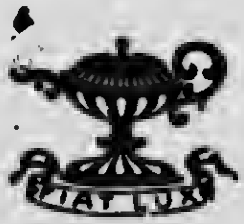
THE DOMINION
ELEMENTARY ARITHMETIC

FOR PUBLIC SCHOOLS

PART II



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PREFACE

During the last decade great changes have taken place in the methods of teaching many of the subjects of the school course. In no subjects have the changes been more apparent than in the mathematical ones, geometry, algebra, and arithmetic. The present book is an effort to meet a pressing demand on the part of the teachers of Canada for an elementary arithmetic, conceived on modern lines, and suited to the needs of the public schools.

The book consists of two parts. Part I. is designed for Grades IV. and V., or for Form III. of the public schools. A child is incapable of using a text-book intelligently before the third book class is reached. At this point a text may with advantage be placed in his hands, and Part I. will, we believe, be found specially suited to the purpose.

Part I. begins with two chapters on number work, covering the ground already familiar to the pupil. These exercises, reviewing as they do the ordinary number relations and containing simple problems based upon them, will serve to familiarize the child with the use of a text-book. Then follows a series of short chapters presenting the main facts of arithmetic with practical applications in a way which we believe will be found suited to the intelligence of children at this period of their school life.

A short chapter on simple fractions has been introduced after the simple rules. This chapter does little more than state definitely facts already familiar to the pupils. In later chapters vulgar and decimal fractions and percentage are introduced in an elementary way. This is done to enable those pupils who leave school at the end of the Third Form to have a general, if elementary, idea of these subjects, so important from a practical point of view.

Part II. is designed to complete the public school course. Throughout, the principles and facts set forth in Part I. are reviewed; such new material and extensions of the subject as are deemed necessary have been added; the exercises will be found to contain more difficult and complex problems.

The inductive method of presenting the suhject has been followed as far as possihle. The pupil is called npon all the way through to express what he has discovered, thus arriving at exact definitions and statements of facts. Review exercises relating to the particnlar part of the suhject under discussion, and also special review sections covering the whole ground already familiar to the pupil, are introduced with each chapter. This will, we believe, secure to the child all the advantages of the "spiral method" withont its many evident disadvantages. Each chapter ends with a series of prohlems which reqnires the pupils to be independent of special rules or snggestions arising out of chapter headings.

The book is not a book of problems only. This, we believe, will commend it to teachers. We are firmly convinced that a carefnl and exact statement of facts, hy means of definitions, will be fonnd helpful to both pupil and teacher. Want of exactness in statement and the lack of appreciation of the precise meaning of words are among the chief causes of defective teaching, especially in suhjects which may be classified as exact sciences. Rnles, therefore, we have omitted, but definitions have been plainly stated after the facts which make them necessary have been worked ont. Occasionally a chapter begins with a statement of fact or a definition, hnt where such is the case it is because the facts upon which it is based have become familiar through previous work.

Further, we have not hesitated to introduce solntions where it seems necessary to make olear the process involved and to guide the pupil in a method of doing his work. Many years of experience as teachers and examiners in mathematical suhjects have convinced us that not enough attention is paid to securing, on the part of pupils, clear statements of the meaning of the steps involved in the working of prohlems.

We have introdnced, under denominate numbers in Part I., only the tables of measnres in common use in this country. The metric system, tahles of English money, Troy weight, etc., will be fonnd at the end of Part II. Teachers who desire can present these tahles earlier. This arrangement has been adopted to avoid confusion in the elementary stages.

THE AUTHORS.

CONTENTS

CHAP.		PAGE
I.	REVIEW EXERCISES	
	i. Notation and Numeration	9
	ii. Simple Rules	11
	iii. Compound Numbers	14
II.	FACTORS, CANCELLATION, MEASURES, MULTIPLES	
	i. Factors	21
	ii. Cancellation	22
	iii. Measures	23
	iv. Multiples	26
	Oral Exercise	28
	v. General Review	29
III.	VULGAR FRACTIONS	
	i. Reduction of Fractions	31
	(*a*) Review Exercises	31
	(*b*) Compound Fractions	36
	ii. Addition of Fractions	38
	iii. Subtraction of Fractions	40
	iv. Multiplication and Division of Fractions	44
	v. Complex Fractions	48
	vi. Denominate Fractions	52
	Oral Exercise	56
	vii. General Review	57
IV.	DECIMALS	
	i. Notation and Numeration	63
	ii. Addition of Decimals	65
	iii. Subtraction of Decimals	66

CHAP. PAGE

IV. DECIMALS—*Continued*

iv. Multiplication of Decimals . . . 68
v. Division of Decimals 69
vi. Reduction of Decimals 71
vii. Decimals of Denominate Numbers . . 73
Oral Exercise 76
viii. General Review 77

V. PERCENTAGE 79

VI. APPLICATIONS OF PERCENTAGE

i. Trade Discount 83
ii. Profit and Loss 86
iii. Commission 90
iv. Insurance 93
v. Taxes 98
vi. Customs and Excise Duties . . . 102
vii. Interest 104
viii. Bank Discount 108
Oral Exercise 110
ix. General Review 111

VII. SHARING, PROPORTIONAL PARTS, OR DISTRIBUTIVE PROPORTION

i. Sharing 114
ii. Partnership 115
iii. General Review 117

VIII. INVOLUTION AND EVOLUTION

i. Involution 118
ii. Square Root 120

IX. MENSURATION

i. The Parallelogram 124
ii. The Triangle 126

CHAP. PAGE

IX. MENSURATION—*Continued*

III. The Right-Angled Triangle . . . 127
IV. The Circle 129
V. Rectangular Solids 132
VI. The Cylinder 134
Oral Exercise 135
VII. General Review 136

X. MISCELLANEOUS AND INDUSTRIAL PROBLEMS . 137

XI. METRIC SYSTEM AND TABLES

I. Metric System 143
II. Tables 149

ANSWERS 151

ELEMENTARY ARITHMETIC

PART II

CHAPTER I

REVIEW EXERCISES

I. NOTATION AND NUMERATION

EXERCISE 1

Point off the following numbers into periods and read each number:

1. 361280202; 275248604; 720006; 201204000; 2002012.

2. 607070; 8100180; 10150105; 1015010; 101501; 7007022.

3. 70070220; 700702202; 770077077; 500050005; 6076076.

4. 800808; 3030003; 40004400; 309093039.

Express in words:

5. 707.7, 850.79, 5695.06, 473.628.

6. 564.18, 7840.06, 4005.07, 36000.41.

7. 3000.71, 901,007, 720,009, 1820.106.

8. 31400.06, 50000.604, 36000.107.

9. 404004.001, 440000.04, 40004.004.

10. 700700.5; 8070036.4; 40440440.4.

11. In which period may there be fewer than three figures?

12. Name the periods in order to the left of the decimal point, as far as trillions.

Write in figures the following:

13. (*a*) Eight hundred thousand and eight.

(*b*) Eight hundred thousand and eighty.

(*c*) Eight hundred thousand, eight hundred.

(*d*) Eight thousand, eight hundred and eight.

(*e*) Eight thousand, eight hundred and eighty.

(*f*) Eighty thousand, eight hundred.

14. (*a*) One million, one thousand, one hundred and one.

(*b*) One million, ten thousand, one hundred and ten.

(*c*) One million, one hundred and one thousand and one.

(*d*) One million, one hundred thousand and one.

(*e*) One million and one.

15. One tenth; one hundredth; one thousandth; six tenths; sixty-six hundredths; sixty-six thousandths; seven tenths; seventy hundredths; five thousandths; four hundred and five thousandths; two thousand, and six ten-thousandths.

16. Five, and five tenths; four, and four hundredths; six, and six thousandths; ten, and eleven hundredths; eleven, and seventy-four thousandths; nineteen, and ninety-five ten-thousandths.

EXERCISE 2

Write in Roman numerals:

1. 444, 999, 949.
2. 1499, 2409, 1902.
3. 1875, 1901, 1839
4. 3849, 1844, 1900.
5. 1794, 1497, 1990.
6. 2345, 1999, 1444.

Write in figures :

7. XCIX, MCXXIX, CMXC, CMXCIV, DLIV.

8. MIX, MDIX, MCD, MCCCXXXIX, DXLIV.

9. MDCCCLXXXIX, MDXL, MCDXC, MCMXCV.

10. What numbers can be expressed by means of the letters C and X, taken separately or in combination ?

11. Multiply MCMII by MDCCCXIV, and divide the result by CCCXVII.

II. SIMPLE RULES

EXERCISE 3

Add the following :

1.	2.	3.	4.
74	897	754	9978
58	896	569	3985
76	875	937	3755
69	897	875	7674
49	987	669	7778
99	898	676	8589
78	696	384	5588
73	767	494	5656
96	898	787	9999
45	454	555	7778
38	578	987	7897
78	589	497	6846
97	879	758	7785
44	786	589	8755
76	386	564	5678
66	378	785	7648

5. Write down the following statement of six weeks' cash receipts; add the amounts vertically and horizontally,

and prove the correctness of your work by adding your results:

	MON.	TUES.	WED.	THUR.	FRI.	SAT.	TOTAL
1st	$84.56	$74.68	$57.92	$78.81	$51.27	$73.28	.....
2nd	73.55	65.43	81.47	86.57	74.23	36.19	.....
3rd	91.32	47.62	90.54	64.93	83.57	75.64	.....
4th	64.39	54.98	76.41	71.46	54.39	46.37	.....
5th	57.95	49.17	42.86	92.78	67.44	85.16	.....
6th	78.19	63.58	59.29	63.69	96.08	79.31	.....
Totals...	.....	.....	.....	.....	.....	.....	.....

Subtract and verify the results:

6. 370001884706
   197094793759

7. 550077006301
   184738956975

8. 900700600500
   156987784907

9. 307040502070
   156489765097

10. Subtract 78563 ten successive times from 888072, and add the ten successive remainders.

Multiply the following and verify the results:

11. 90007006 by 406.
12. 98700987 by 789.
13. 45678947 by 38.
14. 76897957 by 849.

EXERCISE 4

Divide the following and prove the results:

1. 768497689 by 59.
2. 380078000 by 693.
3. 507080903 by 178.
4. 910008100 by 377.

5. What number must be added to 280 so that 133 times the sum will be 95 times 399?

6. Find a number such, that if it is added twenty-nine times to 54678, the sum will be 70541

7. The product of four numbers is 827658432; the first number is 12, the product of the second and third is 144. Find the fourth.

8. The number 8967 is both divisor and quotient of an example in division, and the remainder is the largest possible. Find the dividend.

9. The quotient is 12434, the remainder 2743, and the dividend eighty-seven million nine hundred and eleven thousand one hundred and twenty-three. Find the divisor.

EXERCISE 5

1. A grocer mixed 106 lb. tea costing 38c. per pound, 75 lb. costing 42c. per pound, and 94 lb. costing 45c. per pound, and sold the mixture at 60c. per pound. What was his gain on the whole?

2. If 24 men do a work in 10 days, and 40 boys do it in 8 days, which will be the cheaper—to get boys to do it at 40c. each a day, or men at 75c. each a day?

3. How much water must be added to 63 gal. of brandy worth $4.40 per gallon, in order that the mixture may be worth $3.60 per gallon?

4. A coal dealer paid $965 for coal. He sold 160 t. at $5 a ton, and then the remainder cost him only $3 a ton. How many tons did he buy?

5. A drover bought 247 sheep at $4.75 each, and 42 more at $4.80 each; 8 of them died, and he sold the rest at $6 each. How much did he gain?

6. Seven hundred and twenty navvies have provisions for 50 days, but after 20 days an additional number arrive, and the provisions are exhausted in 10 days. Find the number of navvies in the additional number.

7. If 26 sheep are worth 5 oxen, 2 oxen are equal in value to 3 horses, and 7 horses can be purchased for $455, find the value of a sheep.

8. A man hired a laborer on the agreement that for each day he worked he should receive $1.50 and his board, but for every day he was idle he should pay 50c. At the end of 40 days the laborer received $40. How many days did he work?

III. COMPOUND NUMBERS

EXERCISE 6

1. Reduce the following to yards:

43 rd.; 101 rd. 2 yd.

2. Reduce the following to rods:

523 yd.; 2507 ft.; 1131 in.

3. Reduce 7 mi. 5 rd. 2 yd. 2 ft. 11 in. to inches, and prove the result by reducing the number of inches to miles, rods, etc.

4. Reduce the following to square yards:

365 sq. rd.; 75 sq. rd.; 19 sq. yd.

5. Reduce the following to square rods:

890 sq. yd.; 5000 sq. yd.

6. Reduce 5 a. 39 sq. rd. 3 sq. yd. 7 sq. ft. 100. sq. in. to square inches.

7. From 7 mi. 31 rd. 1 yd. 1 ft. 3 in. take 1 mi. 39 rd. 1 yd. 2 ft. 7 in.

8. A man walked round his farm, which is 3 mi. 25 rd. 3 yd. in perimeter, every day during the month of June. How far did he walk in making the circuits?

9. Divide 313 mi. 208 rd. 4 yd. 1 ft. 11 in. by 19.

10. A person takes 110 steps in a minute, the length of each being 30 in. At what rate per hour does he walk?

11. The fore-wheel of a carriage is 10 ft. in circumference and the hind one is 16 ft. How many more revolutions will one wheel make than the other in 1 mi.?

EXERCISE 7

1. How many hours are there from noon on the 15th of June till 9 a.m. on December 31st following?

2. If telegraph posts are placed 80 yd. apart, and a train passes one every 4 sec., how many miles an hour is it running?

3. What will it cost to feed 13 horses for 40 weeks when hay is $10 per ton and oats 40c. per bushel, if a horse eats 15 lb. of hay and 12 qt. of oats per day?

4. From Belleville to Madoc is 26 mi. 80 rd., and a carriage wheel turns 11088 times in going the distance. Find the circumference of the wheel in feet and inches.

5. A box with a cover is 2 ft. long, 2 ft. wide, and 2 ft. deep on the outside and is made of boards 1 in. thick. How many square feet of lumber are required to make it, and how many cubic inches of space are inside it?

6. *A* owns a farm of 25 a. 19 sq. rd. 7 sq. yd.; *B* owns a farm $\frac{1}{4}$ the size of *A*'s; *C*'s is 9 a. 18 sq. yd. 7 sq. ft. less than 9 times as much as *B*'s. Find the amount of land in the three farms.

7. How many miles will a boy walk to plough 3 a., turning a furrow of 9 in.?

8. A man rolling a wheelbarrow takes 85 steps, each 2 ft. 6 in. long, in 1 min. How often will the wheel of the barrow, which is 46 in. in circumference, revolve in 1 hr.?

9. On a field I sow $17.85 worth of barley, at 84c. per bushel, using 2 bu. and 2 pk. to the acre. Find the size of the field.

EXERCISE 8

1. A cubic foot of wheat weighs 48 lb. How many bushels of wheat will a bin 8 ft. long, 5 ft. wide, and 3 ft. deep hold?

2. Rule in proper form and make out the following bill:

Mr. Thomas Kennedy, bought from The T. Eaton Co., Toronto, December 1st: 1½ doz. knives at $3.50 per dozen; 1 doz. dinner plates at $3 per dozen. December 6th: 1½ doz. cups and saucers at $1.10 per dozen; ½ doz. forks at $3 per dozen; 4 pitchers at 50c. Date the bill September 20th, 1908, and receipt as clerk for The T. Eaton Co.

3. What is the total cost of the following: 108 eggs at 13c. per dozen; 128 lb. of pork at $6.25 per cwt.; 1650 lb. of bran at $12 per ton; 6060 lb. of wheat at 87c. per bushel; 375 lb. of sugar at 20 lb. for a dollar; 963 lb. of oats at 68c. per bushel?

4. A wagon wheel 11 ft. in circumference, makes 48 revolutions in a minute. How many miles an hour is the wagon traveling?

5. How many bushels of oats are equal in weight to 68 bu. of barley and 51 bu. of wheat?

6. A man bought a rectangular field 40 rd. long by 25 rd. wide, paying therefor at the rate of $300 per acre, and then had it fenced at the rate of $1.50 per rod. How much did the field cost him?

7. A farmer sold a load of hay at $16.25 per ton; the whole weight of the wagon and hay was 2875 lb.; the wagon alone was found to weigh 1083 lb. How much did the farmer receive for his hay?

8. A lot 150 ft. long and 100 ft. wide, is to be surrounded by a close board fence 6 ft. high. What will the boards cost at $12.50 per thousand feet?

EXERCISE 9

1. If a road is 4 rd. wide, how many miles of it will make 10 a.?

2. If a cow gives 12 qt. 1 pt. of milk every day, and 1 lb. 8 oz. of butter can be made from 25 qt. of milk, how many pounds of butter can be made in one week from the milk of 16 cows?

3. If 1 lb. of thread makes 3 yd. of linen 1¼ yd. wide, how many pounds would make 45 yd. of linen 1 yd. wide?

4. If you buy 3 lb. of butter at 25c. per pound, 5 lb. of tea at 56c. per pound, 6 bars of soap at 17c. per bar, 12 gal. of oil at 27c. per gallon, and 8 oranges at 40c. per dozen, and the merchant throws off 10c. for each dollar's worth purchased, how much change would you get out of a $10 bill?

5. A barn 80 ft. long and 60 ft. wide, is built on a plot of ground 308 ft. long and 204 ft. wide. The rest of the plot is covered with cordwood to a depth of 8 ft. How many cords of wood are there?

6. Some Atlantic liners consume 200 t. of coal per day. They average 8 days out and 8 days back. In case of accidents they carry a supply of 4 days extra. How many cubic yards of the hold of such a steamer will be occupied with coal for her round trip, if each ton is 33 cu. ft.?

7. Find the cost of digging a cellar 48 ft. long, 30 ft. wide, and 6 ft. deep, at 20c. per cubic yard, and flooring it with Portland cement at 10c. per square yard.

8. A load of wood 10 ft. long, 2 ft. 8 in. wide, and 3 ft. high, was sold for $3.

(*a*) What was the price per cord?

(*b*) At $4 per cord, what would the load be worth?

9. A farmer sold a load of barley weighing 4032 lb., when barley was 40c. per bushel. In weighing the grain, the dealer made a mistake and took it as rye and paid for it at 49c. per bushel. How much did the farmer gain or lose by the mistake?

10. A cord of wood and one hundred bushels of grain fill equal spaces. A cubic bin whose edge is 12 ft. contains 45900 lb. of grain. Find the weight of 1 bu. of this grain.

EXERCISE 10

1. What length of road 44 ft. wide will contain 1 a.? What length a chain wide?

2. At $20 per M, board measure, what will be the cost of 2-inch plank for a 4-foot sidewalk half a mile long?

3. A piece of road 180 ft. long and 66 ft. wide is to be lowered 1 ft. 8 in. How many cubic yards of earth will have to be removed?

4. What length of wall $7\frac{1}{2}$ ft. high and 2 ft. thick can be built with 15 cords of stone?

5. A cubic foot of water weighs $62\frac{1}{2}$ lb., and gold is 19 times as heavy as water. Find the weight of a cubic inch of gold.

6. A farm 90 rd. long and 80 rd. wide is to be divided into 7 fields of equal size. How many acres, rods, yards, feet, and inches will there be in each field?

7. Take a million inches from 100 miles. *Answer must be in miles, rods, yards, feet, and inches.*

EXERCISE 11

1. A man paid for a piece of land 32 rd. wide by giving 240 cords of wood at $4 per cord. Land being worth $40 an acre, find the length of the piece of land.

2. Each side of the roof of a barn is 62 ft. by 25 ft. How many shingles, each covering 16 sq. in. of the roof, will it require?

3. Find the cost, at 24c. per square yard, of plastering the walls and ceiling of a room 35 ft. long, 25 ft. wide, and 10 ft. high, deducting 2 doors 7 ft. by 4 ft., and 4 windows 6 ft. by 4 ft.

4. A field contains 15 a. and is 330 yd. long. What will it cost to build around it a 5-foot close board fence at $15 per M?

5. How many cubic yards of gravel will be required for 3 mi. of road, the gravel to be laid 9 ft. wide and averaging 8 in. deep?

6. A sulky wheel 14 ft. 8 in. in circumference, made 7200 revolutions in 2 hr. What distance did the sulky go during 1 hr.?

7. Find the cost of wire, at 8c. per 5 yd., for a barbed wire fence 5 wires high, to enclose a field 36 rd. wide and 45 rd. long.

8. In rolling a grass plot 24 yd. long, and containing 400 sq. yd., how many times must a roller 3 ft. 4 in. wide be drawn over it lengthwise so that the whole plot may be rolled?

9. How many cubic feet are there in the schoolroom if it is 30 ft. long, 24 ft. wide, and 12 ft. high? If there are 40 pupils in attendance, how many cubic feet of air does that allow for each pupil?

EXERCISE 12

1. Find the area of a square field if a side is 12 rd.

2. Find the area of a square field if a side is 8 rd. 4 yd.

3. Find the area of a square field if a side is 12 ch.

4. If the middle points of the sides of a section of land are joined by fences, find the area of the square field enclosed within the fences.

5. An oblong field is 100 rd. long and 80 rd. wide. Find how many acres it contains. Find the distance around it. How long will it take a person to plough the field if his horses travel at the rate of 4 mi. an hour, and a furrow is 9 in. wide?

6. Fill in the blanks in the following:

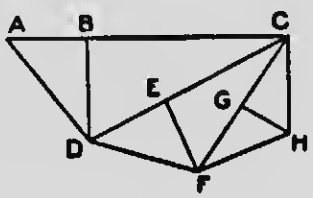
	Area of field.	Length.	Breadth.	Perimeter.
(*a*)	6 a.	40 rd.	?	?
(*b*)	?	20 ch.	8 ch.	?
(*c*)	?	?	20 rd.	100 rd.
(*d*)	10 a.	?	5 ch.	?

7. Fill in the following blanks:

	Height of box.	Length.	Breadth.	Cubic Content.	Surface.
(*a*)	6 ft.	4 ft.	3 ft.	?	?
(*b*)	8 ft.	?	4 ft.	160 cu. ft.	?
(*c*)	$5\frac{1}{2}$ ft.	4 ft.	?	52 cu. ft.	?

8. Find the area of the following figure:

AC = 1.26 in. BD = .55 in.
CD = .95 in. EF = .4 in.
CF = .71 in. GH = .21 in.



CHAPTER II

FACTORS, CANCELLATION, MEASURES, MULTIPLES

I. FACTORS

EXERCISE 13

1. Give two factors of 10, 35, 14, 77, 33, 55.

2. Resolve into three factors 45, 30, 42, 70, 66.

3. Give the prime factors of 144, 90, 75, 72, 84.

4. Name the prime numbers between 60 and 75.

5. Give all the common factors of each of the following pairs of numbers: 16 and 24; 24 and 30; 36 and 42; 70 and 60; 25 and 35.

6. Give three pairs of numbers that have no common factor.

7. Give the Highest Common Factor of each of the following pairs of numbers: 27 and 36; 72 and 64; 45 and 75; 100 and 75; 125 and 75; 108 and 81.

8. How can you tell without actually dividing whether a number is exactly divisible by 3?

9. Change the units' digit in each of the following numbers to make it exactly divisible by 3: 112, 244, 512, 322.

10. Resolve each of the following numbers into prime factors: 360, 560, 845, 1640.

11. Find the number that has the following factors: 2, 3, 5, 7, and 11.

12. Resolve 249984 into prime factors, and show that it is the continued product of three consecutive numbers.

II. CANCELLATION

EXERCISE 14

1. Divide each of the following:

$$\frac{9 \times 7}{3 \times 7} = \qquad \frac{7 \times 5 \times 120}{7 \times 5 \times 30} = \qquad \frac{15 \times 20 \times 25}{30 \times 50} =$$

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 quotient of $\frac{18 \times 22 \times 35 \times 42}{49 \times 33 \times 15}$.

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

6. A farmer exchanged 8 bbl. of apples for 240 yd. of cloth at 12c. a yard. Find the selling price of apples.

7. If 256 doz. eggs pay for 56 yd. of cloth at 96c., what is the price of eggs?

8. If 360 sheep are exchanged for 25 horses at $144, what is each sheep worth?

9. A man worked 8 days for 24 bu. of potatoes worth 40c. a bushel. How much did he earn each day?

10. How many tubs of butter (54 lb.), at 28c. a pound, will pay for 378 yd. muslin, at 16c. a yard?

11. At what price will 260 doz. eggs pay for 78 yd. silk at 95c.?

12. Find the quotient obtained by dividing the continued product of the even numbers between 11 and 21 by the continued product of the numbers 1 to 8 inclusive.

13. A number has the following factors: 8, 15, 24, 42, 65, and 77. Divide this number by the continued product of all the prime numbers less than 15.

III. MEASURES

EXERCISE 15

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. Set down 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. Set down 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.

1. *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 or the difference between a multiple of one of them and the other.*

2. To find the H. C. F. when the numbers are large.

Example 1. Find H. C. F. or G. C. M. of 52 and 91.

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

13 is a divisor of 39 and, therefore, of $13 + 39$ or 52. Since it divides 39 and 52 it also divides $39 + 52$ 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 16

Find the H. C. F. of:

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

3. 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 17

Find the H. C. F. of:

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

EXERCISE 18

1. A rectangular field is 6880 ft. long and 4840 ft. wide. Find the length of the longest string that will measure both a side and an end of the field.

2. A land-owner has three fields containing 24 a., 18 a., and 42 a. 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?

3. 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?

4. *A*, *B*, *C*, and *D* start together and travel the same way round an island which is 600 mi. in circuit. *A* goes 20 mi. per day, *B* 30, *C* 25, and *D* 40. How long must their journeyings continue in order that they may all come together again?

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

6. *A* and *B* purchased horses at the same rate per head. The value of *A*'s horses was \$623 and of *B*'s \$1068. How many horses did each buy?

7. Find the largest and the smallest numbers that will divide 64610 and 72204, leaving as remainders 27 and 23, respectively.

8. Find the least number which, taken from 6000, leaves a remainder of which 67 is a divisor.

9. 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.?

IV. MULTIPLES

EXERCISE 19

1. Name three multiples of each of the following numbers: 5, 7, 8, 9, $2\frac{1}{2}$, $3\frac{1}{4}$.

2. Name the numbers of which the following numbers are multiples: 21, 35, 55, 63, 77.

3. Name 4 numbers that contain both 2 and 7 as factors.

4. Name the least number that is a multiple of 4 and 7; of 6 and 11; of 5 and 8; of 6 and 9; of 8 and 12; of 10 and 15; of 9 and 12.

5. Make a list of five multiples common to 2, 3, and 4; to 3, 4, and 6; to 4, 5, and 6; to 2, 3, 4, and 5.

Find the Least Common Multiple of:

6. 12, 15, 18, and 20.
7. 20, 25, 30, and 32.
8. 30, 40, 50, and 60.
9. 32, 36, 48, and 60.
10. 36, 60, 72, and 84.
11. 56, 60, 84, and 112.

12. Find three numbers that on being divided by both 4 and 5 will leave a remainder of 1.

13. Find the three smallest numbers that on being divided by both 5 and 6 will leave a remainder of 2.

EXERCISE 20

1. Find the L. C. M. of 11, 7, 21, 28, 22, 27, 81, 243, 216, and the G. C. M. of 94605 and 96509.

2. (*a*) What multiple of 595 divided by 505 gives as quotient 595?

(*b*) Find the least common multiple of \$2, \$3, \$4, \$5, \$10, \$20, \$50, and \$100.

3. What is the smallest sum of money with which you can buy chickens at 25c., or geese at 50c., or turkeys at

75c., or lambs at $3, or sheep at $5, or pigs at $7, or cows at $35, or horses at $140, and have exactly $15 left for expenses?

4. A certain hall 60 ft. long is to be carpeted. It is found that by stretching the carpet lengthwise, any one of four pieces, the width, respectively, being $\frac{3}{4}$ yd., 1 yd., $1\frac{1}{4}$ yd., and $1\frac{1}{2}$ yd., will exactly fit the hall without cutting anything from the width of the carpet. If the narrowest piece, worth $1.10 per yard, be chosen, what will be the least cost of carpeting the hall?

5. Find the smallest number of bushels of wheat which would equal in weight an exact number of bushels of rye or of barley.

6. There are four bells, each of which strikes at intervals of 3, 7, 12, and 14 sec. The four begin to strike at 12 o'clock. When will they next strike together, and how often will they strike in unison in 7 min.?

7. Three men whose steps are 2 ft. 6 in., 2 ft 9 in., and 3 ft., start to walk together with their left feet forward. How often will they put the left foot down together in walking a mile?

8. Two cog-wheels, containing 48 and 56 cogs, respectively, are working together. After how many revolutions of the larger wheel will two cogs, which once touch, touch again?

9. Two cog-wheels, containing 32 cogs on one and 36 on the other, are working together. The larger wheel makes 64 revolutions per second. How often will the same cogs come in contact during 6 working days of 8 hr. each?

10. The G. C. M. of two numbers is 210; their L. C. M. is 120120; one of the numbers is 2730. Find the other number.

ORAL EXERCISE

1. A drover bought 25 sheep at $6 a head, and 5 cows at $42 a head. Find the cost of the whole.

2. Find the least number which, divided by 8, 10, and 12, will leave 3 for remainder in each case.

3. The H. C. F. of two numbers is 3, and their L. C. M. is 36; one of the numbers is 9. Find the other.

4. How many cords of wood are there in a pile 24 ft. long, 4 ft. wide, and 8 ft. high?

5. Multiply 12 by 12, add 6, divide by 10, multiply by 5, divide by 3. What is the result?

6. Find the least number from which 7, 14, and 21 can each be subtracted an exact number of times.

7. If a man take 3 steps in going 10 ft., how many would he take in going a mile?

8. A room is 76 ft. in perimeter and it is 8 ft. longer than wide. Find its dimensions.

9. From $\frac{2}{3}$ of $125 subtract $\frac{4}{5}$ of $117.

10. A boy had 7 five-cent pieces, 6 ten-cent pieces, and 3 twenty-five-cent pieces. How much money had he in all?

11. Simplify $12 \times (7 + 8 - 6) \times (112 - 36 \times 3)$.

12. Divide $22 among *A*, *B*, and *C*, giving *A* $2 as often as *B* gets $3 and *C* $6.

13. 36 is $\frac{4}{5}$ of what number?

14. What is the length of the longest stick that will exactly measure 4 ft., 5 ft. 4 in., and 2 yd. 8 in.?

15. *A* bought a horse for 20 per cent. less than $150, and sold him for 10 per cent. more than $150. How many dollars did he gain?

V. GENERAL REVIEW

EXERCISE 21

1. Divide \$20 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 three other numbers is 231. Find the sum of the three numbers.

7. If the multiplier is 704 and the product is 217536, 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 $1\frac{1}{2}$ in. lumber, the walls being 18 in. thick, and lumber being worth \$60 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. *A* can dig 25 post holes in a day, *B* can dig 30. What is the least number of post holes which will furnish exact days' labor, either for each working alone or for both working together?

13. Find the prime factors of 8400, 3820, and 1380, and from these write down the G. C. M. and the L. C. M. of these numbers.

14. Find the least amount of tea which can be put up in packets of $\frac{1}{2}$ lb., $\frac{3}{4}$ lb., $1\frac{1}{2}$ lb., or $2\frac{1}{2}$ lb.

15. 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?

16. Find all the divisors of 360.

17. 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.

18. 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 lb.

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

20. A boy buys a kodak for $5. His films cost 45c. for 12 pictures, and it costs 3c to develop and print each picture. Each picture sells for 10c. Find the profit on 8 doz. pictures, if none are spoiled.

21. The front wheel of a carriage is 9 ft. 4 in. in circumference, and the hind one 11 ft. 8 in. How many miles has the carriage gone when two points on the wheels, which were touching the ground at starting, have touched the ground at the same instant 3168 times?

22. The lumber for 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

VULGAR FRACTIONS

I. REDUCTION OF FRACTIONS

(a) Review Exercises

EXERCISE 22

1. Express as an improper fraction each of the following: $4\frac{3}{5}$, $5\frac{1}{10}$, $7\frac{1}{7}$, $2\frac{5}{12}$, $3\frac{3}{8}$.

