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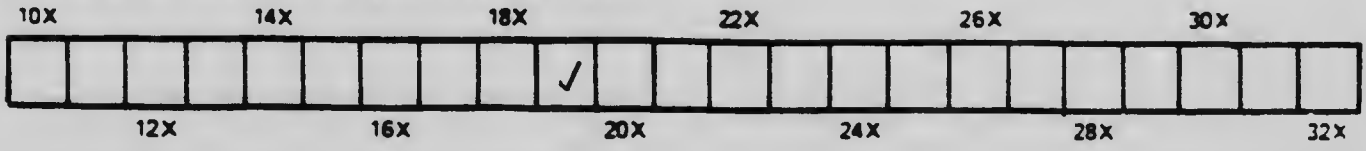
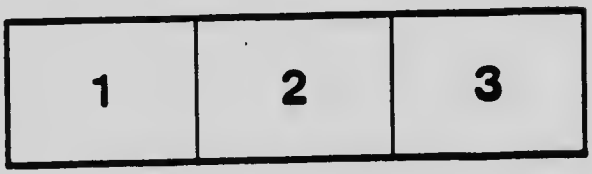
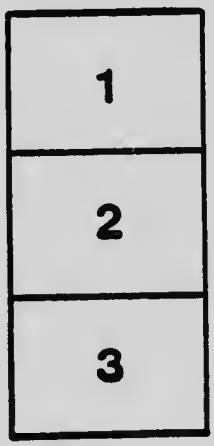
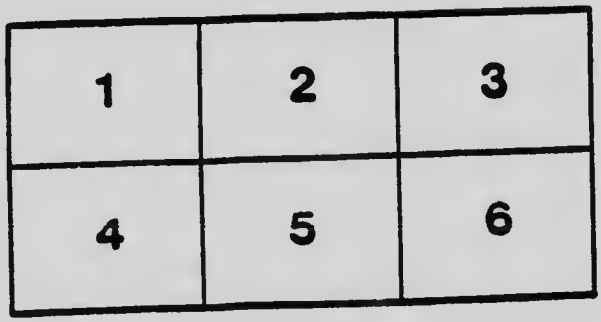








ELEMENTARY ARITHMETIC

FOR

PUBLIC SCHOOLS

REVISED EDITION

PART I

ELEMENTARY ARITHMETIC

FOR PUBLIC SCHOOLS

REVISED EDITION

PART I

PRICE 25 CENTS

W. J. GAGE & COMPANY, LIMITED
TORONTO

PREFACE

THE authors have had in mind three main purposes in preparing this elementary Arithmetic. These may be briefly stated as follows: (1) To aid pupils in becoming accurate and rapid in calculation; (2) to train them in independent thinking and in applying their knowledge of number to the actual business transactions of life; and (3) to aid the teacher in assigning applications of the various principles which have been explained in the class.

The work consists of two parts. Part I. is designed to carry the pupil through the fifth grade, or to cover the first four or five years at school.

Part I. begins with two chapters on number work covering the ground which should be already familiar to the pupil. These review exercises are intended to accustom pupils to the use of a text-book in a subject which hitherto has been entirely oral to them.

A chapter on easy simple fractions has been introduced at a early stage, as the authors believe that, contrary to the opinion of many teachers, when properly presented, fractions present little difficulty to the young mind. The difficulty lies largely in the use of fractional numbers too large to be comprehended by the average pupil.

As many pupils leave school before the sixth and later grades are reached, easy decimals, percentage, and interest have been introduced, since these are subjects that are constantly met with in the ordinary business transactions of life.

Numerous mechanical and practical exercises on the fundamental rules for seat work form an important feature of the book. It is believed that these exercises form a well-graded and progressive series such as will develop the reasoning powers of the pupil and at the same time familiarize him with the important practical applications of the science of numbers.

Part II. is designed to complete the public school course. In this part there is a careful review of the work of Part I., in which the subjects treated in it are expanded and adapted to the growing mind of the learner. The new material which has been added will, it is believed, supply those applications of the science of numbers which are needed by the average pupil in later years.

The *inductive* method of development has been followed. The child has been led to draw his own conclusions and form his own rules. Definitions have, however, been carefully worded, as experience has shown that, when the child is left entirely to himself to word these, they are usually lacking in that exactness which is one of the essential features of all good teaching.

The review exercises at the end of each chapter and the special reviews introduced to cover all the part previously made familiar to the pupil will, it is thought, secure for the treatment all the advantages of the "Spiral method" without its many obvious disadvantages.

THE AUTHORS.

NOTE.—Answers to the problems in this book, together with hints for the solution of the more difficult problems, will be found in the "Handbook to Elementary Arithmetic, Parts I and II, for Public Schools."

CONTENTS

ELEMENTARY ARITHMETIC

PART I

CHAPTER I

I. Suggestive Type Questions for Review

EXERCISE 1

1. Measure with a foot rule (a) the length and the breadth of the room; (b) the length, breadth and height of a box; (c) the height of the shortest, and of the tallest boy in the class.

2. Measure with a yard stick (a) the length and the width of the blackboard; (b) the width of the teacher's desk.

3. Draw lines on the blackboard. Have pupils measure with the eye. Test answers with the foot rule and yard stick. Test other distances in the same manner. Examples, school-yard, stair steps, etc.

4. Find the length of any curved line or circle (use a string). Examples, a buggy wheel, stove pipe, globe, etc.

5. How many inches are there in a foot? How many in a yard? How many inches are there in 3 feet? In 3 yards?

6. A room is 14 yards long and 30 feet wide. How many more feet are there in its length than in its width?

7. Write the table of length.

EXERCISE 2

1. Name all the copper and silver Canadian coins and draw circles representing their size.

2. One dollar, a quarter of a dollar, a half-dollar are equal to how many 5 cent and 10 cent pieces respectively?

3. Read $1.25. Write in figures two dollars and fifty cents, four dollars and five cents.

4. John bought 2 dozen eggs at 14 cents a dozen. What change should he get out of a $1 bill? How do you reckon the change?

5. How many sheets of paper are there in a quire? How many in a ream?

6. How many pens are there in a dozen? How many dozen in a gross? How many pens in a gross?

7. James bought 2 dozen marbles for 5 cents and sold them at 10 cents a dozen. How much did he gain?

8. A boy bought a gross of marbles for 50 cents and sold them at 7 cents a dozen. How much did he gain?

9. Write the table of Canadian money.

EXERCISE 3

1. What things are measured by the pint? By the quart? gallon? peck? bushel?

2. Suppose you had only a pint measure; how could you measure a quart? A gallon? A peck? A bushel?

3. How many pints are there in 6 gallons of coal oil? How many quarts of berries in a 5 gallon pail? How many gallons of oats in a bushel?

4. Take a salmon tin holding a pint, and a tomato tin holding a quart and find how many of each are in a pail of water.

5. What is the meaning of lb.? oz.? doz.?

6. How many ounces are there in 6 lbs.? How many pounds in 32 oz.?

7. If 3 lbs. of tea are divided into 6 oz. packages, how many packages will there be?

8. Write the tables of dry and of liquid measures.

EXERCISE 4

1. Draw the face of a clock. When the minute hand is 11 spaces past XII and the hour hand is between VI and VII, what time is it? When the hour hand is between VIII and IX and the minute hand at X, what is the time?

2. Make the Roman numerals from 1 to 100.

3. Write the names of the days of the week, the months of the year. How many days in each month?

4. How many days are there from March 8th to April 29th?

5. Which is the better wages, 20 cents an hour or $1.50 a day, if a day is 10 hours long?

6. Which would you rather have, $2 a day for a week or $15 a week?

7. How many hours are there in three and one half days? In one and a third days?

8. Write the table of time.

9. A dealer pays 16 cents a gallon for milk and sells it at 10 cents a quart. How much does he make on a quart? On a gallon? On 12 quarts?

10. If you buy 3 lbs. of meat at 9 cents a pound, how much does it cost? If you pay for it with half a dollar, what change will you receive?

11. How many feet are there in 7 yds. and 2 ft.?

EXERCISE 5

1. If I add 14 to 20 what is the result?

2. What number added to 26 will make 40?

3. What number taken from 69 will leave 37?

4. If a teacher is standing 12 feet from one side of a room and 16 feet from the other side, how wide is the room?

5. Mary has a ten-cent piece and two five-cent pieces. If she spends 5 cents at a store, and buys 2 two-cent postage stamps, how many cents will she have left?

6. John had 15 cents and spent 10 cents for paper and pencils. His father then gave him 5 cents. How much did he then have?

EXERCISE 6

1. Read the following numbers: 47, 84, 95, 61, 100.

2. Write in figures: Fifty-four, twenty, ninety-two, sixty-nine.

3. Read as tens and units: 17, 59, 95, 99.

4. Write as one number: Seven tens and eight units, nine tens and one unit, four tens and eight units.

5. Express in figures the following: V, X, II, VI, XIII, IV, L, XIX, XXIV, XC, XLIV.

6. Express the following in two ways: four, seven, ten, twenty-four, forty-nine.

7. Write in words: 36, XXVIII, 44, 99, XIV.

8. Find a number equal to $4+5-3+7-5$.

9. Find the value of $3\times5+2\times6$.

10. Find the value of IV+VI+X−IX.

II. ADDITION

Add:

EXERCISE 7

1.

2	1	2	3	4	3	4	5
2	2	3	4	4	4	5	3
2	2	2	2	4	5	2	2
2	1	1	3	4	5	3	4
2	2	3	4	3	4	4	3
2	1	2	3	3	3	5	5
2	2	3	2	3	3	4	4
2	1	2	4	3	4	3	1

2.

4	6	5	4	42	36	46
6	3	6	4	24	43	34
3	4	3	6	61	45	43
5	5	5	6	16	54	64
6	6	6	5	15	66	59
5	3	3	6	34	23	44
6	4	5	5	43	32	66
6	5	6	6	65	46	34
5	3	3	6	56	64	

3.

22	25	14	51	34	44
32	32	41	15	43	55
33	21	52	25	15	22
12	42	25	34	24	33
21	33	35	24	43	21
31	45	53	32	32	14
23	24	42	42	24	41
42	54	34	51	34	35
32	35	43	42	45	53

4.	7	5	3	4	64	56	76
	7	6	4	6	64	54	67
	7	7	5	7	63	53	77
	7	4	6	4	62	55	66
	7	4	7	6	62	65	74
	7	7	7	7	63	64	47
	7	6	6	4	64	63	57
	6	5	5	6	46	65	56
	7	7	4	7	45	46	65
	6	7	3	5	44	63	67
	—	—	—	—	—	—	—
5.	5	8	8	6	87	66	48
	6	8	7	7	78	68	84
	7	8	7	8	68	88	57
	8	7	8	6	86	86	75
	8	7	8	7	58	58	85
	7	7	7	8	85	85	68
	6	6	8	6	48	67	86
	5	6	7	7	84	78	58
	8	6	8	8	88	87	64
	8	8	7	5	78	78	48
	—	—	—	—	—	—	—
6.	7	6	4	8	89	28	64
	8	7	5	6	68	72	46
	9	8	9	5	49	82	68
	4	9	7	6	78	38	86
	9	9	8	9	45	83	75
	7	9	9	9	36	94	57
	9	9	8	9	45	49	69
	9	8	9	8	48	76	96
	9	7	7	7	94	67	48
	9	6	5	7	84	48	84
	8	5	9	6	65	83	95
	—	—	—	—	—	—	—

7. Add by columns and lines:

$$
\begin{array}{l}
7+8+4+9+6+5+7+5+7+9= \\
3+7+7+6+7+8+5+9+7+6= \\
6+5+5+4+6+9+7+8+9+5= \\
7+5+7+7+8+9+6+3+9+7= \\
7+6+2+5+9+5+4+5+2+6= \\
9+7+3+4+3+4+7+9+7+5= \\
8+8+6+3+6+8+4+4+5+9= \\
4+4+7+6+7+0+5+7+9+3= \\
6+9+8+7+8+5+6+5+3+8= \\
\underline{7+6+9+8+9+6+7+4+6+4=}
\end{array}
$$

8. There are eight rows of trees, with nine trees in each row. How many trees are there?

9. How many quarts of water will fill 4 jugs, if each jug holds three quarts?

10. There are 24 sheets of paper in a quire. How many sheets are there in five quires?

11. A farmer sold five acres of land at $84 an acre. How much did he get for his land?

12. George sold 7 pigeons at 55 cents each. How much money did he receive for them?

13. There are 12 inches in one foot. How many inches are there in six feet?

14. A room is 18 feet long and 15 feet wide. How long a string will exactly stretch round its walls?

15. Find the cost of six dozen eggs at 27 cents a dozen.

III. SUBTRACTION

EXERCISE 8

Subtract:

1.	48	39	47	58	47	84	79
	23	16	32	17	25	22	36
	—	—	—	—	—	—	—
2.	97	84	96	79	59	48	96
	13	21	26	45	36	32	44
	—	—	—	—	—	—	—
3.	40	50	60	40	50	60	70
	11	13	14	24	16	28	19
	—	—	—	—	—	—	—
4.	45	84	93	94	62	75	83
	26	46	37	48	24	64	27
	—	—	—	—	—	—	—

5.	45−15=	76−42=	93−48=	85−17=
6.	74−18=	75−46=	66−37=	37−18=
7.	35−16=	46−17=	67−18=	88−49=
8.	84−28=	35−26=	64−29=	75−38=

Add and subtract:

9.	28	65	74	85	78	93	85
	16	16	37	39	49	47	76
	—	—	—	—	—	—	—
10.	75	75	67	45	72	63	54
	29	49	52	19	18	36	19
	—	—	—	—	—	—	—

11. John earns 48 cents and James 54 cents in a day. How much more does James earn than John in 3 days?

12. How many bouquets can I make of 3 dozen roses, if I put 9 roses in each bouquet?

13. A room is 14 yards long and 12 yards wide. How many more feet are there in its length than in its width?

IV. MULTIPLICATION

EXERCISE 9

1. Tell the result:

7×5	7×7	7×9
4×9	4×5	7×4
8×5	8×6	8×8
4×3	4×8	4×6
6×7	6×3	6×7
5×6	5×9	5×3
3×4	3×5	3×9
5×8	7×6	9×9

2. Write the table of 4 times up to 4 times 9.

3. Write the table of 6 times up to 6 times 12.

4. Write the table of 8 times up to 8 times 9.

5. Multiply the following:

12	25	36	48	16
3	3	4	5	6
24	34	25	43	15
6	7	5	8	9

6. Find the value of each of the following:

24×3	32×5	45×6	35×2
15×4	37×4	23×7	37×4

7. If a man pays $5 for a sheep, how much should he pay for 48 sheep?

8. I bought 4 pigs at $12 each and 9 sheep at $5 each. How much more did the pigs cost than the sheep?

9. How many inches are there in 6 feet?

V. DIVISION

EXERCISE 10

1. How many 2's are there in 4? in 10? in 12?

2. Divide 2[illegible] by 2; 42 by 2; 64 by 2.

3. Tell the result:

36 + 4	32 + 7	70 + 9	36 + 9
40 + 8	45 + 8	36 + 7	48 + 7
16 + 2	37 + 6	45 + 6	45 + 4
18 + 5	27 + 5	55 + 9	39 + 7

4. Divide:

24 by 3;	by 8;	by 6;	by 4;	by 5.
36 by 4;	by 9;	by 6;	by 12;	by 8.
40 by 5;	by 8;	by 10;	by 7;	by 6.
48 by 4;	by 6;	by 8;	by 2;	by 9.

5. If 5 oranges cost 30 cents, what will 1 orange cost? What will 4 cost?

6. A newsboy spent 36 cents in buying papers at 3 cents each. He sold all at 5 cents each. How much did he gain?

7. If 3 cords of wood cost $15, what will 5 cords cost?

8. Find the cost of a dozen apples at 3 for 5 cents.

9. If 5 exercise-books cost 35 cents, what will be the cost of 4 exercise-books?

10. There are 72 sheaves in 9 stooks. How many sheaves are there in each stook?

11. How many school-days are there in 20 weeks?

12. A room is 24 feet long and 18 feet wide. How many yards is it round the room?

13. Tom went to the store to buy 6 pounds of sugar at 6 cents a pound. How much change did he get out of 50 cents?

CHAPTER II

FUNDAMENTAL RULES AND OPERATIONS

SECTION I. DEFINITIONS

I. QUANTITY

A boy buys 6 pounds of rice, 3 yards of cloth, 4 dozen eggs, paying 2 dollars for all. He has purchased a certain quantity of each for a certain amount or quantity of money. *Anything* that can be estimated or measured, as rice, cloth, eggs, money, etc., is called *A Quantity.*

1. Name six other quantities.

II. UNIT

1. In buying rice by the pound, cloth by the yard, and eggs by the dozen we require a certain definite quantity or single thing, viz., 1 pound, 1 yard, 1 dozen, in order to measure them. This single thing or definite quantity is called *A Unit.*

1. What is the unit of 5? of 5 books? of 8 miles?

2. How many units in 6 cents? in 6? in 9 pencils?

3. What is the unit in selling bricks by the thousand, matches by the gross?

III. NUMBER—KINDS OF UNITS AND NUMBERS

1. What is the unit in 6 acres? In 4 yards? In 7 oranges? In 3 dozen eggs? In 9? In 2 hundred? In 3 pair? In 8 pair of boots?

2. How often is the unit repeated in 6 acres? In 4 yards? In 7 oranges? In 4 dozen eggs? In 7?

3. In example (1) explain the use of 6, 4, 7, 3, 9, 2, 3, 8.

2. *A number* is that which expresses the measure of a quantity, or answers the question, "How many units are contained in the quantity?"

3. The units used to measure the particular kind of quantity in example 1, viz., 1 acre, 1 yard, 1 orange, 1 dozen, 1 pair of boots, are called *Concrete Units.*

4. The units of 9, 2 hundred, 3 pair, which are applicable to the measure of any quantity, are *Abstract Units.*

5. Numbers like 6 acres, 4 yards, 7 oranges, 3 dozen eggs, 8 pairs of boots, which not only show the number of times a unit is repeated, but also specify the objects which are counted, are *Concrete Numbers*, or *Concrete Quantities.*

6. Numbers like 9, 2 hundred, 3 pair, which merely show the number of times a unit is repeated, are called *Abstract Numbers.*

IV. ARITHMETIC

7. Arithmetic is the science of numbers and the art of computing by them.

EXERCISE 11

1. Give five examples of quantities.

2. What is the unit of 6? Of 8 men? Of 5 marbles?

3. State which of the following numbers are abstract and which concrete:—8, 9 pairs, 7 pears, 3 dozen, 6 dozen eggs, 4 cows, 11 quarts, 8 hundred.

4. In each of the following numbers state the unit and state whether it is a concrete or an abstract unit: 18 apples, 13 pair of boots, 9 hundred, 7 gallons.

SECTION II. NUMERATION AND NOTATION

INTRODUCTORY EXERCISE

1. Name the numbers from one to one hundred.
2. Write them in figures.
3. Count by naming the digits one, two, three, four, five, six, seven, eight, nine, ten, twenty, thirty, ————up to ninety.
4. How many tens in 10, 20, 30,————100?
5. What part does ten play in naming numbers?

Arabic Notation

8. In dealing with numbers we first find it necessary to have a system of naming them or a *Numeration*, and next to have a method of writing them, or a *Notation*.

I. ONE, TWO AND THREE FIGURE NUMBERS.

In counting, after we have reached nine, we say ten, one and ten, or eleven, two and ten, or twelve, three and ten, or thirteen—nine and ten or nineteen, two tens, or twenty, twenty one—three tens, or thirty, until we reach nine tens and nine, or ninety-nine. One more than ninety-nine makes ten tens, or *One Hundred*.

In writing numbers, the whole numbers under ten are expressed by means of nine symbols or figures, as follows:—1, 2, 3, 4, 5, 6, 7, 8, 9. Larger numbers are expressed by a decimal notation, in which these nine digits are combined with the symbol 0 (read zero or nought). In other words, according to the place in the number these digits with 0 may represent ones, tens or hundreds, and so we can express all numbers.

If a digit represents ones, it has the first place at the right of the numbers; if tens, the second place to the left; if hundreds, the next place to the left of the tens. To write ten we put 1 in the ten's place and 0 in the one's place thus: 10. To write one hundred we put 1 in the hundred's place and fill the ten's and the one's places with ciphers, thus: 100. So two hundred is expressed 200, etc. If we wish to write the number two hundred and fifty-six, we put the digit representing the hundreds in the hundreds' place, the digits representing the tens in the tens' place, and the digits representing the ones or units, in the ones' place, thus: 256

NOTE.—The principle of forming and expressing numbers may be illustrated by making bundles of wooden splints, ten in each bundle, and then making bundles of hundreds by taking for each hundred ten bundles of ten each, and so on.

II. ANY NUMBER

By using three figures the largest number we can write is nine hundred and ninety-nine (999). The next number is ten hundred or one thousand. To represent this number in figures we put 1 in the fourth place and put zeros in the hundreds' tens', and ones' places, thus: 1000. Two thousand will be written 2000, etc.

If we wish to write hundreds, tens and units with the thousands, we proceed as before, placing the hundreds', tens', and units' digits in their respective places. Following this plan we write nine thousand five hundred and forty-two thus: 9542, making the thousands take the fourth place, the hundreds the third, the tens the second, and the units the first.

1. What are the names of the places to thousands?

2. How much is the value of the figure increased by placing another at the right of it?

When we count above a thousand, we say one thousand, two thousand, three thousand, etc.—nine-hundred and ninety-nine thousand, one thousand thousand or one million.

We have seen that we can avoid writing the words units, tens, and hundreds by giving each figure a place, so we can avoid writing thousands, millions, billions, etc., by assigning each a place called a period. Thousands have the period or three places at the left of the units' period, millions the three places at the left of the thousands' period, billions the three places at the left of the millions' period, etc. The places in any period have the same name as in the units' period, so we have ones, tens, and hundreds of units; ones, tens and hundreds of thousands; ones, tens, and hundreds of millions, etc. These periods numbering from the right are called units, thousands, millions, billions, etc., and are separated by a comma as 3, 456, 789, to assist in reading.

The following plan for reading numbers will illustrate the above explanations:

BILLIONS			MILLIONS			THOUSANDS			UNITS		
Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones
									3	0	8
						0	6	9	3	1	8
		1	3	4	7	2	6	9	4	2	7

These numbers are read as follows:—

Three hundred and eight.

Sixty-nine thousand, three hundred and eighteen.

One billion, three hundred and forty-seven million, two hundred and sixty-nine thousand, four hundred and twenty-seven.

NAME AND ORIGIN

9. The system of notation described above in which numbers are expressed by means of figures, is the one in general use at the present time, and is called the "*Arabic Notation*" because it was introduced into Europe by the Arabs who had obtained it from the Hindus.

Roman Notation

1. Read the figures or numerals found on a clock face.

2. Read the numerals denoting the chapters of this book.

10. These are called Roman Numerals because they were used among the Romans. Why are they more difficult to work with than our common numerals?

You will have but little need of Roman Numerals, as they are now employed only to denote the chapters and sections of a book or a date.

11. The following is a brief description of this notation:—

1st. Instead of *figures* being used to express numbers, the following *letters* are employed, viz.:

I, V, X, L, C, D, M, of which the simple values are respectively:

1, 5, 10, 50, 100, 500, 1000.

2nd. *If two characters of the same value are placed side by side, or if a character is followed by one of less*

value than itself, the number denoted by the expression is the *sum* of the simple values, thus, XX represents 20; XI denotes 11.

3rd. *If a character is followed by one of greater value than itself*, the number denoted by the expression is the *difference* of their simple values, thus, IX represents 9; XL represents 40.

12. *To write any number in Roman Numerals.* Resolve the number into its different parts and always write down one part before proceeding to another, beginning at the left hand side.

Ex. Express 1895 in Roman numerals:—

1895 = 1000, 800, 90, and 5.
1000 = M
800 = DCCC
90 = XC
5 = V;
Hence, 1895 = MDCCCXCV.

EXERCISE 12

Write in figures:

1. Seven; nine; four; two.
2. Thirty-six; eighty-four; twenty; sixty-nine.
3. Forty-four; seventy; ninety-six; sixteen.
4. Fourteen; twelve; thirty-nine; fifty-six.
5. Write as one number:
   four tens and eight units; nine tens and seven units; three tens and six units; six tens.

Write in words the numbers expressed by the following figures:

6. 7, 11, 15, 19, 59, 84, 96, 98.
7. 71, 23, 28, 91, 44, 17, 22, 34.
   20, 37, 48, 76, 99, 69, 70, 87.

EXERCISE 13

Write in figures the following numbers:

1. One hundred and forty-nine; three hundred and eight; nine hundred and seventy-four.

2. Two hundred; four hundred and twenty; six hundred and ninety-four.

3. Five hundred and sixty; nine hundred and eight; four hundred and forty-four.

4. 7 hundreds, 3 tens and 5 units; 9 hundreds and 6 tens; four hundreds and 6 units.

Write in words the numbers expressed by the following figures.

5.	207,	371,	185,	190,	368.
6.	570,	472,	807,	909,	990.
7.	368,	584,	760,	321,	999.

EXERCISE 14

Express in figures the following numbers:

1. Six thousand and six; four thousand three hundred; nine thousand and eighty.

2. Three thousand seven hundred; seven thousand nine hundred and six; three thousand and eighty-four.

3. Sixty-four thousand and nine; eight hundred and seven thousand and sixty-eight; seven hundred thousand three hundred and sixteen.

4. Four millions, thirty thousand and ninety-seven; eight hundred and nine millions, seven thousand and thirty-nine; five hundred and eighty-six millions and seven.

Write in words the numbers expressed by the following figures:

5. 7077, 85079, 56950, 473628.

6. 56418, 784006, 400507, 360004.

EXERCISE 15

Write in Roman Numerals:

1. 19, 24, 49, 84, 99.
2. 187, 208, 781, 962, 999.
3. 1301, 1390, 1684, 1815, 1878.

Write in figures:

4. XLIV, LXIX, XCIV, LXXI.
5. XCIX, CXXIX, CLXXVII.
6. DLV, MDCIV, MDCCCXIX, MXC.
7. MCCXC, MIX, MCDXC, MCM.
8. L is placed to the left of only what letters?
9. X is placed to the left of only what letters?

EXERCISE 16

1. In the number 44444 compare the value of 4 in the right hand place with that of 4 in the third place from the right.

2. Write in figures the largest number that can be expressed by means of four figures, also the smallest number.

3. Take 9 and place two noughts so that its value may be increased ten times, a hundred times.

4. Write the numbers next above 25999, 9999, 89909, and the numbers next below 400000, 40690, 20400.

5. Decompose 45,269; 3,176,007. How many hundreds in 74 tens; 168 tens; 1000 tens?

6. Write in Roman Notation the number representing this year and those representing the next five years.

7. How many people in the village, town, or city in which you live? How many in your Province? How many in Canada?

SECTION III. ADDITION

INTRODUCTORY EXERCISE

1. State all the pairs of numbers whose sum is 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20.

2. Write the numbers 3, 6, 7, 5, 4, 8, 1, 2, 9 and state the result when each is increased by 5, 8, 7, 3, 9.

NOTE.—Much rapid drill work of this nature should be given for a short time each day.

In adding, aim at reading a column like a word. Group in tens where you can and try to combine numbers as far as possible instead of adding each individually. Check or prove your work by adding the columns from the top downward.

Example

4	
6	44
7	34
8	
9	27
5	
3	10
2	
44	

13. *Addition* is the process of finding a number that is equivalent to two or more numbers.

14. The number found by the addition is called the *Sum*.

15. The numbers which are added together are called *Addends*.

16. Only like numbers can be added. Thus: 4 cents and 7 cents can be added together, but not 4 cents and 7 marbles.

17. The sign of addition, +, is called *Plus* and when placed between two numbers, shows that they are to be added.

18. The sign, =, is called the *Sign of Equality*, and when placed between two numbers shows that they are equal, thus 4+5=9, 4 plus 5 equals 9.

Addition may be divided into two cases.

1. Addition of numbers in which the sum of any column is less than ten.

2. Addition of numbers in which the sum of any column exceeds nine units of that column.

CASE I

To add any column of figures whose sum does not exceed nine.

Example: How many are 21+15+12?

These may be added by decomposing the numbers into tens and units as follows:—

21=2 tens+1 unit.

15=1 ten +5 units.

12=1 ten +2 units.

Hence we have four tens+8 units which is written 48. In actual practice, however, addition is done as follows:—

21
15
12
—
48

Write the numbers as above, placing *units* under *units*, and *tens* under *tens*, and begin at the right to add. Thus, 2 and 5 are 7, and 1 are 8, which we write in the place of units; adding the tens we have 1 and 1 are 2, and 2 are 4, which we write in the tens' place. Hence the entire sum is 48 cents.