2. How is a whole or mixed number reduced to an improper fraction?

Reduce to fractional form:

3. $3\frac{4}{7}$.
4. $4\frac{1}{3}$.
5. $9\frac{7}{7}$.
6. $4\frac{5}{9}$.
7. $11\frac{1}{12}$.
8. $12\frac{3}{5}$.
9. $35\frac{11}{12}$.
10. $82\frac{5}{17}$.
11. $51\frac{17}{18}$.
12. $86\frac{5}{19}$.
13. $99\frac{1}{11}$.
14. $78\frac{19}{20}$.

EXERCISE 23

1. William has 3 oranges. To how many boys can he give one-third of an orange?

2. Express 11 as a fraction with 9 for denominator.

3. *A* rode a mile each $\frac{1}{10}$ hr. on his bicycle; he rode $2\frac{3}{10}$ hr. How far did he ride?

4. Change 16 to sevenths and 23 to elevenths.

5. Mary has a ribbon $7\frac{5}{6}$ yd. long. If she cuts it into pieces each $\frac{1}{6}$ yd. long, how many pieces will she have?

6. *A* gave a quarter to each of 18 boys out of a five-dollar bill. How many quarters had he left?

7. What fractions with denominator 32 are equivalent to 4, 8, and 16 respectively?

8. Change $3\frac{1}{7}$ to fourteenths and $9\frac{3}{20}$ to fortieths.

9. How many eighths of a pound are there in $7\frac{1}{2}$ lb.?

10. If $\frac{3}{4}$ yd. of cloth are needed for a vest, how many vests can be made from $11\frac{1}{4}$ yd.?

11. To make badges $\frac{1}{8}$ yd. long for a class, requires $5\frac{3}{8}$ yd. of ribbon. How many pupils are in the class?

12. How many more sixths of a yard are there in $5\frac{2}{3}$ yd. than in $4\frac{5}{6}$ yd.?

EXERCISE 24

1. Express $\frac{19}{6}$, $\frac{13}{4}$, $\frac{15}{2}$, $\frac{17}{7}$ as mixed numbers.

2. How are improper fractions reduced to mixed numbers?

Reduce the following improper fractions to whole or mixed numbers:

3. $\frac{47}{6}$.	7. $\frac{472}{7}$.	11. $\frac{325}{25}$.
4. $\frac{89}{7}$.	8. $\frac{196}{16}$.	12. $\frac{476}{17}$.
5. $\frac{107}{9}$.	9. $\frac{982}{15}$.	13. $\frac{982}{19}$.
6. $\frac{429}{5}$.	10. $\frac{725}{45}$.	14. $\frac{4407}{136}$.

EXERCISE 25

1. From $\$\frac{63}{8}$ a man paid away \$7. How much money had he left out of this sum?

2. John has $\$\frac{27}{4}$. How much money has he?

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

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

5. If a bottle holds $\frac{1}{8}$ gal., how many gallons will 7 doz. such bottles hold?

6. How far has *A* gone, if he rides on his bicycle for $\frac{14}{7}$ hr. at the rate of a mile each $\frac{1}{7}$ hr?

7. *A* wishes to measure some oats. He has a bucket three-fills of which make a bushel. The oats fill this bucket 167 times. How many bushels of oats are there?

8. The perimeter of a rectangular room is $\frac{214}{8}$ ft. It is $5\frac{3}{8}$ 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 $\frac{1}{88}$ mi. How many posts are there?

11. In one scale of a balance there are $\frac{127}{4}$ 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 be in making 200 boxes, and what is the least number of additional boxes he may make to be employed an exact number of hours?

EXERCISE 26

1. Express $\frac{10}{15}$ as sevenths and $\frac{12}{18}$ as eighths.

2. Write out 8 fractions equivalent to $\frac{3}{4}$. Make a statement setting forth the conditions under which fractions are equivalent.

3. How many twelfths are there in $\frac{1}{3}$? in $\frac{2}{3}$? in $\frac{3}{4}$?

4. Reduce $\frac{1}{5}$, $\frac{3}{5}$, and $\frac{3}{4}$ each to twentieths.

5. " $\frac{1}{3}$, $\frac{2}{3}$, and $\frac{5}{6}$ " " eighteenths.

6. " $\frac{3}{8}$, $\frac{5}{8}$, and $\frac{5}{12}$ " " twenty-fourths.

7. Reduce $\frac{1}{3}$, $\frac{2}{3}$, and $\frac{1}{4}$ each to sixtieths.
8. " $\frac{3}{4}$, $\frac{5}{8}$, and $\frac{3}{10}$ " " thirty-seconds.
9. How many fourths are there in $\frac{12}{16}$? in $\frac{10}{20}$?
10. Reduce $\frac{3}{12}$, $\frac{5}{20}$, and $\frac{27}{36}$ each to fourths.
11. " $\frac{10}{25}$, $\frac{21}{35}$, and $\frac{33}{40}$ " " fifths.
12. " $\frac{20}{28}$, $\frac{10}{35}$, and $\frac{28}{49}$ " " sevenths.

EXERCISE 27

1. Supply numerators in $\frac{7}{11} = \frac{\quad}{99}$; $\frac{2}{5} = \frac{\quad}{45}$; $\frac{5}{13} = \frac{\quad}{65}$.
2. " " " $\frac{12}{20} = \frac{\quad}{5}$; $\frac{15}{25} = \frac{\quad}{5}$; $\frac{21}{28} = \frac{\quad}{4}$.
3. " " " $\frac{12}{16} = \frac{\quad}{4}$; $\frac{30}{36} = \frac{\quad}{6}$; $\frac{30}{42} = \frac{\quad}{7}$.
4. " " " $\frac{42}{84} = \frac{\quad}{7}$; $\frac{42}{60} = \frac{\quad}{10}$; $\frac{56}{64} = \frac{\quad}{8}$.
5. " denominators " $\frac{7}{17} = \frac{56}{\quad}$; $\frac{9}{13} = \frac{81}{\quad}$; $\frac{11}{13} = \frac{99}{\quad}$.
6. " " " $\frac{3}{9} = \frac{1}{\quad}$; $\frac{5}{10} = \frac{1}{\quad}$; $\frac{35}{50} = \frac{7}{\quad}$.
7. " " " $\frac{21}{24} = \frac{7}{\quad}$; $\frac{48}{56} = \frac{6}{\quad}$; $\frac{36}{42} = \frac{6}{\quad}$.
8. " " " $\frac{15}{25} = \frac{3}{\quad}$; $\frac{28}{70} = \frac{1}{\quad}$; $\frac{84}{90} = \frac{7}{\quad}$.

EXERCISE 28

1. Express the terms of the following fractions as factors and give an equivalent fraction to each, the terms used being in each case the smallest possible whole numbers:

$\frac{8}{12}$, $\frac{10}{15}$, $\frac{30}{50}$, $\frac{24}{32}$, $\frac{9}{15}$, $\frac{15}{35}$.

2. State how a fraction is reduced to its lowest terms.

Reduce the following fractions to lowest terms:

3. $\frac{15}{20}$.
4. $\frac{18}{27}$.
5. $\frac{14}{35}$.
6. $\frac{24}{36}$.
7. $\frac{15}{90}$.
8. $\frac{80}{112}$.
9. $\frac{210}{294}$.
10. $\frac{644}{756}$.
11. $\frac{288}{864}$.
12. $\frac{792}{864}$.
13. $\frac{840}{4312}$.
14. $\frac{1176}{1512}$.
15. $\frac{6101}{7171}$.
16. $\frac{5400}{7200}$.
17. $\frac{1296}{2584}$.

18. Draw a line 10 in. long and mark off $\frac{4}{10}$ of it in the easiest way possible.

19. Write down five other fractions, each having the same value as $\frac{7}{12}$.

20. Write down five other fractions, each having the same value as $\frac{11}{132}$, and with smaller terms than this fraction.

21. By how many elevenths is $\frac{10}{11}$ greater than $\frac{119}{187}$?

22. $\frac{35}{60}$ is equal to how many tenths? Fifteenths? Twentieths? Fifths?

EXERCISE 29

1. By what number must the terms be multiplied to reduce $\frac{3}{5}$ to tenths? $\frac{3}{4}$ to twelfths? $\frac{4}{5}$ to fifteenths?

2. Express each of the following fractions as twenty-fourths: $\frac{1}{2}$, $\frac{3}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{5}{12}$.

Reduce to equivalent fractions having the least common denominator:

3. $\frac{3}{4}$ and $\frac{7}{8}$.
4. $\frac{1}{8}$ and $\frac{5}{12}$.
5. $\frac{3}{7}$ and $\frac{8}{11}$.
6. $\frac{5}{8}$ and $\frac{17}{24}$.
7. $\frac{5}{6}$ and $\frac{4}{9}$.
8. $\frac{3}{7}$ and $\frac{5}{8}$.
9. $\frac{3}{8}$ and $\frac{5}{12}$.
10. $\frac{1}{8}$ and $\frac{3}{11}$.
11. $\frac{3}{8}$ and $\frac{7}{9}$.
12. $\frac{4}{7}$ and $\frac{9}{10}$.
13. $\frac{3}{8}$ and $\frac{7}{11}$.
14. $\frac{3}{7}$ and $\frac{7}{9}$.

EXERCISE 30

Reduce the following to equivalent fractions with the least common denominator:

1. $\frac{3}{5}$, $\frac{5}{6}$, $\frac{3}{8}$.
2. $\frac{1}{2}$, $\frac{3}{4}$, $\frac{7}{8}$.
3. $\frac{7}{8}$, $\frac{9}{10}$, $\frac{7}{20}$.
4. $\frac{5}{8}$, $\frac{7}{12}$, $\frac{11}{18}$.
5. $\frac{5}{6}$, $\frac{4}{9}$, $\frac{7}{12}$.
6. $\frac{3}{4}$, $\frac{7}{10}$, $\frac{5}{8}$.
7. $\frac{1}{6}$, $\frac{7}{12}$, $\frac{11}{20}$.
8. $\frac{5}{6}$, $\frac{4}{9}$, $\frac{3}{8}$.
9. $\frac{7}{8}$, $\frac{3}{4}$, $\frac{4}{5}$.
10. $\frac{3}{5}$, $\frac{3}{8}$, $\frac{5}{7}$.
11. $\frac{5}{7}$, $\frac{3}{8}$, $\frac{4}{5}$.
12. $\frac{3}{8}$, $\frac{3}{8}$, $\frac{3}{4}$.

EXERCISE 31

1. Express each of the following as 36ths, and then arrange the fractions in order of magnitude, beginning with the least: $\frac{5}{12}$, $\frac{5}{6}$, $\frac{7}{18}$.

Find which is the greater:

2. $\frac{4}{7}$ or $\frac{5}{9}$.
3. $\frac{5}{9}$ or $\frac{24}{27}$.
4. $\frac{7}{12}$ or $\frac{10}{11}$.
5. $\frac{7}{12}$ or $\frac{11}{18}$.
6. $\frac{17}{30}$ or $\frac{21}{25}$.
7. $\frac{14}{18}$ or $\frac{17}{21}$.

Which is the greatest and which is the least of the following:

8. $\frac{7}{12}$, $\frac{10}{20}$, $\frac{16}{32}$?
9. $\frac{5}{11}$, $\frac{9}{22}$, $\frac{16}{33}$?
10. $\frac{3}{16}$, $\frac{2}{5}$, $\frac{7}{32}$?
11. $\frac{9}{10}$, $\frac{17}{20}$, $\frac{21}{25}$?
12. $\frac{9}{11}$, $\frac{13}{18}$, $\frac{17}{21}$?
13. $\frac{5}{6}$, $\frac{6}{7}$, $\frac{8}{9}$?

Arrange in ascending order of magnitude:

14. $\frac{17}{81}$, $\frac{3}{18}$, $\frac{5}{27}$, $\frac{4}{84}$, $\frac{2}{9}$.
15. $\frac{1}{2}$, $\frac{3}{5}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{13}{20}$.

16. Find a fraction, with 60 for denominator, intermediate in value between $\frac{4}{5}$ and $\frac{5}{6}$.

17. Find a fraction, with 112 for denominator, greater than $\frac{6}{7}$ and less than $\frac{7}{8}$.

(*b*) COMPOUND FRACTIONS

EXERCISE 32

1. Find by measurement $\frac{2}{3}$ of a line 1 ft. long.

2. Find by measurement $\frac{2}{3}$ of $\frac{3}{4}$ of a line 1 ft. long.

3. (*a*) Draw a rectangle 5 in. by 2 in. and find the area of $\frac{3}{5}$ of it.

(*b*) Mark off $\frac{1}{2}$ of $\frac{4}{5}$ of this rectangle.

4. How do you find $\frac{2}{3}$ of a foot? $\frac{2}{3}$ of a rectangle?

5. How do you find $\frac{2}{3}$ of $\frac{3}{4}$ of a foot? $\frac{1}{2}$ of $\frac{2}{3}$ of a rectangle?

4. Fractions like $\frac{2}{3}$, $\frac{3}{4}$ ft., $\frac{3}{7}$ ft., $\frac{5}{8}$ which express a number of the equal parts of a *unit*, are **Simple Fractions.**

5. Fractions like $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{1}{2}$ of $\frac{3}{5}$, $\frac{5}{6}$ of 12, $\frac{1}{3}$ of $2\frac{1}{2}$, which express a number of the equal parts of a fraction, are **Compound Fractions.**

6. Classify the following fractions as *Simple* or *Compound*: $\frac{5}{8}$, $\frac{5}{8}$ ft., $\frac{5}{6}$ of $\frac{2}{3}$, $\frac{5}{6}$ of $\frac{2}{3}$ ft., $\frac{4}{7}$ of 14, $\frac{1}{2}$, $\frac{1}{2}$ of $\frac{5}{8}$, $\frac{6}{7}$, $\frac{8}{5}$.

7. Find $\frac{1}{2}$ of 6-sevenths; $\frac{1}{3}$ of 12-seventeenths; $\frac{1}{6}$ of 10-elevenths.

Example 1. Find $\frac{1}{3}$ of $\frac{1}{4}$.

$$\frac{1}{4}=\frac{3}{12};$$

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

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

9. Find $\frac{3}{4}$ of $\frac{1}{5}$; $\frac{3}{5}$ of $\frac{1}{2}$; $\frac{3}{5}$ of $\frac{1}{3}$; $\frac{3}{4}$ of $\frac{2}{5}$.

Example 2. Find $\frac{3}{5}$ of $\frac{4}{7}$.

$$\frac{4}{7}=\frac{20}{35}$$

$$\frac{1}{5} \text{ of } \frac{4}{7}=\frac{1}{5} \text{ of } \frac{20}{35}=\frac{4}{35};$$

$$\therefore \frac{3}{5} \text{ of } \frac{4}{7}=3\times\frac{4}{35}=\frac{12}{35}=\frac{3\times 4}{5\times 7}$$

$$=\frac{\text{the product of the numerators}}{\text{the product of the denominators}}.$$

EXERCISE 33

Simplify the following fractions:

1. $\frac{4}{7}$ of $\frac{5}{11}$.
2. $\frac{3}{7}$ of $\frac{9}{23}$.
3. $\frac{3}{4}$ of $4\frac{1}{4}$.
4. $2\frac{3}{4}$ of $\frac{5}{8}$.
5. $\frac{5}{7}$ of $\frac{4}{5}$ of $\frac{3}{5}$.
6. $\frac{4}{5}$ of $\frac{3}{11}$ of $\frac{5}{8}$.

7. $\frac{3}{11}$ of $\frac{5}{7}$ of $2\frac{1}{6}$.
8. $\frac{5}{6}$ of $\frac{4}{7}$ of $\frac{7}{8}$ of $\frac{8}{9}$.
9. $\frac{4}{7}$ of $\frac{3}{4}$ of $\frac{9}{10}$ of $\frac{8}{13}$.
10. $\frac{5}{8}$ of $\frac{4}{7}$ of $\frac{7}{9}$ of $\frac{9}{11}$.
11. $\frac{5}{8}$ of $\frac{3}{5}$ of $\frac{9}{12}$ of $\frac{2}{3}$.
12. $\frac{1}{3}$ of $\frac{3}{4}$ of $\frac{1}{2\frac{1}{3}}$ of 7.
13. $\frac{3}{5}$ of $\frac{4}{11}$ of $\frac{1}{1\frac{1}{3}}$ of $5\frac{3}{4}$.
14. $\frac{5}{7}$ of $8\frac{3}{4}$ of $\frac{1}{3}$ of $2\frac{1}{7}$.

15. A man owned $\frac{1}{4}$ of a farm, and sold $\frac{1}{3}$ of his share. Show that he sold $\frac{1}{12}$ of the farm.

16. Some boys owned $\frac{3}{8}$ of a boat; they sold $\frac{2}{3}$ of their share. What part of the boat did they sell?

17. Having $\frac{3}{4}$ of a bushel of potatoes I gave away $\frac{5}{8}$ of what I had. What part of a bushel did I give away?

18. A boy had $\frac{9}{10}$ of a dollar, and spent $\frac{2}{3}$ of it. How much did he spend?

19. If a man has $\frac{5}{8}$ of a section of land in wheat, and $\frac{2}{3}$ of his crop is destroyed by hail, find how many acres are destroyed.

II. ADDITION OF FRACTIONS

EXERCISE 34

1. Find the sum of $\frac{3}{10}$, $\frac{7}{10}$, and $\frac{9}{10}$.

2. Reduce $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ to equivalent fractions with a common denominator, and find their sum.

Example 1. Find the sum of $\frac{2}{5}$, $\frac{5}{6}$, and $\frac{3}{10}$.

$$\frac{2}{5}=\frac{2\times 6}{5\times 6}=\frac{12}{30}$$

$$\frac{5}{6}=\frac{5\times 5}{6\times 5}=\frac{25}{30}$$

$$\frac{3}{10}=\frac{3\times 3}{10\times 3}=\frac{9}{30};$$

$$\therefore \frac{2}{5}+\frac{5}{6}+\frac{3}{10}$$

$$=\frac{12}{30}+\frac{25}{30}+\frac{9}{30}=\frac{46}{30}=1\frac{8}{15}.$$

Here a number of fifths, sixths, and tenths are to be added. The addends must be reduced to equivalent ones with the same denominator. When this is done the sum is found as in addition of integers.

EXERCISE 35

Add together the following fractions :

1. $\frac{2}{3}$ and $\frac{3}{4}$.
2. $\frac{4}{5}$ and $\frac{7}{8}$.
3. $\frac{5}{12}$ and $\frac{7}{15}$.
4. $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{3}{4}$.
5. $\frac{1}{2}$, $\frac{3}{5}$, and $\frac{7}{8}$.
6. $\frac{4}{25}$, $\frac{9}{10}$, and $\frac{3}{50}$.
7. $\frac{5}{6}$, $\frac{2}{7}$, $\frac{3}{4}$, and $\frac{5}{12}$.
8. $\frac{3}{4}$, $\frac{7}{15}$, $\frac{5}{6}$, and $\frac{5}{12}$.
9. $\frac{3}{5}$, $\frac{4}{7}$, $\frac{13}{21}$, and $\frac{7}{15}$.
10. $\frac{1}{4}$, $\frac{1}{5}$, $\frac{5}{6}$, and $\frac{3}{5}$.
11. $\frac{3}{5}$, $\frac{4}{5}$, $\frac{11}{12}$, and $\frac{29}{45}$.
12. $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{12}$, and $\frac{1}{17}$.

13. *A* spends $\frac{1}{4}$ of his income on food, $\frac{1}{10}$ on rent, and $\frac{1}{5}$ on clothes. What part of his income does *A* spend?

14. What fraction of a dollar would \$$\frac{2}{5}$, \$$\frac{1}{10}$, and \$$\frac{3}{7}$ be altogether?

15. In a class, $\frac{1}{3}$ of the pupils have 1 mistake in spelling, $\frac{2}{5}$ have 2 mistakes, and $\frac{4}{21}$ have 3 mistakes. What fraction of the class has mistakes?

16. *A* has a journey to make; the first day he goes $\frac{1}{4}$ of it, the second $\frac{2}{5}$ of it, and the third $\frac{4}{15}$ of it. What fraction of the journey did he go in the three days?

EXERCISE 36

1. A market gardener sold 3 bu. of potatoes to one man; $2\frac{1}{2}$ bu. to a second, and $1\frac{1}{4}$ bu. to a third. How many bushels did he sell to these three?

Example 2. Add together $2\frac{1}{4}$, $3\frac{4}{5}$, $7\frac{5}{12}$, and $\frac{7}{10}$.

$$2\tfrac{1}{4}+3\tfrac{4}{5}+7\tfrac{5}{12}+\tfrac{7}{10}$$

$$=2+3+7+\frac{1}{4}+\frac{4}{5}+\frac{5}{12}+\frac{7}{10}$$

$$=12+\frac{15}{60}+\frac{48}{60}+\frac{25}{60}+\frac{42}{60}$$

$$=12+\frac{130}{60}=12+2\tfrac{1}{6}=14\tfrac{1}{6}.$$

EXERCISE 37

Find the sum of the following fractions:

1. $2\frac{1}{2}$, $3\frac{3}{5}$, and $4\frac{1}{5}$.
2. $2\frac{1}{3}$, $\frac{5}{12}$, and $7\frac{11}{12}$.
3. $2\frac{4}{7}$, $3\frac{1}{3}$, and $4\frac{9}{14}$.
4. $3\frac{3}{5}$, $1\frac{3}{4}$, and $\frac{1}{12}$.
5. $1\frac{5}{12}$, $\frac{11}{36}$, and $2\frac{9}{7}$.
6. $30\frac{1}{8}$, $4\frac{9}{10}$, and $10\frac{5}{6}$.
7. $2\frac{1}{3}$, $4\frac{1}{4}$, $7\frac{1}{12}$, and $8\frac{5}{12}$.
8. $7\frac{5}{8}$, $10\frac{5}{12}$, $4\frac{1}{3}$, and $7\frac{7}{30}$.
9. $1\frac{1}{8}$, $3\frac{1}{3}$, $2\frac{3}{4}$, and $5\frac{5}{12}$.
10. $4\frac{1}{3}$, $5\frac{1}{4}$, $3\frac{1}{8}$, and $9\frac{1}{12}$.
11. $4\frac{3}{8}$, $3\frac{1}{3}$, $4\frac{5}{6}$, and $\frac{4}{12}$.
12. $5\frac{1}{3}$, $6\frac{3}{4}$, $3\frac{3}{8}$, and $\frac{1}{12}$.

13. At a school picnic $2\frac{3}{8}$ gal. of coffee, $5\frac{5}{8}$ gal. of milk, $4\frac{1}{8}$ gal. of tea, and $1\frac{1}{8}$ gal. of cocoa are drunk. How many gallons are drunk altogether?

14. One tub of butter has $25\frac{1}{4}$ lb., a second has $24\frac{3}{8}$ lb., a third $27\frac{3}{8}$ lb., and a fourth $30\frac{3}{4}$ lb. How much butter is there in the four tubs?

15. One number is $14\frac{3}{8}$, a second one is $2\frac{1}{8}$ greater than this, and a third one is $4\frac{5}{12}$ greater than the second. Find the sum of the three numbers.

16. One remnant has $2\frac{1}{8}$ yd. in it, a second $1\frac{3}{4}$ yd., a third $\frac{9}{10}$ yd., a fourth $1\frac{5}{8}$ yd., and a fifth $2\frac{1}{3}$ yd. How much cloth is there in the five pieces?

17. A farmer sold $145\frac{3}{4}$ bu. of wheat, $248\frac{1}{3}$ bu. of oats, $316\frac{3}{4}$ bu. of peas, and $149\frac{5}{8}$ bu. of barley during the year 1908. How many bushels of grain did he sell that year?

III. SUBTRACTION OF FRACTIONS

EXERCISE 38

1. Reduce $\frac{1}{2}$ and $\frac{1}{3}$ to equivalent fractions with a common denominator, and find their difference.

2. Reduce $\frac{2}{5}$ and $\frac{1}{2}$ each to tenths, and find their difference. Illustrate your work hy a diagram.

3. Before subtracting one fraction from another, how must the fractions be expressed?

Example 1. From $\frac{4}{5}$ take $\frac{5}{8}$.

Since $\frac{4}{5} = \frac{32}{40}$ and $\frac{5}{8} = \frac{25}{40}$;

therefore $\frac{4}{5} - \frac{5}{8} = \frac{32}{40} - \frac{25}{40} = \frac{7}{40}$.

4. Give a rule for subtracting one fraction from another.

EXERCISE 39

Find the difference between:

1. $\frac{5}{7}$ and $\frac{3}{7}$.
2. $\frac{7}{8}$ and $\frac{3}{8}$.
3. $\frac{5}{6}$ and $1\frac{1}{2}$.
4. $\frac{17}{20}$ and $\frac{1}{2}$.
5. $\frac{23}{24}$ and $\frac{11}{16}$.
6. $\frac{2}{7}$ and $\frac{4}{15}$.
7. $\frac{5}{6}$ and $\frac{19}{20}$.
8. $\frac{5}{7}$ and $\frac{13}{100}$.
9. $\frac{3}{10}$ and $\frac{5}{6}$.
10. $\frac{9}{14}$ and $\frac{16}{35}$.
11. $\frac{11}{33}$ and $\frac{19}{55}$.
12. $\frac{9}{35}$ and $\frac{7}{30}$.

13. A certain fraction is added to $\frac{3}{5}$ and the sum is $\frac{11}{15}$. What fraction is added to $\frac{3}{5}$?

14. Add $\frac{3}{5}$ to the difference between $\frac{4}{5}$ and $\frac{8}{15}$.

15. Of a pole, $\frac{1}{6}$ is white, $\frac{2}{3}$ red, and the rest blue. What part of it is blue?

16. To a certain fraction $\frac{5}{6}$ is added, and when $\frac{7}{12}$ is taken from the sum the remainder is $1\frac{17}{30}$. Find the fraction.

EXERCISE 40

1. From 864 subtract 442. Explain each step in the process.

2. From $9\frac{3}{5}$ subtract $8\frac{1}{3}$. Explain each step in the process.

3. From 9 subtract $6\frac{3}{5}$. Explain each step in the process. $(9 = 8\frac{5}{5}.)$

Example 2. From $5\frac{3}{8}$ take $2\frac{1}{4}$.

$5\frac{3}{8} = 4 + 1 + \frac{8}{12} = 4\frac{10}{12}$
$2\frac{1}{4} = 2\frac{2}{12} \quad = 2\frac{2}{12}$
$2\frac{8}{12}$,

or $5\frac{3}{8} = 5\frac{9}{12}$; $5\frac{9}{12} + \frac{1}{12} = 5\frac{10}{12}$
$2\frac{1}{4} = 2\frac{3}{12}$; $2\frac{3}{12} + 1 = 3\frac{3}{12}$
$2\frac{8}{12}$,

or $5\frac{3}{8} + \frac{1}{4}$ $\Big\} = \Big\{ 5\frac{10}{12}$
$2\frac{1}{4} + \frac{1}{4}$ $\Big\}$ $\quad\quad 3$
$2\frac{8}{12}$.

Find the value of:

4. $3\frac{3}{7} - 1\frac{1}{3}$.
5. $2\frac{1}{5} - 1\frac{1}{10}$.
6. $6\frac{1}{2} - 2\frac{1}{12}$.
7. $8\frac{3}{7} - 5\frac{4}{5}$.
8. $3\frac{5}{12} - 1\frac{5}{8}$.
9. $2\frac{5}{6} - 1\frac{7}{12}$.
10. $5\frac{3}{14} - 2\frac{10}{11}$.
11. $4\frac{7}{8} - 1\frac{13}{14}$.
12. $9 - 4\frac{2}{7}$.

13. Out of \$10, a woman spent $\$2\frac{3}{4}$. How much had she left?

14. From 20 yd. of ribbon there were sold to one person $1\frac{1}{2}$ yd., to another $2\frac{1}{4}$ yd., and to another $4\frac{3}{8}$ yd. How many yards remain unsold?

EXERCISE 41

Simplify the following:

1. $\frac{1}{60} - \frac{1}{12} + \frac{1}{30} + 2\frac{1}{4}$.
2. $1\frac{3}{7} + \frac{5}{6} - 1\frac{9}{21} + 3\frac{3}{5}$.
3. $1\frac{1}{3} + 2\frac{5}{6} - \frac{7}{12} + 9\frac{3}{4}$.
4. $\frac{3}{7} + 4\frac{5}{14} - 1\frac{1}{21} - 2\frac{5}{28}$.
5. $1\frac{1}{3} - 1\frac{3}{7} - 2\frac{1}{14} + 5\frac{1}{6}$.
6. $50\frac{5}{18} - 4\frac{3}{4} - 8\frac{1}{9} - 5\frac{7}{36}$.
7. $16 - 3\frac{1}{6} + 4\frac{2}{3} - 3\frac{5}{6}$.
8. $8 - 4\frac{1}{3} - 5\frac{7}{15} + 2\frac{5}{12}$.
9. $7\frac{5}{12} - 3\frac{2}{7} + 8\frac{1}{3}\frac{7}{4} - 10\frac{5}{8}$.
10. $8\frac{7}{24} - 2\frac{3}{16} - 4\frac{1}{4}\frac{9}{8} + 5\frac{7}{12}$.

EXERCISE 42

1. The sum of two numbers is $26\frac{1}{4}$, and the less is $7\frac{5}{7}$. What is the greater?

2. From a barrel of vinegar containing $31\frac{1}{2}$ gal., $14\frac{1}{16}$ gal. were drawn. How much was there left?

3. From a piece of silk containing $35\frac{3}{4}$ yd., $14\frac{5}{8}$ yd. were sold. How much remained in the piece?

4. *A* has two farms, one of $70\frac{3}{7}$ a., and the other of $118\frac{13}{28}$ a. If he sells $87\frac{11}{14}$ a., how much land has he left?

5. How much paper has a printer left, if he had on hand $30\frac{7}{12}$ reams, and has used $7\frac{1}{3}$ reams for one job and $8\frac{3}{4}$ reams for another?

6. A grocer, having mixed $15\frac{3}{4}$ lb. of tea with $32\frac{11}{12}$ lb. of a different kind, sold all the mixture but $13\frac{1}{3}$ lb., how much did he sell?

7. *B* started on a journey of 100 mi.; the first day he travelled $30\frac{5}{12}$ mi.; the second day $36\frac{2}{3}$ mi. How far has he yet to go?

8. Henry had $\$47\frac{1}{3}$, and James as much, lacking $\$9\frac{5}{12}$. How many dollars had James?

9. The selling price of a horse was $\$125\frac{3}{7}$; the gain was $\$26\frac{1}{4}$. What was the cost price?

10. Find the sum of the greatest and least of the fractions $\frac{3}{5}$, $\frac{5}{11}$, $\frac{4}{5}$, $\frac{7}{10}$, the sum of the other two, and the difference of these sums.

EXERCISE 43

1. $\$249\frac{1}{4}$ is $\$134\frac{1}{3}$ less than the value of my horse and carriage. What are they worth?

2. A boy paid $\$\frac{1}{2}$ for a ball, $\$\frac{1}{6}$ for a slate, $\$\frac{7}{8}$ for a knife, and $\$\frac{7}{12}$ for a book. How much did he spend?

3. What is the entire weight of 4 crocks of butter weighing as follows: The first $10\frac{1}{4}$ lb., the second $11\frac{5}{8}$ lb., the third $13\frac{5}{12}$ lb., and the fourth $14\frac{1}{2}$ lb.?

4. A grocer has three barrels of molasses; the first contains $28\frac{3}{8}$ gal., the second $42\frac{7}{16}$, and the third $36\frac{1}{4}$ gal. How many gallons are in the three barrels?

5. What number is that from which, if $5\frac{1}{12}$ is taken, the remainder will be $2\frac{1}{16}$?

6. A merchant sold $34\frac{1}{8}$ yd. of cloth for $\$94\frac{5}{16}$, $39\frac{1}{24}$ yd. for $\$124\frac{1}{8}$, and $70\frac{1}{8}$ yd. for $\$184\frac{1}{3}$. How many yards of cloth did he sell, and how much did he receive for the whole?

7. Four geese weigh, respectively, $9\frac{1}{8}$ lb., $10\frac{1}{3}$ lb., $12\frac{7}{16}$ lb., and $11\frac{1}{6}$ lb. What is their entire weight?

8. A lady hired a gardener at 15c. an hour for 3 days. How much did she pay him if he worked $6\frac{5}{12}$ hr. the first day, $7\frac{1}{6}$ the second, and $5\frac{1}{4}$ the third?

9. If $5\frac{1}{7}$ gal. of brandy are mixed with $1\frac{9}{14}$ gal. of water and $3\frac{5}{21}$ gal. of whiskey, how many gallons are there in all?