After a little practice the pupil should proceed as follows: 2, 7, 8; set the 8 in the units' column. Next, 1, 2, 4; set the 4 in the tens' column.

EXERCISE 17

(1)

16 horses.
21 "
10 "

(2)

18 boys.
20 "
60 "

(3)

12 girls.
14 "
13 "

(4)	(5)	(6)	(7)
421	312	241	405
132	231	134	363
425	413	523	121
(8)	(9)	(10)	(11)
342	213	143	351
406	305	322	204
131	461	232	243
(12)	(13)	(14)	(15)
240	650	513	408
401	122	106	371
357	126	260	110
(16)	(17)	(18)	(19)
2341	3213	4021	1056
3214	2340	1045	6131
3034	4326	3923	2802
(20)	(21)	(22)	(23)
23241	31042	12304	21304
31402	24535	35242	30562
44235	32411	41452	28122

EXERCISE 18

PROBLEMS

1. A boy spent 23 cents for a melon, 32 cents for peaches, and 24 cents for pears; how many cents did he spend?

2. Of the trees in an orchard, 23 are peach trees, 10 are plum trees, 12 are pear trees, and 43 are apple trees; how many trees are there in the orchard?

3. A farmer has 323 acres in barley, 42 acres in corn, 123 acres in wheat, and 101 in oats; how many acres has he in cultivation?

4. A gentleman paid 225 dollars for a buggy, 231 dollars for a horse, 300 dollars for a carriage, and 40 dollars for harness; what did he pay for all?

5. A man travelled on the cars for four days as follows: the first day he went 313 miles, the second day 242 miles, the third day 220 miles, and the fourth day 214 miles; how many miles did he travel in the four days?

6. A merchant bought four bales of cloth; the first bale measured 305 yards, the second 213 yards, the third 240 yards, the fourth 211 yards; how many yards did he buy?

7. Four merchants loaded a freight train with cotton; the first put on 213 bales, the second 232 bales, the third 312 bales, and the fourth 121 bales; how many bales were put on?

8. A merchant went to Winnipeg and invested 5213 dollars in dry goods, 2431 dollars in groceries, 1000 dollars in hardware, and 345 dollars in confectionery; how much did he invest?

CASE II

To add when the sum of any column exceeds Nine Units of that column.

Ex. 2. Find the sum of 358, 369, 328, and 9.

358
369
328
9

1064

For convenience in adding, write the numbers, placing units under units, tens under tens, etc. Begin at the column of the lowest order, add 9, 17, 26, 34: 34 units=3 tens and 4 units. Write the 4 under the units' column and add the 3 tens with the column of tens; thus, 5, 11, 16: 16 tens=1 hundred and 6 tens. Write 6 under the column and add 1 with the column of hundreds; thus, 4, 7, 10: 10 hundreds=1 thousand and 0 hundreds. Write 0 under the column of hundreds, and write 1 under the column of thousands, making the sum 1064.

This may be illustrated with a few bundles of splints bound together with India rubber bands, as follows:

358= 3 hund. +5 tens +8 units
369= 3 " +6 " +9 "
328= 3 " +2 " +8 "
9= 9 "
9 hund. +13 tens +34 units
= 9 " +1 hund. +3 tens+3 tens+4 units
=10 " +6 tens +4 units
=1064.

19. *PROOF.*—Begin at the top of the units' column and add the several columns downwards; if the two results agree, the work may be presumed to be correct.

EXERCISE 19

Add together:

(1)

42 dollars.
28 "
43 "

(2)

16 cents.
18 "
44 "

(3)

55 boys.
13 "
84 "

(4)

48 girls.
25 "
72 "

(5)	(6)	(7)	(8)	(9)	(10)
45	84	16	46	84	95
69	72	61	64	46	50
32	91	85	51	87	68

(11)	(12)	(13)	(14)	(15)	(16)
69	52	50	76	20	89
28	50	40	82	58	93
73	35	30	74	71	20
64	11	20	98	63	17
21	57	10	88	94	36

(17)	(18)	(19)	(20)	(21)	(22)
752	342	253	897	156	851
423	426	541	111	481	318
709	151	422	343	423	805
820	737	735	625	782	167

(23)	(24)	(25)	(26)	(27)	(28)
4813	1122	2291	3574	4449	1951
5914	7914	5723	3333	2575	2468
6115	1234	2102	4680	4404	5555
7036	8024	6838	3391	3686	6666

(29)	(30)	(31)	(32)	(33)	(34)
5788	3455	2729	4044	3282	1185
2693	6521	8272	5260	6341	5073
1112	6817	3228	3788	3161	9962
6762	7773	9561	5473	2827	9467
8104	6839	5587	2667	7214	3478
9276	4318	9127	4218	2891	8096
3189	2764	2896	9376	4731	1287

(35)	(36)	(37)	(38)
43474	73422	77823	13536
38242	75638	21684	71882
67891	18208	18516	81385
84870	32378	33902	80246
22171	27225	14656	91257
19476	18518	18917	61817

Prove the foregoing results by adding the columns from the top down.

Add together:

EXERCISE 20

(1)	(2)	(3)
$69.93	$1728.48	$12978.
5.83	14.50	6455.
28.94	2215.40	4942.
58.20	719.63	21540.
.75	.95	41873.
350.00	8.70	9418.
15.24	6.25	709.
6.25	3104.41	4075.
$	$	$

EXERCISE 21

Find the sum of:

1. 6472+8733+4633+4854.
2. 2732+8756+9783+4578.
3. 1617+8743+7284+9621.
4. 2650+4062+8705+9030.
5. 5005+6007+7583+4783.
6. 27845+67832+74281+68432.
7. 47823+68421+70070+60504.
8. 127+6434+7805+66782+4987+8768.
9. 10+8756+405+66782+9+17+874+78.
10. 7560+804+7854+87400+576+8+678+94.
11. 1525+920+820+16+37800+6874+27+9.
12. 7+89+897+987+9284+576+87+37+557.
13. $309.43+$918.30+$9.48+$100.49+$3127.24.

EXERCISE 22

1. The following is a statement of the cash sales of a certain firm for the first five weeks of the year 1912:

Day	1st wk.	2nd wk.	3rd wk.	4th wk.	5th wk.	Total A
Monday . .	$137.58	$196.47	$412.18	$259.78	$ 93.27	
Tuesday . .	275.70	213.48	217.40	117.25	175.20	
Wednesday .	368.40	271.45	234.58	318.40	124.60	
Thursday .	319.47	307.47	47.18	117.25	175.47	
Friday . .	260.39	325.40	68.74	147.80	212.90	
Saturday .	370.44	111.90	314.60	212.48	118.75	
Totals B . .						

Find the sum of total A and of total B.

EXERCISE 23

1. *A* gave 27 dollars for a cow, 45 dollars for an ox, and 150 dollars for a horse; what did they all cost?

2. *A* has 120 acres of land, *B* has 310 acres, *C* has 515 acres, and *D* has 715 acres; how many acres have they all together?

3. There are 31 days in January, 28 in February, 31 in March, and 30 in April, how many days are there in these four months?

4. A man travelled 215 miles one week, 195 the next, 273 the next, and 378 the next; how far did he travel?

5. *A* weighs 127 pounds, *B* 215 pounds, *C* 176 pounds, *D* 184 pounds, and *E* 234 pounds; what is the sum of their weights?

6. A farmer raised 576 bushels of corn, 918 bushels of oats, 3149 bushels of wheat, and 2785 bushels of rye; how many bushels did he raise in all?

7. *A* owns 214 acres of land, *B* owns 719 acres, *C* owns 2136 acres, and *D* owns 372 acres; how many acres do they own altogether?

8. *A* bought a horse for 168 dollars, and a carriage for 376 dollars, and sold them so as to gain 89 dollars; how much did he receive for them?

9. In one book there are 725 pages, in another book there are 327 pages, and in another book there are as many as in both the former; how many pages in all?

10. A merchant bought cloth for 756 dollars, silk for 859 dollars, muslin for 367 dollars, and calico for 255 dollars; how much did all cost?

EXERCISE 24

1. A man dying willed his estate as follows:—To his wife, $5500; to each of his four sons, $3200; to each of his three daughters, $2800; to a church, $1950; to a school, $2430. How much was his estate?

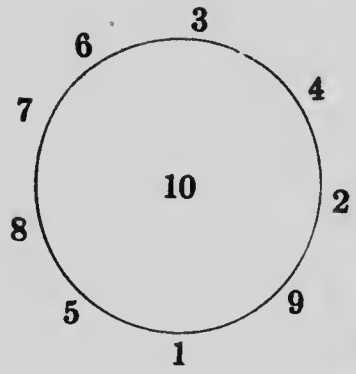
2. In 1912 in the Province of Ontario there were 8546 miles of railway track; in Quebec, 3883 miles; in New Brunswick, 1545 miles; in Nova Scotia, 1357 miles; in Prince Edward Island, 269 miles; in Manitoba, 3520 miles; in Saskatchewan, 3754 miles; in Alberta, 1897 miles; and in British Columbia, 1855 miles; in Yukon 102 miles. How many miles of railway track were there in Canada in 1912?

3. During the year ending June 30th, 1910, Canada exported Agricultural products, $90,433,747; Animals and their products, $53,926,575; Fisheries produce, $15,663,162; Mineral produce, $40,093,017; manufactures $31,494,916. Find the total value of these export

4. From Port Arthur to Sault Ste. Marie is 273 miles; from Sault Ste. Marie to Sarnia, 318 miles; from Sarnia to Port Colborne, 308 miles; from Port Dalhousie to Kingston, 170 miles; from Kingston to Montreal, 178 miles; and from Montreal to Quebec, 160 miles. How far is it from Port Arthur to Quebec by water?

5. In 1836 there were 16 miles of railway in Canada; in 1847 there were 38 miles more; in 1850 there were 12 miles more than in 1847. In 1851 there were 93 miles built; in 1852, 46 miles, in 1853, 301 miles; in 1854, 258 miles; in 1855, 113 miles; in 1856, 537 miles; in 1857, 30 miles; in 1858, 419 miles; in 1859, 131 miles; and in 1860, 71 miles. How many miles of railway were in operation in 1860?

SECTION IV. SUBTRACTION



INTRODUCTORY EXERCISE

1. Take each of the numbers on the outside of the circle from 10. Replace 10 with other numbers up to 17 and perform the same operation.

NOTE.—This or a similar device should be used frequently for rapid oral drill.

2. How much must be added to the lower of each of the following pairs of numbers to make the upper one?

9	7	10	30	25	80
4	2	5	14	14	38
—	—	—	—	—	—

In the last pair think: 38 and 2 are 40, and 40 more make 80; therefore the number to be added is 2+40=42.

If you buy an article for 35 cents and give the merchant a 50-cent piece, he would make change thus: "35, 40, 50," counting out a 5-cent piece and a ten-cent piece, giving you 15 cents change; or 35, 40, 45, 50, giving you three 5-cent pieces.

Finding the difference between two numbers is called *Subtraction.*

20. The number found by taking one number from another is called the *Difference* or *Remainder.*

21. The number from which the other is taken is called the *Minuend.*

22. That which is taken from the Minuend is called the *Subtrahend.*

23. The sign of subtraction, −, is called *Minus*, and when placed between two numbers shows that the one on the right of the sign is to be taken from the one on the left of it. Thus 6−2, is read 6 minus 2, and means that 2 is to be taken from 6.

24. Only similar numbers can be subtracted; thus, 4 boys from 7 boys; 6 cents from 8 cents, etc.

NOTE.—The *Difference* between two numbers is sometimes defined as the number which, added to one number, makes another. The *Subtrahend* is then the number to which the difference is added to make the *Minuend.* And as a great deal of subtraction is "making change," this definition should be considered as well as the one given above.

Subtraction may be divided into two cases:

1. *When no figure of the subtrahend is greater than its corresponding figure of the minuend.*

2. *When a figure of the subtrahend is greater than the corresponding figure of the minuend.*

CASE I

To subtract when no figure of the subtrahend is of greater value than its corresponding figure of the minuend.

Example 1. Subtract 335 from 678.

678=6 hundreds+7 tens+8 units.
335=3 hundreds+3 tens+5 units.
Difference=3 hundreds+4 tens+3 units=343

In actual practice the subtraction is done as follows:

$$\begin{array}{r} 678 \\ 335 \\ \hline 343 \end{array}$$

We write the less number under the greater, placing *units* under *units* and *tens* under *tens*. Beginning with the units we say 5 units from 8 units leave 3 units, and we set the 3 in the units' column below. Then 3 tens from 7 tens leave 4 tens, and we set the 4 in the tens' column. Lastly, 3 hundreds from 6 hundreds leave 3 hundreds, and we set the 3 in the hundreds' column. Hence we have as the whole remainder 3 hundreds 4 tens and 3 units, or 343.

EXERCISE 25

(1)	(2)	(3)	(4)	(5)	(6)
625	456	763	617	767	896
312	215	512	215	123	432
(7)	(8)	(9)	(10)	(11)	(12)
279	807	796	736	967	875
136	502	452	432	234	345
(13)	(14)	(15)	(16)	(17)	(18)
8763	9076	3769	5076	4872	7659
4321	4054	1546	3075	2342	3237
(19)	(20)	(21)	(22)	(23)	(24)
8769	4876	8275	8799	8591	5857
3257	2142	3251	2542	7230	1234
(25)	(26)	(27)	(28)	(29)	(30)
784	82345	57596	72578	27397	67385
361	22121	21321	41362	22315	24121

(31)	(32)	(33)	(34)	(35)
57897	67858	87578	96754	81296
21472	32721	21335	21423	20135

36. 314 from 678.
37. 425 from 658.
38. 561 from 789.
39. 1235 from 3768.
40. 3726 from 4969.
41. 2532 from 8748.

EXERCISE 26

PRACTICAL PROBLEMS

1. In a school of 74 pupils, 31 are boys; how many girls are there?

2. A girl had 75 cents and paid 31 cents for a slate; how many cents had she left?

3. A man bought a horse for 98 dollars, and sold it for 82 dollars; how much did he lose?

4. Two parties played a game of base-ball and made 87 runs. One party made 53 runs; how many did the other party make?

5. Jane and Susan together answered 87 questions in geography. Jane answered 43 of them; how many did Susan answer?

6. A gentleman bought a buggy for 225 dollars, and sold it for 268 dollars; what was his profit?

7. A man bought a horse for 265 dollars, and sold it for 232 dollars; how much did he lose?

8. A man deposited 5237 dollars in the bank; he afterwards drew out 3125 dollars; how much remained?

To subtract when a figure in the Subtrahend is of greater value than its corresponding figure in the Minuend:

Example 2. From 522 subtract 285.

522=5 hundreds+2 tens+2 units.
285=2 hundreds+8 tens+5 units.

We cannot take 5 units from 2 units, nor 8 tens from 2 tens, so it is necessary to decompose the hundreds and the tens of the Minuend:—

522=5 hundreds+2 tens+ 2 units.
=5 hundreds + 1 ten+12 units.
=4 hundreds+11 tens+12 units.
285=2 hundreds+ 8 tens+ 5 units.
The difference=2 hundreds+ 3 tens+ 7 units=237.

25. This is called the "*Borrowing*" or *Decomposition*" method of subtraction and the one most commonly used.

522
285
—
237

In actual practice the work is performed as follows:—

5 from 12 leaves 7; 8 from 11 leaves 3; and 2 from 4 leaves 2. The remainder=237.

There is another method of performing subtraction, which depends on the following principle:

The difference between two numbers remains the same when each of them is increased by the same number.

For example, 5−2=3. Now, if we add 10 to each we have 15−12=3, as before.

In Ex. 2, if we add 10 units to 2 units we have 12 units. Then 5 units from 12 units leave 7 units, which we write in the units' place. Now as we added 10 units to the minuend, if we add an equal number to the subtrahend the difference will remain the same. But 10 units=1 ten. Adding 1 ten to 8 tens we have 9 tens; and as we cannot take 9 tens from 2 tens, we add 10

tens, thereby making 12 tens; then 9 tens from 12 tens leave 3 tens, which we write in the tens' place. Since we added 10 tens to the minuend, we must add an equal number to the subtrahend, in order that the difference may remain the same. But 10 tens=1 hundred. Adding 1 hundred to 2 hundreds we get 3 hundreds; and taking 3 hundreds from 5 hundreds we get 2 hundreds, which we write in the hundreds' place. *This is the method usually employed. This is called the "Borrowing and Carrying" or "Equal Addition" method.*

26. *PROOF.*—**Add the remainder to the subtrahend; the sum will equal the minuend if the work is correct.**

EXERCISE 27

(1)	(2)	(3)	(4)	(5)	(6)
8672	5283	8175	2534	6735	7219
3728	2426	2836	1235	5376	1972
(7)	(8)	(9)	(10)	(11)	(12)
8522	7135	6347	8135	7345	4372
6243	1872	2563	2453	2876	2583
(13)	(14)	(15)	(16)	(17)	(18)
35672	43763	87253	73875	63527	53413
23828	24235	34365	38376	14238	28401
(19)	(20)	(21)	(22)	(23)	(24)
40001	70000	60606	90800	73002	70101
18765	8924	28476	12576	18456	12347
(25)	(26)	(27)	(28)	(29)	(30)
57108	70564	67853	60000	50406	90001
13842	18727	19875	18906	18293	78478

EXERCISE 28

1. From 700000 take 57604; from 584006 take 7089.
2. From 672850 take 49709; from 784300 take 19756.
3. From 600084 take 125006; from 100000 take 99999.
4. From 800008 take 90099; from 707070 take 90909.

5. 6004 – 2576	9001 – 4752	7600 – 2456.
6. 9090 – 5407	7060 – 5094	8000 – 5264.
7. 7007 – 3009	5555 – 2089	7000 – 5387.
8. 8201 – 7056	7253 – 1847	5000 – 2754.

9. A horse was bought for $125, and sold for $117. How much was lost by the sale?

10. A roll of carpet contained 156 yards, but 79 yards were sold from it. How much remained?

11. A house cost $5440, and was sold for $6000. How much was the gain?

12. A man died in 1901 at the age of 75 years. When was he born?

13. A town which 10 years ago had a population of 3745, has now a population of 6996. What is the gain?

14. I went to a store and bought a knife for 56 cents, and gave the storekeeper a four-dollar bill (400 cents) to pay for it. How much change did he give me back?

EXERCISE 29

1. Find the remainder after taking 897 as often as possible from 5005.

2. The greater of two numbers is 7003, and the difference between them is 745. Find the smaller number.

3. To what number must 5784 be added so that the sum may be 10000?

4. From the difference between 75006 and 91804 take 578.

5. From the difference between 80070 and 90009 take the difference between 57008 and 58707.

6. From the difference between 75846 and 64368 take the sum of 364, 458, 379 and 5909.

7. The subtrahend is the sum of 807, 789, and 375; the remainder is the difference between 7856 and 7983. Find the minuend.

8. After 984 was subtracted four times in succession from a certain number, 507 was left. Find the number from which 984 was taken.

9. Find a number which added to 1487 will give the difference between one million and nine hundred and ninety-nine.

10. From the sum of all the odd numbers between 761 and 776 take the difference between one hundred thousand and ninety-seven thousand and eight.

EXERCISE 30

Find the result of:

1. 768+276−369+284−782.
2. 369+784+468−266−368−248.
3. 1764−839+786+724−368−256.
4. 136−769−284+968+268+372.
5. 269−1846+368−274+2976+769.
6. 769+785+368−784−369−249.
7. 1896−2846+362−489+3007+249.
8. 2845+3624−78695+784+93768.
9. 7369−245−12456+85769−2572.
10. 3004+2006−5008−3604+7200.

EXERCISE 31

1. A man owing $1369, paid at one time $264, and at another $748. How much did he still owe?

2. A man bought a farm for $6780, he spent $1875 for improvements and $977 for stock; he then sold the whole for $9000. Did he gain or lose, and how much?

3. What number increased by the difference between 1458 and 2362 will make the sum of 3641, 789 and 7008?

4. A collector received $1200 from four men; from the first he got $352; from the second $67 more, and from the third $94 less than from the second. How much did he receive from the fourth?

5. At an election, in which there were two candidates, the whole number of votes was 3694; the defeated candidate received 1369 votes. What was the majority?

6. A boy shot an arrow up the road 173 feet and another down the road 234 feet; his little brother brought them to him. How far did he walk to get them?

EXERCISE 32

1. The sum of six numbers is 78360. Five of them are 7245, 3684, 14569, 685, and 9768. Find the sixth one.

2. On a farm of 640 acres there are 310 acres in wheat, 75 acres in oats, 15 acres in peas, 13 acres in hoed crop, and the rest in pasture. How many acres are in pasture?

3. In a box there are red, blue, green, and black balls. The red, blue, and green balls together number 198; the blue and black, 123; and the red and blue, 160. If there are 47 black balls, how many are there altogether?

4. Queen Victoria was born in the year 1819 and died in 1901; Gladstone was born in 1809 and died in 1898. How much older than Victoria was Gladstone when he died?

5. In 1911 the rural population of Quebec was 1032618, and the urban 970094. In 1901 these numbers were 992667 and 656231 respectively. What was the increase (*a*) in rural population; (*b*) in urban; and (*c*) in both?

6. In 1911 and 1901 the population of Montreal was respectively 470480 and 267730, and in the same two years that of Toronto was 376538 and 208040. By how much more did the population of Montreal increase than that of Toronto during this decade?

7. A man bought three farms. For the first he paid $3768; for the second, $4900; and for the third he gave $125 more than for the other two put together. He sold all three farms for $17500. Did he gain or lose, and how much?

EXERCISE 33

1. I bought 3 dozen eggs at 15 cents a dozen; 2 pairs of ducks at 45 cents a pair; and 4 turkeys at 78 cents each. In payment I gave a five-dollar bill. What change should I get back?

2. John has 527 marbles; Tom has 129 less than John; Harry has 274 more than Tom. How many has Will, if he has 86 less than Tom and Harry together?

3. Four girls have together 6039 cents; the first has 1285 cents; the second 493 cents less than the first; the third 562 cents more than the second. How much has the fourth?

4. A boy goes up 16 steps of a ladder that has 45 steps; he then comes down 7 steps; then up 10 steps; then up 4 steps; then down 9 steps; then down 3 steps; then up 6 steps. What step from the top and bottom will he be standing on?

5. A basket contained oranges, nuts and eggs, in all 1769; there were 1096 oranges and nuts together; and 1262 nuts and eggs together. How many nuts were there?

6. A man bought a horse for $87, and another for $95. While he owned them, they cost him $10 for feed. He sold both of them for $220. How much did he gain?

7. A man bought a knife for 35 cents, a book for 49 cents and a bag for 83 cents. He sold all for two dollars. Did he gain or lose, and how much?

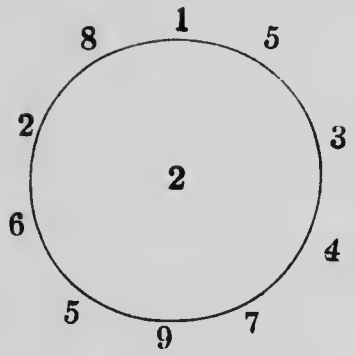
8. A man borrowed $7023; at one time he paid back $1284; at another time $2008. How much less than $5000 does he still owe?

9. A man paid $1043 for a horse and $495 less than that for a carriage. For how much must he sell both together in order to gain $273?

10. Mary has 168 cents, Jane has 82 cents, and Annie has 39 cents; Mary gives Annie enough to make her money equal to Jane's. How much has Mary left?

11. If 36 pupils fill all the seats in the room but 9, and there are 24 girls, how many boys must there be in the class?

SECTION V. MULTIPLICATION



INTRODUCTORY EXERCISE

1. Multiply each of the numbers on the outside of the circle by 2. Replace 2 by 3, 4, 5, 6, 7, etc., to 12, and repeat the operation.

2. Multiply each number by 3 and add 2 to the result. Repeat the operation, replacing 3 by 4, 5, 6, 7, etc., and add 2 to the result; adding 3, 4, 5, etc., to the result.

Instead of *adding* a number to the result a number might be *subtracted* from the result. Rapid daily practice in this work, using this or a similar device, will enable pupils to work rapidly and accurately.

3. Count by twos, threes, fours, etc., to one hundred.

DEFINITIONS

What will 5 hats cost at 6 dollars each? Since 1 hat costs 6 dollars, 5 hats will cost 6+6+6+6+6 dollars or 30 dollars, *i.e.*, 6 dollars is repeated 5 times, thus, 5 times 6 dollars is 30 dollars.

27. When any number is to be repeated a given number of times, the work may be shortened by a process called *Multiplication*.

What other process is Multiplication a short form of?

Example:

6 Multiplicand
5 Multiplier

30 Product.

28. The number resulting from the Multiplication is called the *Product.*

29. The number to be added or repeated is called the *Multiplicand.*

30. The number denoting how many times the Multiplicand is to be repeated is called the *Multiplier.*

The *Sign* of Multiplication is formed by two short lines crossing each other slantingly; thus ×, and is read times when it precedes the Multiplicand. When it follows the Multiplicand, it is read *Multiplied by.* Thus 4 × 8 dollars is read 4 times 8 dollars; and 8 dollars × 4 is read 8 dollars *multiplied by* 4.

NOTE.—Review *Concrete* and *Abstract* Numbers, Chapter I. Section I.

31. In Multiplication the *Multiplier* must be thought of as *abstract;* the *Multiplicand may be either concrete or abstract,* and the Product is like the *Multiplicand.*

Thus: 5 dollars—Concrete Multiplicand
8—Abstract Multiplier

40 dollars—Concrete Product.

Multiplication may be divided into two cases:—

1. When the Multiplier does not exceed twelve.

2. When the Multiplier exceeds twelve.

CASE I

When the Multiplier does not exceed twelve:

Ex. 1. How many are 4 times 87 boys?

First Operation *Second Operation*

87 boys 4 times 87 = 4 times 8 tens + 4 times 7 units
87 " = 32 tens + 28 units
87 " = 320 + 28
87 " = 348

Sum, 348 boys

Third Operation

87 boys
4
28
320
348 boys

Fourth Operation

87 boys
4
348 boys

In the first operation we find the result by addition. In the second operation we find the result or product by decomposing the Multiplicand into tens and units, and after multiplying each by the multiplier, adding the results.

The third operation shows how the second may be shortened. The 28 is 4 times 7 units, the 320 is 4 times 8 tens. These together make the whole product, 348.

In the fourth operation which is much shorter, we write down 87 once, and we put 4, the number of times it is to be taken, under the units' figure of the Multiplicand. We then begin at the right hand side to multiply by 4; 4 times 7 units are 28 units, or 2 tens and 8 units. We write the 8 units under the units and add the 2 tens to the product of the tens. We next take 4 times 8 tens. 4 times 8 tens are 32 tens and 2 tens make 34 tens, or 3 hundreds and 4 tens. Then we write down 4 in the tens' place and 3 in the hundreds' place.

EXERCISE 34

	(1)	(2)	(3)	(4)
Multiply	7432	8432	72312	92123
By	2	2	3	4

(5)	(6)	(7)	(8)	(9)
39 boys	47 cents	137 cows	186 apples	234 girls
5	6	7	8	9

Multiply

10. 315 by 6.
11. 480 by 7.
12. 614 by 5.
13. 7842 by 3.
14. 6843 by 7.
15. 8742 by 5.
16. 9764 by 8.
17. 8973 by 6.
18. 14068 by 5.
19. 18007 by 4.
20. 82709 by 8.
21. 21876 by 7.
22. 70095 by 9.
23. 58799 by 6.
24. 71873 by 9.
25. 6742 by 8.
26. 6040 by 9.
27. 61783 by 7.

EXERCISE 35

PRACTICAL PROBLEMS

1. What will 4070 lemons cost at 4 cents each?

2. What will 37086 oranges cost at 5 cents each?

3. A man paid 387 dollars for a house; how much should he give for 7 such houses?

4. What will 3043 pair of boots cost at 5 dollars a pair?

5. There are 56 sheep in one flock; how many sheep are there in 6 such flocks? What is the value of each flock at 7 dollars a head?

6. A man bought 384 pounds of sugar; he sold 290 pounds; how much had he left? How much did he receive for what he sold, at 9 cents a pound? What is the remainder worth at 8 cents a pound? at 7 cents a pound?

FACTORS

1. Multiply 3 by 2 and the product by 4. How many times 3 is the result?

2. Multiply any number by 2 and the product by 4. How many times the number is the result?

3. Multiplying by what number is the same as multiplying by 6 and the result by 7?

4. Six times 7 times any number is how many times the number? Nine times 8 times any number is how many times that number?