10. *A* paid $\$46\frac{1}{2}$ for an ox, and $\$57\frac{5}{12}$ more than this for a horse. For how much must he sell them to gain $\$26\frac{1}{8}$?

IV. MULTIPLICATION AND DIVISION OF FRACTIONS

EXERCISE 44

Multiply:

1. $\frac{1}{12} \times 4$.
2. $\frac{1}{16} \times 8$.
3. $\frac{9}{28} \times 7$.
4. $\frac{1}{12} \times 10$.
5. $\frac{12}{21} \times 9$.
6. $\frac{1}{14} \times 28$.
7. $\frac{1}{24} \times 21$.
8. $\frac{7}{16} \times 24$.
9. $\frac{1}{36} \times 25$.
10. How is a fraction multiplied by a whole number?

EXERCISE 45

Divide:

1. $\frac{1}{15}$ by 3.
2. $\frac{3}{56}$ by 7.
3. $\frac{6}{24}$ by 9.
4. $2\frac{1}{8}$ by 17.
5. $7\frac{1}{8}$ by 6.
6. $4\frac{2}{3}$ by 7.
7. $\frac{7}{11}$ by 5.
8. $5\frac{1}{3}$ by 7.
9. $4\frac{3}{7}$ by 10.
10. How is a fraction divided by a whole number?

EXERCISE 46

Find the value of :

1. $\frac{5}{6} \times 18$.
2. $\frac{5}{9} \times 45$.
3. $\frac{5}{6} \times 43$.
4. $\frac{7}{16} \times 124$.
5. $\frac{12}{15} \times \frac{9}{10}$.
6. $\frac{9}{10} \times \frac{5}{21} \times \frac{7}{25}$.
7. $\frac{6}{7} \times \frac{9}{12} \times \frac{14}{15}$.
8. $\frac{10}{11} \times \frac{3}{10} \times \frac{7}{12}$.
9. $\frac{45}{49} \times \frac{56}{65} \times \frac{91}{72}$.
10. $\frac{16}{21} \times \frac{9}{28} \times \frac{35}{54}$.
11. $\frac{9}{10} \times \frac{16}{27} \times \frac{35}{48}$.
12. $\frac{312}{728} \times \frac{20}{21} \times \frac{7}{9}$.

13. What should be paid for $\frac{1}{2}$ of $\frac{7}{8}$ of a pound of tea, at the rate of $\frac{13}{16}$ of a dollar per pound?

14. What should be paid for $\frac{2}{3}$ of a barrel of apples, if the whole barrel is worth $\frac{15}{16}$ of a dollar?

15. *A* has $\frac{3}{4}$ of \$375, *B* has $\frac{4}{5}$ as much, and *C* $\frac{3}{5}$ as much as both. How many dollars has each, and how many have they all?

EXERCISE 47

Find the value of :

1. $3\frac{1}{4} \times 5\frac{2}{7}$.
2. $6\frac{2}{3} \times 7\frac{2}{5}$.
3. $17\frac{2}{5} \times 16\frac{2}{3}$.
4. $39\frac{3}{5} \times 33\frac{1}{3}$.
5. $5\frac{2}{7} \times 4\frac{3}{11} \times 77 \times 4\frac{1}{4}$.
6. $3 \times 7\frac{1}{2} \times \frac{11}{45} \times 3\frac{3}{11}$.

EXERCISE 48

1. Multiply the sum of $4\frac{3}{4}$ and $2\frac{1}{7}$ by the difference between $9\frac{1}{5}$ and $7\frac{1}{6}$.

2. When apples cost \$$3\frac{3}{5}$ per barrel, find the cost of $25\frac{5}{6}$ bbl.

3. Find the cost of $7\frac{1}{4}$ doz. eggs at $22\frac{1}{2}$c. per dozen.

4. Convert $2\frac{2}{15}$ of $\frac{3}{5} \times \frac{7}{8}$ into a simple fraction.

5. How much must be added to $\frac{4}{15}$ of 168 to make $\frac{8}{9}$ of $\frac{2}{3}$ of 750?

6. Multiply the sum, difference, and product of $\frac{2}{3}$ and $\frac{3}{5}$ together.

7. Find the cost of $51\frac{1}{2}$ yd. of braid at $22\frac{1}{2}$c. per yard.

8. A merchant sold three pieces of silk containing $17\frac{1}{2}$ yd., $13\frac{3}{4}$ yd., and $18\frac{5}{8}$ yd., respectively, at $\$1\frac{3}{4}$ per yard. How much did he receive for the silk?

9. How much more did $40\frac{3}{4}$ dozen eggs at $22\frac{1}{2}$c. a dozen cost, than $56\frac{3}{8}$ lb. of beef at $12\frac{1}{2}$c. per pound?

10. Mr. Jones rented a house at $\$42\frac{1}{2}$ a month, taking a lease for 5 yr., but disposed of the lease at the end of $3\frac{1}{2}$ yr. How much rent did he pay?

11. On $\frac{1}{3}$ of my field I planted corn; on $\frac{3}{5}$ of the remainder I sowed wheat; on $\frac{3}{4}$ of the remainder I planted potatoes; the rest, consisting of $\frac{1}{3}$ of an acre, was planted in beans. How large was my field?

EXERCISE 49

Simplify:

1. $\frac{3}{4} \times (\frac{1}{4} + \frac{1}{2})$.
2. $5 \times (7 - 2\frac{1}{2})$.
3. $(3\frac{3}{4} - 2\frac{1}{2}) \times 2\frac{1}{2}$.
4. $4\frac{1}{2} - \frac{1}{2}$ of $3\frac{1}{7}$.
5. $(\frac{1}{3} - \frac{1}{4} + \frac{1}{6}) \times 24$.
6. $(4\frac{1}{2} + \frac{1}{3} - 5\frac{5}{6}) \times 2\frac{1}{4}$.
7. $(\frac{3}{4} + \frac{5}{6}) \times (\frac{5}{8} - \frac{1}{3})$.
8. $\frac{1}{2} \times (\frac{3}{5} - \frac{2}{5}) + \frac{1}{4}$.
9. $(2\frac{1}{2} + 3\frac{1}{3} - 4\frac{1}{4}) \times 12$.
10. $60 - (2\frac{1}{4} + 4\frac{3}{8}) \times 8$.
11. $2\frac{1}{4} \times \frac{5}{6}$ of $\frac{1}{12} - \frac{3}{10}$.
12. $\frac{5}{8}$ of $1\frac{1}{3} + \frac{3}{5}$ of $4\frac{1}{2}$.

6. The inverted divisor is called the *reciprocal* of the divisor, reciprocal numbers being those which, multiplied together, will produce unity.

EXERCISE 50

Divide:

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

EXERCISE 51

1. A farmer sold 27⅞ a. of land for $1150. How much per acre did he receive?

2. If it takes 43⅓ yd. of cloth to make 5 suits of clothes, how many yards will be needed to make 12 suits?

3. A pole 28 ft. high casts a shadow $64\frac{3}{10}$ ft. long. How long a shadow will a pole 15 ft. high cast at the same time?

4. If 21 a. of land yield 735⅜ bu. of oats, how many bushels will 45 a. yield at the same rate?

5. A train goes 184¾ mi. in 6 hr. How far does it go in 1⅓ hr.?

6. If 2 a. of land yield 75⅞ bu. of barley, how many acres will be required to yield 210 bu. at the same rate?

7. The cost of 30 t. of coal was $107.08⅓. At what rate per cwt. must it be sold to gain ⅛ of the cost?

8. A man's wages are $3⅛ per day; his expenses are $1⅞. How many days must he work to save $46⅛?

9. Find the weight of water in a rectangular cistern 7½ ft. long, 3⅜ ft. wide, and 4⅓ ft. deep.

10. Find a number which, divided by 5⅛, the quotient increased by 2⅔, and the sum multiplied by 5⅐, the product is 36.

EXERCISE 52

Simplify:

1. $(\frac{3}{8}+\frac{5}{10})\div(\frac{7}{8}-\frac{3}{8})$.
2. $7\frac{1}{2}\div(\frac{3}{4}\text{ of }\frac{1}{3}+1\frac{7}{12})$.
3. $\frac{3}{4}\text{ of }\frac{2}{5}\div 4\frac{1}{3}+7\frac{1}{7}$.
4. $\frac{1}{7}\text{ of }\frac{3}{8}\div(1\frac{1}{3}+1\frac{1}{4})$.
5. $(7\frac{3}{8}+2\frac{1}{2})\div(15\frac{5}{12}-3\frac{3}{4})$.
6. $2\frac{1}{4}\times 3\frac{1}{3}-(5\frac{1}{2}\div 2\frac{1}{7})$.
7. $(7\frac{3}{8}+6\frac{1}{4})\div(7\frac{1}{4}-6\frac{3}{8})$.
8. $\frac{19}{12}\div 1\frac{1}{6}+\frac{3}{4}\text{ of }\frac{4}{5}$.
9. $2\frac{1}{4}\times 3\frac{1}{3}\div 5\frac{1}{2}\div 2\frac{1}{7}$.
10. $2\frac{1}{4}\div 3\frac{1}{3}\div 5\frac{1}{2}\div 2\frac{1}{7}$.

V. COMPLEX FRACTIONS

7. Expressions such as $\frac{\frac{3}{4}}{7}$, $\frac{4}{2\frac{1}{2}}$, $\frac{3\frac{1}{4}}{5}$, are called **Complex Fractions.**

8. A **complex fraction** is one in which either the numerator or denominator, or both, are fractions.

Example 1. Simplify $\frac{3\frac{1}{4}}{5}$.

Since the numerator of a fraction is the dividend, and the denominator the divisor,

$$\frac{3\frac{1}{4}}{5} = 3\tfrac{1}{4} \div \frac{5}{1} = \frac{13}{4} \times \frac{1}{5} = \frac{13}{20}.$$

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

In many cases it is simpler to multiply the numerator and denominator of the complex fraction by the L. C. M. of the denominators; thus, multiplying both numerator and denominator by 4,

$$\frac{2\frac{1}{2}+1\frac{1}{4}}{2\frac{1}{2}-1\frac{1}{4}} \text{ becomes } \frac{10+5}{10-5} \text{ or } \frac{15}{5} = 3.$$

EXERCISE 53

Simplify:

1. $\frac{52}{3\frac{1}{4}}$.
2. $\frac{3\frac{3}{4}}{5}$.
3. $\frac{1\frac{1}{2}}{1\frac{1}{11}}$.
4. $\frac{\frac{11}{12}}{7\frac{11}{12}}$.
5. $\frac{4\frac{1}{2}}{2\frac{3}{8}}$.
6. $\frac{9\frac{7}{8}}{2\frac{1}{17}}$.
7. $\frac{5\frac{3}{11}}{2\frac{7}{11}}$.
8. $\frac{8\frac{3}{4}}{5\frac{1}{8}}$.
9. $\frac{15\frac{3}{4}}{7\frac{1}{8}}$.
10. $\frac{9}{3\frac{3}{11}}$.
11. $\frac{23}{2\frac{1}{3}+\frac{2}{3}}$.
12. $\frac{2\frac{1}{2}+1\frac{1}{3}}{3\frac{1}{3}-2\frac{1}{2}}$.

13. $\frac{14\frac{1}{2}-6\frac{1}{3}}{3\frac{1}{3}+7\frac{1}{5}}$.

14. $\frac{4\frac{1}{15}+6\frac{1}{5}}{9\frac{1}{2}-3\frac{1}{4}}$.

15. $\frac{2\frac{1}{2}+1\frac{5}{48}}{9\frac{2}{7}-\frac{33}{112}}$.

16. $\frac{3\frac{1}{2}\text{ of }1\frac{1}{2}}{1\frac{1}{3}\text{ of }1\frac{1}{4}}$.

17. $\frac{3\frac{3}{7}\text{ of }2\frac{11}{12}}{\frac{1}{3\frac{1}{3}}\text{ of }8\frac{9}{14}}$.

18. $\frac{4\frac{4}{15}\text{ of }2\frac{5}{8}}{5\frac{1}{2}-4\frac{1}{3}}$.

19. $\frac{2\frac{1}{4}+2\frac{1}{2}}{5\frac{1}{2}\times\frac{1\frac{1}{2}}{3}}$.

20. $\frac{2\frac{1}{3}-1\frac{2}{7}}{1\frac{2}{3}\text{ of }1\frac{7}{9}}$.

21. $\frac{7\frac{2}{3}+2\frac{1}{2}}{15\frac{5}{12}-3\frac{3}{4}}$.

22. $\frac{4\frac{2}{3}-2\frac{1}{10}}{4\frac{2}{3}\div 2\frac{1}{10}}$.

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

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

25. $\frac{4\frac{1}{2}+7\frac{3}{8}}{7\frac{3}{8}+6\frac{3}{4}}$.

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

27. $\frac{20\frac{1}{4}-10\frac{1}{2}}{20\frac{1}{4}+10\frac{1}{2}}$.

EXERCISE 54

1. *A* can dig a garden in 2 da. Draw a diagram of the garden and show the part he can dig in 1 da.

2. Show by a diagram the part *A*, who can do a piece of work in 4 da., can do in 1 da.

3. Show by a diagram the part of a piece of work *A* could do in 1 da., if he can do it all in 6 da.

4. *A* can do $\frac{1}{2}$ of a piece of work in 1 da. How long will it take him to do the whole of it?

5. *A* can do $\frac{1}{3}$ of a piece of work in 1 da. How long will it take him to do the whole of it?

6. *A* can do $\frac{3}{5}$ of a piece of work in 1 da. How long will it take him to do the whole of it?

7. *A* can do a piece of work in 5 da. which *B* can do in 4 da. How much of the work can they together do in 1 da.?

8. *A* can do a piece of work in 4 da.; *B* can do it in 6 da. If both work together, in what time will it be done?

9. *A*'s working power is $\frac{1}{2}$ of *B*'s. How long will it require *B* to do a work which *A* can do in 6 da.?

10. A's working power is $\frac{5}{4}$ of B's. How long will it require B to do a work which A can do in 12 da.?

11. A's working power is $\frac{4}{5}$ of B's. How long will it require A to do a work which B can do in 12 da.?

12. A can do a piece of work in 8 da., and B can do it in 9 da. How long will it require A and B working together to do it?

Part of the work A does daily $= \frac{1}{8}$;

" " " B " " $= \frac{1}{9}$;

" " " A and B do daily $= \frac{1}{8} + \frac{1}{9} = \frac{17}{72}$;

therefore they do $\frac{1}{72}$ of the work in $\frac{1}{17}$ da.;

therefore they do the whole work in $\frac{72}{17}$ da., or $4\frac{4}{17}$ da.

13. A can do a piece of work in 12 hr,, and B can do it in 15 hr. In what time can both working together do the work?

14. A can do a piece of work in 20 da., B can do it in 24 da., and C can do it in 30 da. In what time will they all do it working together?

15. A quantity of flour lasts a man and wife 9 da., and the wife alone 27 da. How long would it last the man alone?

16. A can do a piece of work in 20 da.; after working at it for 8 da., B comes to help him, and they finish the work in 5 da. How long would it take B by himself to do the work?

17. A cistern has three pipes; the first will fill it in 10 hr., the second in 12 hr., and the third in 15 hr. In what time will they together fill the cistern?

18. A, whose working capacity is $\frac{1}{2}$ B's, can mow a piece of grass in 4 da. If both A and B work together, in what time will they do the work?

19. A can do $\frac{3}{5}$ of a piece of work in 8 da.; B can do $\frac{3}{4}$ of the same work in 12 da. In what time could both working together do two such pieces of work?

20. A and B can mow a field in 12 da.; A and C in 15 da.; B and C in 20 da. In what time could A mow it by himself?

A and B can do $\frac{1}{12}$ of the work in 1 da.

A and C can do $\frac{1}{15}$ " " "

B and C can do $\frac{1}{20}$ " " "

Therefore 2 A's, 2 B's and 2 C's can do $\frac{1}{12}+\frac{1}{15}+\frac{1}{20}$ of the work in 1 da. or $\frac{1}{5}$;

therefore A, B and C can do $\frac{1}{2}$ of $\frac{1}{5}$ of the work in 1 da., or $\frac{1}{10}$;

therefore A can do $\frac{1}{10}-\frac{1}{20}$ of the work in 1 da., or $\frac{1}{20}$;

therefore A can do the work in 20 days.

21. A and B can do a piece of work in 8 da.; A and C can do it in 9 da., and B and C in 10 da. In what time can all three working together do it?

22. A and C can dig a garden in 10 da.; B and C can dig $\frac{1}{3}$ of the same garden in 4 da., and B alone can dig it in 20 da. In what time can A do it by himself?

23. A and B can do a piece of work in 20 da.; B and C can do it in 24 da. In what time can each do it by himself, provided B's working power is $\frac{4}{5}$ of A's?

24. *A*'s working power is $\frac{3}{4}$ of *B*'s and *B*'s is $\frac{1}{3}$ of *C*'s. In what time will all three working together do a piece of work which *B* by himself can do in 15 da.?

VI. DENOMINATE FRACTIONS

EXERCISE 55

1. What is the unit in $\frac{3}{4}$ yd.? in $\frac{1}{5}$ mi.? in $\frac{2}{3}$ sec.?

9. A fraction in which *the unit is a denominate number* is said to be a **Denominate Fraction.**

2. Give five examples of denominate fractions.

3. Reduce 3 ft. to inches and find the number of inches in $\frac{1}{4}$ of 3 ft.; in $\frac{3}{4}$ ft.

4. Find $\frac{1}{3}$ of 2 hr. and compare this with $\frac{2}{3}$ of 1 hr.

Example 1. Find the value of $\frac{3}{4}$ yd. in feet and inches.

yd.	ft.	in.
4) 3	0	0
2	3	

Since $\frac{3}{4}$ yd $= \frac{1}{4}$ of 3 yd., we divide 3 yd. by 4 as in compound division.

Example 2. Find the value of $3\frac{1}{4}$ of $\frac{3}{13}$ of 2 t. 3 cwt.

$$3\tfrac{1}{4} \text{ of } \frac{3}{13} \text{ of } 2 \text{ t. } 3 \text{ cwt.} = \frac{13}{4} \text{ of } \frac{3}{13} \text{ of } 2 \text{ t. } 3 \text{ cwt.}$$

$$= \frac{3}{4} \text{ of } 2 \text{ t. } 3 \text{ cwt.}$$

$$= \frac{6 \text{ t. } 9 \text{ cwt.}}{4} = 1 \text{ t. } 12 \text{ cwt. } 25 \text{ lb.}$$

What is the value:

5. Of $\frac{1}{3}$ of a bushel?
6. Of $\frac{2}{3}$ of a mile?
7. Of $\frac{1}{8}$ of a rod?
8. Of $\frac{3}{10}$ of a mile?
9. Of $\frac{1}{5}$ of a ton?
10. Of $\frac{5}{6}$ of an acre?
11. Of $\frac{3}{7}$ of 12 hr. 1 min.? of 26 da. 4 min. $\div 3\frac{1}{3}$?
12. Of $\frac{3}{5}$ of a week $+ \frac{2}{3}$ of a day $+ \frac{3}{5}$ of an hour?
13. Of $\frac{33}{110}$ cwt. $- \frac{5}{13}$ of 2 lb. 8 oz.?

EXERCISE 56

1. \$1 is what part of \$4? of \$5? of \$7? of \$10?

2. \$3 is what part of \$4? of \$5? of \$7? of \$10?

3. What part of a foot is 1 in.? is 2 in.? is 3 in.?

4. Reduce 1 yd. and 1 ft. 5 in. each to inches, and find what part the latter is of the former.

5. Reduce 2 t. 4 cwt. and 2 t. 50 lb. each to pounds, and find what fraction the latter is of the former.

Example 3. Express 4 rd. 2 yd. 1 ft. 4 in. as the fraction of 1 mile.

4 rd. 2 yd. 1 ft. 4 in. = 880 in. and 1 m. = 63360 in.

Now 1 in. $= \frac{1}{63360}$ of 63360 in.;

$\therefore$ 880 in. $= \frac{880}{63360}$ of 63360 in.

Hence the fraction required is $\frac{880}{63360}$ or $\frac{1}{72}$.

6. Before expressing one denominate number as the fraction of another, in what denomination must the numbers be expressed?

7. What fraction is 2 ft. 3 in. of 5 yd.?

8. What fraction of 2 hr. 10 min. is 1 hr. 30 min.?

9. If the unit of measurement is 3 ft. 4 in., what is the measure of 10 ft.? of 6 ft. 8 in.? of 1 ft. 8 in.? of 10 in.?

NOTE. The example, *Express 4 lb. as the fraction of 8 lb.*, may be written in any of the following ways:

(*a*) Reduce 4 lb. to the fraction of 8 lb.

(*b*) What fraction of 8 lb. is 4 lb.?

(*c*) What part of 8 lb. is 4 lb.?

(*d*) If 8 lb. is the unit, what is the measure of 4 lb.?

EXERCISE 57

1. What part of a ton is $\frac{1}{2}$ of an ounce?
2. What part of a mile is $\frac{3}{4}$ of a rod?
3. What part of an acre is $\frac{2}{3}$ of a square foot?
4. Reduce $\frac{3}{4}$ of a pint to the fraction of a gallon.
5. Reduce $\frac{1}{4}$ of an inch to the fraction of a rod.
6. Reduce $\frac{1}{8}$ of a pound to the fraction of a ton.
7. What fraction of 3 mi. is 7 rnr. 3 yd.?
8. Express 2 a. 41 per. as a fraction of 4 a. 97 per.
9. Reduce $\frac{3}{200}$ of a ton to the fraction of an ounce.
10. Reduce $\frac{1}{720}$ of a mile to the fraction of an inch.

EXERCISE 58 (REVIEW)

1. If $\frac{3}{4}$ of an inch on a map corresponds to 7 mi. of a country, what distance on the map represents 20 mi.?

2. If 31 cwt. of cheese cost $651, what will 15 cwt. 50 lb. cost?

3. Bought 2 oz. of tea for 7$\frac{1}{2}$c. What is that per pound?

4. If 99 lb. cost $77.55, how much is that per hundredweight?

5. If, when flour is $5 a barrel, the five-cent loaf of bread weighs 10 oz., what ought to be the weight when flour is $8 a barrel?

6. If 1$\frac{1}{2}$ a. of land sell for $34.50, what will 20 a. 90 per. cost at the same rate?

7. If 18 a. 140 per. cost $900, what will 150 a. cost at the same rate?

8. If 1$\frac{1}{2}$ bn. of wheat cost 1.68\frac{3}{4}$, what will 154 bu. 1 pk. 6 qt. cost?

9. If a train travels 300 mi. in 9 hr. 40 min., how long will it be in travelling 223 mi.?

10. If 7 gal. 1 qt. of wine cost $17.40, what will 3 qt. 1 pt. cost at the same rate?

11. If 15 yd., $\frac{3}{4}$ of a yard wide, will make a dress, how many yards, $\frac{5}{8}$ of a yard wide, will make another dress of the same size?

12. How many yards of cloth, $\frac{5}{8}$ yd. wide, will be required to line 35 yd., $1\frac{1}{4}$ yd. wide?

13. If it reqnires 36 yd. of carpeting, $\frac{3}{4}$ yd. wide, to cover a floor, how many yards, $\frac{1}{3}$ yd. wide, will be required to cover the same floor?

14. A regiment of 1000 men are to have new coats; each coat is to contain $2\frac{1}{8}$ yd. of cloth, $1\frac{1}{4}$ yd. wide, and to be lined with shalloon $\frac{7}{8}$ yd. wide. How many yards of shalloon will be required?

15. A bankrupt owes $4000, and his assets—that is, his whole property—amonnt to no more than $840. What dividend will his creditors receive in the dollar?

16. A merchant became insolvent, owing $6850, and had only $4932 with which to pay his creditors. How mnch should a creditor, whose claim is $1540, receive?

17. What does a bankrnpt pay in the pound if his creditors receive £376 5s. ont of £2076?

18. How much will a creditor lose on a debt of $5342.25 if he receives only $67\frac{1}{2}$c. in the dollar?

19. A creditor loses $37\frac{1}{2}$c. in the dollar of what was dne to him, and thereby loses $330. What was the sum due?

20. The product is $73\frac{1}{4}$; the divisor is $2\frac{3}{5}$; the remainder is $1\frac{1}{4}$. Find the quotient.

21. A man's expenses for a year are \$1200, which is $\frac{3}{4}$ of his salary. If he puts $\frac{1}{5}$ of what he earns in the bank, how long will he be in saving \$1800?

22. A farmer has 60 tons of hay, which is $\frac{3}{4}$ as much as his neighbor has. How much has his neighbor?

23. *A* has $\frac{4}{5}$ of a ton of hay, which is $\frac{2}{3}$ as much as *B* has. How much has *B*?

24. *A* owns $\frac{4}{7}$ of a railroad, and $\frac{2}{3}$ of this is $3\frac{3}{7}$ times what *B* owns. How much does *B* own?

25. How many acres of land has *B*, if $\frac{3}{11}$ of 18 a. is $\frac{6}{11}$ of his number?

26. *A*'s money equals $\frac{8}{11}$ of \$8750, and *A*'s is $\frac{33}{50}$ of *B*'s money. How much money has *B*?

27. *A* rode $2\frac{1}{2}$ hr. at the rate of 12 mi. per hour; *B* rode $\frac{4}{5}$ of this distance. How far did *B* ride?

28. *A*'s money is $\frac{4}{5}$ of *B*'s; *B*'s is $2\frac{1}{2}$ times *C*'s; *C* has \$3450. How much money has *A*?

29. If $\frac{4}{7}$ of the cargo of a ship is worth \$3200, what will be the value of $\frac{3}{5}$ of $\frac{1}{3}$ of the remainder?

30. A farmer sold $\frac{3}{5}$ of $\frac{4}{7}$ of his farm to *B* and $\frac{4}{7}$ of the remainder to *C*. *C* paid \$2345 for his part. At the same rate, what was the value of the farm?

ORAL EXERCISE

1. What number is that which, diminished by $\frac{2}{3}$ of itself, equals 24?

2. The sum of two numbers is $12\frac{3}{5}$, and the less is $4\frac{3}{10}$. What is the greater?

3. If 8 men can do a piece of work in $5\frac{1}{2}$ days, how long will it take 1 man to do the work?

4. If a boy earns $\$\frac{3}{4}$ in a day, how much will he earn in 12 days?

5. If a yard of cloth costs $\$\frac{3}{8}$, how much can be bought for \$6?

6. If 5 gold pens cost $\$7\frac{1}{2}$, how much will 7 gold pens cost?

7. If a man can walk 7 miles in 2 hr., how far can he walk in 3 da. by walking 10 hr. each day?

8. 60 is $\frac{3}{5}$ of what number?

9. 28 is $\frac{4}{7}$ of how many times 6?

10. If a turkey costs $\$2\frac{1}{4}$, how many can be bought for \$36?

11. If a farmer sow 1 bu. 3 pk. of wheat on an acre, how many bushels will be required to seed a 50-acre field?

12. What is the smallest fraction that, added to the sum of $2\frac{1}{3}$ and $3\frac{1}{4}$, will make the result a whole number?

13. Which of the following numbers are prime, and which composite: 29, 35, 42, 47, 51, 67, 73, 87?

14. Find the greatest common divisor of 36 and 45; of 51 and 63; of 24 and 72.

VII. GENERAL REVIEW

EXERCISE 59

1. Write in words 404040404.04.

2. Express the following in Roman numerals: 494, 349, 909, 404, 999.

3. Find the difference between the product and the sum of 75 and 705.

4. The divisor and quotient are each 504 and the remainder is the largest possible. Find the dividend.

5. Resolve 2700 into prime factors and from these find six divisors of this number greater than 100.

6. Find the number which has all the prime numbers between 16 and 40 for its prime factors.

7. Resolve 360, 540, and 588 into prime factors and from these determine (1) all their common factors, and (2) the G. C. F.

8. Simplify $(16 \times 18 \times 24 \times 32 \times 36) \div (96 \times 144 \times 192)$.

9. Tom's age is $\frac{3}{5}$ of Hal's; Hal's age is $\frac{4}{15}$ of his father's. His father's age is 57. How old is Tom?

10. *A*'s money is $\frac{4}{7}$ of *B*'s and together they have $55. How much has each?

11. Make out a bill of the following sales, showing that a payment has been made on account and that a balance remains due: 17½ yd. flannel at 40c.; 18¼ yd. gingham at 8c., 20⅓ yd. tweed at 90c., 3 felt hats at $2.70, 40 yd. ribbon at 9c., 90¼ yd. cotton at 12c. Received in payment 50 lb. butter at 22½c. and 17 doz. eggs at 18c.

EXERCISE 60

1. Find the cost of 75860 bricks at $9.75 per M.

2. 7 lb. black tea at 68c. and 9 lb. of green tea at 75c. are mixed and sold at a gain of $3.69. Find the selling price per pound.

3. If $2\frac{1}{8}$ bu. of potatoes are worth $.70, find the value of 7 bu.

4. What part of $5\frac{1}{11}$ is $\frac{1}{7}$?

5. Name the largest and smallest fractions in

$$\tfrac{11}{13},\ \tfrac{15}{17},\ \tfrac{9}{10},\text{ and }\tfrac{3}{4}.$$

6. At $\frac{3}{10}$ of a dollar per dozen, what will 127 steel pens cost?

7. Goods valued at $8200 were destroyed by fire. What would a man lose who owned $\frac{3}{17}$ of the goods?

8. If 38 yd. of cloth cost $95, what will 24 yd. cost?

9. By selling a carriage for $195, I lost $32.75. For how much should I have sold it to gain $\frac{1}{8}$ of what it cost?

10. What is the value of $\frac{2\frac{1}{2}}{3\frac{1}{3}}$ of $12\frac{1}{2}$?

11. If $3\frac{1}{3}$ cords of wood are worth $12.50, what are $2\frac{1}{3}$ cords worth?

EXERCISE 61

1. If of $350 you spend $125, what fraction of the money will remain?

2. What number is it of which the third part exceeds the fourth part by 3?

3. A boy spent $\frac{1}{5}$, $\frac{3}{10}$, $\frac{1}{4}$ and $\frac{1}{4}$ of his money, and had 26 cents remaining. What had he at first?

4. A man had 100 fowls. He sold $\frac{1}{4}$ of them to one grocer and $\frac{2}{3}$ of the remainder to another grocer. Find the value of the remainder at 25c. apiece.

5. Divide a pole 12 ft. long into two parts so that one part shall be twice the other.

6. Divide $75 into two sums such that $\frac{1}{2}$ of the first sum is equal to $\frac{1}{3}$ the second sum.

7. A carpenter can build a shop in 18 days and with the help of his son in 12 days. In how many days can the son alone do it?

8. A room is $15\frac{2}{3}$ ft. long and $12\frac{1}{2}$ ft. wide. Find the length of a moulding that will reach around it.

9. One man can walk a mile in $\frac{1}{3}$ of an hour, and another in $\frac{3}{11}$ of an hour. In a race of 15 miles, which will win and by how much?

10. If $8\frac{1}{3}$ bu. of wheat are worth \$4.20, find the value of $9\frac{1}{3}$ bn.

11. What is the valne of $\left(3+2\frac{1}{2}-\frac{3}{4} \text{ of } \frac{6}{2}+\frac{4}{\frac{2}{3}}\right) \div 4\frac{1}{3}$?

EXERCISE 62

1. If $4\frac{1}{2}$ bbl. of apples are worth \$45.45, find the value of $5\frac{1}{2}$ bbl.

2. By what number mnst 12 be divided to give a quotient $\frac{2}{3}$?

3. Find the greatest number that is exactly contained in 1600 and 1720.

4. Find the L. C. M. of 160, 170, 180, and 200.

5. Reduce $\frac{162}{243}$ to its lowest terms.

6. Find the value of $\frac{2}{3}$ of $\frac{7}{8}+\frac{5}{6}$ of $\frac{7}{11}$.

7. A man bought a cow for \$35. He sold her milk, which averaged 5 gal. a day, at the rate of 16 qt. for a dollar. It cost 30c. a day to keep the cow. How long will it be before she will pay her cost?

8. (*a*) How high must a pile of wood be if it is 128 ft. long, 8 ft. wide, and contains 32 cords?

(*b*) If a man saw the pile in 16 days and receive \$1.75 a day, how much has been paid per cord for the cutting?