5. What numbers multiplied together will give the following: 24, 42, 72, 108, 36, 54, 84?

82. The numbers which when multiplied together make another number are called the *Factors* of that number. Thus, 7 and 3 are the factors of 21; 2, 3 and 5 are the factors of 30.

Name two factors of 35, 77, 45; three factors of 18, 27, 63, 36.

To multiply by the factors of a number.

Ex.—Multiply 742 by 12.

$12 = 6 \times 2$, or 4×3.

742	742	742
12	6	4
8904	4452	2968
	2	3
	8904	8904

It is thus seen that the *Multiplicand multiplied by the Multiplier, gives the same product as when multiplied by any set of factors into which the Multiplier can be separated.*

EXERCISE 36

Multiply:

1. 178 by 25.
2. 976 by 42.
3. 1879 by 63.
4. 1362 by 49.
5. 8936 by 54.
6. 4729 by 72.
7. 2345 by 81.
8. 3764 by 64.
9. 2978 by 45.
10. 3475 by 18.
11. 7649 by 24.
12. 9365 by 144.

13. In one mile there are 1760 yards; how many yards are there in 56 miles?

14. If sound travels 1142 feet in one second, how far will it move in one minute or 60 seconds?

15. What will 72 bushels of wheat cost at 116 cents for one bushel?

16. If 27 men can do a piece of work in 17 days, how long will it take one man to do the same work?

17. What is the cost of 24 horses at the rate of 125 dollars each?

18. If a yoke of oxen costs 135 dollars, what will 63 yoke cost?

19. If a man spends 945 dollars in a year, how much will he spend at the same rate in 21 years?

CASE II

When the Multiplier exceeds Twelve.

Ex.—Multiply 479 by 57.

479
57

1st partial product 3353=7 times the Multiplicand.
2nd " " 23950=5×10 times Multiplicand=50 [times Multiplicand
Entire " 27303=57 times the Multiplicand.

Since 57 is composed of 7 units and 5 tens or 50, 57 times the number must be equal to 7 times the number plus 50 times the number. 7 times 479 is 3353, the *first partial* product. We get 50 times 479 by first finding 10 times 479 and then multiplying this result by 5. 10 times 479 is 4790 and 5 times 4790 is 23950, the *second partial* product. We write this under the first product so that units may come under units, tens under tens, etc., and then we add the two partial products together.

```
  479
   57
 3353
2395
27303
```

In actual practice we always omit the 0, thus:

Example 2. Multiply 479 by 257.

479
257

1st partial product 3353=7 times 479
2nd " " 23950=50 " 479
3rd " " 95800=200 " 479
Entire product 123103=257 " 479.

In this example the multiplier is composed of 7 units, 5 tens or fifty, and 2 hundreds or 200, so that 257 times the number will be 7 times the number plus 50 times the number plus 200 times the number.

```
  479
  257
 ----
 3353
2395
958
------
123103
```

In actual practice we omit the zeros.

33. *PROOF.*—**Multiply the Multiplier by the Multiplicand. If the product is the same as before, the work is likely to be correct.**

EXERCISE 37

Multiply:

1. 744 by 635.
2. 895 by 336.
3. 972 by 243.
4. 825 by 682.
5. 973 by 745.
6. 8462 by 781.
7. 9643 by 683.
8. 8532 by 763.
9. 8984 by 133.
10. 4659 by 886.
11. 28352 by 345.
12. 41678 by 287.
13. 34073 by 435.
14. 40735 by 628.
15. 29304 by 789.
16. 90705 by 897.
17. 43445 by 678.
18. 37436 by 835.
19. 88888 by 789.
20. 23567 by 597.
21. 6484 by 6372.
22. 7856 by 3375.
23. 6748 by 6334.
24. 4878 by 3437.
25. 8547 by 7733.
26. 85474 by 2547.
27. 46887 by 3489.
28. 56184 by 5474.
29. 56664 by 4871.
30. 25473 by 4487.
31. 73519 by 4735.
32. 81897 by 3456.

To multiply when the Multiplicand, the Multiplier, or both, contain ciphers.

Ex. 4. Multiply 2479 by 4006.

2479	4006 times 2479 equals 4000 times 2479 plus 6 times 2479; 6 times 2479 is 14874; 4000 times 2479 is 9916000. These partial products are written one under the other, as before, the 0's being omitted.
4006	
14874	
9916	
9930874	

EXERCISE 38

Multiply:

1. 415 by 307.
2. 7004 by 902.
3. 2769 by 708.
4. 1364 by 5004.
5. 9006 by 7036.
6. 8009 by 7008.
7. 1684 by 4008.
8. 2002 by 4103.
9. 3678 by 7068.
10. 9999 by 8008.
11. 3674 by 200901.
12. 3798 by 90809.

Ex. 5. Multiply 614000 by 700.

614000	This result is the same as that obtained by multiplying 614 by 7, and then annexing to the right *five* naughts, which is the sum of the number of naughts to the right of both the multiplicand, 614, and the multiplier, 7.
700	
429800000	

EXERCISE 39

Find the value:

1. Of 473×600.
2. Of 847 ×700.
3. Of 9642×6300.
4. Of 1875 ×6340.
5. Of 27×9000.
6. Of 6000×43.
7. Of 18000×623.
8. Of 6400×640.
9. Of 650×650.
10. Of 83600×7500.
11. Of 9230×7000.
12. Of 8000×61000.

EXERCISE 40

1. In 1 ream of paper there are 480 sheets. How many sheets are there in 947 reams?

2. If a cotton mill manufactures 637 yards of cloth in one day, how many yards will it make in 307 days?

3. At $125 each what will 49 horses cost?

4. A merchant bought 29 pieces of cloth; in each piece there were 57 yards. How many yards were there in the whole?

5. If 19008 pounds of hay are required for the horses of a cavalry regiment for one day, how many pounds will be needed for 206 days?

6. What would be the cost of constructing 309 miles of plank road at $3975 a mile?

7. How many apples will an orchard containing 208 trees produce, if the average yield is 1269 apples for each tree?

8. In 3 editions of 750 books each, how many pages are there, if each book contains 407 pages?

9. How many yards of sheeting are there in 57 bales, each bale containing 25 pieces and each piece 43 yards?

EXERCISE 41

1. How much will it cost to build 307 miles of railroad at $4060 a mile?

2. A contractor built 604 miles of railroad at $6500 a mile. How much did he get for it?

3. If 1 acre of land cost $9620, how much will 736 acres cost?

4. If it requires 720 barrels of provisions to supply an army for one day, how many barrels will be required for 365 days?

5. If it cost $98650 to build one mile of railroad, how much will it cost to build 2809 miles?

6. There are 15 fields of corn; in each field there are 97 rows, and 256 hills in each row. How many hills are there in the 15 fields?

7. How many yards of cloth are there in 43 bales, each bale containing 72 pieces, and each piece 29 yards?

8. If a railway train goes 18 miles an hour, how far will it go in 17 days of 24 hours each?

9. A merchant had 26 pieces of cloth of 54 yards each, which he sold for 45 cents a yard. How much did he get for the cloth?

10. A flouring mill grinds 125 barrels of 196 pounds each per day. How many pounds of flour will this mill grind in 9 weeks of 6 days each?

EXERCISE 42

Simplify:

NOTE.—When no brackets occur multiplication must be completed before addition or subtraction.

1. $(784+368)\times(967-285)$.

2. $927+764\times907-365\times708$.

3. $(549\times708)+(345-149)\times579$.

4. $549\times708+345-149\times579$.

5. Two factors of a number are 427 and 403. Find the number.

6. Find the continued product of 11, 13, 17, and 19.

7. The multiplicand is the difference between one million and nine thousand and nine; the multiplier is the sum of 365, 486, and 789. Find the product.

8. How much must be taken from the product of 786 and 639 to get the product of 786 and 539?

9. One of the three equal factors of a number is 407. Find the number.

10. Multiply the sum of the odd numbers by the sum of the even numbers in the following:—47, 54, 61, 68, 75, 82, 89, 96.

EXERCISE 42

1. *B* bought a house for $2960, and gave for it 98 cows at $24 each, and the rest in money. How much money did he pay?

2. One army contains 4575 men, and another 36 times as many, lacking 1936. How many men are there in the second army?

3. Mr. Peters has 2461 gallons of coal oil, Mr. Martin has 1146 gallons, and Mr. Benson has 147 times as much as both. How much has Mr. Benson?

4. A farmer sold 129 cows at $37 each, and received in payment $2000. How much yet remains due?

5. *B* sold 76 hens at 73 cents each, 96 turkeys at 324 cents each, and received in payment 24000 cents. How much remains due?

6. *A*'s barn cost $2485, his house cost 3 times as much, and his farm cost as much as both. What was the cost of the house? What was the cost of the farm?

7. A drover bought 36 horses at $145 a head, and 96 cows at $28 a head. Which cost the most, and how much?

8. *A*'s book contains 248 pages, with 2850 letters on a page, and *B*'s contains 325 pages, with 3465 letters on a page. How many letters are there in *A*'s book. How many in *B*'s?

SECTION VI. DIVISION

1. A man owes a debt of $15 which he agrees to pay by work at $3 a day. How much will he owe at the end of the first day? of the second day? of the third day? of the fourth day? of the fifth day?

How long will it take to cancel the debt? How many times may 3 be subtracted from 15? How many 3's in 15?

2. A man buys a stable for $60 and agrees to pay $15 a month until it is paid for. How much does he owe at the end of the first month? After the second payment? After the third? After the fourth?

How many months will it take to pay for the stable?

How many times may 15 be subtracted from 60? How many 15's in 60?

3. There are 80 oranges in a box. Find by subtraction how many pails of 20 oranges each there are in the box.

How many 20's in 80?

4. Find by subtraction how many 56's there are in 336. What is one of the 6 equal parts of 336?

5. What number may be subtracted 6 times in succession from 72, leaving no remainder?

6. Find by subtraction how many times $1342 is contained in $5368.

Tell one method of finding how many times one number is contained in another.

7. What is the product of 12 and 15? What must 12 be multiplied by to give 180? What must 15 be multiplied by to give 180? How many 12's in 180? How many 15's in 180?

DEFINITIONS

34. *Division* is the process of finding how many times one number is contained in another.

35. The *Dividend* is the number to be divided.

36. The *Divisor* is the number by which the dividend is measured or divided.

37. The *Quotient* is the measure or the number of times the divisor is contained in the dividend.

38. When the *Divisor* does not go an exact number of times into the *Dividend* the excess is called the *Remainder.*

39. The *Sign of Division*, ÷ is read "divided by." It shows that the number *before* it is to be divided by the number after it. Thus, 15÷5=3 is read 15 divided by 5 is equal to 3.

It is also expressed in the following ways:—

$5)\underline{15};\quad 3 \qquad 5)15(3\ \underline{15} \qquad \frac{15}{5}=3$

Two kinds of Division

Suppose that instead of abstract numbers the original multiplication is concerned with *Quantity.*

Ex. Find the cost of 8 yards of print at 9 cents a yard.

From this problem in multiplication two problems may be formed: (1) How much print at 9 cents a yard may be bought for 72 cents? (2) What is the cost of one yard of print if 8 yards cost 72 cents?

(1) For every time 9 cents is contained in 72 cents 1 yard may be bought.

The number of times=72 cents÷9 cents=8
Therefore 8 yards may be bought.

(2) If 8 yards of print cost 72 cents, then one yard will cost one-eighth of 72 cents or 72 cents÷8=9 cents.

1. Examine solution (1) and we see that 72 cents ÷9 cents=8. This is sometimes called Measuring because the 72 cents is measured by 9 cents, *i.e.*, divided into groups of 9 cents each.

40. *If the dividend and divisor are concrete they must be alike and the quotient is abstract.*

2. Examine solution (2) and we see that 72 cents ÷8=9 cents. This is sometimes called *Separation* or *Partition* because 72 cents is separated into 8 equal parts, one of the parts being $\frac{1}{8}$ of 72 cents.

41. *If the dividend is concrete and the divisor abstract the quotient is concrete and like the dividend.*

EXERCISE 44

1. Divide by 2: 8, 12, 16, 20, 18, 24, 22.
2. Divide by 3: 9, 15, 21, 18, 36, 24, 27.
3. Divide by 4: 12, 16, 24, 36, 44, 40, 48.
4. Divide by 5: 25, 35, 45, 55, 60, 40, 50.
5. Divide by 6: 24, 36, 42, 54, 72, 66, 60.
6. Divide by 7: 21, 14, 28, 35, 42, 77, 84, 63.
7. Divide by 8: 32, 48, 56, 72, 88, 96, 40, 80.
8. Divide by 9: 81, 72, 63, 108, 99, 54, 36, 45.
9. Divide by 8: $96, $72, $32, $40, $56, $88, $48.

(NOTE.—The pupil should be required to express each process on his exercise book and be able to state definitely what is meant by questions 8 and 9.)

Division may be divided into two cases.

1. **When the divisor does not exceed twelve.**
2. **When the divisor exceeds twelve.**

CASE I

When the divisor does not exceed twelve.

1. To indicate the division of ten by two we may write:—

$\frac{1}{2}$ of $10=5$; $10\div 2=5$; $\frac{10}{2}=5$, or $\begin{array}{r} 2\overline{)10} \\ 5 \end{array}$

2. Divide 63 by 3.

Think $\begin{array}{l} 3\overline{)6 \text{ tens}+3 \text{ units}} \\ \quad 2 \text{ tens}+1 \text{ unit}=21 \end{array}$ Write $\begin{array}{r} 3\overline{)63} \\ 21 \end{array}$

3. Divide 72 by 3.

Think $\begin{array}{l} 3\overline{)7 \text{ tens}+\ 2 \text{ units}} \\ 3\overline{)6 \text{ tens}+12 \text{ units}} \\ \quad 2 \text{ tens}+\ 4 \text{ units}=24 \end{array}$ Write $\begin{array}{r} 3\overline{)72} \\ 24 \end{array}$

4. Divide 738 by 3.

Think $\begin{array}{l} 3\overline{)7 \text{ hundreds}+3 \text{ tens}+8 \text{ units}} \\ 3\overline{)6 \text{ hundreds}+13 \text{ tens}+8 \text{ units}} \\ 3\overline{)6 \text{ hundreds}+12 \text{ tens}+18 \text{ units}} \\ \quad 2 \text{ hundreds}+4 \text{ tens}+6 \text{ units} \\ \qquad =246 \end{array}$

In ordinary practice we write the result $\begin{array}{r} 3\overline{)738} \\ 246 \end{array}$ and do the work mentally as follows:—

Three will divide 700, two hundred times, leaving one hundred or 10 tens as remainder. Writing down the 2 in the hundreds' place of the quotient we next say "three will divide 13 tens 4 tens' times, leaving 1 ten or 10 units as remainder." Writing down the 4 in the tens' place, we say "three will divide 18 units, 6 times," the 6 being placed in the units' place of the quotient.