9. Which is it better, to pay at the rate of \$6 for 7 yd. of silk or \$7 for 8 yd. of the same silk?

10. The product is 18672 and the multiplier is 25. Find the multiplicand.

11. Find by the shortest method possible the value of

$$1864 \times 25; \quad 176 \times 125; \quad 186 \times 33\tfrac{1}{3};$$
$$725 \div 25; \quad 625 \div 25; \quad 25 \times 25.$$

12. Divide $36 \times 45 \times 54 \times 72 \times 80$ by the continued product of 24, 27, 35, 48, 64, and 81 in the shortest way you can.

EXERCISE 63

1. When water freezes it expands $\frac{1}{10}$. How many cubic inches of water will there be when a block of ice which is 4 ft. $\times$ 2 ft. $\times$ 2 ft. is melted?

2. A horse cost \$125 and is sold for \$115. What fraction of the cost is lost?

3. A horse cost \$150 and is sold at a gain of $\frac{2}{5}$ of the cost. Find the selling price.

4. A horse is sold for \$160, and the gain is $\frac{1}{5}$ of the cost. Find the cost.

5. When \$28 is paid for $2\frac{1}{10}$ tons of hay, what part of a ton will \$1 purchase?

6. When 12 cords of wood cost \$76.50, what is the cost of 1 cord?

7. At $\$\frac{5}{8}$ a yard, how many yards of cloth can be bought for \$43.50?

8. Fill in the blanks in the following problems:

First Number.	Second Number.	Their Sum.	Their Product.
$1\frac{1}{2}$	$2\frac{3}{4}$	—	—
$1\frac{3}{5}$	—	$3\frac{3}{5}$	—
$2\frac{1}{2}$	—	—	$7\frac{1}{2}$
—	$3\frac{3}{4}$	$3\frac{5}{8}$	—
$\frac{3}{4}$	—	$7\frac{1}{2}$	—

9. To what number does $\frac{3}{4}$ bear the same relation that 6 bears to $7\frac{1}{2}$?

10. Find the height of a room 20 ft. by 15 ft., the papering of which, at 15c. per square yard, costs \$14.

EXERCISE 64

1. Two of the dimensions of a rectangular tank containing $12\frac{1}{2}$ t. of water are 8 ft. and 4 ft. What is the other dimension?

2. The water in a rectangular cistern 12 ft. 6 in. by 8 ft. 6 in. has sunk 16 in. How many gallons have run out?

3. If it costs \$33.60 to carpet a floor 18 ft. by 14 ft. with carpet at \$1 per yard, find the width of the carpet.

4. If snow lies $7\frac{1}{2}$ in. deep, how many cubic feet are there on 2 a.?

5. Find the difference in cost of carpeting a room 18 ft. long, 15 ft. wide, with carpet 1 yd. wide, at \$1.25 per yard, or with carpet 27 in. wide, at \$1 per yard.

6. A rectangular garden 30 rd. by 15 rd. is enclosed by a tight board fence 6 ft. high. How much lumber will be required?

7. Two men can do a piece of work in 6 da., and the first does $\frac{1}{2}$ as much work as the second. How long would it take each to do the work alone?

8. A plough takes a 14 in. furrow, and a field is 160 yd. wide. What fraction of the field will be ploughed in a day if the horses travel at the rate of 30 mi. a day and the field is $\frac{1}{4}$ of a mile long?

9. Fill in the blanks in the following problems:

Cost of Article.	Gain in Dollars.	Fraction of Cost Gained.	Selling Price.
\$24	\$6	—	—
\$25	—	$\frac{2}{5}$	—
\$30	—	—	\$36
—	\$12	—	\$36
—	\$15	$\frac{1}{2}$	—
—	\$20	—	\$80

CHAPTER IV

DECIMALS

I. NOTATION AND NUMERATION

EXERCISE 65

1. (*a*) Read 123.456.

(*b*) How are hundreds related to tens? tens to hundreds?

(*c*) How are tens related to units? units to tens?

(*d*) How are tenths related to units? units to tenths?

(*e*) How are hundredths related to tenths? tenths to hundredths?

(*f*) How are thousandths related to hundredths? hundredths to thousandths?

Ten-Thousands.	Thousands.	Hundreds.	Tens.	Units.		Tenths.	Hundredths.	Thousandths.	Ten-Thousandths.
2	2	2	2	2	.	2	2	2	2
3	3	3	3	3	.	3	3	3	3
5	5	5	5	5	.	5	5	5	5
7	7	7	7	7	.	7	7	7	7

2. (*a*) Compare the position of tens and tenths with reference to units.

(*b*) Compare the position of hundreds and hundredths with reference to units.

(*c*) Compare the position of thousands and thousandths with reference to units.

3. (*a*) Express as tenths: 4 nnits, 7 units, 9 units.

(*b*) Express as hnndredths: 5 tenths, 7 tenths, 9 tenths.

(*c*) Express as thousandths: 5 hnndredths, 7 hundredths, 9 hundredths.

(*d*) Express as tenths: 4.7, 5.3, 36.8.

(*e*) Express as hundredths: 4.06, .78, 24.01.

4. Express in decimal form:

$\frac{1}{10}$; $\frac{1}{100}$; $\frac{7}{1000}$; $\frac{31}{1000}$; $6\frac{3}{10}$; $8\frac{31}{100}$.

5. (*a*) Read the numbers 7; 70; 700; 7000.

(*b*) What is the effect of affixing ciphers to whole numbers?

6. (*a*) Read the nnmbers .5; .05; .005; .0005.

(*b*) What is the effect of placing ciphers between a digit and the decimal point?

7. (*a*) Read .1; .10; .100; .1000.

(*b*) What is the effect of affixing ciphers to a decimal?

Write the following decimals in words:

8. .9.
9. .27.
10. .368.
11. .064.
12. 4.31.
13. 7.216.
14. 3.314.
15. 5.8167.
16. 21.3601.
17. 17.0064.
18. 18.00081.
19. 20.01458.

Express in figures the following:

20. Eight tenths; two, and seven hundredths; nine thousandths.

21. Eight hundred and seven, and ninety-four thonsandths; three thousand and seventeen, and seven hnndred and nine ten-thousandths; three, and one thousand and eight millionths.

II. ADDITION OF DECIMALS

EXERCISE 66

1. What kind of numbers can be added together?

2. In addition, how are the addends written so that units of the same order may be added together?

3. In $3.4 + 71.61 + 7.984 + .689 + 367.8$, arrange the addends under one another so that units may be under units, tens under tens, tenths under tenths, etc.

Find the sum of the following:

4.	5.	6.	7.
42.3	12.326	4031.06	.608242
13.06	204.00	108.304	.0315044
8.049	8.3024	9.001345	.8034
1.6	52.007	76.739	.086
.037	324.1	250.0007	.9106

Find the sum of:

8. $4.5 + 70.63 + 1.079 + 25$.

9. $.126 + 3.05 + .07 + .528 + 7.093$.

10. $111.306 + .0317 + 2.793 + .007$.

11. $470.05 + 72.701 + 3.0315 + 413.2658$.

12. $12.3987 + 4.1462 + .02063 + 13 + 10.962$.

EXERCISE 67

1. Add together fifty-nine tenths; six hundred, and seven hundredths; eighteen thousandths; seven, and eight ten-thousandths; and fifty, and five hundredths.

2. In one field there are 12.9 a.; in a second 14.75 a.; in a third 15.675 a.; in a fourth 17.865 a. How many acres are there in the four fields?

3. Five loads of coal weighed as follows: 1.75 t., 1.345 t., 1.5 t., 1.975 t., 2.25 t. How much did the five loads weigh?

4. A merchant bought 147.5 yd. of cloth at one time; 375.25 at another; and 453.125 at a third. How much cloth did he buy?

5. Find the sum of 407 thousandths, 75 millionths, 813 tenths, 6845 hundredths, and 75 ten-thousandths.

6. Simplify $351.76 + 30.09 + .007 + 90.65 + 17.7943$.

7. Six marble blocks weigh, respectively, 5.73 cwt., 4.834 cwt., 7.938 cwt., 7.4 cwt., 18 cwt., and 78.1 cwt. Find their total weight.

8. A train ran 45.7 mi. in the first hour, 51.74 mi. in the second, 50.7504 in the third, and 53.7105 in the fourth. How many miles did the train run during these four hours?

9. A merchant has four pieces of calico measuring, respectively, 25.5 yd., 29.125 yd., 34.25 yd., and 33.75 yd. How many yards are there in the four pieces?

III. SUBTRACTION OF DECIMALS

EXERCISE 68

	1.	2.	3.	4.
From	18.5	2.8706	.50376	.36
Take	2.3476	.49	.065	.12704

From

5. 1.869 take .0374.
6. .0061 " .00089.
7. 6.723 " 2.7981.
8. 9.305 " 7.9.
9. 204.1 take 36.002.
10. 1000 " 999.99.
11. 2 " 1.3678.
12. 17.36 " 9.0184.

Find the valne of:

13. $36 + 7.07 - 24.896 - (3.164 - .799)$.

14. $(273.29 - 41.802) - (7.162 + 51.386 - .09863)$.

EXERCISE 69

1. The length of a second's pendnlum is 39.1392 in., and that of a French metre 39.371 in. Find the difference in length between them.

2. A sovereign weighs 123.274 gr., and a shilling 87.271 gr. Find their difference in weight.

3. Take eleven thousandths from eleven hundredths.

4. Add together the sum and difference of seventy-three thousandths and one hundred and fifteen millionths.

5. From a piece of mnslin containing 27.5 yd., a merchant sold 13.75 yd. How much was left?

6. From one thonsand take one millionth.

7. To how many ponnds of chicory must 28.786 lb. of coffee be added to produce 34.35 lb. of the mixture?

8. A Manitoba farmer had two sections of land, and sold 450.625 a. How many acres had he left?

9. *A* owns nine-tenths of a ship. He sells eight hundred and eighty-eight thousandths of it. How much has he left?

10. When a certain number is taken away from 25.375, 2.7869 is left. Find the number taken away.

EXERCISE 70

Simplify:

1. $94.7 - 48.08 + 41.76 - 36.875 - 27.846$.

2. $78 - 16.45 - 24.786 - 9.95 + 18 - 16.7$.

3. $53 + 52.6 - 18.8946 - 31.254 - .5 + 32.18$.

4. $1.6 + 7.84 + 6.875 - 3.999 - 5.5555$.

5. $.008 + 10.4 - 3.576 - 2.8497 + 7.567$.

6. From the sum of 101.01 and 1.001 take their difference.

7. Find the least nnmber which, added to the snm of .12, 1.5, .07, and 80.3, will make the result a whole number.

8. Mr. Jones, who owned 160.5 a. of land, sold 13.125 a. to one man and 16.004 a. to another. How many acres had he left?

IV. MULTIPLICATION OF DECIMALS

EXERCISE 71

1. How many places of decimals are there in the product of .7 and .09? in the product of .007 and .09?

	2.	3.	4.	5.
Multiply	4.64	53.062	.1346	675.1
By	3.35	4.53	.203	.008

Multiply:

6. 713 by 3.47.
7. 3.96 by .068.
8. 9.07 by 1.06.
9. 13.14 by .0236.
10. 714.6 by 1.124.
11. 9.006 by .0045.

12. A knot equals 1.1515 mi. Find the length of 49 knots.

13. When a certain number is divided by 3.25, the qnotient is 2.00968. Find the number.

14. How many square yards are there in a rectangular lot 56.25 yd. deep and 13.75 yd. wide?

15. Obtain the continued product of 10.45, 1.045, and .1045.

16. Find the cost of 8384 ft. of boards at $16.75 per thousand.

17. A pint of water weighs 1.25 lb. Avoirdupois. What is the weight of 7.8 pints?

18. Gold is 19.26 times as heavy as water. What weight of gold is of the same bulk as 17.342 lb. of water?

19. What is the weight of 5 cu. ft. of water if a cubic foot weighs 62.455 lb. Avoirdupois?

V. DIVISION OF DECIMALS

Example 1. Divide .736644 by 234.6.

We multiply the divisor and dividend by 10; the divisor is now a whole number. The operation will then stand as follows:

```
2346)7.36644(.00314
   7.038
    3284
    2346
     9384
     9384
```

We first bring down 3 tenths and put the decimal point in the quotient. The divisor is not contained in 73 tenths; we therefore put a 0 in the quotient and bring down 6 hundredths. Since the divisor is not contained in 736 hundredths, we put another 0 in the quotient and bring down 6 thousandths. The divisor is now contained in 7366 thousandths. The rest of the work proceeds as in ordinary division.

EXERCISE 72

Divide:

1. 16.578 by 5.4.
2. 48.591 by .96.
3. 2.56 by .0032.
4. 4.126 by 640.
5. 3.1 by .0025.
6. .0012 by 1.6.
7. .0774 by 480.
8. 21.3 by 37.5.

EXERCISE 73

1. What nnmber mnst be multiplied by .0064 to give 10?

2. How often can 1.314 be taken from 394.2?

3. Divide .1 by .001, and the qnotient by 2.

4. The area of a rectangular field is 3414.012 sq. yd. Its width is 125.7 yd. What is its length?

5. If 36.25 yd. of cloth cost $118.90, find the cost of 1 yd.

6. How many bnshels will fill a bin 6 ft. 5 in. long, 4 ft. 3 in. wide, and 5 ft. 7 in. deep, there being 2218.192 cn. in. in a bnshel?

7. If 38.4 bn. of wheat are worth 86.4 bn. of oats, how many bnshels of wheat are worth 199.8 bu. of oats?

8. A farmer sold .125 of his crop of hay in Jannary, .585 in February, and the remainder, 24679 lb., he kept for his own nse. Of how many tons did his crop consist?

9. If 20.5 a. of land prodnce 345.876 bu. of wheat, how much will 30.75 a. yield at the same rate?

EXERCISE 74

1. Multiply 350.4 by .0105 and divide the prodnct by .0000219.

2. At $1.75 per rod, what will it cost to fence a rectangular piece of land 63.5 rd. long and 27.75 rd. wide?

3. Divide the prodnct of .037 and .0025 by the sum of .9, .02, and .005.

4. A cnbical cistern is 5 ft. deep. How many gallons of water will it hold if 277.274 cn. in. make a gallon?

5. The weight of a cnbic foot of water is 62½ lb., and an imperial gallon contains 277.274 cu. in. Find the weight in onnces of a pint of water.

6. What is the least number that must be taken from the sum of $69\frac{1}{2}$, 8.2, 5.445, .065, and $20\frac{1}{12}$, so that it will contain 6.05 an exact number of times?

7. The length of a second's pendulum is 39.37079 in. If 64 French metres are equal to 70 yd., by what decimal of an inch will the length of a second's pendulum differ from one metre?

8. Find the value of $\frac{.321 \times .321 - .179 \times .179}{.321 - .179}$ of \$20.

9. The great pyramid of Cheops measures 763.4 ft. on each side of its base, which is square. How many acres does the pyramid cover?

VI. REDUCTION OF DECIMALS

EXERCISE 75

Express the following decimals as common fractions in their lowest terms:

1. .7.	5. .709.	9. .3005.
2. .36.	6. .0614.	10. .00036.
3. .08.	7. .0078.	11. .712465.
4. .784.	8. .7614.	12. .000875.

Express the following fractions as decimals:

13. $\frac{8}{10}$.	16. $\frac{7}{100}$.	19. $126\frac{341}{1000}$.
14. $\frac{17}{100}$.	17. $2\frac{7}{10}$.	20. $\frac{7}{1000000}$.
15. $\frac{81}{100}$.	18. $16\frac{144}{1000}$.	21. $16\frac{144}{1000000}$.

EXERCISE 76

1. Find the quotient when \$3 is divided by 4.
2. Find the quotient when 3 yd. is divided by 4.
3. Find the quotient when 3 is divided by 4.

Example 1. Reduce $\frac{3}{40}$ to a decimal.

40)3.00(.075
280
200
200

$\frac{3}{40}$ equals $\frac{1}{40}$ of 3 (Art. 106, Part I). 3 equals 30 tenths, and $\frac{1}{40}$ of 30 tenths is 0 tenths. 30 tenths equals 300 hundredths, and $\frac{1}{40}$ of 300 hundredths is 7 hundredths, and 20 hundredths remaining. 20 hundredths equals 200 thousandths, and $\frac{1}{40}$ of 200 thousandths is 5 thousandths; hence $\frac{3}{40} = .075$.

Reduce the following to decimals:

4. $\frac{3}{4}$.
5. $\frac{5}{8}$.
6. $\frac{9}{10}$.
7. $\frac{3}{40}$.
8. $\frac{9}{25}$.
9. $\frac{1}{40}$.
10. $\frac{3}{500}$.
11. $1\frac{7}{8}$.
12. $24\frac{1}{125}$.
13. $3\frac{11}{40}$.
14. $46\frac{9}{10}$.
15. $47\frac{3}{64}$.

EXERCISE 77

1. Change to common fractions in their simplest form:
.25, .36, .96, .096, .375.

2. Change to decimal form: $\frac{7}{25}$, $\frac{9}{1000}$, $\frac{384}{1000000}$.

3. Express in decimal form: $5\frac{7}{10}$, $34\frac{8}{1000}$, $8\frac{17}{20}$.

4. Express as common fractions in their lowest terms:
$.6\frac{1}{3}$, $.4\frac{2}{3}$, $.04\frac{2}{3}$, $.087\frac{1}{2}$.

5. Change to mixed numbers in their simplest form:
$7.5\frac{1}{2}$, $4.3\frac{8}{10}$, $5.16\frac{2}{4}$, $7.0\frac{1}{2}$.

6. Reduce each of these fractions to hundredths:
$\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{8}$, $\frac{3}{8}$, $\frac{1}{125}$, $\frac{6}{125}$.

7. Change the following to decimals, and find the sum of the decimals: $\frac{3}{4}$, $\frac{5}{8}$, $\frac{7}{10}$, $\frac{31}{64}$, $\frac{17}{20}$, $\frac{3}{40}$.

8. Cut as many tablecloths as possible, each containing $3\frac{1}{2}$ yd., from 23.35 yd. of damask, and find how much material remains.

9. Multiply .1234 by 10; by 100; by 1000; by 10000.

10. Divide .1234 by 10; by 100; by 1000; by 10000.

11. What number divided by 1.25 will give the continued product of 11, 1.1,.001?

12. What number multiplied by .4 of 7.8 gives .25 of .4 of $9\frac{1}{2}$ as product?

VII. DECIMALS OF DENOMINATE NUMBERS

EXERCISE 78

1. Reduce $\frac{1}{2}$ lb. to ounces; reduce .5 lb. to ounces.

2. Reduce $\frac{1}{8}$ t. to pounds; reduce .125 t. to pounds.

Example 1. Find the value of .475 of 1 mile.

.475	.475 of 1 mi. = .475 of 8 fur.
8	= 3.8 fur.
3.800 fur.	.8 of 1 fur. = .8 of 40 rd.
40	= 32 rd.
32.000 rd.	Hence .475 of 1 mi. = 3 fur. 32 rd.

Find the value of:

3. .94375 of 1 a.
4. .815625 of 1 lb. Troy.
5. 875 of 1s.
6. .497 of 1 da.
7. .4375 of £1.
8. .965625 of 1 mi.
9. .778125 of 1 t.
10. 2.5384375 of 1 da.

EXERCISE 79

1. Express 9 in. as a fraction of a yard.
2. Express 9 in. as a decimal of a yard.
3. Express 2 ft. as a fraction of 5 ft.
4. Express 2 ft. as a decimal of 5 ft.
5. Express 2 ft. as a fraction of 4 yd.
6. Express 2 ft. as a decimal of 4 yd.

Example 2. Reduce 15 cwt. 18 lb. 8 oz. to the decimal of 1 t., and express 5 t. 15 cwt. 18 lb. 8 oz. in tons only.

16)8 oz.
100)18.5 lb.
20)15.185 cwt.
.75925 t.

8 oz. = (8 ÷ 16) lb. = .5 lb. ;
∴ 18 lb. 8 oz. = 18.5 lb.
18.5 lb. = (18.5 ÷ 100) cwt. = .185 cwt. ;
∴ 15 cwt. 18 lb. 8 oz. = 15.185 cwt.
= (15.185 ÷ 20) t.
= .75925 t. ;
∴ 5 t. 15 cwt. 18 lb. 8 oz. = 5.75925 t.

7. Express 4 hr. 8 min. as a decimal of a day.
8. Express 48 lb. of wheat as a decimal of a bushel.
9. Express 2 oz. as a decimal of a ton.
10. Reduce 5 cwt. 64 lb. to the decimal of 1 t.
11. Reduce 248 rd. to the decimal of 1 mi.
12. Reduce 2 qt. 1 pt. to the decimal of 1 pk.
13. Express 17 cwt. 89 lb. 8 oz. in cwt. only.
14. Express 7 bu. 3 pk. 1 gal. in bushels only.
15. Express $3\frac{3}{4}$ ft. as the decimal of 1 fathom.
16. Express $\frac{2}{7}$ of $\frac{1}{4}$ of $22\frac{3}{4}$ lb. as the decimal of 1 t.

EXERCISE 80 (REVIEW)

1. Express 6.3 min. as the decimal of a week.

2. At a certain place the daily rainfall for a week was: .04, .00, 1.02, .84, .00, .14, 1.54 in. Find the average daily rainfall.

3. The average of four quantities is 18.65 ; the first is 26.207, the second 3.592, and the third is 38.06. Find the fourth.

4. Express the sum of .4 mi., .424 rd., and .4246 yd. as the decimal of a mile.

5. Express 5 w. 5 da. 9 hr. 46 min. 48 sec. as weeks.

6. Which is the greater, .27 of 3 mi. or .72 of a mile, and by how many yards?

7. Cork, whose weight is .24 of that of water, weighs 15 lb. per cubic foot. Find the weight of 3 cu. ft. of oak, which weighs .934 times as much as water.

EXERCISE 81 (REVIEW)

1. .4 of *A*'s money is invested in mines; .025 in ships, and the remainder, amounting to $2532.30, is on deposit in the bank. How much is *A* worth?

2. Divide 20 oz. of gold among *A*, *B*, and *C*, so that *A*'s share may be equal to .4 of *B*'s, and *B*'s 1.3 of *C*'s.

3. A cubic metre contains 1.308 cu. yd. and a gallon 277.274 cu. in. How many gallons will contain a cubic metre?

4. Add together $\frac{3}{11}$ of an acre, $\frac{4}{11}$ of 40 sq. rd., and 7.5625 sq. yd., giving the result in square feet.

5. In a town of 240756 inhabitants, it was found that .0475 of the whole could not read, and only .575 of those able to read could write. How many were there of each?

6. *A* and *B* step together; *A* takes 2.5 ft. each step, and *B* 2.785 ft. When *B* has gone a mile, what part of a mile has *A* still to go?

7. From Hamburg to Bremen is 22.75 German miles, or 109.5 English miles. What fraction of a German mile is an English mile?

8. A cubic foot of water weighs 1000 oz. Find the weight of water in a rectangular cistern 6.2 ft. long, 4.5 ft. wide, and 3.75 ft. deep.

9. Divide $576.58 among 3 men and 4 women, giving each man 1.75 of a woman's share.

ORAL EXERCISE

1. At 40c. a square foot, what will be the cost of a piece of land 40 ft. by 50 ft.?

2. How far will a locomotive, moving at the rate of 8 mi. in 15 min., go in an hour and a half?

3. How long must a box be that is 4 ft. wide and $3\frac{1}{2}$ ft. deep to contain 77 cu. ft.?

4. Find the value of 1037 lb. of oats at 40c. a bushel.

5. When \$400 is paid for 16 acres of land, what will $4\frac{2}{5}$ a. cost?

6. A boy bought a number of oranges at 5c. each for \$2.75 and sold them at 8c. each. How much did he gain?

7. *A* has a certain sum of money; *B* has $2\frac{1}{2}$ times as much; both have \$21. How much has each?

8. *A* and *B* can together do a piece of work in 8 da. *A* can do it by himself in 12 da. How long will it require *B* to do it by himself?

9. Reduce $\frac{55}{396}$ to its lowest terms.

10. Find the greatest number that will exactly divide both 38 and 59, leaving 6 and 11, respectively, as remainders.

11. At \$5 per cord, find the value of a pile of cordwood 48 ft. long and 6 ft. high.

12. What must a boy ask for a pair of skates that cost him \$2.40, that he may take $\frac{1}{3}$ off his asking price and still sell them at cost?

13. If a machine makes 420 grape baskets in 1 hr., how many baskets does it make in $2\frac{1}{2}$ hr.?

14. A baseball team won $\frac{2}{3}$ of the games that it played. It won 42. How many games did it play?

VIII. GENERAL REVIEW

EXERCISE 82

1. Write in figures five hundred and four thousands, and five hundred and four thousandths.

2 From 55 take 37.074.

3. To 47.05 add 37.8 – 24.967.

4. Find the product of 3.5 and 3.5.

5. What part of 96 is .012 ?

6. The product of 3 numbers is 57.6 ; one of them is .024, another is .06. Find the third.

7. If bricks be sold at $8.75 a thousand, how much will 9850 bricks cost?

8. A man sold a coat at an advance of .25 of cost. The selling price was $6.25. Find the cost.

9. Solve the following problems :

	Cost.	Selling Price.	Gain in Dollars.	Fractional Gain.
(*a*)	$18	24	?	?
(*b*)	$27	?	5.25	?
(*c*)	$24	?	?	.25
(*d*)	$?	?	3.60	.75

10. A merchant sold goods for $85.96 and lost $\frac{1}{8}$ of the cost. How much did he lose ?

11. When the dividend is .1 and the divisor is 25.6, find the quotient.

12. One boy runs 6.5 yd. per second, and another runs after him at 7.3 yd. per second. If the first boy had 100 yd. start, how long will it take the second boy to catch him ?

13. Twelve dozen pen-knives cost $108. If they are sold at $1 each, what would be the gain on each ?

14. One pound of wood when burned yields .023 lb. of ashes. What part of the wood was burned away?

15. What will 6875 ft. of boards cost at $12 per M?

16. A wheat crop at $.78 a bushel gives $1833. How many bushels are in the crop?

17. Find answers to the following:

$.04 \times .04$.	$.2 \div .04$.	$.011 \div .44$.
$.011 \times .3$.	$.02 \div .8$.	$.111 \div .1$.
$.044 \times .04$.	$.002 \div .4$.	$.44 \div 110$.
$.1 \times .021$.	$.6 \div .002$.	$.05 \div 100$.

18. A mixture of green and black teas is made, 3 oz. of green to every 5 oz. of black. How much of each kind will there be in 4 lb. of the mixture?

19. A woman sold 8 turkeys and 8 geese for $11.60, getting 25c. a piece more for each turkey than for a goose. What price did she get for each?

20. John, James, and Henry had $1800 divided amongst them. James got twice as much as John, and Henry got twice as much as both John and James. How much did each get?

21. Divide $520 among *A*, *B*, and *C*, so that when *A* receives $1.25, *B* may receive 80c. and *C* 55c.

22. Gunpowder is composed of nitre, charcoal, and sulphur, in the proportion of 15, 3, and 2. A certain quantity of gunpowder is known to contain 20 cwt. of charcoal. Find its weight, and also the weight of nitre and sulphur it contains.

23. A farmer agreed to pay his hired man 10 sheep and $160 for one year's labor. The man quit work at the end of 7 months, receiving the sheep and $60 as a fair settlement. Find the value of each sheep.

CHAPTER V

PERCENTAGE

EXERCISE 83

1. How much is 5 per cent. of \$100; 7 per cent. of \$200?

2. Express 5 per cent. as a number of hundredths; 9%.

3. Express .07 as per cent.; .12 as per cent.

4. Express the following as vulgar fractions in their lowest terms: 5%; 10%; 20%; 25%; $12\frac{1}{2}$%.

5. Express decimally:

(*a*) 8%; 15%; 25%; 6%; 75%; $7\frac{1}{2}$%.

(*b*) $2\frac{1}{2}$%; $6\frac{1}{4}$%; $37\frac{1}{2}$%; $\frac{1}{2}$%; $\frac{3}{8}$%; 245%.

6. 10% of a string is 3 in. long. How long is the entire string?

7. A string is 100 ft. long. What per cent. of its length is the following: 3 ft., 7 ft., 15 ft., 30 ft., $37\frac{1}{2}$ ft.?

8. Express the following fractions as per cents:

$\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$, $\frac{7}{25}$, $\frac{5}{8}$.

EXERCISE 84

Find:

1. 16 per cent. of 450.
2. 20 " of \$75.
3. $33\frac{1}{3}$ " of 69 sheep.
4. $12\frac{1}{2}$ " of 360 ft.
5. $11\frac{1}{9}$ " of \$225.
6. $37\frac{1}{2}$ " of 40 mi.
7. $5\frac{1}{4}$ per cent. of \$200.
8. $2\frac{1}{3}$ " of 600 men.
9. $7\frac{1}{7}$ " of 630.
10. $6\frac{1}{4}$ " of 96 men.
11. $8\frac{1}{3}$ " of 576 sheep.
12. $87\frac{1}{2}$ " of \$320.

EXERCISE 85

1. A man had 50 sheep and sold 3 of them. What per cent. of his sheep did he sell?

2. A man had 25 ducks and lost 7 of them. What part of his ducks did he lose? what per cent. of them?

3. A man had $200, and gained $13 more. What part of his original money was his gain? what per cent. of it?

4. What per cent. of a quantity is the $\frac{1}{2}$ of it? $\frac{1}{4}$ of it? $\frac{1}{8}$ of it? $\frac{3}{4}$ of it? $\frac{1}{5}$ of it? $\frac{2}{5}$ of it?

5. A merchant sold 80 yd. of cloth from a web containing 250 yd. What per cent. of the web did he sell?

6. A farmer who had 800 bu. of wheat sold 320 bu. What per cent. of his wheat did he sell?

7. A fourth of a field has been ploughed. What per cent. of the field remains to be ploughed?

8. 780 is what per cent. of 1300? of 2145?

9. In a class of 48 pupils, 4 are absent. What per cent. are absent?

10. A man's income is $1760; his expenses are $1056. What per cent. of his income does he save?

EXERCISE 86

1. Find the number of which 275 is 25%.

2. How much must be a clerk's salary in order that 17% of it may be $204?

3. A farmer buys a field which adds 19% to his original farm of 300 a. Of how many acres did the farm then consist?

4. How many rods are there in $8\frac{1}{4}\%$ of $12\frac{1}{2}$ mi.?

5. A man sold a field consisting of 25 a., which was 12% of his farm. How many acres were in the farm before he sold the field?

6. A farmer made a profit of 25% by selling sheep at $5 per head. What did he pay for the sheep?

7. A drover sold horses at $90 a head and lost 10%. What did he pay per head for the horses?

8. A man spends 70% of his income and saves $615. Find his income.

9. A sample of an alloy was found to contain 15 lb. of copper, which was 75% of the total weight. Find the weight of the sample.

10. A merchant gained $5460 in business. This was 75% of what he gained the previous year. How much did he gain that year?

11. What number increased by 40% of itself equals 847?

12. *A* sold a house for $5400. He gained 12½% on the cost of the house. Find the cost of the house?

EXERCISE 87

1. In a factory there are 264 men, women, and boys. Find the number of each, if there are 33⅓% more women than boys and 25% more men than women.

2. The sum of two numbers is 7785, and one is 16¼% more than the other. Find the numbers.

3. A town whose population was 10000, increased 10% every year for 3 yr. What was its population at the end of that period?

4. A man having lost 20% of his capital, is worth exactly as much as another who has just gained 15% on

his capital ; the second man's capital was originally $9000. What was the first man's original capital ?

5. Brown purchased $\frac{7}{16}$ of a mill property for $4064.55, and Smith purchased $\frac{9}{31}$ of the same property at a rate 5% higher. What did Smith's part cost him, and what fraction of the property remains unsold?

6. A man dying, left 33⅓% of his property to his wife; 50% of the remainder to his son ; 75% of the residue to his daughter; and the balance, $540, to a children's hospital. How much did the daughter receive ?

7. A farmer raised 20% more wheat this year than last. During both years he raised 1320 bu. How many bushels did he raise each year ?

8. *A* and *B* each sold 240 a. of land, *A* gaining 7½% and *B* losing 12½%. If *A* received $960 more than *B*, what did each pay an acre for the land?

9. *A*'s capital was increased by 10% for two successive years and then it amounted to $5687. What was his original capital ?

10. *A*'s share of a sum of money is $\frac{1}{8}$ of it. This is 8% more than *B*'s and 8% less than *C*'s. What are *B*'s and *C*'s shares of it ?

11. A man owning $\frac{3}{4}$ of a foundry sold $\frac{1}{3}$ of his share to *A*, and $\frac{1}{5}$ of the foundry to *B*. What per cent. of the foundry did he still own ?

12. By selling goods for $380, *A* gains three times the per cent. that he would gain by selling them for $340. What per cent. is gained in the latter case ?

13. *A* is 36 yr. old ; *B* is 33⅓% older than this. In how many years will *B* be 20% older than *A*, should both live as long ?

CHAPTER VI

APPLICATIONS OF PERCENTAGE

I. TRADE DISCOUNT

10. Wholesale merchants and manufacturers catalogue their goods at certain fixed prices. Usually these are the prices charged by the retailers. The price in the catalogue is called the *list*, *gross*, *invoice*, or *catalogue price*.

11. To enable the retail merchant to make a profit, a deduction is made from the list price. If the price which the retail merchant paid were printed in the catalogue, and it fell into the hands of one buying from him, he would, naturally, think that the retailer was overcharging him. Then, also, with a catalogue containing the retailers' prices, the wholesale merchant or manufacturer can meet the fluctuations of the market by merely increasing or decreasing the rate of allowance off the retail prices.

12. Sometimes a second deduction is allowed off what remains after deducting the first one. This is to induce prompt payment by the retail merchant. At times a third deduction is allowed off certain kinds of goods, but this is a matter of special arrangement between the buyer and seller.

EXERCISE 88

1. A manufacturer allows a deduction of 25% from a bill of $300. How much will the purchaser pay?

2. How much will pay for a bill of goods for $600, the allowance off being at the rate of $33\frac{1}{3}\%$?

3. A creditor allows 10% off a debt of $120. How much will settle the debt?

12. The sum deducted from a bill or debt, is called **Discount.**

4. The catalogue price is $500. The price paid is $375. What is the discount?

14. The allowance made by merchants and manufacturers upon their catalogue prices, is **Commercial,** or **Trade Discount.**

5. Find the discount on a debt of $25 at 10%.

6. Find the trade discount on an invoice of $450 at $33\frac{1}{3}\%$?

7. How much will pay for goods invoiced at $60, the rate of discount being 25%?

15. The amount of a bill, less the discounts, is called the **Net Amount,** or **Net Price.**

Example 1. Find the net price of goods bought as follows:

Invoice price $375, discounts off 20% and 5%.

Invoice price = $375.
First discount at 20% = 75
$300.
Second discount at 5% = 15
Net price = $285.

EXERCISE 89

Find the net price of the following bills:

1. Invoice price $450, discount 25%.

2. Invoice price $248, discount $37\frac{1}{2}\%$.

Find the net price of goods bought as follows:

3. Invoice price $820, discounts off 25% and 5%.

4. Invoice price $1630, discounts off 20%, 10%, and 5%.

5. An invoice was $500, trade discounts 20% and 5% off. Find the cost of the goods.

6. What is the difference on an invoice of $340, between 40% direct discount, and discounts of 25% and 15%?

7. Find the rate of discount when $157.50 is allowed off a bill for $420.

8. A bill of goods, list price $441.60, was settled for $276. What rate of discount was allowed?

9. At what price must goods which cost $216 be listed to give 25% gain, after allowing 25%, 20%, and 10% off?

Example 2. What single discount is equal to discounts of 20% and 5%?

Part of price remaining after first discount $= \frac{80}{100}$ of list price.

Second discount $= \frac{4}{100}$ " "

Part of price remaining after the two discounts are allowed

$= \frac{76}{100}$ of list price.

Hence, single discount $= \left(\frac{100}{100} - \frac{76}{100}\right)$ of list price

$= \frac{24}{100}$ of list price

$= 24\%$.

EXERCISE 90

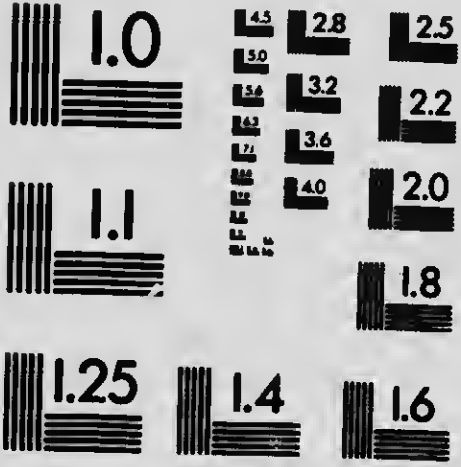
1. Find a single discount equivalent to discounts of 25% and 5%.

2. Find a single discount equivalent to 25%, 10%, and 5%.

3. What direct discount is equivalent to 20% and 10%?

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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4. A dealer buys a book, list price \$1, at a discount of 20%; he sells the book for \$1. What per cent. is the profit?

5. What is the net amount of a bill of \$360, discounts being $12\frac{1}{2}\%$ and 8%? Find a single discount equivalent to these successive discounts.

6. A man paid \$190 for goods, at discounts of 20% and 5%. Find the list price of the goods.

7. A dealer paid \$288 for goods at 20% and 10% off. Find the list price of the goods.

8. A bill of goods was offered at 45% discount, or at 30% and 15% off. Which offer was better for the purchaser?

9. A bill of goods after successive discounts of $33\frac{1}{3}\%$, 10%, and 5% was settled for \$487.35. Find the list price of the goods.

II. PROFIT AND LOSS

EXERCISE 91

1. If an article costs \$20 and is sold for \$24, what is the profit?

2. If an article costs \$20 and is sold for \$16, what is the loss?

3. When is an article sold at a profit?

4. When is an article sold at a loss?

5. How is the amount of profit found?

6. How is the amount of loss found?

16. The *gain or loss* in business transactions is denoted by the Commercial term, **Profit and Loss.**

7. I bought an article for \$100, and sold it to gain 10%. Find the selling price.

8. An article cost 20c. and was sold for 30c. Find the gain per cent.

9. An article which cost 10c. was sold at an advance of 2c. Find the gain per cent.

10. An article which cost \$100 was sold for \$85. What was the loss per cent.?

Example 1. A horse which cost \$65 was sold at a loss of 10%. Find the selling price.

$$\text{Selling price} = \frac{100-10}{100} \text{ of cost price}$$
$$= \frac{90}{100} \text{ of } \$65$$
$$= \$58.50.$$

EXERCISE 92

1. If a house costs \$1200, and is sold to gain 40%, how much is gained and what is the selling price?

2. A merchant invests \$6575 in goods, and sells them to gain 18%. What is his gain?

3. Bought 500 tons of coal at \$4.20 a ton, and sold it at 27% advance. What was the total gain?

4. At what price must goods which cost \$43.50, be sold to lose 12%?

5. A merchant purchases sugar at \$7.50 per cwt. At what price per pound must he sell it in order to gain 10%?

6. A merchant bought 1000 yd. of carpet at 60c. per yard, and sold $\frac{2}{5}$ of it at a profit of 30%, $\frac{1}{2}$ at a profit of 20%, and the rest at a loss of 20%. How much did he receive for the carpet?

7. *A* bought a house for \$3500, expended \$550 in repairing it, and then sold it at a loss of 8% on the total cost. For how much did he sell the house?

8. 840 bu. of wheat, bought at 74c. per bushel, were sold at a profit of 12%. For how much was the wheat sold?

9. *A* bought a lot for \$275; he sold it to *B* at an advance of 40%; *B* sold it to *C* at an advance of $9\frac{1}{11}\%$. How much did *C* pay for the lot?

10. Find the selling price of goods on which there is a loss of 3% and an actual loss of \$117.81.

Example 2. I bought a horse for \$130 and sold him for \$162.50. How much was my gain per cent.?

Gain on \$130 = \$32.50;

$$\therefore \text{ gain} = \frac{32.50}{130} \text{ of cost}$$

$$= 25\% \text{ of cost.}$$

EXERCISE 93

1. If I buy a pair of boots for \$6 and afterwards sell them for \$7.50, what per cent. do I gain?

2. A grocer sells a barrel of oranges for \$7.50 which cost him \$6.25. What is his gain per cent.?

3. *A* bought books for \$275 and sold them for \$264. Find his loss per cent.

4. A grocer retails his coffee so that he charges as much for 4 lb. as he paid for $6\frac{1}{2}$ lb. Find his gain per cent.

5. Brooms are bought wholesale at \$20 per gross. What per cent. profit will be made by selling them at 20c. each?

6. A merchant buys hats at \$8 per dozen and retails them at \$1.50 each. Find his gain per cent.

7. A speculator sold half a section of land for the cost of $\frac{5}{8}$ of a section. Find his gain per cent.

8. *A* bought a carriage for $84, which was 40% less than its value. He sold it for 5% less than its value. Find his gain per cent.

Example 3. A grocer sold a quantity of sugar for $324, and thereby lost 10% of the cost. Find the cost of the sugar

$\frac{90}{100}$ of the cost of sugar = $324;

$\therefore$ " " " = $\frac{100}{90}$ of $324

= $360.

EXERCISE 94

1. A man sells a piece of cloth for $52.67, and thereby gains 15%. What was the cost of the cloth?

2. A tradesman adds 35% to the cost price of his goods, and gives his customers a reduction of 10% on their bills. What profit does he make?

3. A merchant sold a piece of cloth for $ and thereby lost 25%. What per cent. would have been the gain had he sold it for $34?

4. *A* sells goods to *B* at a gain of 12%, and *B* sells the same goods to *C* at a gain of 7½%; *C* paid $3762.50 for the goods. How much did *A* pay for them?

5. A dealer sold an article for $8.10 and lost 10%. At what selling price would he have gained 10%?

6. *A* sold a town lot to *B* and gained 12½%. *B* sold it to *C* for $306 and lost 15%. How much did the lot cost *A*?

7. A grocer bought 6 cwt. of sugar for $52.10; he used 65 lb. himself and sold the rest so as to make 1⅛c. per pound profit on the whole quantity. How much per pound did he sell it for?

8. A farmer sells a merchant 30 bu. of wheat at 90c. per bushel and makes a profit of 20% ; the merchant sells the farmer 5 yd. broadcloth at $3.60 per yard, 16 yd. calico at 8c. per yard, and 44 yd. cotton cloth at 13c. per yard, and makes a profit of 25%. Which gains the more by the transaction, and how much?

9. A man sold two farms for $3000 each ; on one he gained 20%, and on the other he lost 20%. Did he gain or lose on the whole, and how much?

III. COMMISSION

17. A business man often employs another to buy or sell goods, collect accounts, and transact business for him. The person so employed is known as an agent and is variously spoken of as a Commission Merchant, Broker, Factor, Collector, or Consignee, depending upon the kind of business he carries on for his employer, who is known as the Principal. Thus, a lumber merchant in Canada may employ an agent in Liverpool, England, to whom he consigns lumber to be sold ; or a merchant in Canada may have an agent in Paris, France, to buy and ship to him certain kinds of goods.

18. The agent is paid a certain percentage of the sum received for the sales or expended for purchases.

19. The entire sum received for the goods sold is the *gross proceeds.* After the agent has deducted pay for his services, the necessary expenses, etc., what remains is called the *net proceeds.*

EXERCISE 95

1. How much will an agent receive for selling goods to the value of $500 at 4% ?

2. How much will an agent receive for collecting a debt of \$780 at $3\frac{1}{2}\%$?

3. An agent received \$24.50 for selling goods for another. He charged 5% of the sum received for the goods. For how much were the goods sold?

4. For buying a city lot an agent received \$250. He charged 4% of the sum for which he sold the lot. Find how much the purchaser paid for the lot and how much the owner received for it.

20. The charge made by an agent for buying or selling goods, is called **Commission.**

EXERCISE 96

Find the commission on:

1. \$360 at 4%.
2. \$790 at 2%.
3. \$1200 at $2\frac{1}{2}\%$.
4. \$4800 at $2\frac{1}{3}\%$.

5. A broker buys 3 tons of currants at \$8.75 per cwt. What is his commission at $2\frac{1}{2}\%$?

6. An agent collected 80% of a debt of \$3250. What is his commission at $4\frac{1}{2}\%$, and how much did he pay over to his employer?

7. An agent collected 75% of a debt of \$1500, for which he received a commission at $3\frac{3}{8}\%$. How much did his principal receive?

8. A flour merchant sold 860 bbl. of flour at \$6.75 a barrel. Find his commission at $2\frac{1}{2}\%$. What were the net proceeds of the sale?

EXERCISE 97

1. If \$62.50 is charged for collecting \$1250, what is the rate of commission?

2. An agent who charges commission only on what he invests, received $3672, and invests $3600. What per cent. does he charge?

3. An agent received $82.80 for buying goods to the value of $1440. What was his rate of commission?

4. An agent sold a house and lot for $5760 and remitted $5616 to his principal. Find his rate of commission.

5. An agent having sold a consignment of flour for $3578, retained $95.70 to pay charges amounting to $6.25 and his own commission. At what rate was his commission charged?

6. An agent purchased 5 t. of sugar at $5\frac{1}{2}$c. per pound. His principal sent $563.75 to pay for the sugar and the agent's charges. At what rate were his charges made?

7. *A* shipped 140 bbl. of apples to his agent, who sold them for $408; and remitted such a sum as enabled *A* to realize $2.55 per barrel. What rate of commission was charged?

8. 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 in oranges, what rate of commission did he charge for the investment?

EXERCISE 98

1. An agent receives $27.45 for purchasing goods at $4\frac{1}{2}\%$ commission. Find the value of the goods.

2. Find the amount of the sales when a commission of $2\frac{1}{4}\%$ gives the agent $36.81.

3. A lad earned $21.16 collecting accounts for a physician. He was allowed $5\frac{3}{4}\%$. What amount did he collect?

Example 1. I send my agent \$1470 with instructions to deduct his commission at 5%, and invest the balance in wheat. How much does he invest?

Commission on \$100 at 5% = \$5.
Sum invested out of \$105 = \$100.
" " \$1470 = $\frac{\$1470 \times 100}{105}$
= \$1400.

4. An agent charges $1\frac{3}{4}$% of the amount invested; he receives \$956.45 to invest and pay the commission. How much is his commission?

5. An agent receives \$31.55 as his compensation for purchasing goods at 4% commission. What amount must the principal remit to him to pay for the goods and the commission?

6. Sent \$2600 to my agent to invest after deducting his commission at 4%. What sum did he invest?

7. An agent bought 4000 bu. of wheat. His commission at $2\frac{1}{2}$% was \$62, storage and freight charges were \$58. How much per bushel did the wheat cost the principal?

8. How many barrels of flour at \$5 per barrel can be bought for \$3468, after deducting a commission of 2% for buying?

IV. INSURANCE

21. Companies are organized to make good losses of property from fire, water, wind, lightning, or other specified causes. They charge a rate per cent. on the value of the property for making good the loss. Such companies are called **Insurance Companies.** These are of two chief classes, *Stock Companies and Mutual Companies.* In the

former, the capital is owned by the members of the company, who are called *Stockholders*. These share the profits, if any, and become responsible for the losses, in proportion to the capital which each man owns. In a Mutual Insurance Company, the persons whose properties are insured become members of the company and give **Premium Notes** for their proportionate shares of the salaries of the officials and possible losses. After these expenses are met, if there is any surplus, it is returned to the members of the company, *pro rata*.

22. The following are the chief kinds of property insurance :

(1) *Fire Insurance*, or indemnity for loss by fire.

(2) *Marine Insurance*, indemnity for loss or damage of vessels or their cargoes by the accidents of navigation.

(3) *Insurance of Live Stock*, or indemnity for loss of horses, cattle, etc., by lightning, or other specified causes.

(4) *Transit Insurance*, or indemnity for loss or damage to merchandise during transportation from one place to another.

(5) *Accident Insurance*, or indemnity for loss of property by accident.

23. A person who wishes to effect an insurance makes an application to a company, usually through an agent of the company, who supplies him with the necessary form to be filled in and signed. If the agent approves of the application, he gives the applicant an *interim receipt* for the money paid and forwards the application to the company. The interim receipt binds the company until a

policy is issued by the company or the application has been declined by it. In the latter case, the part of the sum paid proportionate to the unexpired time is returned.

24. If loss or damage occurs to the property, the person whose property is insured fills in a *claim paper*, stating his loss. This is forwarded to the company, which immediately sends an inspector to the place, who reports to the company the extent of the loss.

25. If the property is completely destroyed, the sum for which it was insured is paid. If the loss is only partial, the full value of the property destroyed is paid, provided this does not exceed the sum mentioned in the written agreement. No insurance company will insure property to the full extent of its value.

26. The written agreement of insurance is called **the Policy.**

27. The sum paid for the insurance is called the **Premium.** It is always a certain per cent. of the sum for which the property is insured.

EXERCISE 99

1. What sum must be paid for insuring a house for \$2000 at $1\frac{1}{4}\%$?

2. What must be paid to insure a vessel for \$5000 at 2%?

3. What sum must be paid for insuring a house worth \$5000 for $\frac{3}{5}$ of its value at $\frac{1}{2}\%$?

4. What sum must be paid for insuring a factory worth \$75000 for $\frac{2}{3}$ of its value at $\frac{1}{3}\%$?

Find the premium on :

5. $840 at $1\frac{1}{3}\%$.
6. $375 at 3%.
7. $7360 at $1\frac{1}{2}\%$.
8. $6280 at $\frac{3}{4}\%$.

9. How much will it cost to insure a house for $3000 at $\frac{5}{8}\%$, and the furniture for $1600 at $\frac{1}{4}\%$.

10. A merchant had 1200 bbl. of flour, worth $5.80 per barrel, insured for $\frac{3}{4}$ of its value at $1\frac{1}{3}\%$. Find the premium.

11. A factory is worth $6500 and the machinery $7500. The factory is insured for 80% of its value at $1\frac{1}{2}\%$, and the machinery for 75% of its value at $1\frac{2}{3}\%$. Find the premium paid.

EXERCISE 100

1. A farmer paid $61.25 for insuring his property for $3500. What was the rate charged ?

2. If I paid $34.35 for insuring property for $4580, what was the rate charged ?

3. A schoolhouse is insured for $7800, and the premium is $46.80. Find the rate of insurance.

4. A merchant paid $60 for insuring his stock of goods worth $6000 for $\frac{2}{3}$ of their value. What was the rate of insurance ?

5. A store worth $4320 was insured for $\frac{3}{4}$ of its value. The premium was $108. What rate of insurance was charged ?

6. The sum of $280 was paid for the insurance, at $\frac{1}{2}$ of its value, of a factory worth $40000. What rate per cent. was charged ?

7. A shipment of goods was insured for $6000. This sum covered the value of the goods, $5930, the premium,

and $2.50 for expenses. What was the rate per cent. of the premium?

8. The sum of $1802.50 was paid for the insurance, at $\frac{1}{8}$ of its value, of a ship worth $360000. What was the rate per cent. of premium, if $2.50 was charged for necessary expenses?

EXERCISE 101

1. The premium at $2\frac{1}{2}\%$ on a cargo of goods amounted to $1750. What was the value of the cargo?

2. The premium for insuring a house at $\frac{1}{4}\%$ is $24. For what sum is the policy drawn?

3. The premium for insuring a house and furniture at $1\frac{1}{2}\%$ is $79.14. For what sum is the property insured?

4. Mr. Jones paid $575 for the insurance of a cargo of wheat at $1\frac{1}{4}\%$. For what sum was it insured?

5. A man insured $\frac{5}{8}$ of the value of his stock of goods at $1\frac{3}{8}\%$ and paid $77.92 premium. Find the value of the goods.

6. A man paid $81 for insuring property for $\frac{3}{8}$ of its value at $1\frac{1}{8}\%$. Find the value of the property.

7. A vessel and cargo valued at $35000 are insured for $\frac{4}{5}$ of their value at $1\frac{3}{4}\%$. If this vessel were destroyed, what will be the actual loss to the insurance company?

8. If a person who is insured for $6000 at an annual premium of $31.40 per $1000, dies after 12 payments, how much more will his heirs get than has been paid in premiums?

9. (*a*) What is the premium on $5000 at 2%?

(*b*) If a policy for $5000 covers both the value of the property and the premium paid at 2%, what must be the value of the property?

(*c*) For what sum should goods worth $4900 be insured at 2% so that, in case of total loss, the owner may recover both the value of the goods and the premium paid?

10. For what sum must a house worth $2400 be insured at 4% so that, in case it is burned, the owner may recover both its value and the premium paid?

V. TAXES

28. Money is needed to enable the Dominion, Provincial, and Municipal Governments to discharge their several duties. The money raised by these parties is called a *tax*. In the case of the Dominion and Provincial Governments, the money is expended in public works, building and maintaining public institutions, paying officials, etc. Municipalities expend money in erecting and maintaining municipal buildings, making roads, building bridges, maintaining schools, paying the various municipal officials, etc.

29. When the tax is paid directly by the person who is to bear the burden, it is a *Direct Tax*.

30. When the tax is paid by a person who expects to have it repaid to him by increasing the price of an article on which a tax has been paid and which he sells to another, the tax is an *Indirect Tax*, and is called a *Duty*.

31. For direct taxation, property is regarded as *Real* or *Personal*. *Real Property* consists of *fixed* property, as land and houses *Personal Property* consists of *movable* property, as cash, merchandise, cattle, salary, etc.

32. 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.*

33. 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 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.

EXERCISE 102

1. If a man pays annually 1% of the value of his property, estimated at \$10000, what is the amount of his tax?

2. If I am taxed 1½% on real estate valued at \$8000, what is the amount of my tax?

Example 1. The people of a school section wish to build a new schoolhouse, which will cost \$2850. The taxable property of the section is valued at \$190000. What will be the tax in the dollar, and what will be a man's tax whose property is valued at \$7500?

Tax on \$190000 = \$2850;

$\therefore$ tax on \$1 = $\$\frac{2850}{190000} = \$.015 = 1\frac{1}{2}$c.

Tax on \$7500 = 1½c × 7500 = \$112.50.

3. A town is to be taxed \$23200 on an assessed valuation of \$2900000. What is Jones's tax on an assessed valuation of \$5400?

4. In a school section a tax of \$800 is to be raised. If

the amount of taxable property is $250000, what will be the tax in the dollar, and what will be *A*'s tax, whose property is valued at $1800?

5. A town needs $24000 for a new schoolhouse, $15000 to pay salaries of teachers and others, and $5000 for expenses. It receives $2000 in Government grants. The rest was raised on property valued at $2800000. What is the tax rate?

6. *A* 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 *A*'s tax, if he is assessed for $7640 for real estate and $2860 for personal property.

7. S.S. No. 5, Esquesing, is assessed for $150000. The trustees have built a schoolhouse costing $1800.

(*a*) What will the schoolhouse cost a ratepayer whose property is assessed for $4500?

(*b*) What would be the *rate* of taxation per annum on the whole section if the house were paid for in six equal annual payments, without interest?

EXERCISE 103

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 $15\frac{1}{4}$ mills on the dollar, what must be the assessed value of 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 $1\frac{1}{8}\%$. Find the assessed value of his property.

6. *A* paid a tax of $109.08. The rate of taxation was $14\frac{2}{3}$ mills on the dollar. His real property was assessed for $4[illegible]5. Find the assessed value of his personal property.

7. A tax of $7030, after allowing 5% for collecting, is to be raised; the rate is $12\frac{1}{2}$ mills on the dollar. Find the assessed valuation of the property.

8. A building costing $18135 was built by the proceeds of a tax levied upon property in a town, the rate of taxation being 5 mills on the dollar, and the cost of collection $2\frac{1}{2}\%$. Find the assessed valuation of the property.

EXERCISE 104

1. In a certain school district the rate of taxation is $4\frac{3}{4}$ cents an acre. If there are 12160 acres of assessable land, what is the amount of taxes?

2. In a certain school district, the rate of taxation being $5\frac{1}{2}$ cents per acre, the tax collected was $848.10; find the amount of assessable land.

3. In a school district 4 miles square the tax levied amounted to $460.80; find the rate of taxation per acre.

4. There are 16000 acres in a school district; the trustees must raise the following sums in addition to the government grant: for teacher's salary $420, for secretary-treasurer's salary $25, for payment of debenture $210, and for incidentals $145. Find the rate of taxation.

5. A ratepayer in a district in which the rate of taxation is $5\frac{1}{4}$ cents per acre pays taxes amounting to $50.40. How many acres does he own?

6. A land company owns 8 quarter-sections in a school district in which the rate of taxation is 6.25 cents per acre. Find the amount of taxes to be paid.

7. In 1911 the rate of taxation in a school district of 27 sections of assessable land was 4.5 cents per acre. In 1912 the trustees find that their expenditure would be $432 more than in 1911. Find the rate of taxation per acre in 1912.

8. In a city the total assessment of real and personal property is $3,250,000. In this city a man is assessed for $25,000 and pays $450 in taxes. Find the rate in mills on the dollar and the total tax levied in this city.

VI. CUSTOMS AND EXCISE DUTIES

34. Goods entering Canada from foreign countries are required to be landed at certain places, called *Ports of Entry.*

35. 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.

36. *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.

37. The sums collected on imported goods are called **Customs Duties.**

38. Certain articles, such as spirituous or malt liquors, cigars, snuff, 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.

39. 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.**

40. On other articles the duty is levied on the quantity of the goods without regard to their cost.

This is called a **Specific Duty.**

41. On some articles both kinds of duties are levied.

EXERCISE 106

1. Find the duty on 2750 gal. of spirits at $1.92 per gallon.

2. Find the duty on 8 hhd. of sugar, each weighing 1200 lb. gross, at $1\frac{3}{8}$c. per pound, 16% being allowed for tare.

3. Find the duty on an importation of ready-made clothing, invoiced for $1750, at 35%.

4. Find the duty on an importation of 375 lb. of sugar-candy, invoiced at 4c. per pound, on which a specific duty of $\frac{1}{2}$c. per pound and an ad valorem duty of 35% are levied.

5. Find the duty on 3600 pint bottles of wine, valued at 15c. per bottle, on which a specific duty of 25c. per gallon and an ad valorem duty of 30% are levied.

6. An importer paid $7320 duty on a consignment of manufactured furs. Find the invoiced valuation, the duty being 30%.

7. How many pounds of rice are there in a consignment, valued at 4c. per pound, on which the duty is $48, made up of a specific duty of 2c. per pound and an ad valorem one of 10%?

8. A jeweller imported 30 doz. watches from Geneva, invoiced at 420 francs per dozen. Find the duty at 25%, allowing a franc to equal $.193.

9. An importation of aromatic spirits of ammonia, invoiced at $1.50 per gallon, on which a specific duty of $2.40 per gallon and an ad valorem duty of 30% are charged, required $798 to release it from bond. How many gallons were there?

VII. INTEREST

EXERCISE 106

1. Find the interest on $640 at $6\frac{1}{4}\%$ for 9 mo.

2. Find the interest on $560 at $5\frac{3}{4}\%$ for half a year.

3. Find the interest on $500 for 146 days at 7%.

4. Find the amount of $480 for 8 mo. at 8%.

5. Find the amount of $1500 from March 14, 1906, to April 3, 1907, at 6%.

6. A man borrows $3500 for 3 mo. at $7\frac{1}{2}\%$. What amount must he return at the end of that period?

7. Find the interest on $6278 for 93 days at 6%.

8. Find the amount of a note for $260, made on March 21, 1908, at 6% per annum, on July 1, 1908.

9. If $300 is put on interest at the rate of $4\frac{1}{2}\%$, what will it amount to at the end of 6 mo.?

EXERCISE 107

Example 1. At what rate per cent. must \$756 be put at interest for 4 yr. to yield \$241.92 interest?

Interest on \$756 for 1 yr. $= \frac{\$241.92}{4} = \$60.48.$

Interest on \$100 for 1 yr. $= \frac{100}{756}$ of \$60.48 $= \$8$;

$\therefore$ rate $= 8\%$.

1. A man pays \$72 for the use of \$900 for 1 yr. What is the rate per cent.?

2. A man lent \$484 for 5 yr., and received \$181.50 for the interest. What was the rate per cent.?

3. If \$103.68 interest is received on a principal of \$432 for 4 yr., what is the rate per cent.?

4. At what rate per cent. will \$824 amount to \$957.90 in 3 yr. 3 mo.?

5. I borrow \$125, and at the end of 16 mo. return \$134. Find the rate of interest.

6. A residence costing \$7500 is rented for \$56.25 per month. What rate of interest does the money yield?

7. Seven months after date a note for \$1800 amounted to \$1873.50. What was the rate of interest?

8. The amount of \$1022 for 260 da. is \$1054.76. At what rate per cent. per annum is the money loaned?

EXERCISE 108

Example 2. In what time will \$800 amount to \$880 at 8%?

Interest $= \$880 - \$800 = \$80.$

The interest on \$800 at 8% for 1 yr. $= \$64.$

Time to produce \$64 interest $= 1$ yr.;

$\therefore$ " " \$80 " $= \frac{80}{64}$ yr. $= 1\frac{1}{4}$ yr.

Find the time in which

1. The interest on \$360 at $6\frac{1}{4}\%$ will be \$67.50.

2. The interest on \$275 at 6% will be \$57.75.

3. The interest on \$560 at $7\frac{1}{2}\%$ will be \$94.50.

4. The amount of \$1168 at $7\frac{1}{2}\%$ will be \$1195.60.

5. The amount of \$600 at $5\frac{1}{2}\%$ will be \$613.75.

6. On what day will the interest on \$803, loaned on June 30, at 6%, be \$23.10?

7. How long a time would it require for \$625 to amount to \$756.25 at 7%?

8. A principal of \$600 was loaned May 20, 1896, at $7\frac{1}{2}\%$. At what date did it amount to \$796.87$\frac{1}{2}$?

9. In what time will any sum of money double itself at 6% simple interest?

EXERCISE 109

Example 3. What principal will produce \$200 interest in 146 da. at 5% per annum?

Principal to give \$5 interest in 365 da. = \$100

" " \$200 " " 365 da. = $\frac{200}{5}$ of \$100

" " \$200 " " 1 da. = $365 \times \frac{200}{5}$ of \$100;

$\therefore$ " " \$200 " " 146 da. = $\frac{365}{146} \times \frac{200}{5}$ of 100

= \$10000.

1. What principal will produce \$39.90 interest in 1 yr. at $5\frac{1}{4}\%$?

2. What principal will produce \$63.45 interest in $1\frac{1}{2}$ yr. at 6%?

3. A man borrowed money at 7% and paid $245 interest a year. How much money did he borrow?

4. What sum of money will produce $300 interest in $2\frac{1}{2}$ yr. at 6% simple interest?

5. A man bequeathed his wife $875 a year, his daughter $770 a year, and his son $630 a year. What sum must be invested at 7% to produce these sums?

6. Suppose a gentleman's interest on money, at 6%, is $45 per month, how much is he worth?

Example 4. What principal will amount to $496 in 1 yr. 4 mo. at 5% per annum?

The interest on $100 at 5% for $1\frac{1}{3}$ yr. $= \$6\frac{2}{3}$;
$\therefore$ the principal which amounts to $\$106\frac{2}{3}$ in $1\frac{1}{3}$ yr. $= \$100$;
$\therefore$ " " " $\$496$ in $1\frac{1}{3}$ yr. $= \frac{496}{106\frac{2}{3}}$ of $\$100$
$= \$465$.

Find the principal that:

7. Amounts to $382.50 in 1 yr. at $6\frac{1}{4}$%.

8. Amounts to $772.50 in 8 mo. at $4\frac{1}{2}$%.

9. The amount of a certain principal was $307.20 for $3\frac{1}{2}$ yr. and $312 for $3\frac{3}{4}$ yr. Find the principal and the rate.

10. Find the principal that produces $12.96 interest, at 6%, from June 5 to December 2.

11. What interest is due on $584, at 6%, from March 7 to August 19?

12. $450. Toronto, Dec. 15, 1907.

Four months after date, I promise to pay to the order of James Cowan four hundred and fifty dollars, with interest at $6\frac{1}{2}$% per annum, at the Imperial Bank, for value received.

Adam Jones.

How much should Cowan receive when this was paid?

VIII. BANK DISCOUNT

42. Much of the capital used in business is borrowed, usually from banks. The money is loaned on notes. As a rule the names of at least two persons are required on the note. Thus, suppose a merchant desires to obtain a loan of \$1000 for 60 days he makes a note in the form given below and has it *indorsed* or guaranteed by some reliable person, who thus becomes responsible with the borrower for the payment of the loan. The merchant takes it to a bank which deducts the interest on \$1000 for 63 days, at the current rate of interest, and gives him the proceeds. The bank collects the \$1000 at the end of the 63 days. The 3 days added to the specified time are called *days of grace*, which must elapse before payment can be *legally* enforced.