5. Divide 7257 by 3.

$$3)\overline{7257}$$
$$\overline{2419}$$

When the divisor does not exceed 12 the multiplication and subtraction and reasoning are performed mentally. The quotient only being written down, the work thus is greatly shortened. This process is called *Short Division*. When all the steps are written down the process is called *Long Division*.

```
 9
10
400
2000
3)7257(2419
6000
1257
1200
 57
 30
 27
 27
```

After some practice the ciphers are omitted and the work arranged as follows:—

In dividing 7259 by 3 we find that the quotient is 2419 and the remainder is 2, thus:—

$$3)\overline{7259}$$
$$\overline{2419} \text{ and 2 over.}$$

```
3)7257(
 6xxx
 12
 12
  5
  3
 27
 27
```

When a remainder occurs it may be written as above, or the division of the remainder by the divisor may be expressed thus $\frac{2}{3}$; so that the quotient in this case will be $2419\frac{2}{3}$ which is read: Two thousand four hundred and nineteen and two-thirds.

Divide 70268 by 7.

Divisor 7)70268 Dividend.

10038 Quotient. 2 Remainder.

42. *PROOF.*—**Multiply the Quotient by the Divisor, and to the Product add the Remainder, if any, and if the result is the same as the Dividend the work is likely to be correct.**

EXERCISE 45

(1) 2)36(	(2) 2)58(	(3) 2)54(	(4) 2)92(	(5) 2)96(
(6) 3)576(	(7) 3)465(	(8) 3)723(	(9) 3)873(	(10) 3)975(
(11) 4)852(	(12) 4)764(	(13) 4)932)	(14) 4)576(	(15) 4)748(
(16) 5)735(	(17) 5)850(	(18) 5)975(	(19) 5)745(	(20) 5)835(
(21) 6)732(	(22) 6)846(	(23) 6)924(	(24) 6)972(	(25) 6)834(
(26) 7)784(	(27) 7)798(	(28) 7)833(	(29) 7)966(	(30) 7)959(
(31) 8)896(	(32) 8)936(	(33) 8)944(	(34) 8)976(	(35) 8)992(
(36) 9)468(	(37) 9)576(	(38) 9)864(	(39) 9)738(	(40) 9)666(

EXERCISE 46

(1) 2)456	(2) 2)736	(3) 2)548	(4) 2)374	(5) 2)538

(6) 3)735	(7) 3)816	(8) 3)522	(9) 3)414	(10) 3)738
(11) 3)669	(12) 3)513	(13) 3)546	(14) 3)765	(15) 3)825
(16) 4)512	(17) 4)624	(18) 4)732	(19) 4)576	(20) 4)824
(21) 4)736	(22) 4)816	(23) 4)972	(24) 4)608	(25) 4)436
(26) 5)615	(27) 5)735	(28) 5)645	(29) 5)785	(30) 5)840
(31) 5)815	(32) 5)935	(33) 5)780	(34) 5)765	(35) 5)880
(36) 6)834	(37) 6)648	(38) 6)654	(39) 6)774	(40) 6)864
(41) 6)1476	(42) 6)3336	(43) 6)2514	(44) 6)3654	(45) 6)7338
(46) 7)2569	(47) 7)4732	(48) 7)8456	(49) 7)9359	(50) 7)9870
(51) 8)7256	(52) 8)3656	(53) 8)7576	(54) 8)29352	(55) 8)111032
(56) 9)8892	(57) 9)3978	(58) 9)2565	(59) 9)63288	(60) 9)67356

EXERCISE 47

1. At 6 cents each, how many oranges can be bought for 354 cents?

2. At 2 dollars a day, how many days' work can I hire for 346 dollars?

3. How many pounds of rice at 4 cents a pound can I buy for 3672 cents?

4. In three feet there is 1 yard; how many yards are there in 693 feet?

5. If 8 men can dig 768 rods of ditch in 3 weeks, how many rods can 1 man dig in the same time?

6. If 7 yards of cloth cost 637 cents, what will 1 yard cost?

7. If 9 men dig 135 bushels of potatoes in 1 day, how many bushels can 1 man dig in 1 day?

8. When 7 is multiplied by a certain number the product is 861, what is the number?

9. If 6 bins of equal size are exactly filled by 36312 bushels of grain, how much does each bin hold?

EXERCISE 48

PRACTICAL PROBLEMS

1. When flour is worth 8 dollars a barrel, how many barrels could be bought for 3456 dollars?

2. If 7 casks of sugar weigh 8792 pounds, what is the average weight of each cask?

3. A father dying left an estate of 37356 dollars to be divided equally among his wife, two sons and his three daughters; what was the share of each?

4. Five men bought a horse for 160 dollars; they hire him out at 4 dollars a day for 24 days, and sell him for 120 dollars; how much will each one gain?

5. A grocer bought 15 barrels of flour for 100 dollars; he sold it so as to gain 20 dollars; how much did he receive per barrel?

6. If 66 apples are divided equally among 5 boys, how many does each boy receive?

7. If 4 sacks of coffee weigh 523 pounds, what is the weight of each?

8. If 626 dollars are divided equally among 5 men, what will be the share of each?

9. In one week there are 7 days; how many weeks are there in 365 days?

When the divisor exceeds twelve.

Example. Divide 4839 by 17.

Arrange 4839 as follows:—

4839=48 hundreds+ 3 tens+9 units
=34 hundreds+143 tens+9 units
=34 hundreds+136 tens+79 units.

Therefore 4839÷17=2 hundreds+8 tens+4 units, leaving 11 units of the 4839 for remainder. The result is expressed thus:—284 times and 11 remainder or 284 $\frac{11}{17}$ times.

```
   4
  80
 200
17)4839(284
  3400
  1439
  1360
    79
    68
    11
```

Another way of doing this is as follows, which is only another way of stating that 4839=34 hundred+136 tens+79 units:

```
17)4839(284
   34
   143
   136
    79
    68
    11
```

In actual practice the work is usually done as follows:—

In performing the work we usually state it as follows:—

Since 17 is not contained in 4 thousands any thousand times, we unite the 4 thousand to the 8 hundreds, making 48 hundreds; 17 is contained in 48 hundreds 2 hundred times. We set down 2 as the first figure in the quotient, then multiply 17 by 2, and subtract the product 34 from 48. The remainder is 14. To this remainder we annex the 3 tens of the dividend, making 143 tens; 17 is contained in 143 tens 8 tens times. We set down 8 as the next figure of the quotient, then multiply 17 by 8, and subtract the product 136 from 143. The remainder is 7; to this remainder annex the next figure of the dividend, and continue as before.

Example. Divide 74198 by 37.

```
37)74198(2005
   74
   ---
    198
    185
    ---
     13
```

Therefore $74198 \div 37 = 2005$ times and 13 remainder.

In this example we find there is no remainder on subtracting 74 from 74, and on bringing down 1, the third figure of the dividend, 37 is not contained in it; we therefore write 0 as the second figure of the quotient.

When we bring down 9, the next figure of the dividend, 37 is not contained in 19; we therefore write another 0 as the third figure of the quotient. When we bring down 8, the last figure of the dividend, 37 is contained in 198, 5 times, and we go on as before.

NOTE.—*For every figure of the dividend brought down one figure must be written in the quotient.*

EXERCISE 49

Divide:

1. 764 by 31.
2. 367 by 41.
3. 987 by 53.
4. 4567 by 61.
5. 2936 by 74.
6. 38271 by 65.
7. 29781 by 56.
8. 71847 by 76.
9. 67654 by 122.
10. 39298 by 801.
11. 80157 by 346.
12. 466281 by 936.
13. 159750 by 425.
14. 539902 by 239.
15. 999999 by 198.
16. 2802690 by 990.
17. 8769059 by 379.
18. 6008005 by 196
19. 8991207 by 1449.
20. 9672160 by 1560.
21. 6192138 by 1653.
22. 3515772 by 1736.
23. 9876480 by 1976.
24. 24197460 by 2492.
25. 82315050 by 1905.
26. 13896225 by 2975.
27. 16084440 by 5058.
28. 23103465 by 6391.
29. 18356508 by 16074.
30. 572105376 by 78617.
31. 344943192 by 13476.
32. 1806147420 by 35805.
33. Divide 36509200364 by 364.
34. Divide 768435368436 by 76842.
35. The divisor is 836; the dividend is 838508; find the quotient.

ABBREVIATED PROCESS IN LONG DIVISION

I

To divide by a composite number.

48. *A Composite Number* is one which may be produced by multiplying together two or more numbers neither of which is 1. Since $16 = 8 \times 2$, 16 is a *Composite Number*.

Example. Divide 564 by 6.

$$6)\overline{564}$$
$$\overline{94} \text{ times.}$$

What are the factors of 6?

Divide 564 by 3 and the result by 2.

$$3)\overline{564}$$
$$2)\overline{188}$$
$$\overline{94}$$

How does the result compare with that when dividing by 6?

1. If a number be divided by 3 and the result by 2, what has the number really been divided by? 5 and 3?

Example. Divide 8904 by 42.

$$7)\overline{8904}$$
$$6)\overline{1272}$$
$$\overline{212}$$

What is 8904? what is 212?

What is 1272 in its relation to 8904?

If we multiply 212 by 42, what is the product? How many times is 42 contained in 8904?

Example. Divide 8769 by 42.

$$7)\overline{8769}$$
$$6)\overline{1252} \text{ and } 5 \text{ units over} = 5$$
$$\overline{208} \text{ and } 4 \text{ sevens over} = 28$$
$$\text{Remainder} = \overline{33}$$

Since the factors of 42 are 7 and 6, we divide by these factors in succession. First, dividing by seven we obtain 1252 for quotient and 5 for remainder. This is 5 units. We then divide the quotient by six and obtain 208 for quotient and 4 for remainder. This is 4 groups of 7 units each or 28 units. The remainder is, therefore, 28 units+5 units=33 units.

44. Hence, The true remainder is found by multiplying the last remainder by the first divisor and adding to the product the first remainder.

EXERCISE 50

Divide:

1. 46827 by 27.
2. 87468 by 64.
3. 97648 by 63.
4. 13853 by 45.
5. 8642396 by 35.
6. 7308216 by 49.
7. 8742 by 25.
8. 66842 by 96.
9. 87648 by 81.
10. 419421 by 99.
11. 339240 by 132.
12. 806345 by 144.

EXERCISE 51

1. There are 24 hours in a day. How many days are there in 1032 hours?

2. If a man walks 25 miles in a day, how long will it take him to walk 950 miles?

3. Sound moves 37060 feet in 34 seconds. How far will it move in 1 second?

4. A drover bought 23 head of cattle for $736. What was the price per head?

5. In 1 year there are 52 weeks. How many years are there in 6708 weeks?

6. If 75 shares of bank stock sell for $9225, what is the price per share?

7. A man bought a farm of 524 acres for $24104. What was the average price per acre?

8. How many bales could be made out of 281765 pounds of cotton, allowing 517 pounds to the bale?

9. If a steamship sails 5836 miles in 17 days, what would be the average daily distance sailed?

10. A flour barrel holds 196 pounds of flour. How many barrels would it take to hold 406700 pounds?

II

To divide when there are ciphers at the right of the divisor.

INTRODUCTORY EXERCISE

1. Read 80, 30, 50, 1500, 6000 as tens.

2. How many tens in 87? in 925? in 1235? in 3106?

3. What do you do in order to divide any number into tens?

4. Divide the following numbers into tens:—
95, 104, 276, 475, 479, 510, 689, 970, 999, 1006, 2708, 5396, 89534.

5. Read 400, 300, 500, 2000, 6000, as hundreds.

6. How many hundreds in 385, 453, 2165, 6189?

7. What do you do to divide any number into hundreds?

8. Divide the following numbers into hundreds or by 100:—395, 3724, 5196, 37291, 4006, 39003, 41204.

9. Read as thousands:—72000, 1000000, 4289, 724689.

10. What do you do to divide any number into thousands or by 1000?

11. Divide the following numbers by 1000:—
8964, 37529, 964375, 4000375, 293006, 5163008.

Ex. Divide 8593 by 700.

The divisor, 700, may be resolved into the factors 7 and 100. We first divide by the factor 100 by cutting off two figures at the right, and get 85 for the quotient and 93 for the remainder. We then divide the quotient, 85, by the other factor, 7, and obtain 12 for the quotient and 1 for a remainder. The last remainder, 1, being multiplied by the divisor, 100, and 93, the first remainder, added, we obtain 193 for the true remainder.

7)85
12 and 93 rem.

Hence, *To divide when there are ciphers at the right of the divisor, we cut off the ciphers from the divisor and the same number of figures from the right of the dividend; we then divide the remaining figures of the dividend by the remaining figures of the divisor and prefix the remainder to the figures cut off, and the result will be the true remainder.*

EXERCISE 52

Divide:

1. 725 by 30.
2. 7642 by 60.
3. 8642 by 700.
4. 97861 by 300.
5. 72369 by 90.
6. 94678 by 80.
7. 3786 by 1700.
8. 21500 by 3600.
9. 378751 by 12300.
10. 984721 by 6400.
11. 1684273 by 2500.
12. 9486279 by 15000.

EXERCISE 53

1. In a yard there are 36 inches. How many yards are there in 3888 inches?

2. There are 60 minutes in an hour. How many hours are there in 3900 minutes?

3. There are 16 ounces in a pound. How many pounds are there in 1968 ounces?

4. How many pounds of beef at 18 cents a pound can be bought for 540 cents?

5. There are 64 pints in a bushel. How many bushels are there in 2688 pints?

6. A farmer sold 24 horses for $5640. How much did he receive apiece for them?

7. How many bushels of oats, at 56 cents a bushel, can be bought for 13272 cents?

8. If 48 acres of land produce 2064 bushels of corn, how much will be produced from 1 acre?

Example. Divide 975 by 32.

$$\begin{array}{r} 32)975(30 \\ \underline{96} \\ 15 \end{array}$$

The divisor = 32, the Dividend = 975, the Quotient = 30 and the Remainder = 15.

1. Multiply the Divisor by the Quotient and subtract the result from the Dividend. What is the result? Compare it with the *Remainder*.

2. Multiply the Divisor by the Quotient and add the Remainder to the Product. What is the result?

3. Subtract the Remainder from the Dividend and divide the result by the Divisor. What is the result?

4. Subtract the Remainder from the Dividend and divide the result by the Quotient. What is the result?

If any *three* of the four numbers, that form the Divisor, Dividend, Quotient and Remainder be given, we can find the *fourth*.

45. Let Divisor, Dividend, and Quotient be given. Multiply the Divisor by the Quotient, subtract the result from the Dividend, and we have the Remainder.

46. Let Divisor, Quotient, and Remainder be given. Multiply the Divisor by the Quotient, add the Remainder to the result, and we have the Dividend.

47. Let Divisor, Dividend, and Remainder be given. Subtract the Remainder from the Dividend, divide the result by the Divisor, and we have the Quotient.

48. Let Quotient, Dividend, and Remainder be given. Subtract the Remainder from the Dividend, divide the result by the Quotient, and we have the Divisor.

EXERCISE 54

1. The divisor is 8, the dividend 44, and the quotient 5. Find the remainder.

2. Given the divisor, the dividend, and the quotient, how do you find the remainder?

3. The divisor is 12, the quotient 7, and the remainder 5. Find the dividend.

4. Given the divisor, the quotient, and the remainder, how do you find the dividend?

5. The divisor is 9, the dividend 61, and the remainder 7. Find the quotient.

6. Given the divisor, the dividend, and the remainder, how do you find the quotient?

7. The quotient is 9, the dividend 115, and the remainder 7. Find the divisor.

8. Given the quotient, the dividend, and the remainder, how do you find the divisor?

9. The divisor is 85, the quotient 109; there is no remainder. Find the dividend.

10. The divisor is 97, the quotient 203, the remainder the largest possible. Find the dividend.

EXERCISE 55

1. What number besides 1001 is contained an exact number of times in 271271?

2. Find the smallest number which subtracted from 78964 will make it exactly divisible by 881.

3. The divisor is 1001, the quotient 221, and the remainder the largest possible. Find the dividend.

4. The divisor and quotient are each 795, and the remainder the largest possible. Find the dividend.

5. When 313 is added to the dividend, it is exactly divisible by 383, the quotient being 587. Find the dividend.

6. In a division question the quotient is 5 times and the divisor is 9 times the remainder. Find the dividend, the remainder being 29.

7. The quotient is 709, the divisor 584, and the remainder one-half of the divisor. Find the dividend.

8. A number when divided by 7 has 5 for remainder, and when the quotient is divided by 5, the new quotient is 472 and the remainder is 3. Find the number.

9. By what number must 76 be multiplied to give the same product as 1444 and 504?

SECTION VII. REVIEW EXERCISES

EXERCISE 56

1. A carpenter can earn $45 a month; his expenses are at the rate of $24 a month. He wishes to purchase a lot of ground which contains 19 acres, and is held at $42 per acre. In what time may he save enough to make the purchase?

2. A farmer bought land from *A* at \$60 an acre, and the same quantity from *B* at \$85 an acre. The whole amounted to \$53215. How many acres did he buy from each?

3. A merchant sold a piece of cloth containing 45 yards, another piece containing 57 yards, and another containing 63 yards, at \$14 a yard. What did the whole amount to?

4. A man left \$2535 to each of his four children, but one of them dying the three remaining children divided the money equally among them. How much did each receive?

5. A man earns \$25 a week, and spends \$12 a week; he saves \$195. How many weeks does he work?

6. A farmer has 24 cows and 93 sheep, worth \$1521; if the sheep are worth \$5 each, how much is each cow worth?

7. If 28 men earn 7946 cents in a day, and 25 boys earn 5450 cents in a day, how much more does one man earn in a day than one boy?

8. How many barrels of flour at \$6 a barrel are equal in value to 1100 tons of coal at \$9 a ton?

9. If a mechanic earns \$52 a month, and his expenses are \$34 a month, how long will it take him to pay for a farm of 36 acres, worth \$12 an acre?

EXERCISE 57

1. If 3 pounds of coffee cost 30 cents, what will 8 pounds cost?

The cost of 3 pounds of coffee = 30 cents;

" 1 pound " $= \frac{30}{3}$ cents = 10 cents;

" 8 pounds " $= 8 \times 10$ cents = 80 cents

2. What will 15 slates cost, if 5 slates cost 80 cents?

3. If 4 trees cost 72 cents, what will 3 trees cost?

4. If 6 barrels of flour cost $48, what will 7 barrels cost?

5. What will be the cost of 16 cords of wood, if 4 cords cost $24?

6. If 15 yards of cloth cost $75, what will 20 yards cost?

7. If 7 pounds of beef cost 56 cents, what will 5 pounds cost?

8. If 12 men can earn $36 in a day, how much can 4 men earn in the same time?

9. If 28 acres of land cost $4480, how much will 43 acres cost at the same rate?

EXERCISE 58

1. If 7 men do a piece of work in 36 days, in how many days can 28 men do it?

Time for 7 men to do the work = 36 days;
" 1 man " " = 7×36 days;
" 28 men " " = $\frac{7 \times 36}{28}$ = 9 days.

2. If 15 workmen can do a piece of work in 25 days, in what time can 25 men do the same?

3. A field can be mowed by 40 men in 9 days. In how many days would it be finished by 30 men?

4. If 16 men can build a house in 20 days, how long would it take 10 men to build it?

5. If 19 men can finish a work in 437 days, how long will it take 23 men to do the same work?

6. If 18 horses can cart away earth from a cellar in 75 days, in how many days would 27 horses do this work?

7. Ten men engage to build a house in 63 days, but 3 of them being taken sick, how long will it take the rest to build the house?

8. If 6 carpenters can build a house in 72 days, how long would it take 9 carpenters to build the same?

EXERCISE 59

1. If 4 men can dig a garden in 7 days, how many men would be required to dig it in 1 day?

2. If 28 men can mow a field of grass in 15 days, how many men will be required to mow it in 4 days?

3. If 7 men can reap a field of wheat in 18 days, how many men would be required to do the same work in 6 days?

4. A piece of work was to have been performed by 144 men in 36 days, but a number of them having been discharged, the work was performed in 48 days. How many men worked?

5. If 20 men can perform a piece of work in 15 days, how many men will it take to do it in 12 days?

6. How many men in 26 days can perform the same amount of work that 39 men can do in 76 days?

7. A drain is dug by 49 men in 96 days. How many men would have been required to dig it in 84 days?

8. If 8 workmen can build a wall in 27 days, how many workmen would be required to build it in 3 days?

9. If 100 workmen can perform a piece of work in 12 days, how many men are sufficient to perform the work in 8 days?

CHAPTER III

DENOMINATE NUMBERS

SECTION I. DEFINITIONS, TABLES AND REDUCTION

INTRODUCTORY EXERCISE

1. What is the unit in 3 acres? in 5 feet? in 7 apples? in 4 dozen eggs? in 5? in 4 hundred? in 6 pair? in 8 pair of boots?

2. How often is the unit repeated in 3 acres? in 5 feet? in 7 apples? in 4 dozen eggs? in 5? in 4 hundred? in 6 pair? in 8 pair of boots?

3. What is the difference between the units in 3 apples and 3 feet? between those in 8 boys and 8 hours? between those in 5 ships and 5 quarts?

49. Concrete units are of two kinds, those which specify the object *without giving a definite idea* of its magnitude; *e.g.* 7 apples, 8 pairs of boots and those which express a definite measure of some kind, as of value, time, distance, weight, area, capacity, etc.; *e.g.* 4 lbs., 8 tons, 4 pints, etc.

4. From the following concrete numbers select those which express a definite measure of some kind, as of value, distance, etc.:—3 apples, 5 pounds, 5 books, 4 hours, 2 inches, 7 pair of gloves, 10 acres, 3 quarts, 8 horses.

50. Those concrete numbers which express a definite measure of some kind, as of value, time, distance, weight, area, capacity, etc., are *Denominate Numbers*.

5. What is the difference between the mode of expressing the following denominate numbers:—3 feet, and 3 feet 4 inches; 5 hours, and 5 hours 30 minutes 10 seconds; 6 pounds, and 6 pounds 5 ounces?

51. When a denominate number is expressed in only one denomination, it is a *Simple Denominate Number* or a *Simple Quantity.*

52. When a denominate number is expressed in two or more denominations, it is a *Compound Denominate Number* or a *Compound Quantity.*

Canadian Money

53. Canadian Money is the legal currency of the Dominion of Canada. It is composed of *dollars*, *cents*, and *mills*. The **dollar** is the unit, and is denoted by the symbol **$**.

10 Mills = 1 cent.
100 cents = $1.

Dollars are separated from cents, in writing, by a *point*. Thus $6.75 is read six dollars and seventy-five cents. Any number of cents less than ten, when written with dollars, occupies the second place to the right of the *point*, and the first place is occupied by a cypher; thus $4.05 is read four dollars and 5 cents. The *mill* is one-tenth of a cent, and is written one place to the right of the cents; thus $3.775 is read 3 dollars, 77 cents, and 5 mills.

The present silver coins of the Dominion are the fifty-cent piece, the twenty-five cent piece, the ten-cent piece, and the five-cent piece. The only copper coin is the one-cent piece.

NOTE.—The *mill* is not coined; it is used only in computation. When the final result of a business computation contains mills, if 5 or more, they are reckoned 1 cent, and if less than 5 they are rejected.

INTRODUCTORY EXERCISE

1. How many cents are there in $2? in $3? in $5?

2. How many cents are there in $3.16? in $4.25?

3. How many cents are equal to a five-dollar bill?

4. How many cents are equal to a dollar-bill and 25 cents?

5. How many cents are there in a half-dollar and a quarter-dollar?

6. How many cents are there in one dollar and a half?

7. How many dollars are there in 400 cents? In 700 cents?

8. How many dollars and cents are there in 375 cents?

9. How many two-dollar bills are equal to 800 cents?

10. How many ten-cent pieces are there in $4?

11. How many cents are equal to 2 five-dollar bills?

12. How many five-cent pieces are there in $2?

13. What is the difference in value between $2 and 200 cents? Between 425 cents and $4.25?

54. The process of changing the denomination or name of a number without changing its value is *Reduction*.

14. Which is the unit of greater value, $1 or 1 cent? 1 quarter-dollar or 1 five-cent piece?

55. Hence, there are **two kinds of Reduction:—**

(*a*) Reduction when the unit is changed to one of a *lower value*. This is *Reduction Descending*.

(*b*) Reduction when the unit is changed to one of a *higher value*. This is *Reduction Ascending*.

EXERCISE 60

Reduce to cents:

1.	$5;	$7.36;	$17.04.
2.	$29.18;	$414.36;	$200.09.
3.	$361.07;	$500.75;	$1000.10.
4.	11875.63;	$3647.29;	$76841.06.
5.	$20063.07;	$141368.79;	$10010010.01.
6.	$40706.34;	$123867.04;	$10009001.90.

Reduce to dollars and cents:

7.	368 cents;	700 cents;	1236 cents.
8.	3641 cents;	7008 cents;	910988 cents.
9.	54168 cents;	500709 cents;	684007 cents.
10.	300041 cents;	280014 cents;	340001 cents.

56. English or Sterling Money

4 farthings (far.) . . . . = 1 penny, or 1d.
12 pence . . . . . = 1 shilling, or 1s.
20 shillings . . . . . = 1 pound, or £1.

NOTE 1.—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. 1 guinea = 21 shillings.

INTRODUCTORY EXERCISE

1. Repeat the table of English money.
2. How many far. in 2d.? in 3 d.? in 6 d.? in 8d.?
3. How many pence in 12 far.? in 16 far.? in 20 far.?
4. How many pence in 2s.? in 3s.? in 5s.? in 6s.?
5. How many far. in 1s.? in 2s.? in 3s.? in 5s.?
6. How many shillings in £1. 12s.? in £2 15s.?
7. How many shillings are there in 24d.? in 36d.?

8. How many shillings and pence are there in 28d.? in 42d.? in 54d.? in 66d.?

9. How many pounds are there in 40s.? in 80s.?

10. How many pounds and shillings are there in 50s.? in 68s.? in 84s.? in 96s.?

Ex. 1. Reduce £6 5s. 3¼d. to farthings.

£1 = 20s.

£6 5s. 3¼d.

20

125s.

12

1503d.

4

6013 far.

£6 = 6×20s. = 120s.

£6 5s. = 120s. + 5s. = 125s.

1s. = 12d.

125s. = 125×12d. = 1500d.

125s. 3d. = 1500d. + 3d. = 1503d.

1d. = 4 far.

1503d. = 1503×4 far. = 6012 far.

1503¼d. = 6012 far. + 1 far. = 6013 far.

Ex. 2. How many £. s. d. in 3679 farthings?

4 | 3679 far.

12 | 919 3 far.

20 | 76 7d.

£3 16s.

3679 far. = (3679÷4)d. = 919d. 3 far.

919d. = (919÷12)s. = 76s. 7d.

76s. = £(76÷20) £3 16s.

Hence, 3679 far. = £3 16s. 7d. 3 far.

Ans. £3 16s. 7¾d.

EXERCISE 61

Reduce:

1. 7s. 8d. to pence.
2. £1 3s. to farthings.
3. 7145d. to £., etc.
4. 6185s. to £., etc.
5. £10 0s. 6d. to pence.
6. £2 6s. 8d. to pence.
7. 3910 far. to £., etc.
8. 7163 d. to £., etc.
9. £191 9s. 11¾d. to far.
10. £3 6s. 10¼d. to far.
11. Express £5 18s. 6d. in dollars and cents.
12. Express £3 15s. 9d. in dollars and cents.

57. Avoirdupois Weight

16 drams (dr.) . = 1 ounce . . . . . or 1 oz.
16 ounces . . = 1 pound . . . . . or 1 lb.
100 pounds . . = 1 hundred-weight, 1 cental, or 1 cwt.
20 hundred-weight = 1 ton . . . . . or 1 t.

NOTE 1.—Avoirdupois Weight is used for weighing everything except jewels, precious metals, and medicines when dispensed.

NOTE 2.—The Dominion standard unit of weight is the pound.

NOTE 3.—"One-sixteenth part of the Dominion standard pound shall be an ounce, and one-sixteenth part of such ounce shall be a dram, and one seven-thousandth part of the Dominion standard pound shall be a grain."

NOTE 4.—In Great Britain 112 lb. make a hundred-weight, and 2240 lb. make a ton, called the long ton.