43. Bank Discount is, therefore, simple interest collected *in advance* upon the sum due on a note at its maturity.

Example 1.

\$350.86. Toronto, July 5th, 1908.

Three months after date, for value received, I promise to pay William Robinson, or order, three hundred and fifty $\frac{86}{100}$ dollars, at the Dominion Bank.

James Thompson.

Discounted August 1st, 1908, at 6%.

The note *matures* nominally on October 5, legally on October 8.

The *term of discount* is from August 1, to October 8, or for 68 days.

The *bank discount* is the interest of \$350.86 at 6% for 68 days, which is \$3.92.

The *proceeds* = \$350.86 − \$3.92 = \$346.94.

EXERCISE 110

1. Find the date of maturity, the term of discount, the bank discount, and the proceeds of the following:

(*a*) A note for $657 drawn for 3 mo. on April 19, 1908, without interest, and discounted May 3, at 8%.

(*b*) A note for $511 drawn on Aug. 23, 1908, for 90 days and discounted on Oct. 25, at 5½%.

2. What is the bank discount and present worth of a note of $584, drawn Jan. 8 at 11 months, discounted at the bank May 10, at 5%?

3. What is the bank discount on a note for $730 at 6% for 30 days, days of grace included?

4. Suppose a bill for $1200 is drawn on the 12th of August at 6 months, and paid by a banker on the 1st of January, find the money he takes off at 7%.

Example 2. The proceeds of a note for 30 days at 6% are $556.92. What is the face of the note?

Bank discount for 33 days on $1 at 6% = $.0054.
Proceeds of $1 " " " = $1 − $.0054
= $.9946.
Face of note of which proceeds is $.9946 = $1;
∴ " " " $556.92 = $\frac{\$556.92}{.9946}$
= $559.94.

5. I owe a bill amounting to $73.25, and I give my note for 90 days. How must I draw it to cover the discount at 7%?

6. *A* has a note of $1000 to pay at the Imperial Bank. At the time of its maturity he pays $300 and gives a note for 3 months, days of grace included, for the balance. The rate of discount being 8% per annum, what was the face of the note?

7. Discounted the following note 4 months, days of grace included, before it was due at the Bank of Montreal at 9% per annum. What did I receive for it?

$500. Toronto, Jan. 1, 1908.

One year from date I promise to pay K. L. the sum of five hundred dollars with interest at 8% per annum, for value received. D. E.

8. A note for $1750 was drawn on Aug. 10, for 4 months. It was discounted on Oct. 1, at the Dominion Bank, at 7½% per annum. What sum was received for it?

ORAL EXERCISE

1. I paid 3½% for collecting a debt of $400. What sum did I receive?

2. An agent received $75 for selling 400 barrels of flour at $7.50 per barrel. Find his rate of commission.

3. Find the premium for insuring property to the value of $2400 at ⅝%.

4. A farmer paid $9.50 for insuring his barn and its contents, at ½%. For what amount did he insure?

5. A merchant bought tea at 30c. a pound and sold it at 45c. Find his gain per cent.

6. A man sold a hat for ⅘ of what he paid for it. Find his loss per cent.

7. A grocer bought coffee so that he could sell it at 36c. and make a profit of 33⅓%. Find the cost.

8. A number is divided into three parts which are as 1, 3, 6. If the second part is 24, find the number.

9. If to ⅓ the cost of a lot you add $50, the sum will be ⅓⅓ of the cost. Find the cost of the lot.

10. Six-sevenths of ⅔ of a number is 28. Find it.

11. What principal will give $12 interest in 8 months at 6%?

12. In what time will the interest on $500 at 8% be $60?

13. At what rate will $800 make $45 interest in 9 mo.?

14. One number is 3½ times another and the difference between them is 20. Find the numbers.

15. How many boxes 6 in. long, 4 in. wide, and 3 in. deep can be packed in a space 3 ft. each way?

16. Three men or four boys can do a work in 8 days. In what time can 3 men and 4 boys do it?

IX. GENERAL REVIEW

EXERCISE 111

1. Make a bill of the following items: Mrs. Hay bought of Brown Bros., July 5, 1908, 8 lb. 8 oz. of currants at 8c. per pound, 25 lb. of rice at $5 per cwt., 9 bars of soap at 3 for 25c.; July 19, 43 yd. of cotton at 7c. per yard, 16 yd. of dress goods at 29c. per yard, ½ doz. spools at 3 for 10c.; July 29, paid cash on account $5 and bought 3 qt. of maple syrup at $1.20 per gallon, and paid the balance in cash on Aug. 9.

2. (*a*) Make out the following account neatly, accurately, and in proper form: John Wilson bought from you to-day, 7½ lb. cheese at 12c. per pound, 6¼ lb. butter at 23. per pound, 2½ lb. tea at 55c. per pound, 27 lb. sugar at $1 per 12 lb.

(*b*) He paid you cash and you allowed him 5% off.

(*c*) Receipt the account.

3. The average of 7 numbers is 26.98. The average of the first two is 34.5, and of the next three 19.3. Find the average of the remaining two.

4. The value of an equal number of half-crowns, shillings, pence, and farthings is £3 12s. 1d. How many are there of each coin?

5. Divide £2 19s. 0¾d. between A and B, giving to B half as much more as to A.

6. Find the cost of gilding the entire outside surface of a covered box 3 feet long, 2 ft. 6 in. wide, and 1 ft. 9 in. deep, at $1.20 per square foot.

7. In a factory the men receive $10 a week; 4 times as many women, $9 a week; and 10 times as many boys, $5 a week. What is the average wages of each?

EXERCISE 112

1. Divide $2900 among A, B, and C, so that 7 times A's share, 4 times B's, and 8 times C's are all equal.

2. A drover bought 6 head of cattle, the average price being $50 a head. Four actually cost $32, $35, $48, and $55, respectively. Find the cost of each of the others, one costing $5 more than the other.

3. A coal dealer buys 80 t. of coal, retails it at 36c. a bag, and gains $20. Had he sold it at 32c. a bag, he would have lost $30. Find the weight of a bag of coal.

4. A grocer bought 30 loads of potatoes of 25 bu. each, paying 55c. a bushel. He found 1 bu. 2 pk. in each load worthless, and he sold the rest at 25c. per peck. Find his gain.

5. How many seconds will it require a train 76 yd. long, travelling 30 mi. per hour, to clear 100 yd.?

6. Divide $175 among A, B, and C, so that as often as A gets $5, B may get $4, and as often as B gets $3, C may get $2.

7. If 13 geese are worth as much as 7 turkeys and a turkey is worth \$1.30, what will 32 geese and 13 turkeys be worth?

8. What will 3 lb. 1 oz. 12 dr. of an article cost, if 17 lb. 1 oz. 10 dr. cost \$176?

EXERCISE 113

1. Divide \$2600 among *A*, *B*, and *C*, so that *A* shall get half as much again as *B* and twice as much as *C*.

2. Two pieces of cloth of the same length cost \$26.82 and \$34.56, respectively. The price of the first piece was 74½c. per yard. Find the price of the second piece per yard.

3. In dividing a number successively by 6, 7, 8, the remainders are 4, 5, 7, respectively. Find the whole remainder.

4. How much water must be added to a cask of 60 gal. of wine, at \$2.50 per gallon, to reduce the price to \$1.60 per gallon?

5. *A* and *B* earn \$4.62 in 7 da.; *A* and *C*, \$7 in 10 da.; *B* and *C*, \$8.36 in 11 da. How much does each earn per day?

6. If 126 lb. of tea and 44 lb. of coffee can be bought for \$97.30, and 29 lb. of coffee are worth \$10.15, what is the value of a pound of tea?

7. If a cubic foot of water weighs 1000 oz., and a gallon of water weighs 10 lb., how many gallons will be required to fill a rectangular tank 12 ft. long, 4 ft. wide, and 4 ft. deep?

8. The bank discount on a note for 3 months, at 7½% per annum, is \$3.45. Find the face of the note.

CHAPTER VII

SHARING, PROPORTIONAL PARTS, OR DISTRIBUTIVE PROPORTION

I. SHARING

EXERCISE 114

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 915 into five parts proportional to 1, 2, 3, 4, and 5.

7. Divide 1815 into three parts which shall be to each other as $2\frac{1}{2}$, $3\frac{1}{3}$, and $4\frac{1}{4}$.

8. 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?

9. 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.

II. PARTNERSHIP

EXERCISE 115

1. 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.

(*a*) If Smith puts in \$2000 and Jones \$2000, how should a profit of \$500 be shared?

(*b*) If Smith puts in \$2000 and Jones \$3000, how should a profit of \$500 be shared?

44. An association of two or more persons in business, with an agreement to share the profits and losses, is a **Partnership.**

45. The Association is called a **Firm** or **Company.**

46. The persons associated are the **partners.**

47. The money or property invested in the business is the **Capital** or **Stock.**

Example 1. *A* and *B* engage in trade; *A* furnishes \$6000 and *B* \$4000; they gain \$1200. What is each one's share of the gain?

The total sum in trade is \$6000 + \$4000 = \$10000; with which they gain \$1200.

Gain on \$10000 = \$1200;

" $\quad \$1 = \$\frac{1200}{10000} = \$\frac{12}{100}$;

" $\quad \$6000 = \$\frac{6000 \times 12}{100} = \$720 = A$'s share;

" $\quad \$4000 = \$\frac{4000 \times 12}{100} = \$480 = B$'s share.

EXERCISE 116

1. *A*, *B*, and *C* buy a house for \$2500; *A* pays \$500, *B* \$1200, *C* \$800; they rent it for \$300. What is each one's share of the rent?

2. A man dying, willed to his son \$6500, to his widow \$8000, and to his daughter \$5500; but his estate amounted to only \$12000. How much did each get?

3. *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?

4. *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, and *C* 60 mi. What part of the hire ought each to pay?

5. *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 profit?

6. *A*, *B*, *C*, *D* formed a partnership with a capital of \$30000. *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?

7. *A*, *B*, and *C* carry on a coal business. *A* invests \$8500, *B* \$9000, and *C* \$12000. At the end of the year *B*'s share of the gain is \$4050. Find the total gain.

8. Three men engaged in business. *A* received \$90, *B* \$115, and *C* \$148 of the gain. *C*'s capital was \$740. What was the total capital?

9. *A*, *B*, and *C* enter into partnership. *A* invests \$700 and receives \$105 as his share of the gain. *B* invests \$580, and *C*'s share of the profits is \$48. Find *B*'s profits and *C*'s capital.

III. GENERAL REVIEW

EXERCISE 117

1. The divisor is 144; the quotient is 5 times the divisor, and the remainder is the largest possible. Find the dividend.

2. There are two rectangular farms, each containing 200 a.; one is 500 rd. long and the other 400 rd. How many more rods of fencing will be required to enclose one than the other?

3. A miller gets every ninth bushel for grinding the wheat, and a bushel of wheat produces 42 lb. of flour. How many pounds of wheat must be taken to the mill to obtain 196 lb. or one barrel of flour?

4. The circumference of a circle measures 3.14159 times its diameter. What will be the length of the circumference of a circle whose diameter measures 27.258 mi.?

5. A drover lost .065 of his flock by wolves, .105 by disease, and .27 by theft. He then sold .75 of what remained, and had 280 sheep left. Find the number of his original flock.

6. If .275 of the price of a yard of cloth exceeds $\frac{7}{8}$ of the price by $9\frac{1}{2}$c., what is the price per yard?

7. A box is 12 ft. by 10 ft. by 6 ft. inside measurement. Find how many cubic feet it contains. How many bushels of grain will it hold if a bushel contains 2218 cu. in.? How many gallons of water will it hold if a gallon contains $277\frac{1}{4}$ cu. in.? Find the weight of the water if a pint of water weighs a pound and a quarter.

8. The woodshed is 10 ft. by 6 ft., and is 6 ft. high. It is $\frac{2}{3}$ full of wood. How many cords are there, and what is the value at $3.50 per cord?

CHAPTER VIII

INVOLUTION AND EVOLUTION

I. INVOLUTION

EXERCISE 118

1. What is the product when 2 is used as a factor twice? 3 times? 4 times?

2. What is the product when 3 is used as a factor twice? 3 times? 4 times? 5 times?

48. The product obtained by taking a number one or more times as a factor, is called a **power** of that number. The power is known by the number of times the number is taken as a factor: thus, 2 is the first power of 2; 4 is the second power; 8 is the third power; 16 is the fourth power.

49. The second power of a number is called its **square,** and the third power its **cube.**

3. Find the square of 7; of 5; of 9; of 12.

4. Find the cube of 3; of 4; of 5; of 7.

5. Find the fourth power of 2; of 3; of 5; of 6.

6. How often is 2 taken as a factor to produce 8? 32? 64?

50. *The number of times a number is used as a factor,* to produce a power, is indicated by a figure placed to the right and a little above the number. This is called the **Exponent or Index:** thus, in $8 = 2^3$, 3 is the index.

7. Indicate that 5 is to be taken as a factor 4 times; that 6 is to be taken as a factor 3 times.

8. State to what each of the following is equal: 2^4, 3^3, 5^8, 9^2, 12^3.

EXERCISE 119

Square the following numbers:

1. 23.
2. $25\frac{1}{2}$.
3. $17\frac{1}{3}$.
4. 8.5.
5. 7.9.
6. 367.
7. $36\frac{1}{3}$.
8. $\frac{5}{8}$.
9. $7\frac{5}{12}$.

EXERCISE 120

Cube the following numbers:

1. 19.
2. 75.
3. 4.5
4. $2\frac{1}{3}$.
5. $3\frac{1}{3}$.
6. 7.4.
7. 207.
8. 24.5.
9. $7\frac{2}{3}$.

EXERCISE 121

Raise the following numbers to the powers indicated:

1. 85^2.
2. 25^3.
3. $(.07)^2$.
4. $(.15)^3$.
5. $(2.5)^3$.
6. $(.33)^4$.
7. $(1\frac{3}{4})^2$.
8. $(\frac{2}{3})^4$.
9. $(2\frac{1}{3})^3$.

EXERCISE 122

1. Multiply the second power of eleven by its third power.

2. Multiply the third power of six by the second power of five.

3. Of what number is 5007 one of the two equal factors?

4. Of what number is 202 one of the three equal factors?

5. Find the number of which one of the four equal factors is 5.

6. A rectangular field is 54 rd. long and 36 rd. wide. Find the area of a square field with an equal perimeter.

7. Simplify $2^3 \times 3^2 \times 4^2 \div 4^3 \times 3$.

8. Simplify the following:

(*a*) $5^4 \div 5^2$ $\quad 6^3 \div 2^3$ $\quad 8^3 \div 2^5$.

(*b*) $(\frac{1}{2})^3 \times (\frac{1}{3})^2 \div (\frac{1}{6})^2$.

II. SQUARE ROOT

EXERCISE 123

1. Resolve each of the follqwing numbers into *two equal* factors: 16, 25, 81, 49, 100.

51. One of the *two equal factors* of a number is called its **Square Root.**

2. Find the square root of 9; of 36; of 64; of 144.

3. Square integral numbers of one digit and ascertain the number of figures in the square of a number of one figure.

4. Square integral numbers between 10 and 99 and find the number of figures in the square of a number of two figures.

5. Square integral numbers between 100 and 999 and ascertain the number of figures in the square of a number of three figures.

52. It will thus be seen that a number expressed by one digit has one or two figures in its square; one expressed by two figures has three or four figures in its square; one expressed by three figures has five or six figures in its square, etc.

6. Tell the number of figures in the square root of the following numbers: 841, 2304, 9801, 88804, 6889, 776161.

EXERCISE 124

1. Examine the following method of squaring 25:

$$\begin{array}{rl} 25 = & 20+5 \\ \underline{25} = & \underline{20+5} \\ 125 = & 20\times 5+5^2 \\ \underline{500} = & 20^2+20\times 5 \\ 625 = & 20^2+2\times 20\times 5+5^2 \\ = & 20^2+(2\times 20+5)\times 5. \end{array}$$

2. Square 43 in a similar way and examine the result.

3. Square 56 in a similar way and examine the result.

53. *It will thus be seen that the square of a number consists of the square of the tens, plus twice the tens multiplied by the units, plus the square of the units.*

Example 1. Find the square root of 2025.

$$\begin{array}{r|l} 20 & 25(45 \\ & 16 \\ \hline 85 & 425 \\ & 425 \\ \hline \end{array} \qquad \begin{array}{l|l} 1600+2\times 40\times 5+5^2 & (40+5 \\ 1600 & \\ \hline 2\times 40+5 & 2\times 40\times 5+5^2 \\ & 2+40\times 5+5^2 \end{array}$$

Since the square of tens is hundreds, the part of 2025 expressed by 25 contains no part of the square of the tens. These figures are, therefore, disregarded for the present. The greatest square in 20 hundred is 16 hundred, the square root of which is 4 tens.

The remainder, 425, is equal to twice the tens plus the units multiplied by the units. Twice the tens is 8 tens; 8 tens is contained in 42 tens 5 times.

Twice the tens plus the units is 85, and 85 multiplied by 5 is 425. The square root is 45.

EXERCISE 125

Find the square root of the following :

1. 289.	4. 625.	7. 9025.
2. 361.	5. 1296.	8. 2401.
3. 576.	6. 5625.	9. 4096.

Example 2. Find the square root of 4124961.

```
4|12|49|61 (2031
  4
403 | 1249
    | 1209
4061 | 4061
     | 4061
```

After finding the first figure of the root and subtracting its square from the left-hand period and bringing down the next period, 12, it is found that 40 is not contained in 12. A 0 is put in the root, and the next period is brought down. The part of the root already found is doubled and 40 is written as a divisor. It is called 400, and it is found that it goes into 1249 3 times ; 3 is put in the root and annexed to the 40 ; 403 is now multiplied by 3, and the product, 1209, is written under the 1249, and subtracted, etc.

EXERCISE 126

Find the square root of :

1. 390625.	5. 820836.	9. 25080064.
2. 262144.	6. 734449.	10. 19228225.
3. 117649.	7. 5764801.	11. 44502241.
4. 499849.	8. 40005625.	12. 61685316.

EXERCISE 127

1. A man owns a farm in the form of a square, which contains 10 a. How many rods in length or breadth is it ?

2. What would it cost to fence a square lot containing 160 a., at the rate of $4 per rod ?

3. I have a room in the form of a square, which requires 100 yd. of carpet to cover it. What is the size of the room, if the carpet is 1 yd. wide?

4. What is one of the two equal factors of 15625?

5. A garden contains 1452 sq. yd., and it is 3 times as long as it is broad. Find its length and breadth.

6. A certain public hall in a city contains 2646 sq. ft., and its length is $1\frac{1}{2}$ times its breadth. What are the dimensions of the hall?

7. A merchant bought a certain number of yards of muslin, giving as many cents for each yard as there were yards. The whole cost $72.25. How many yards did he buy and at what price per yard?

8. What must be the dimensions in feet and inches of a square garden lot, which shall be equal to two rectangular ones measuring, respectively, 5 rd. by 29 rd. and 8 rd. by 18 rd?

9. A rectangular court that is twice as long as it is wide contains 31250 sq. ft. How long and wide is it?

10. The area of a square field is 10 a. What will it cost to build a wall round it at 85c. per square yard of walling, if the wall be 2 yd. high?

11. A body of soldiers in column forms 361 ranks 9 abreast. If they were drawn up in solid square, how many would there be in each face?

12. A piece of cloth is 5 times as long as broad, and costs £19. Supposing the piece to be 4s. 9d. a square yard, find the dimensions of the piece.

13. A square bin has a capacity of 1920 cu. ft. and is $7\frac{1}{2}$ ft. deep. Find its length.

CHAPTER IX

MENSURATION

I. THE PARALLELOGRAM

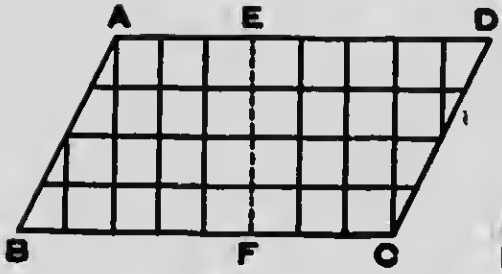


Fig. 1.

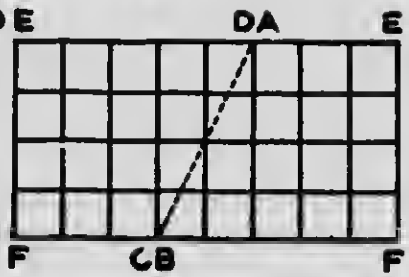


Fig. 2.

EXERCISE 128

1. Examine Fig. 1. Compare the direction of its opposite sides.

54. A **Parallelogram** is a four-sided figure whose opposite sides are parallel.

2. Make a parallelogram from a piece of stiff paper or cardboard. Dividing it vertically as in EF, change it into a rectangle as in Fig. 2. Compare the areas of the two figures.

3. What is the length of the rectangle? What is the breadth of the rectangle?

55. *It is thus evident that the area of a parallelogram is equal to that of a rectangle whose length is the length of the parallelogram and whose breadth is the height of the parallelogram.*

EXERCISE 129

1. How many square yards are there in the surface of a table 1 yd. 2 ft. 3 in. long by 1 yd. 9 in. wide?

2. A county ditch 18 ft. wide and 105 rd. long was dug diagonally across a farm. How many square rods did the owner lose?

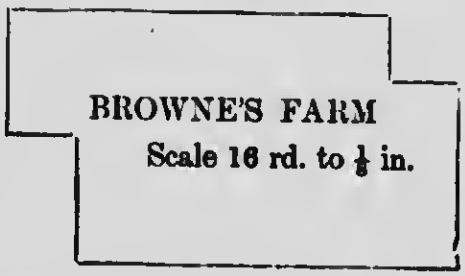
3. Find the cost of gilding the entire outside surface of a covered box 3 ft. long, 2 ft. 6 in. wide, and 1 ft. 9 in. deep, at $1.20 per square foot.

4. At $15 per M, board measure, what will be the cost of 2-in. plank for a 4-ft. sidewalk half a mile long?

5. Trees are planted 12 ft. apart round the sides of a rectangular field 40 rd. long, containing 2 a. Find the number of trees.

6. (*a*) Find the area of Browne's farm.

(*b*) Find the cost of the boundary fence at 75c. per rod.



7. At 30c. 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?

8. The Manufacturers and Liberal Arts Building of the Columbian Fair was in the form of a rectangle and covered an area of 30 a. 76 sq. rd. 19 sq. yd. 7 sq. ft. The building was 787 ft. wide. How many feet in length was it?

9. On a map drawn to the scale of 1 in. to a mile, a township measures $3\frac{1}{3}$ in. long by $1\frac{1}{4}$ in. wide. How many acres are there in it?

II. THE TRIANGLE

EXERCISE 130

1. Construct a triangle of any shape and draw lines to meet, parallel to any two sides.

(*a*) What figure have you thus formed?

(*b*) Compare the area of the triangle with that of the parallelogram.

2. Construct other triangles, and by drawing lines parallel to any two sides complete the parallelograms.

56. *It will be seen that the area of any triangle is one-half that of the parallelogram upon the same base and of the same altitude.*

3. The gable end of a barn measures along the base 24 ft. and the perpendicular distance from the base to the ridge is 12 ft. How many square feet of lumber will be required to enclose it?

4. A rectangle is 16 in. long and 10 in. wide, and a triangle has a base 8 in. long and a perpendicular height of 10 in. How many times greater is the rectangle than the triangle?

5. How much will it cost to enclose a barn which is 36 ft. long, 24 ft. wide, 14 ft. to the plates, and 10 ft. from the plates to the ridge, with lumber at $14 per thousand?

6. The slant height of an octagonal steeple is 56 ft. and the circumference at its base is 32 ft. How much will it cost to cover it with sheets of tin 28 in. by 10 in. at 7c. per sheet?

7. The area of a triangular field is $1\frac{1}{2}$ a., and the perpendicular height is 750 links. Find the length of the base.

III. THE RIGHT-ANGLED TRIANGLE

57. The sides which enclose the right angle of a right-angled triangle are called the **Base** and **Perpendicular.**

58. The side opposite to the right angle is the **Hypothenuse.**

EXERCISE 131

Find the areas of the following right-angled triangles:

1. Base 10 yd. 2 ft. and perpendicular 10 yd. 2 ft.
2. Base 3 chains and perpendicular 40 yd. 1 ft.

Find the perpendicular or base in the following right-angled triangles:

3. Area 34 a. and base 40 chains.
4. Area $76\frac{1}{2}$ a. and base 7200 links.
5. Area $19\frac{3}{5}$ a. and perpendicular 616 yd.
6. Area 33.124 a. and perpendicular 1820 links.

59. In Fig. 3 take HC = GB. Then the square on GB is equal to the square on HC. DCH is a right-angled triangle and the squares ABCD, EGBF are the squares on its sides. Move each of the triangles HEG, DCH into the positions ADK, EFK. The figure formed is the square on DH, the hypothenuse of the right-angled triangle DHC, and is evidently equal to the sum of the squares on its sides.

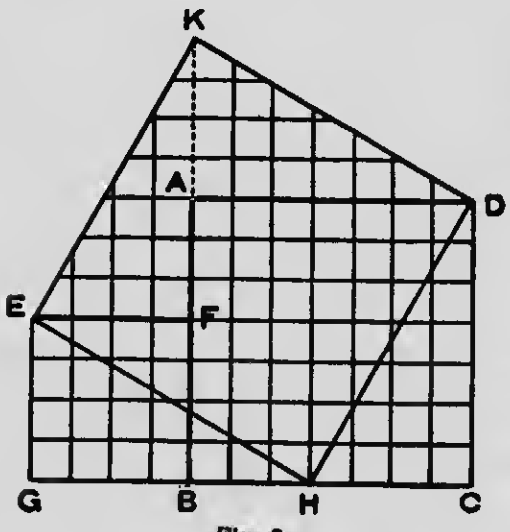


Fig. 3.

60. *Hence in any right-angled triangle the square on the hypothenuse is equal to the sum of the squares on its sides.*

EXERCISE 132

Find the hypothenuse of the following right-angled triangles :

1. Base 13 in., perpendicular 84 in.

2. Base 25 ft., perpendicular 312 ft.

Find the perpendicular of the following right-angled triangles :

3. Base 17 in., hypothenuse 145 in.

4. Base 240 ft., hypothenuse 818 ft.

5. If the gable end of a barn 42 ft. wide is 20 ft. high, what is the length of the rafters ?

6. Find the width of a house whose rafters are 12 ft. and 16 ft. respectively and form a right angle where they meet.

7. A ladder 78 ft. long stands close against a building. How far must it be drawn out at the foot that the top may be lowered 6 ft. ?

8. 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 ?

9. 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 ?

10. Find the cost of fencing a field in the form of a right-angled triangle, its base being 208 yd. and the hypothenuse 233 yd. long, at 25c. per yard.

11. How far is it from the diagonally opposite corners of a cube 20 in. long ?

IV. THE CIRCLE

61. A Circle is a plane surface bounded by one line, called the **circumference,** and is such that all straight lines drawn from a point within it, called the **centre,** to the circumference, are equal to one another.

62. The Radius of a circle is a straight line drawn from the centre to the circumference.

63. The Diameter of a circle is a straight line drawn through the centre of the circle, and terminated at both ends by the circumference.

EXERCISE 133

1. Procure a round ruler 1 in. in diameter and find what length of string will just reach round it.

2. If possible, measure a cylinder 7 in. in diameter to find what length of string will just reach round it.

3. Measure the circumference and diameter of a stove pipe and compare the length of the circumference with that of the diameter.

64. 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, $\pi = 3\frac{1}{7}$.

Find the circumference of circles whose diameters are :

4. 35 ft.	6. 4 yd. 2 ft.	8. 7 ch. 84 l.
5. 91 chains.	7. 1 rd. 5 yd.	9. 5 yd. 1 ft. 4 in.

Find the diameter of circles whose circumferences are :

10. 44 in.	12. 264 in.	14. 5 ch. 39 l.
11. 10 ft. 1 in.	13. 15.4 mi.	15. 73 yd. 1 ft.

16. The radius of a fountain is 21 ft. Find the cost of enclosing it with an iron railing, at $3.60 per yard.

EXERCISE 134

1. From a piece of leather or tough paper make a circle and divide it into triangles as in Fig. 4. Change the circle into the form of Fig. 5. Into what shape, nearly, has the circle been changed?

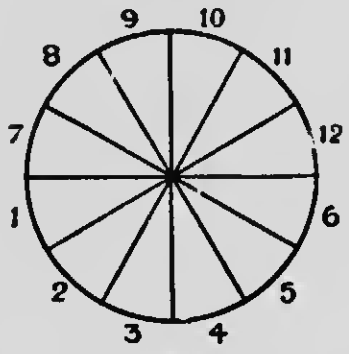


Fig. 4.

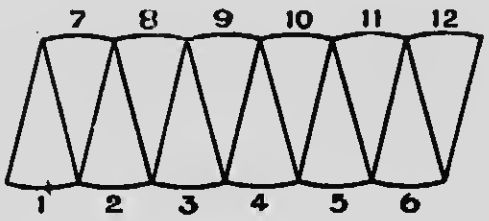


Fig. 5.

2. If the circle had been cut into twice as many equal parts and arranged as in Fig. 5, it would still more nearly resemble the shape of what figure?

3. (*a*) What is the length of Fig. 5, in terms of the circumference?

(*b*) What is the width of the figure, in terms of the radius?

4. Compare the area of Fig. 5 with that of the circle in Fig. 4.

5. If Fig. 5 is 22 in. long and 7 in. wide, what is its area?

6. What is the area of a circle 7 in. in radius?

65. It is evident that *the number of units of area of the circle is found by multiplying one-half the number of units in the circumference by the number of units in the radius.*

Thus, area $= \frac{1}{2}c \times r = \frac{1}{2} \times 2\pi r \times r = \pi r^2$.

Find the area of circles with the following diameters :

7. 84 in.	9. 525 ft.	11. 483 links.
8. 98 yd.	10. 133 ft.	12. 126 ft.

Find the area of circles with the following circumferences :

13. 77 in.	15. 220 yd.	17. 473 links.
14. 90.2 chains.	16. 3 rd.	18. 1 mi.

Find the area of circles with the following radii :

19. 3 ft. 6 in.	21. 7 chains.	23. 1 rd. 5 yd.
20. 7 ft. 7 in.	22. 1.75 rd.	24. 35 chains.

EXERCISE 135

1. How many yards of carpeting 1 yd. wide would be required to cover a circular hall 45 ft. in diameter?

2. How many feet of iron must a blacksmith buy for the tires of 12 wheels 4 ft. in diameter ?

3. What space would the driving wheel of a locomotive 5 ft. 3 in. in diameter pass over in making 25 revolutions ?

4. A circular lawn 220 yd. in diameter is surrounded by a gravel path 12 ft. wide. Find the cost of making the path at 36c. per square yard.

5. 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.

6. The diameter of a circle is 126 in. Find the length of an arc of 50° ; of 65° ; of 80° ; of 90°.

7. A circle 5 ft. 2 in. in diameter has another 2 ft. in radius inscribed within it. Find the area of the part of the large circle without the smaller one.

V. RECTANGULAR SOLIDS

EXERCISE 136

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 $3\frac{1}{3}$ ft.

3. Length 9 in., width $4\frac{1}{3}$ in., depth $2\frac{1}{4}$ 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 the last example 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. A piece of copper 1 ft. long, 9 in. wide, and $\frac{5}{8}$ in. thick is rolled into a plate 6 ft. long and 4 ft. wide. How thick will the plate be?

8. 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?

9. A rectangular cistern is partly full of water and has 250 gal. in it. If the length of the cistern be $6\frac{1}{4}$ ft. and the breadth $3\frac{1}{2}$ ft., find the depth of the water.

10. A rectangular 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?

11. To drain a swamp in Dereham, the township council had a ditch dug 1 mi. long, 3 ft. deep, 6 ft. wide at the surface and 4 ft. wide at the bottom. Find the total cost at 9c. per cubic yard.

EXERCISE 137

1. 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. ?

2. 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 $\frac{4}{5}$ of a cubic foot ?

3. The surface area of a rectangular solid 1 ft. 3 in. long and 14 in. wide is 1000 sq. in. Find its depth.

4. 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, $13\frac{1}{2}$ in. thick, and 6 ft. high ?

5. 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. ?

6. 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 ?

7. It costs $584.50 to excavate the basement of a rectangular building $125\frac{1}{4}$ ft. long and 28 ft. wide, at 25c. per cubic yard. How deep was the excavation ?

8. A cubic foot of copper is rolled into a sheet 48 ft. long, and 4 ft. wide. How thick is the sheet ?

9. 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 ?

10. A cubic foot of swamp oak weighs 43 lb. Find the weight of 15 planks, each 24 ft. by 14 in. by 3 in.

11. Water in freezing expands 10%. Find the weight of ice on the surface of a pond 200 ft. long, 77 ft. wide, which is frozen to a depth of 6 in.

VI. THE CYLINDER

Fig. 6.

66. A Cylinder is a solid bounded by two circular plane faces and a curved face, every part of which is equally distant from a straight line joining the centres of the plane faces.

EXERCISE 138

Find the surface of each of the cylinders whose diameter and height are, respectively :

1. 42 in. and 40 in.
2. $3\frac{1}{2}$ in. and 10 in.
3. 126 in. and 20 ft.
4. 21 ft. and 4 ft.

Find the volume of each of the cylinders whose diameter and height are, respectively :

5. 14 in. and 1 ft.
6. 42 in. and $3\frac{1}{3}$ ft.
7. 14 ft. and 5 ft.
8. 21 ft. and 6 ft.

Find the diameter of each of the cylinders whose solid content and height are, respectively :

9. 308 cu. in. and 8 in.
10. 1331 cu. in. and 14 in.
11. $115\frac{1}{2}$ cu. ft. and 12 ft.
12. 2079 cu. ft. and 24 ft.

EXERCISE 139

1. The area of the curved face of a cylinder is 400 sq. in. It is 5 in. in radius. Find its height.

2. It costs $31.68 to decorate the curved face of a pillar 21 ft. high, at 36c. per square foot. Find the diameter of the pillar.

3. A roller is 6 ft. long and 3 ft. 6 in. in diameter. How much ground is rolled in 1000 revolutions?

4. How often would the roller in the last example turn in rolling a 10-acre field?

5. 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?

6. Find the cost, at \$1.75 per cubic yard, of sinking a shaft 120 ft. deep and 6 ft. in diameter.

7. If a cubic foot of iron weighs 488 lb., find the weight of a solid iron pillar 14 ft. long and 9 in. in diameter.

8. How many cubic feet of earth must be taken out in digging a well 30 ft. deep and 6 ft. in diameter?

ORAL EXERCISE

1. How much lumber is there in 12 planks 18 ft. long and 15 in. wide?

2. The length of a room is $\frac{1}{3}$ more than its width, and the area of the floor is 30 sq. yd. Find its dimensions.

3. A schoolroom is 30 ft. long and 24 ft. wide, and has seats for 48 pupils. How much floor space is allowed for each pupil?

4. Find the area of a circle 1 ft. 9 in. in radius.

5. How many Canadian cents can be placed side by side upon a board 3 ft. 6 in. long and 1 ft. 4 in. wide?

6. A cylindrical stone pillar is 28 in. diameter and 24 ft. high. Find its cubic content.

7. At \$4.50 per cord, find the value of a pile of wood 12 ft. long, 4 ft. wide, and 8 ft. high.

8. Find the cost of digging a rectangular cistern 6 ft. long, 6 ft. wide, and 8 ft. deep at \$1.20 per cubic yard.

9. Two men can do a work in 6 hr.; one of them can do it alone in 10 hr. In what time can the other do it?

VII. GENERAL REVIEW

EXERCISE 140

1. A certain number is added to .3005 and the sum divided by 2.04. The result is 2.6375. Find the number added to .3005.

2. Express the sum of 7.125 mi., 3.375 rd. and .8625 yd. as feet.

3. What will it cost to put a close board fence around the school grounds, if the fence is 5 ft. high and lumber costs $18 per M, the posts and scantling costing $\frac{1}{4}$ as much as the boards, the grounds being 8 rd. wide by 20 rd. long?

4. An agent sold a consignment of merchandise for $5000. What was the balance due the consignor after deduction of $115.75 freight, $250 duty, cartage, and storage, and 5% brokerage?

5. A stock of goods worth $7305 is insured for $\frac{2}{3}$ of its value. The premium paid is $77.92. Find the rate of insurance.

6. A town needs $6860 to build a bridge. Allowing 2% for collecting, for what sum must the town property be assessed so that it can be raised by 4 mills on the dollar?

7. Find the duty on 20 hhd. of molasses, each containing 63 gal., invoiced at 24c. per gallon, at 50% ad valorem, allowing $1\frac{1}{2}$% for leakage.

8. *A* loaned *B* $120 for 1 yr. and 8 mo. and received as payment in full at the end of that time $130.25. What rate per cent. interest did *B* pay?

9. A jeweller bought a number of watches for $2790, and sold part of them at $40 each for $1120, losing $120 on those sold. At what must he sell each of the remainder in order to make a total gain of $200?

CHAPTER X

MISCELLANEOUS AND INDUSTRIAL PROBLEMS

1. Find the cost of sending the following telegrams at 25c. for the first 10 words and 1c. for each additional word:

(*a*) 16 words. (*b*) 40 words. (*c*) 54 words.

2. How much will it cost to talk over a long-distance telephone for 7 min. at 75c. for the first 3 min. and 5c. for each additional minute?

3. Find the freight charges on 1750 lb. of sugar shipped from Toronto to Calgary, at $1.52 per cwt.

4. A piece of work has been half done by *A*, *B*, and *C* working together in 8 da. If *A* and *B* together can finish it in 12 da., in what time could *C* have finished it?

5. A train 132 yd. long passes a post in 6 sec. At what rate per hour is the train moving?

6. A bin is 12 ft. long, 8 ft. broad, and when filled holds 2000 bu. How deep is it?

7. If a steer, when killed and dressed, weighs $\frac{7}{10}$ as much as when alive, what was the weight of one that weighed 756 lb. when dressed?

8. A farmer drew his produce to market, a distance of 4.75 mi., at a cost of $2.42 per load. If each load had 66 bu., find the cost of moving his crop of 3450 bu.

9. A fruit grower shipped 1200 ten-pound boxes of cherries to Vancouver, where they were sold at 80c. per box. Picking and packing cost 1c. per lb., freight and

refrigeration 20c. per box, and other expenses amounted to $20. Find the net amount received by the fruit grower.

10. Solve the following and fill in the blanks :

Cost.	Selling Price.	Gain in Dollars.	Gain %.
$12	?	$2.50	?
$15	?	?	6%
?	$18.50	$4.50	?
?	$18.50	?	7%
?	?	$12.40	4%

11. A coal bin $10\frac{1}{2}$ ft. by $7\frac{1}{2}$ ft. by $5\frac{1}{3}$ ft. is filled with egg coal. How many tons are in it, if 1 t. occupies 35 cu. ft. of space?

12. Mark goods that cost as follows so that there will be a profit of 25% after giving the indicated discount:

(*a*) Cost 48c. discount 20%.

(*b*) Cost 54c. " 10%.

(*c*) Cost 80c. " $16\frac{2}{3}$%.

13. When coal at the mine costs $2.80 per long ton, freight $.75 per short ton, cartage and delivery $1.15 per short ton, what per cent. of gain is made by a dealer who sells coal at retail at $6.50 per short ton?

14. One year a coffee planter had 96 a. of land on which were planted 450 coffee trees per acre. Each tree yielded 1.8 lb. of raw coffee on the average, which was sold on the plantation at $6\frac{3}{4}$c. per pound. It cost the planter $3\frac{1}{2}$c. per pound to raise the coffee.

Find (*a*) The number of pounds of coffee sold.

(*b*) The net gain of the planter.

(*c*) The gain per cent. on his outlay if the plantation cost him $10000.

15. At a factory where 1000 men and women are employed, the average daily wage is \$2.50 for a man and \$1.50 for a woman. The total wage per day is \$1750. How many men are employed?

16. In the Amazon Valley a native tapped 250 rubber trees and secured $\frac{3}{4}$ gal. of milk from each tree. Each gallon of milk yielded $2\frac{1}{4}$ lb. of rubber. Between June and December the trees were tapped 12 times, each tapping yielding as much milk as the first.

Find (*a*) the number of pounds of rubber per tree obtained at each tapping.

(*b*) The total number of pounds collected during the season.

(*c*) If the rubber was sold in New York at \$1.45 per pound, find the sum received.

17. How far may a person go in an automobile at the rate of 25 mi. per hour and drive back at the rate of $7\frac{1}{2}$ mi. per hour, to be 65 min. away?

18. The average yield of wheat per acre in varions countries was as follows: Canada, 21.4 bu.; Great Britain, 31.8 bn.; France, 26 bu.; Germany, 19.4 bu.; United States, 13.4 bu.; Argentina, 18.6 bu. Find the yield from 56 a. in each of these countries.

19. An Alberta farmer had a field of wheat 1 mi. long and $\frac{5}{8}$ mi. wide. In ploughing it, he used two gang ploughs, each turning $12\frac{1}{2}$ a. per day of 10 hr. He sowed 6 pk. of seed to the acre, at 90c. per bushel. The crop averaged 22.5 bu. per acre, and was sold at the elevator at 65c. per bushel. The cost of plonghing, threshing, and transporting to the elevator amounted to $10\frac{1}{2}$c. per bushel.

Find (*a*) the nnmber of acres in the field.

(*b*) The number of days it took to plough the field.

(*c*) The cost of the wheat before it was stored in the elevator.

(*d*) The profit to the farmer from this field.

20. The hay from 15 a. was stored in a mow 60 ft. by 27 ft., and when well settled filled it to the depth of 20 ft. How many tons did the field yield per acre, if 450 cu. ft of hay is 1 t.?

21. Each snmmer a farmer fills his coal bin with furnace coal for next winter. The bin is $8\frac{3}{4}$ ft. by 7 ft. by 6 ft.

Find (*a*) the number of tons he burns, 35 cu. ft. of hard coal being 1 ton.

(*b*) The cost at $7.25 per ton.

22. The elevation of certain places above the sea-level is as follows:

(*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.	Crowsnest Lake	4424 ft.
	Michel	3853 ft.	MacLeod	3128 ft.
	Crowsnest	4438 ft.	St. Marys River	2795 ft.
(*c*)	Winnipeg	757 ft.	Virden	1444 ft.
	Port. la Prairie,	854 ft.	Wolseley	1950 ft.
	Carberry	1258 ft.	Indian Head	1924 ft.
	Brandon	1194 ft.	Regina	1885 ft.

Find (1) the average height of the places in (*a*); in (*b*); and in (*c*).

(2) How much the average of (*b*) exceeds that of (*c*).

23. In what time would a field 80 by 60 rd. pay for underdraining lengthwise at 2c. per foot, if the field yield 2 bu., at 66c. per acre, more than before draining? The drains are 4 rd. apart and the first drain runs down the centre of the field.

24. 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 and ashes for $17.20, how much has the improved farm cost me per acre?

25. A map measures 4 ft. 6 in. by 3 ft. 3 in. and is drawn on the scale of $\frac{1}{3}$ in. to a mile. How many acres does the map represent?

26. At a cheese factory, milk was paid for according to the amount of butter fat it contained. How much did a farmer receive who brought 6400 lb. of milk that tested $3\frac{3}{4}\%$ of butter fat, the factory price of butter fat being $27\frac{1}{2}$c. per pound?

27. A farmer, by feeding his cows $2 worth of meal per day more than he had been feeding them, increased the percentage of butter fat from $3\frac{1}{2}\%$ to 4%, and increased the daily yield of milk from 2000 lb. to 2250 lb. How much did he gain per day by the experiment, the price of butter fat being 27c. per pound?

28. The wings of a dragon fly make 28 beats per second. A bee's wings make 6 less than 7 times as many as this, and is 5 less than $\frac{1}{2}\frac{3}{2}$ of the number of beats of a house fly's wings made in a second. How many beats do the wings of a house fly make per second?

29. A grocer paid $86.40 for 3 cases of cocoa. There were 12 boxes in a case; each box held 6 lb. in $\frac{1}{4}$-pound

tins. He sold the cocoa at 25c. per tin. Find his total gain and his gain per cent.

30. How many feet of lumber will it take to make an open bookcase 12 ft. high, 4 ft. long, and 12 in. deep, if there are 10 shelves in the case?

31. A lumber camp of 50 men has provisions for 96 da., but after 30 da., 10 additional men arrive. How long will the provisions now last?

32. The average spruce tree yields enough wood for 500 lb. of paper. A printing establishment used 1500000 lb. of paper during the year 1907. How many trees were necessary to produce the paper?

33. A business block worth $48000, owned by three men, was insured for $\frac{3}{4}$ of its value. One had $21000 invested, one $18000, and one $9000. The block was completely destroyed by fire. What amount of insurance was due each man?

34. A drover bought sheep at a certain price per head. He sold $\frac{2}{5}$ at a gain of 20%, $\frac{3}{10}$ at a gain of 25%, and the rest at a loss of 10%, and gained on the whole $235. How much did he pay for the sheep?

35. A stone wall under a building 100 ft. long by 76 ft. wide is 10 ft. high and $2\frac{1}{2}$ ft. thick. How many cubic feet are there in the wall?

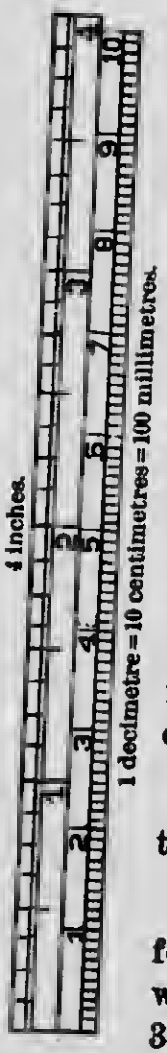
36. A man on an Alberta cattle ranch increased the number of his cattle in four successive years by $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$ of the number he had at first, and at the end of the 1st, 2nd, and 3rd years, respectively. He then had 4850 head. How many had he at first?

37. A room is 25 ft. long and 15 ft. wide. It has a semicircular bow 20 ft. long thrown out on one side. Find the area of the whole room.

CHAPTER XI

METRIC SYSTEM AND TABLES

I. METRIC SYSTEM



67. 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.

68. Its advantages are:

(*a*) All arithmetical operations are the same as in whole numbers.

(*b*) It does away with the Reduction, Addition, Subtraction, Multiplication, and Division of compound quantities.

(*c*) Its general introduction, by giving all nations the same system of weights and measures, would greatly facilitate trade and commerce.

69. The principal units of the system are the following:

70. Unit of Length. The metric standard for measurement of distance is the **Metre**, which is 39.37 inches long, or almost 3 ft. 3¾ in.

71. Unit of Capacity. The volume of a box one-tenth of a metre long, wide, and deep is the standard unit of capacity. Snch a measure is called a **Litre**, and is equal to 1.761 pints (imperial).

72. Unit of Weight. The weight of so much distilled water at a temperatnre of 4°C. as would fill a measure one-hundredth of a metre (a centimetre) long, wide, and deep is the standard nnit of weight and is called a **Gram.**

73. By nsing Latin and Greek prefixes denominations higher and lower than the standard units are formed, the Greek numerals indicating mnltiples and the Latin ordinals indicating decimal divisions; thus:

Deca	stands	for	10	times the unit.
Hecto	"	"	100	
Kilo	"	"	1000	
Deci	"	"	10th	part of the unit.
Centi	"	"	100th	
Milli	"	"	1000th	

METRIC TABLES

74. MEASURES OF LENGTH

The unit is the Metre.

10	*millimetres (mm.)*	= 1	*centimetre*	-	=	.01*m*	
10	centimetres (cm.)	= 1	decimetre	-	=	.1	"
10	decimetres (dm.)	= 1	*metre (m)*	-	=	1.	"
10	metres (m.)	= 1	decametre	-	=	10.	"
10	decametres (Dm.)	= 1	hectometre	-	=	100.	"
10	hectometres (Hm.)	= 1	*kilometre (Km.)*	=	1000.	"	
10	kilometres (Km.)	= 1	myriametre	-	=	10000.	"

The measures more commonly used are in italics.

Cloth, etc., is measnred by the *metre;* very small distances by the *millimetre;* great distances by the *kilometre.*

For approximate conversions either way nse the following ratios:

8 metres = 315 inches very nearly.
8 kilometres = 5 miles nearly.

EXERCISE 141

1. How many metres in a decametre? in a hectometre? in a kilometre? How many decametres in a hectometre? in a kilometre.

2. What part of a metre is a decimetre? a centimetre? a millimetre? What part of a centimetre is 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 actual measurement.

4. Find the value of each of the following expressions in metres:

(*a*) .435 m. + 825 cm. + 4263 mm. + .1595 Km.

(*b*) .927 Km. − 6495 cm.; 4.37 cm. − 42.87 mm.

(*c*) 8 × .0457 Km.; 38019 mm. ÷ .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 $25000 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 in miles very nearly?

8. The width of the Atlantic is about 3000 mi. What is the width in kilometres?

75. SQUARE OR SURFACE MEASURE

100 sq. millimetres (sq. mm.)	= 1 sq. centimetre	= .0001	sq. metre.
100 sq. centimetres (sq. cm.)	= 1 sq. decimetre	= .01	"
100 sq. decimetres (sq. dm.)	= 1 sq. metre	= 1.	" = 1 centare.
100 sq. metres (sq. m.)	= 1 sq. dekametre	= 100.	" = 1 are.
100 sq. dekametres (sq. Dm.)	= 1 sq. hectometre	= 10000.	" = 1 hectare.
100 sq. hectometres (sq. Hm.)	= 1 sq. kilometre	= 1000000.	"

NOTE. The are, centare and hectare are used only in land measure.

The are is slightly less than 4 sq. rods.

The hectare is slightly less than $2\frac{1}{2}$ acres.

EXERCISE 142

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, then .3 of it for $384 an are. What did he get for what he sold? How much had he left?

4. How many bricks, each 21 cm. long and 11 cm. broad, will be required to pave a court 5.5 m. wide and 6.3 m. long?

76. CUBIC MEASURE

The units of this table are obtained by cubing the units of the table of Linear Measure.

1000 cu. millimetres	= 1 cu. centimetre	= .000001	cu. m.
1000 cu. centimetres	= 1 cu. decimetre	= .001	" = 1 litre.
1000 cu. decimetres	= 1 cu. metre	= 1.	" = 1 stere.

In measuring wood the *stere* is the unit; it is about $1\frac{4}{13}$ cubic yards. $3\frac{7}{11}$ steres are about 1 cord.

Since, in cubic measnre, 1000 nnits of each denomination make one of the next higher order, each denomination must have three places. For instance: 5 cu. m., 5 cu. dm., 5 cu. cm. is written 5.005005 cn. m.

The *litre* is principally used in measuring liquids, and the *hectolitre* in measnring grains, fruits, roots, etc., in large qnantities.

EXERCISE 143

1. Write 5.14 cu. decimetres as cubic metres.
2. Write 8765345 cubic centimetres as cubic metres.
3. Add 3 cu. m. 18 cn. 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. metres, then in cu. dm.

4. How many steres of wood are there in a pile 31 m. long, 2.4 m. wide, and 2.5 m. high?
5. How many litres are there in a rectangular tank 4.5 m. long, 2.5 m. wide, and 3.2 m. deep?
6. What is the depth of a rectangular bin 7.5 m. long, 4.4 m. wide to contain 3300 hectolitres of grain?

77. MEASURES OF WEIGHT

10 milligrams	(mg.) = 1 centigram	=	.01 gram
10 centigrams	(cg.) = 1 decigram	=	.1 "
10 decigrams	(dg.) = 1 gram	=	1. "
10 grams	(gr.) = 1 dekagram	=	10. "
10 dekagrams	(Dg.) = 1 hektogram	=	100. "
10 hektograms	(Hg.) = 1 kilogram	=	1000. "

The gram equals 15.432 Troy grains. It is used in weighing letters, mixing and compounding medicines and in weighing all light articles.

The *kilogram* eqnals about 2¼ lb. Avoirdnpois. 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 lb.

The Avoirdnpois ounce is abont 28 grams.

A litre of water at its greatest density weighs a kilogram.

EXERCISE 144

1. Write 8 Kg., 7 Dg., and 7 gr. as grams.
2. Write 7 kilograms and 18 grams as grams.
3. Write 247 centigrams as grams.
4. Write 12 grams, 2 centigrams and 1 milligram as grams.
5. At $6 a ton for coal, what will it cost to heat a building 30 days if it takes 400 kilograms a day?
6. How many grains are there in 2 grams?
7. How many pounds Avoirdupois in 976.25 grams?
8. How many grams in 12 lb. Troy? in 12 lb. Avoir.?
9. 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?
10. What weight of water will fill a vat 76 cm. long, 65 cm. wide, and 42 cm. deep?
11. Give the weight in milligrams of a pill when a mass of 14.35 g. is made into 70 pills.
12. The pressure of the atmosphere on a certain day was 14¾ lb. Avoir. to the square inch. What would be the corresponding pressure in kilograms to the square centimetre?

II. TABLES

78. ENGLISH OR STERLING MONEY

4 farthings (far.)	= 1 penny,	or 1d.
12 pence	= 1 shilling,	" 1s.
20 shillings	= 1 pound,	" £1.

NOTE 1. Farthings are usually written as a fraction of 1d. Thus 1 far. is written ¼d.; 2 far., ½d.; 3 far., ¾d.

NOTE 2. £1 sterling = $4.86⅔, and 1s. = 24⅓ cents.

EXERCISE 145

1. Reduce £10 0s. 6d. to pence.
2. Reduce 7163d. to £ s. d.
3. Find the sum of £7 6s. 8d., £5 9s. 3d., £8 9s. 7d., and £9 7s. 9d.
4. Divide £12 1s. 6d. by £1 6s. 10d.
5. What is the value of 39 oxen at £15 7s. 11¼d. each?
6. What fraction of £3 2s. 6¾d. is 14s. 10¼d.?

79. TROY WEIGHT

24 grains (gr.)	= 1 pennyweight,	or 1 dwt.
20 pennyweights	= 1 ounce,	" 1 oz.
12 ounces	= 1 pound,	" 1 lb.

NOTE 1. This is chiefly used for weighing gold, silver and jewels.

NOTE 2.
7000 Troy grains = 1 lb. Avoirdupois.
5760 " " = 1 lb. Troy.
437½ " " = 1 oz. Avoirdupois.
480 " " = 1 oz. Troy.

80. APOTHECARIES' WEIGHT

20 grains (gr.)	= 1 scruple,	or 1 sc. or 1 ℈.
3 scruples	= 1 dram,	" 1 dr. " 1 ʒ.
8 drams	= 1 ounce,	" 1 oz. " 1 ℥.
12 ounces	= 1 pound,	" 1 lb. " 1 ℔.

NOTE 1. The ounce and pound of Apothecaries' Weight are the same as in Troy Weight.

NOTE 2. Druggists buy their medicines by Avoirdupois Weight and dispense them by Apothecaries' Weight.

EXERCISE 146

1. A miner having 112 lb. of gold sent his mother 17 lb. 10 oz. 15 dwt. 10 gr., and 3 lb. 16 dwt. less to his father. How much did he retain?

2. What is the weight of one dozen spoons, each weighing 1 oz. 2 dwt. 16 gr.?

3. If from 2 lb. of silver enough is taken to make a dozen spoons, weighing 1 oz. 10 dwt. 2 gr. each, how much will be left?

4. Find the value of .815625 lb. Troy.

5. Reduce 15 dwt. 15 gr. to the decimal of an ounce Troy.

6. 7000 gr. make a pound Avoirdupois, and 5760 gr. a pound Troy. How many pounds Avoirdupois are of the same weight as 420 lb. Troy?

7. In one year the average weekly wage of the English laborer was 33 shilliugs, and of the Canadian laborer $10.745. Which laborer was the better paid, and by how much?

8. A kilogram is equal to 32.1507 oz. Troy. Find the weight in kilograms of 6 dozen silver spoons, each weighing 2 oz. 15 dwt.

9. Kerr, the Canadian, won the 200 metre race in 22$\frac{4}{5}$ sec. How many yards did he run per second?

ANSWERS

Ex. 2. *10.* 100, 200, 300, 10, 20, 30; 90, 110, 120, 130, 210, 220, 230, 310, 320, 330. *11.* 10884.

Ex. 3. *10.* 4559755.

Ex. 4. *5.* 5. *6.* 547. *7.* 478769. *8.* 80416055. *9.* 7070.

Ex. 5. *1.* $50.92. *2.* Boys by $52. *3.* 14 gal. *4.* 215 t. *5.* $311.15. *6.* 1440 navvies. *7.* $18.75. *8.* 30 da.

Ex. 6. *3.* 444617 in. *6.* 32897152 sq. in. *7.* 5 mi. 311 rd. 5 yd. 2 in. *8.* 92 mi. 126 rd. 2 yd. *9.* 16 mi. 162 rd. 3 yd. 5 in. *10.* $3\frac{1}{3}$ mi. *11.* 198.

Ex. 7. *1.* 4773 hr. *2.* $40\frac{10}{11}$ mi. *3.* $819. *4.* 12 ft. 6 in. *5.* $26\frac{1}{15}$ ft. *6.* 78 a. 146 sq. rd. 20 sq. yd. 7 sq. ft. 90 sq. in. *7.* 33 mi. *8.* $3326\frac{4}{12}$. *9.* $8\frac{1}{2}$ a.

Ex. 8. *1.* 96 hu. *2.* $13.40. *3.* $154.85. *4.* 6 mi. *5.* 186 bu. *6.* $2070. *7.* $14.56. *8.* $37.50.

Ex. 9. *1.* $1\frac{1}{2}$ mi. *2.* 84 lb. *3.* 12 lb. *4.* $2.80. *5.* 3627 cd. *6.* $4888\frac{8}{9}$ c. yd. *7.* $80. *8.* (*a*) $4.80, (*b*) $2.50. *9.* Gain $1.68. *10.* 34 lb.

Ex. 10. *1.* 60 rd., 40 rd. *2.* $422.40. *3.* $733\frac{1}{3}$ c. yd. *4.* 128 ft. *5.* $1187\frac{1}{2}$ lb. *6.* 6 a. 68 sq. rd. 17 sq. yd. 2 sq. ft. $82\frac{7}{8}$ sq. in. *7.* 84 mi. 69 rd. 2 yd. 2 ft. 2 in.

Ex. 11. *1.* 120 cd. *2.* 2790 shingles. *3.* $51.28. *4.* $247.50. *5.* 3520 c. yd. *6.* 10 mi. *7.* $71.28. *8.* 15 times. *9.* 8640 c. ft., 216 c. ft.

Ex. 12. *2.* 2304 sq. yd. *3.* 14 a. 64 sq. rd. *4.* 320 a. *5.* 50 a., $1\frac{1}{2}$ mi., $137\frac{1}{2}$ hr. *6.* (*a*) 24 rd., 128 rd.; (*b*) 16 a., 224 rd.; (*c*) $3\frac{3}{4}$ a., 30 rd.; (*d*) 20 ch., 50 ch. *7.* (*a*) 72 c. ft., 108 sq. ft.; (*b*) 5 ft., 184 sq. ft.; (*c*) $2\frac{4}{11}$ ft., $88\frac{10}{11}$ sq. ft. *8.* .61105 sq. in.

Ex. 13. *11.* 2310. *12.* 62, 63, 64.

Ex. 14. *6.* $3.60. *7.* 21c. *8.* $10. *9.* $1.20. *10.* 4 tubs. *11.* 28½c. *12.* 24. *13.* 20160.

Ex. 16. *1.* 23. *2.* 37. *3.* 41. *4.* 56. *5.* 45. *6.* 61. *7.* 42. *8.* 11. *9.* 813. *10.* 630. *11.* 928. *12.* 1429.

Ex. 17. *1.* 7. *2.* 21. *3.* 7. *4.* 607.

Ex. 18. *1.* 40 ft. *2.* 6 a. *3.* 60 ft.; *A*, 10; *B*, 12; *C*, 15. *4.* 600 da. *5.* 12 in. *6.* 7 and 12 horses. *7.* 29, 131. *8.* 37. *9.* 7 ft.

Ex. 20. *1.* 149688, 119. *2.* (*a*) 505; (*b*) $300. *3.* $435. *4.* $440. *5.* 28 bu. *6.* 84 sec., 5 times. *7.* 32. *8.* 6. *9.* 1332400. *10.* 9240.

Ex. 21. *1.* $8, $12. *2.* 5, 7, 11, 13. *3.* 18 ft., 9 ft. *4.* 1, 2, 4, 5, 8, 10, 14, 20, 28, 35, 40, 56, 70, 140. *5.* 9. *6.* 33. *7.* 309. *8.* 165 c. ft. *9.* $132.84. *10.* 825371. *11.* 2976 rails. *12.* 1650. *13.* 20, 36901200. *14.* 7½ lb. *15.* 1938 tiles. *16.* 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30, 36, 40, 45, 60, 72, 90, 120, 180, 360. *17.* (*a*) 1, 2, 3, 4, 6, 12; (*b*) 12; (*c*) 1151208. *18.* 336 c. ft., 10080 lb. *19.* 6⅔ ft. *20.* $3.12. *21.* 28 mi. *22.* $25.

Ex. 25. *5.* 16½ gal. *6.* 65 mi. *7.* 55⅔ bu. *8.* 18¾ ft. by 13 ft. *9.* 2 mi. 74⅞ rd. *10.* 440 poles. *11.* 46⅔ lb. *12.* 33⅓ hr., 4 boxes.

Ex. 30. *1.* $\frac{2}{12}$, $\frac{3}{12}$, $\frac{4}{12}$. *2.* $\frac{1}{6}$, $\frac{1}{8}$, $\frac{1}{9}$. *3.* $\frac{12}{24}$, $\frac{12}{24}$, $\frac{12}{24}$. *4.* $\frac{15}{30}$, $\frac{16}{30}$, $\frac{20}{30}$. *5.* $\frac{44}{88}$, $\frac{14}{88}$, $\frac{22}{88}$. *6.* $\frac{44}{66}$, $\frac{33}{66}$, $\frac{48}{66}$. *7.* $\frac{144}{1728}$, $\frac{216}{1728}$, $\frac{864}{1728}$. *8.* $\frac{48}{72}$, $\frac{54}{72}$, $\frac{60}{72}$. *9.* $\frac{24}{48}$, $\frac{32}{48}$, $\frac{42}{48}$. *10.* $\frac{140}{1008}$, $\frac{432}{1008}$, $\frac{756}{1008}$. *11.* $\frac{756}{1008}$, $\frac{720}{1008}$, $\frac{864}{1008}$. *12.* $\frac{44}{132}$, $\frac{45}{132}$, $\frac{66}{132}$.

Ex. 31. *8.* $\frac{14}{16}$, $\frac{12}{16}$. *9.* $\frac{14}{18}$, $\frac{9}{18}$. *10.* $\frac{3}{4}$, $\frac{7}{12}$. *11.* $\frac{8}{12}$, $\frac{11}{12}$. *12.* $\frac{11}{12}$, $\frac{17}{12}$. *13.* $\frac{8}{9}$, $\frac{5}{9}$. *14.* $\frac{6}{15}$, $\frac{5}{15}$, $\frac{9}{15}$, $\frac{11}{15}$, $\frac{3}{5}$. *15.* $\frac{1}{2}$, $\frac{14}{28}$, $\frac{3}{4}$, $\frac{5}{7}$, $\frac{1}{7}$. *16.* $\frac{14}{21}$. *17.* $\frac{91}{119}$.

Ex. 33. *16.* $\frac{1}{2}$. *17.* $\frac{14}{15}$ bu. *18.* $\$\frac{9}{16}$. *19.* 256 a.

Ex. 35. *13.* $\frac{11}{15}$. *14.* $\$\frac{11}{15}$. *15.* $\frac{11}{15}$. *16.* $\frac{5}{8}$.

Ex. 37. *13.* $14\frac{44}{105}$ gal. *14.* $108\frac{1}{15}$ lb. *15.* $53\frac{17}{180}$. *16.* $9\frac{44}{180}$ yd. *17.* 861 bu.

Ex. 39. *13.* $\frac{1}{3}$. *14.* $\frac{11}{15}$. *15.* $\frac{11}{15}$. *16.* $\frac{1}{3}$.

Ex. 40. *4.* $1\frac{11}{15}$. *5.* $1\frac{1}{15}$. *6.* $3\frac{1}{15}$. *7.* $2\frac{11}{15}$. *8.* $1\frac{1}{15}$. *9.* $1\frac{1}{2}$. *10.* $2\frac{11}{15}$. *11.* $2\frac{11}{15}$. *12.* $4\frac{1}{7}$. *13.* $\$7\frac{1}{2}$. *14.* $11\frac{8}{15}$ yd.

Ex. 41. *1.* $2\frac{11}{15}$. *2.* $4\frac{1}{2}$. *3.* $7\frac{1}{15}$. *4.* $1\frac{17}{21}$. *5.* $3\frac{8}{15}$. *6.* $31\frac{1}{2}$. *7.* $13\frac{1}{15}$. *8.* $\frac{8}{15}$. *9.* $\frac{11}{12}$. *10.* $7\frac{1}{15}$.

Ex. 42. *1.* $18\frac{1}{8}$. *2.* $16\frac{9}{16}$ gal. *3.* $20\frac{1}{12}$ yd. *4.* $101\frac{1}{16}$ a. *5.* $14\frac{1}{16}$ rm. *6.* $34\frac{1}{12}$ lb. *7.* $33\frac{1}{16}$ mi. *8.* $38\frac{1}{16}$. *9.* $96\frac{1}{16}$. *10.* $\frac{11}{16}$, $\frac{11}{16}$, $\frac{101}{1000}$.

Ex. 43. *1.* $383\frac{7}{16}$. *2.* $1\frac{11}{16}$. *3.* $49\frac{5}{16}$ lb. *4.* $107\frac{11}{16}$. *5.* $8\frac{11}{16}$. *6.* $145\frac{1}{16}$ yd., $403\frac{1}{16}$. *7.* $44\frac{5}{16}$ lb. *8.* $3. *9.* $10\frac{1}{16}$ gal. *10.* $177\frac{7}{16}$.

Ex. 46. *13.* $\frac{9}{1000}$. *14.* $\frac{9}{16}$. *15.* *A*, $281.25; *B*, $300; *C*, $348.75; $930.

Ex. 47. *1.* $17\frac{5}{16}$. *2.* $49\frac{1}{8}$. *3.* 290. *4.* 1320. *5.* 7390$\frac{1}{2}$. *6.* $20\frac{1}{8}$.

Ex. 48. *1.* $14\frac{13}{100}$. *2.* $93. *3.* 1.63\frac{1}{8}$. *4.* $1\frac{5}{16}$. *5.* 309$\frac{1}{16}$. *6.* $\frac{11}{16}$. *7.* 11.58\frac{3}{4}$. *8.* 95\frac{1}{8}$. *9.* 1.95\frac{1}{16}$. *10.* 1667\frac{1}{2}$. *11.* 9 a.

Ex. 49. *1.* $\frac{1}{2}$. *2.* $23\frac{1}{8}$. *3.* $3\frac{7}{8}$. *4.* $2\frac{1}{16}$. *5.* 6. *6.* $2\frac{1}{8}$. *7.* $\frac{11}{100}$. *8.* $\frac{1}{16}$. *9.* 19. *10.* 7. *11.* $\frac{3}{4}$. *12.* $1\frac{1}{16}$.

Ex. 51. *1.* 41\frac{3}{8}$. *2.* 104 yd. *3.* $34\frac{1}{16}$ ft. *4.* 1576$\frac{1}{2}$ bu. *5.* $41\frac{1}{16}$ mi. *6.* 5$\frac{1}{8}$ a. *7.* $.2141$\frac{3}{8}$. *8.* 24 da. *9.* 7218$\frac{3}{4}$ lb. *10.* $25\frac{3}{16}$.

Ex. 52. *1.* 7$\frac{1}{2}$. *2.* 3$\frac{3}{4}$. *3.* $7\frac{11}{16}$. *4.* $\frac{3}{16}$. *5.* $\frac{1}{16}$. *6.* 5. *7.* $21\frac{1}{16}$. *8.* $1\frac{1}{16}$. *9.* $\frac{11}{1000}$. *10.* $\frac{11}{16}$.

Ex. 53. *1.* 16. *2.* $\frac{3}{4}$. *3.* $\frac{3}{16}$. *4.* $\frac{9}{16}$. *5.* $1\frac{1}{2}$. *6.* $4\frac{1}{2}$. *7.* 2. *8.* $1\frac{1}{2}$. *9.* 2. *10.* $2\frac{3}{4}$. *11.* $7\frac{1}{8}$. *12.* $3\frac{1}{2}$. *13.* $\frac{1}{16}$. *14.* $1\frac{1}{16}$. *15.* $\frac{9}{16}$. *16.* $2\frac{1}{2}$. *17.* $29\frac{1}{16}$. *18.* 16. *19.* $1\frac{1}{8}$. *20.* $\frac{1}{16}$. *21.* $\frac{9}{16}$. *22.* $1\frac{11}{16}$. *23.* $\frac{1}{16}$. *24.* $\frac{9}{16}$. *25.* $\frac{9}{16}$. *26.* $1\frac{1}{16}$. *27.* $\frac{1}{16}$.

Ex. 54. *6.* $1\frac{1}{2}$ da. *7.* $\frac{9}{16}$. *8.* $2\frac{1}{2}$ da. *9.* 3 da. *10.* 9 da. *11.* 16 da. *13.* $6\frac{2}{3}$ hr. *14.* 8 da. *15.* $13\frac{1}{3}$ da. *16.* $14\frac{2}{3}$ da. *17.* 4 hr. *18.* $1\frac{1}{2}$ da. *19.* $13\frac{1}{3}$ da. *21.* $5\frac{11}{16}$ da. *22.* 15 da. *23.* *A*, 36 da.; *B*, 45 da.; *C*, $51\frac{1}{3}$ da. *24.* 5 da.

Ex. 55. *5.* 3 pk. 1 qt. $1\frac{1}{2}$ pt. *6.* 213 rd. 1 yd. 2 ft. 6 in. *7.* 4 yd. 2 ft. $5\frac{1}{2}$ in. *8.* 96 rd. *9.* 17 cwt. 50 lb. *10.* 88 sq. rd. 26 sq. yd. 8 sq. ft. *11.* 5 hr. 9 min.; 7 da. 2 hr. 12 min. *12.* 4 da. 23 hr. 28 min. *13.* 1 lb. $7\frac{5}{16}$ oz.

Ex. 56. *7.* $\frac{9}{16}$. *8.* $\frac{5}{16}$. *9.* 3, 2, $\frac{1}{2}$, $\frac{1}{2}$.

Ex. 57. *1.* $\frac{1}{1000}$. *2.* $\frac{1}{100}$. *3.* $\frac{1}{1000}$. *4.* $\frac{1}{2}$. *5.* $\frac{9}{100}$. *6.* $\frac{1}{1000}$. *7.* $\frac{1}{16}$. *8.* $\frac{1}{16}$. *9.* $\frac{1}{16}$. *10.* $\frac{1}{16}$.

Ex. 58. *1.* $1\frac{1}{16}$. *2.* $325.50. *3.* 62c. *4.* 78\frac{1}{2}$. *5.* 6$\frac{1}{2}$ oz. *6.* $567.525. *7.* $7152\frac{11}{16}$. *8.* $173.74\frac{7}{16}$. *9.* 7 hr. 11 min. 8 sec. *10.* $2.10. *11.* 18 yd. *12.* 98 yd. *13.* 30$\frac{1}{2}$ yd. *14.* 4166$\frac{2}{3}$ yd.

15. 21c. *16.* $1108.80. *17.* 3s. $7\frac{11}{17}$d. *18.* 1736.23$\frac{1}{2}$. *19.* $880. *20.* 27. *21.* 5 yr. *22.* 80 t. *23.* $\frac{11}{12}$ t. *24.* $\frac{1}{8}$. *25.* 12$\frac{1}{2}$ a. *26.* $8750. *27.* 24 mi. *28.* $6900. *29.* 746\frac{1}{2}$. *30.* $7035.

Ex. 59. *1.* Four hundred and four million, forty thousand, four hundred and four, and four-hundredths. *3.* 52095. *4.* 254519. *5.* 108, 135, 180, 225, 300, 540, etc. *6.* 247110827. *7.* 1, 2, 3, 4, 6, 12; 12. *8.* 3. *9.* 6 yr. *10.* *A*, $20; *B*, $35. *11.* $34.98.

Ex. 60. *1.* $739.635. *2.* 95c. *3.* 2.04\frac{1}{2}$. *4.* $\frac{11}{17}$. *5.* $\frac{11}{12}$; $\frac{3}{4}$. *6.* 79$\frac{1}{2}$c. *7.* $984. *8.* $60. *9.* $318.85. *10.* 10$\frac{1}{2}\frac{1}{3}$. *11.* 10.26\frac{11}{14}$.

Ex. 61. *1.* $\frac{9}{14}$. *2.* 36. *3.* $2.08. *4.* $6.25. *5.* 8 ft., 4 ft. *6.* $30, $45. *7.* 36 da. *8.* 56$\frac{1}{3}$ ft. *9.* Second, $2\frac{5}{11}$ mi. *10.* 4.70\frac{1}{2}$. *11.* $2\frac{1}{14}$.

Ex. 62. *1.* $55.55. *2.* 18. *3.* 40. *4.* 122400. *5.* $\frac{1}{2}$. *6.* $1\frac{5}{14}$. *7.* 37 da. *8.* (*a*) 4 ft.; (*b*) 87$\frac{1}{2}$c. *9.* $6 for 7 yd. *10.* 1146$\frac{2}{3}\frac{1}{3}$. *11.* $\frac{5}{14}$.

Ex. 63. *1.* 25134$\frac{5}{11}$. *2.* $\frac{3}{11}$. *3.* $210. *4.* $120. *5.* $\frac{3}{20}$ t. *6.* 6.37\frac{1}{2}$. *7.* 52.2 yd. *8.* 4$\frac{1}{2}$, 4$\frac{1}{3}$; 1$\frac{1}{10}$, 2$\frac{2}{3}$; 3$\frac{1}{3}$, 5$\frac{7}{12}$; $\frac{7}{15}$, $\frac{11}{12}\frac{1}{5}$; 7$\frac{1}{14}$, 3$\frac{5}{12}$. *9.* $\frac{1}{12}$. *10.* 12 ft.

Ex. 64. *1.* 12$\frac{1}{2}$ ft. *2.* 885$\frac{5}{11}$ gal. *3.* 2 ft. 6 in. *4.* 54450 c. ft. *5.* $2.50. *6.* 8910 ft. *7.* 14 da., 10$\frac{1}{2}$ da. *8.* $\frac{7}{12}$.

Ex. 65. *8.* Nine-tenths. *9.* Twenty-seven hundredths. *10.* Three hundred and sixty-eight thousandths. *11.* Sixty-four thousandths. *12.* Four, and thirty-one hundredths. *13.* Seven, and two hundred and sixteen thousandths. *14.* Three, and three hundred and fourteen thousandths. *15.* Five, and eight thousand one hundred and sixty-seven ten-thousandths. *16.* Twenty-one, and three thousand six hundred and one ten-thousandths. *17.* Seventeen, and sixty-four ten-thousandths. *18.* Eighteen, and eighty-one hundred thousandths. *19.* Twenty, and one thousand four hundred and fifty-eight hundred-thousandths. *20.* .8; 2.07; .009. *21.* 807.094; 3017.0709; 3.001008.

Ex. 67. *1.* 663.0388. *2.* 61.19 a. *3.* 8.82 t. *4.* 975.875 yd. *5.* 150.164575. *6.* 490.3013. *7.* 122.002. *8.* 201.9009 mi. *9.* 122.625 yd.

Ex. 68. *13.* 15.809. *14.* 173.03863.

Ex. 69. *1.* .2318 in. *2.* 36.003 gr. *3.* .099. *4.* .146. *5.* 13.75 yd. *6.* 999.999999. *7.* 5.564 lb. *8.* 829.375 a. *9.* 012. *10.* 22.5881.

Ex. 70. *1.* 23.659. *2.* 28.114. *3.* 87.1314. *4.* 6.7605. *5.* 11.5493. *6.* 2.002. *7.* .01. *8.* 131.371 a.

Ex. 71. *12.* 56.4235 mi. *13.* 6.53146. *14.* 773.4375. *15.* 1.141166125. *16.* $140.432. *17.* 9.75 lb. *18.* 334.00692 lb. *19.* 312.275 lb.

Ex. 72. *1.* 3.07. *2.* 50.615625. *3.* 800. *4.* .006446875. *5.* 1240. *6.* .00075. *7.* .00016125. *8.* 568.

Ex. 73. *1.* 1562.5. *2.* 300 times. *3.* 50. *4.* 27.16 yd. *5.* $3.28. *6.* 118.61... bu. *7.* 88.8 bu. *8.* 42.55 t. *9.* 518.814 bu.

Ex. 74. *1.* 168000. *2.* $319.375. *3.* .0001. *4.* 779.01... gal. *5.* 20.057... oz. *6.* .11. *7.* .00421 in. *8.* $10. *9.* 13.378... a.

Ex. 75. *13.* .8. *14.* .17. *15.* .27. *16.* .07. *17.* 2.07. *18.* 16.126. *19.* 126.367. *20.* 3.00007.

Ex. 76. *4.* .75. *5.* .625. *6.* .1875. *7.* .225. *8.* .15625. *9.* .025. *10.* .0375. *11.* 1.875. *12.* 24.008. *13.* 3.525. *14.* 46.3125. *15.* 47.140625.

Ex. 77. *7.* 3.484375. *8.* 6; 2.35 yd. *11.* .015125. *12.* $\frac{1}{125}$.

Ex. 78. *3.* 151 sq. rd. *4.* 9 oz. 15 dwt. 18 gr. *5.* 10½d. *6.* 11 hr. 55 min. 40⅘ sec. *7.* 8s. 9d. *8.* 309 rd. *9.* 1556 lb. 4 oz. *10.* 2 da. 12 hr. 55 min. 21 sec.

Ex. 79. *7.* 1722.... da. *8.* .8 bu. *9.* .0000625 t. *10.* .282 t. *11.* .775 mi. *12.* .3125 pk. *13.* 17.895 cwt. *14.* 7.875 bu. *15.* .625 fath. *16.* .001625 t.

Ex. 80. *1.* .000625. *2.* .5114... in. *3.* 6.741. *4.* .40156625 mi. *5.* 5.7725 wk. *6.* First, 158.4 yd. *7.* 175.125 lb.

Ex. 81. *1.* $4404. *2.* *A*, $3\frac{81}{121}$ oz.; *B*, $9\frac{81}{121}$ oz.; *C*, $7\frac{11}{121}$ oz. *3.* 220.0929.. gal. *4.* 17888.0625 sq. ft. *5.* 11436; 6576. *6.* 8079.. mi. *7.* $\frac{81}{121}$. *8.* 3.26953125 t. *9.* Woman, $62.333; Man, $109.08275.

Ex. 82. *5.* $\frac{1}{1331}$. *6.* 40000. *7.* $86.1875. *8.* $5. *9.* (*a*) $6, $\frac{1}{8}$; (*b*) $32.25, $\frac{1}{16}$; (*c*) $30, $6; (*d*) $4.80, $8.40. *10.* $24.56. *11.* .00390625. *12.* 125 sec. *13.* 25c. *14.* .977. *15.* $82.50. *16.* 2350 bu. *18.* Green, 1 lb. 8 oz.; black, 2 lb. 8 oz. *19.* 35c., 60c. *20.* John, $200; James, $400; Henry, $1200. *21.* *A*, $250; *B*, $160; *C*, $110. *22.* 133⅓ cwt.; nitre, 100 cwt.; sulphur, 13⅓ cwt. *23.* $8.

Ex. 85. *1.* 6%. *2.* $\frac{1}{25}$, 28%. *3.* $\frac{11}{160}$, 6$\frac{7}{8}$%. *4.* 50%, 25%, 20%, 75%, 16$\frac{2}{3}$%, 40%. *5.* 32%. *6.* 40%. *7.* 75%. *8.* 60%, 36$\frac{4}{11}$%. *9.* 8$\frac{1}{3}$%. *10.* 40%.

Ex. 86. *1.* 1100. *2.* $1200. *3.* 357 a. *4.* 330 rd. *5.* 208$\frac{1}{2}$ a. *6.* $4. *7.* $100. *8.* $2050. *9.* 20 lb. *10.* $7280. *11.* 605. *12.* $4800.

Ex. 87. *1.* 110 men, 88 women, 66 boys. *2.* 3600, 4185. *3.* 13310. *4.* $12937.50. *5.* $4076.163, $\frac{163}{1000}$. *6.* $1620. *7.* 600 bu., 720 bu. *8.* $20. *9.* $4700. *10.* *B*, $\frac{11}{171}$; *C*, $\frac{11}{171}$. *11.* $\frac{1}{25}$. *12.* 6$\frac{1}{4}$%. *13.* 24 yr.

Ex. 88. *1.* $225. *2.* $400. *3.* $108. *4.* $125. *5.* $2.50. *6.* $150. *7.* $45.

Ex. 89. *1.* $337.50. *2.* $155. *3.* $584.25. *4.* $1114.92. *5.* $380. *6.* $12.75. *7.* 37$\frac{1}{2}$%. *8.* 37$\frac{1}{2}$%. *9.* $500.

Ex. 90. *1.* 28$\frac{4}{7}$%. *2.* 35$\frac{7}{8}$%. *3.* 28%. *4.* 25%. *5.* $289.80, 19$\frac{1}{2}$%. *6.* $250. *7.* $400. *8.* 45%. *9.* $855.

Ex. 92. *1.* $480, $1680. *2.* $1183.50. *3.* $567. *4.* $38.28. *5.* 8$\frac{1}{2}$c. *6.* $720. *7.* $3726. *8.* $696.192. *9.* $420. *10.* $3927.

Ex. 93. *1.* 25%. *2.* 20%. *3.* 4%. *4.* 62$\frac{1}{2}$%. *5.* 44%. *6.* 125%. *7.* 25%. *8.* 58$\frac{1}{3}$%.

Ex. 94. *1.* $45.80. *2.* 21$\frac{1}{2}$%. *3.* 6$\frac{1}{4}$%. *4.* $3125. *5.* $9.90. *6.* $320. *7.* 11c. *8.* Merchant, $2.50. *9.* Lost $250.

Ex. 95. *1.* $20. *2.* $27.30. *3.* $490. *4.* $6250, $6000.

Ex. 96. *5.* 13.12\frac{1}{2}$. *6.* $117, $2483. *7.* $1086.75. *8.* 145.12\frac{1}{2}$, 5659.87\frac{1}{2}$.

Ex. 97. *1.* 5%. *2.* 2%. *3.* 5$\frac{1}{4}$%. *4.* 2$\frac{1}{2}$%. *5.* 2$\frac{1}{2}$%. *6.* 2$\frac{1}{2}$%. *7.* 12$\frac{1}{2}$%. *8.* 2%.

Ex. 98. *1.* $610. *2.* $1636. *3.* $368. *4.* $16.45. *5.* $820.30. *6.* $2500. *7.* 65c. *8.* 680 bbl.

Ex. 99. *3.* $15. *4.* $400. *9.* $30.75. *10.* $69.60. *11.* $171.75.

Ex. 100. *1.* 1$\frac{1}{4}$%. *2.* $\frac{3}{4}$%. *3.* $\frac{1}{8}$%. *4.* 1$\frac{1}{2}$%. *5.* 3$\frac{1}{8}$%. *6.* $\frac{7}{8}$%. *7.* 1$\frac{1}{2}$%. *8.* $\frac{1}{8}$%.

Ex. 101. *1.* $70000. *2.* $9600. *3.* $5276. *4.* $46000. *5.* $7792. *6.* $12000. *7.* $27510. *8.* $3739.20. *9.* (*a*) $100; (*b*) $4900; (*c*) $5000. *10.* $2500.

Ex. 102. *3.* $43.20. *4.* 3½ mills, $5.76. *5.* 1½c. *6.* $164.0625. *7.* (*a*) $54; (*b*) 2 mills.

Ex. 103. *1.* $8400. *2.* $330000. *3.* $600000. *4.* $304000. *5.* $4218.75. *6.* $3250. *7.* $592000. *8.* $3720000.

Ex. 104. *1.* $577.60. *2.* 15420 a. *3.* 4½c. *4.* 5c. *5.* 960 a. *6.* $80. *7.* 7c. *8.* 18 mills, $58500.

Ex. 105. *1.* $5280. *2.* $110.88. *3.* $612.50. *4.* $7.125. *5.* $274.50. *6.* $24400. *7.* 2000 lb. *8.* $607.95. *9.* 280 gal.

Ex. 106. *1.* $30. *2.* $16.10. *3.* $14. *4.* $25.60. *5.* $1594.93. *6.* $3565.625. *7.* $95.976. *8.* $264.36. *9.* $306.75.

Ex. 107. *1.* 8%. *2.* 7½%. *3.* 6%. *4.* 5%. *5.* 5¼%. *6.* 9%. *7.* 7%. *8.* 4½%.

Ex. 108. *1.* 3 yr. *2.* 3½ yr. *3.* 2½ yr. *4.* 115 da. *5.* 5 mo. *6.* Dec. 22. *7.* 3 yr. *8.* Oct. 4, 1900. *9.* 16⅔%.

Ex. 109. *1.* $760. *2.* $604.30. *3.* $3500. *4.* $2000. *5.* $32500. *6.* $9000. *7.* $360. *8.* $750. *9.* $240, 8%. *10.* $438. *11.* $15.84. *12.* $459.75.

Ex. 110. *1.* (*a*) July 22, 80 da., $11.52, $645.48; (*b*) Nov. 24, 30 da., $2.31, $508.69. *2.* $9.46, $574.54. *3.* $3.60. *4.* $10.35... *5.* $75.60... *6.* $714. *7.* $523.80. *8.* $1723.75.

Ex. 111. *3.* 61.96. *4.* 20. *5.* *A*, £1 3s. 7½d.; *B*, £1 15s. 5½d. *6.* $41.10. *7.* $6.40.

Ex. 112. *1.* *A*, $800; *B*, $1400; *C*, $700. *2.* $62.50, $67.50. *3.* 128 lb. *4.* $292.50. *5.* 12 sec. *6.* *A*, $75; *B*, $60; *C*, $40. *7.* $39.30. *8.* $32.

Ex. 113. *1.* *A*, $1200; *B*, $800; *C*, $600. *2.* 96c. *3.* 328. *4.* 33⅓ gal. *5.* *A*, 30c.; *B*, 36c., *C*, 40c. *6.* 65c. *7.* 1200 gal. *8.* $184.

Ex. 114. *1.* 72, 126. *2.* 55, 66, 77. *3.* 684, 576. *4.* $125, $225, $150. *5.* $150, $200, $250. *6.* 61, 122, 183, 244, 305. *7.* 450, 600, 765. *8.* 153 bu., 170 bu., 187 bu. *9.* 525 bu., 350 bu.

Ex. 116. *1.* *A*, $60; *B*, $144; *C*, $96. *2.* $3900, $4800, $3300. *3.* *A*, $14.40; *B*, $9.60. *4.* *A*, $6.30; *B*, $5.25; *C*, $420. *5.* *A*, $10920; *B*, $5460. *6.* *A*, $1080; *B*, $1260; *C*, $1440; *D*, $1620. *7.* $13275. *8.* $1765. *9.* *B*, $87; *C*, $320.

Ex. 117. *1.* 103823. *2.* 168 rd. *3.* 5¼ bu. *4.* 85.63346 mi. *5.* 2000 sheep. *6.* $1.80. *7.* 720 c. ft., 560.937... bu., 4487.502... gal., 44875.022... lb. *8.* 1⅛ cd., $6.5625.

Ex. 122. *1.* 161051. *2.* 5400. *3.* 25070049. *4.* 8242408. *5.* 625. *6.* 2025 sq. rd. *7.* 6. *8.* 25, 27, 16, $\frac{1}{2}$.

Ex. 125. *1.* 17. *2.* 19. *3.* 24. *4.* 25. *5.* 36. *6.* 75. *7.* 95. *8.* 49. *9.* 64.

Ex. 126. *1.* 625. *2.* 512. *3.* 343. *4.* 707. *5.* 906. *6.* 857. *7.* 2401. *8.* 6325. *9.* 5008. *10.* 4385. *11.* 6671. *12.* 7854.

Ex. 127. *1.* 40 rd. *2.* $2560. *3.* 10 yd. by 10 yd. *4.* 125. *5.* 66 yd. by 22 yd. *6.* 63 ft. by 42 ft. *7.* 85 yd., 85c. *8.* 280 ft. 6 in. *9.* 250 ft. by 125 ft. *10.* $1496. *11.* 57. *12.* 20 yd. by 4 yd. *13.* 16 ft.

Ex. 129. *1.* $2\frac{3}{16}$ sq. yd. *2.* $114\frac{6}{11}$ sq. rd. *3.* $41.10. *4.* $316.80. *5.* 132 trees. *6.* 160 a., $528. *7.* $13.20. *8.* 1687 ft. *9.* 3840 a.

Ex. 130. *3.* 144 sq. ft. *4.* 4 times. *5.* $26.88. *6.* $32.256. *7.* 4 ch.

Ex. 131. *1.* 512 sq. ft. *2.* 1331 sq. yd. *3.* 17 ch. *4.* 2125 l. *5.* 308 yd. *6.* 3640 l.

Ex. 132. *1.* 85. *2.* 313. *3.* 144. *4.* 782. *5.* 29 ft. *6.* 20 ft. *7.* 30 ft. *8.* 96 ft. *9.* 85 ft. *10.* $136.50; 34.64... in.

Ex. 133. *4.* 110 ft. *5.* 286 ch. *6.* 44 ft. *7.* 33 yd. *8.* 24 ch. 64 l. *9.* 51 ft. 4 in. *10.* 14 in. *11.* 3 ft. $2\frac{1}{2}$ in. *12.* 84 in. *13.* 4.9 mi. *14.* 1 ch. $71\frac{1}{2}$ l. *15.* 70 ft. *16.* $158.40.

Ex. 134. *7.* 5544 sq. in. *8.* 7546 sq. yd. *9.* $216562\frac{1}{2}$ sq. ft. *10.* $13898\frac{1}{2}$ sq. ft. *11.* 1.832985 a. *12.* 12474 sq. ft. *13.* $471\frac{3}{8}$ sq. in. *14.* 64.7185 a. *15.* 3850 sq. ft. *16.* $21\frac{31}{32}$ sq. yd. *17.* $17796\frac{5}{8}$ sq. l. *18.* $50\frac{10}{11}$ a. *19.* $38\frac{1}{2}$ sq. ft. *20.* 180 sq. ft. 106 sq. in. *21.* 15.4 a. *22.* 9.625 sq. rd. *23.* $346\frac{1}{2}$ sq. yd. *24.* 385 a.

Ex. 135. *1.* $176\frac{11}{14}$ yd. *2.* $150\frac{6}{7}$ ft. *3.* $422\frac{1}{2}$ ft. *4.* $1013.76. *5.* 77 sq. in. *6.* 11 in., $71\frac{1}{2}$ in., 88 in., 99 in. *7.* 1210 sq. in.

Ex. 136. *1.* (*a*) $121\frac{1}{2}$ sq. in.; (*b*) $91\frac{1}{2}$ c. in. *2.* $86\frac{2}{3}$ sq. ft., 50 c. ft. *3.* 138 sq. in., $87\frac{2}{3}$ c. in. *4.* 216. *5.* 4320 sq. in. *6.* $14\frac{12}{17}$ ft. *7.* $\frac{5}{256}$ in. *8.* $16\frac{2}{3}$ ft. *9.* 22 in. nearly. *10.* 28.88... in. *11.* $264.

Ex. 137. *1.* $6\frac{1}{4}$ ft. *2.* $1107\frac{23}{36}$ gal. *3.* 10 in. *4.* 8640 bricks. *5.* $4\frac{4}{5}$ ft. *6.* $3\frac{1}{3}$ ft. *7.* 18 ft. *8.* $\frac{1}{16}$ in. *9.* $5\frac{4}{7}$ ft. *10.* 4515 lb. *11.* 437500 lb.

Ex. 138. *1.* 8052 sq. in. *2.* 129¼ sq. in. *3.* 833⅓ sq. ft. *4.* 957 sq. ft. *5.* 1848 c. in. *6.* $32\frac{1}{27}$ c. ft. *7.* 770 c. ft. *8.* 2079 c. ft. *9.* 7 in. *10.* 11 ft. *11.* 3½ ft. *12.* 10½ ft.

Ex. 139. *1.* $12\frac{8}{11}$ in. *2.* 16 in. *3.* 7333⅓ sq. yd. *4.* 6600 times. *5.* 6912c. *6.* $220. *7.* 3019½ lb. *8.* 848¼ c. ft.

Ex. 140. *1.* 5.08. *2.* 37678.275 ft. *3.* $99.792. *4.* $4384.25. *5.* 1.6%. *6.* $1750000. *7.* $148.932. *8.* 5⅛%. *9.* $53¾.

Page 137. *1.* (*a*) 31c.; (*b*) 55c.; (*c*) 69c. *2.* 95c. *3.* $26.60. *4.* 24 da. *5.* 45 mi. *6.* 26.7... ft. *7.* 1080 lb. *8.* $126.50. *9.* $580. *10.* $14.50, 20¾%; $15.90, 90c.; $14, 32⅛%; 17\frac{31}{107}$, $1.21; $310, $322.40. *11.* 12 t. *12.* (*a*) 75c.; (*b*) 75c.; (*c*) $1.20. *13.* $47\frac{8}{11}$%. *14.* (*a*) 77760 lb.; (*b*) 2527.20; (*c*) 25.272%. *15.* 250 men. *16.* $1\frac{7}{16}$ lb., 4050 lb., $5872.50. *17.* 6¼ mi. *18.* 1198.4 bu., 1780.8 bu., 1456 bu., 1086.4 bu., 750.4 bu., 1041.6 bu. *19.* (*a*) 400 a.; (*b*) 16 da.; (*c*) $1470; (*d*) $4380. *20.* 4⅛ t. *21.* (*a*) 10½ t.; $76.12½. *22.* (1) 3010 ft., 3656¼ ft., 1408¼ ft.; (2) $2248\frac{8}{11}$ ft. *23.* 10 yr. *24.* $23.25. *25.* 12130560 a. *26.* $66. *27.* $3.40. *28.* 330 beats. *29.* $21.60, 25%. *30.* 112 ft. *31.* 55 da. *32.* 3000 trees. *33.* $14000, $12000, $6000. *34.* $2000. *35.* 8550 c. ft. *36.* 2910 head. *37.* $502\frac{8}{11}$ sq. ft.

Ex. 141. *1.* 10, 100, 1000; 10, 100. *2.* $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, $\frac{1}{10}$. *4.* (*a*) 172.448 m.; (*b*) 862.05 m.; .83 mm.; (*c*) 365.6 m.; 391$\frac{3}{7}$ m. *5.* $272.18¾. *6.* $1801325. *7.* 7.6475 mi. *8.* 4800 km.

Ex. 142. *1.* 12000000 sq. m. *2.* 8.35 sq. m. *3.* $155163.648; 101.018 ares. *4.* 1500.

Ex. 143. *1.* .00514 cu. m. *2.* 8.765345 cu. m. *3.* 1219.24940201 cu. m.; 1219249.40201 cu. dm. *4.* 186 st. *5.* 36000 l. *6.* 10 m.

Ex. 144. *1.* 8077 g. *2.* 7018 g. *3.* 2.47 g. *4.* 12.021 g. *5.* $72. *6.* 30.864 grains. *7.* 2.15221 lb. *8.* $4479\frac{8}{11}$ g.; $5443\frac{4}{11}\frac{4}{11}$ g. *9.* 321.70 grains. *10.* 207480 g. *11.* 205 mg.; 1.03575 Kg.

Ex. 145. *1.* 2406d. *2.* £29 16s. 11d. *3.* £30 13s. 3d. *4.* 9. *5.* £600 9s. 6¾d. *6.* $\frac{11}{1000}$.

Ex. 146. *1.* 79 lb. 3 oz. 5 dwt. 4 gr. *2.* 1 lb. 1 oz. 12 dwt. *3.* 5 oz. 19 dwt. *4.* 9 oz. 15 dwt. 18 gr. *5.* .78125 oz. *6.* 345.6 lb. *7.* Canadian, $2.715. *8.* 6.155... Kg. *9.* 9.76... yd.