NOTE 5.—7000 grains (gr.) = 1 lb. avoirdupois.
437½ grains = 1 oz. avoirdupois.
14 lb. = 1 stone (st.)

INTRODUCTORY EXERCISE

1. Repeat the table of Avoirdupois Weight.
2. How many drams in 2 oz.? in 3 oz.?
3. How many ounces in 2 lb.? in 3 lb. 4 oz.? in 4 lb.?
4. How many pounds in 6t.? in 8t.? in 3 t. 500 lb.?
5. What part of a pound is 4 oz.? is 8 oz.? is 12 oz.?
6. How many tons in 58 cwt.? in 112 cwt.? in 200 cwt.?
7. How many pounds in 32 oz.? in 40 oz.? in 70 oz.?
8. How many hundred-weight in 300 lb? in 575 lb.?
9. How many pounds in 1t. 1cwt. 8 lb.? in 2t. 3 cwt.?
10. How many tons in 5000 lb.? in 8000 lb.?

Ex. 3. Reduce 3 t. 6 cwt. 51 lb. 7 oz. to ounces:

3 t. 6 cwt. 51 lb. 7 oz.
20
66 cwt.
100
6651 lb.
16
106423 oz.

Ex. 4. Reduce 147658 lb. to tons, etc.

100 | 147658 lb.
20 | 1476 cwt. 58 lb.
73 t. 16 cwt. 58 lb.

EXERCISE 62

Reduce:

1. 2 t. 81 lb. to ounces.
2. 5 lb. 6 oz. to ounces.
3. 21645 oz. to cwt., etc.
4. 7846 dr. to cwt.
5. 1 t. 18 lb. to drams.
6. 5 t. 5 cwt. 5 oz. to oz.
7. 76385 oz. to tons, etc.
8. 3 cwt. 8 lb. 5 oz. to ounces.
9. 51649 lb. to tons, etc.
10. 365 lb. to stones.
11. 12 st. 8 oz. to drams.
12. 100000 dr. to t., cwt., etc.

58. Long Measure

12 inches (in.)	= 1 foot,	or 1 ft.
3 feet	= 1 yard,	or 1 yd.
5½ yards	= 1 rod,	or 1 rd.
40 rods	= 1 furlong,	or 1 fur.
8 furlongs	= 1 mile,	or 1 mi.

1 mi = 320 rd. = 1760 yd. = 5280 ft. = 80 chains.

NOTE 1.—The Dominion standard unit of length is the yard.

NOTE 2.—The mile used in the foregoing table is called a *Statute Mile*. The geographical or nautical mile, also called a *knot*, is equal to 1.15 statute miles. The knot is used in estimating the speed of vessels.

NOTE 3.—Gunter's chain is used in measuring land. It is 22 yards in length, and is divided into 100 links, each link being 7.92 inches long.

NOTE 4.— 6 feet . . . . = 1 fathom.
120 fathoms . . . = 1 cable length.
880 fathoms . . = 1 mile.

NOTE 5.—The Hand (the breadth of the hand and thumb) used in measuring the height of horses at the shoulder is 4 inches.

INTRODUCTORY EXERCISE

1. Repeat the table of Lineal Measure.
2. How many feet in 4 yds.? in 6 yds. 1 ft.?
3. How many inches is this page in width? in length?
4. How many yards around this room? How many feet?
5. How many feet are there in 7 yd. 2 ft.?
6. How many yards are there in 84 in.?
7. A horse is 16 hands high. How many feet high is it?
8. How many feet are there in 16 yd. 1 ft.?
9. A road is a chain wide. How many feet wide is it?
10. It is 6 chains round a square lot. How many yards are there in one side?
11. A harbor is 6 fathoms 4 ft. deep. How many feet deep is it?
12. How many fathoms are there in 48 yards?
13. Measure a cent to find the length of its diameter. How many cents can be placed in a straight line between two points 10 inches apart?

EXERCISE 63

Reduce:

1. 2 mi. 45 rd. to rods.
2. 84 yd. 1 ft. to inches.
3. 12 fathoms 1 ft. to feet.
4. 17 hands 2 in. to feet.
5. 7845 in. to yards, etc.
6. 4562 rd. to miles.
7. 17 chains to inches.
8. 7689 in. to chains.
9. 145 yd. 1 ft. 6 in. to inches.

INTRODUCTORY EXERCISE

1. Observe the outside of a box; of a sheet of paper; of an apple.

59. The outside of anything is called its *surface*.

2. How many surfaces are there on an apple? on a sheet of paper?

3. Find the length and width of the surface of a page of this book; of the top of your desk.

60. The length and width of a surface are called its *dimensions*.

4. Find the dimensions of this page; of the top of the desk; of a pane in the window.

5. Examine the angle formed by the two lines in this cross.

Compare these angles with one another.

Compare one of them with the angle at the corner of a page of this book.

61. Such angles are *right angles*.

6. Examine this figure. How many sides has it? What kind of angle is each of the four angles?

62. A figure bounded by four straight lines, with each of its angles a right-angle, is a *rectangle.*

7. Draw the following rectangles:—4 in. by 3 in.; 2 in. by 5 in.; 3 in. by 6 in.

63. A rectangle which is longer than wide is an *oblong.*

8. Draw a rectangle 1 in. long by 1 in. wide.

Compare the lengths of the four sides with one another.

64. A rectangle with all its sides equal is a *square.*

65. A rectangle 1 in. long and 1 in. wide is a *square inch*, and any surface equal in area to this, no matter what its shape may be, is a square inch.

66. A rectangle 1 ft. long and 1 ft. wide is a *square foot*, and any surface equal in area to this is a square foot.

9. Draw a square foot and subdivide it into square inches.

How many square inches make a square foot?

10. Draw a square yard upon the blackboard and subdivide it into square feet.

How many square feet make a square yard?

11. Letting an inch represent a yard, draw a square to represent a square rod.

Subdivide the figure into square inches.

As each inch represents a yard in length, what surface will be represented by a square inch?

How many entire squares are there in the figure?

How many oblongs are there?

How many of these oblongs are equal to one full square?

To how many full squares are all the oblongs equal?

What part of an oblong is the small square?

What part of a full square is it?

How many square inches are there in the figure?

As each square inch represents a square yard, how many square yards make a square rod?

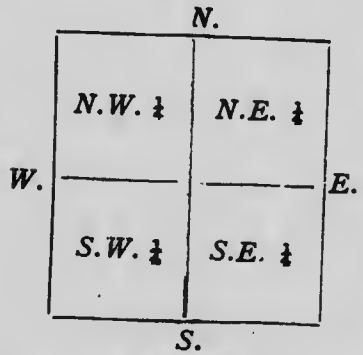
67. Surface or Square Measure

144 square inches (sq. in.)	= 1 square foot,	or 1 sq. ft.
9 square feet . .	= 1 square yard,	" 1 sq. yd.
$30\frac{1}{4}$ square yards .	= 1 square rod,	" 1 sq. rd.
160 square rods . .	= 1 acre, . .	" 1 a.
640 acres	= 1 square mile	" 1 sq. mi.

NOTE 1.—10,000 square links = 1 square chain.

10 square chains = 4840 sq. yd. = 1 acre.

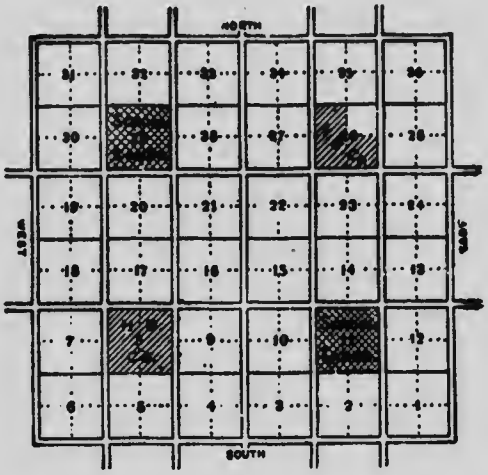
NOTE 2.—Measurement of Land in the Prairie Provinces:



A SECTION.

A section is a tract of land 320 rods or 1 mile square, and therefore contains 640 acres. It is divided into half sections which are designated North, East, South or West halves, or the N.E., S.E., S.W., and N.W. quarters.

A Township is a tract of land six miles square, and therefore contains 36 sections which are numbered in the following manner :



ROADS.—The above diagram shows the sub-division of a township under the third system of survey. The double lines indicate the position of the road allowances, which are one chain or 66 feet in width. Under the first and second systems in use in the older portions of Manitoba and Saskatchewan a road allowance one and one-half chains or 99 feet in width was laid off around each section.

INTRODUCTORY EXERCISE

1. How many square inches in 2 square feet ? in 5 square feet ?

2. How many square feet in 12 square yards ? in 9 square yards ?

3. How many square yards in 93 square feet ? in 117 square feet ?

4. How many square rods in half an acre?

5. How many square rods are there in 5 sq. chains?

6. How many acres are in a section and a half of land?

7. What is the difference between 3 sq. in. and 3 in. square? 3 in. square is a square each side of which is 3 in. long, and hence = 9 sq. in.

EXERCISE 64

Reduce:

1. 8 sq. yd. to square inches.
2. 9 sq. yd. 10 sq. ft. to square inches.
3. 17856 sq. in. to square feet.
4. 36847 sq. in. to square yards.
5. 5 a. 40 rd. to square rods.
6. 7845 sq. rd. to acres.
7. 70 sq. ch. to square rods.
8. 4800 sq. rd. to sq. chains.
9. 20 sq. ch. to square feet.
10. 17 sq. yd. 97 sq. in. to square inches.
11. 7645 sq. rd. to acres.
12. 2 quarter-sections to square rods.

EXERCISE 65

1. What shape is a quarter-section? how many acres does it contain?

2. A man owns the N.W. $\frac{1}{4}$ and the S. half of section 4 in a certain township. How many acres has he? how much will it cost to fence it at 30 cents a rod?

3. How much more will it cost at 50 cents a rod to fence the S.W. $\frac{1}{4}$ and the N.E. $\frac{1}{4}$ than the E. half of a section?

4. What is the W. $\frac{1}{2}$ and the S.E. $\frac{1}{4}$ of section 6 worth at $11.50 an acre?

5. A man owning section 9 of a certain township wishes to enclose it with a fence and to divide it into four fields. How much more fence will be required to divide it into four long fields than to divide it into four quarter-sections?

6. Calculate the value of the land in a township at $14.50 an acre.

7. Taking the area of Saskatchewan to be 250650 square miles, what amount of money would be raised each year if a cent an acre be charged for school purposes?

8. Find the length of fence required to fence a quarter-section, also three quarter-sections lying in a row.

9. How far is it by road in any township from (1) the south-west corner of section 1 to the north-west corner of section 13? (2) the south-east corner of section 2 to the north-west corner of section 21? (3) the north-west corner of section 18 to the centre of the road allowance between sections 24 and 23? (4) the centre of the road allowance between sections 16 and 17 to the north-east corner of section 25?

INTRODUCTORY EXERCISE

1. Examine a covered box or a brick.

Find the length, width and depth of the brick.

68. The length, width and depth of box or brick are its *dimensions*.

2. Find the dimensions of a chalk box; of this book; of the top of your desk.

69. A body having three dimensions is a *solid*.

70. The space it occupies is called its *volume*.

3. Examine the faces of the brick or chalk box. What is their shape?

How many faces are there on each of these solids?

71. A solid bounded by six rectangular faces is a *rectangular solid*.

4. Cut a rectangular solid 1 inch long and 1 inch wide, from a board an inch thick.

72. Such a rectangular solid is a *cubic inch*; any space equal in volume to this, no matter what its shape may be, is called a cubic inch.

5. How many cubic inches are there in rectangular solids of the following dimensions:—

(a) 1 inch long, 1 inch wide, and 1 inch thick?
(b) 3 " 1 " " 1 "
(c) 5 " 1 " " 1 "
(d) 5 " 2 " " 1 "
(e) 5 " $\frac{1}{2}$ " " 1 "
(f) 5 " 4 " " 2 "
(g) 8 " 6 " " 4 "

6. How many cubic inches are there:

(a) in a brick, 8 in. long, 4 in. wide, 2 in. thick?

(b) in a piece of scantling, 20 in. long, 6 in. wide, and 2 in. thick?

7. Find the number of cubic inches in a rectangular solid, 12 in. long, 12 in. wide, and 12 in. thick. Express these dimensions in feet.

73. A rectangular solid 1 ft. long, 1 ft. wide, and 1 ft. thick contains a *cubic foot*, and any volume equal to this space is a cubic foot.

8. Find number of cubic feet in a rectangular block of stone, 3 ft. long, 2 ft. wide and 1 ft. thick.

9. Find the number of cubic feet in a rectangular block of stone, 5 feet long, 3 ft. wide, and 2 ft. thick.

10. Define the terms cubic inch, cubic foot, cubic yard.

11. Draw a cubic yard upon the blackboard.

Subdivide it into cubic feet.

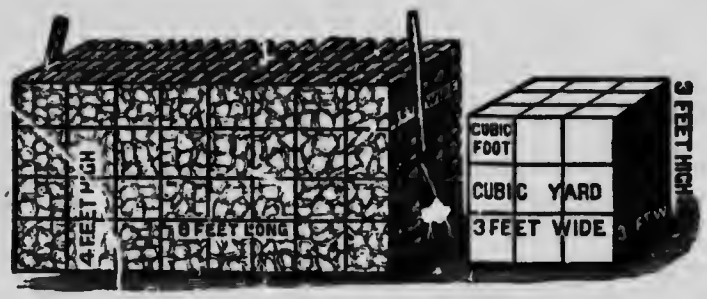
How many cubic feet can be placed on one of the faces of the cubic yard?

How many tiers of such cubic feet are there in the cubic yard?

How many cubic feet make a cubic yard?

74. Cubic or Solid Measure

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



NOTE 1.—A cord is a pile of wood or stone, equal to the volume of a rectangular solid 4 ft. wide, 4 ft. high, and 8 ft. long.

NOTE 2.—Firewood and rough stone are measured by the cord.

NOTE 3.—16 cubic feet = 1 cord ft.

INTRODUCTORY EXERCISE

1. Repeat the table of Cubic Measure.
2. How many cubic feet in 3 cu. yd.? in 5 cu. yd.?
3. How many cubic feet in 3 cord ft. 12 cu. ft.?
4. How many cubic yards in 54 cu. ft.? in 108 cu. ft.?

EXERCISE 66

Reduce:

1. 7689 cu. ft. to cords.
2. 8469 cu. in. to cu. feet.
3. 78 cu. ft. 640 cu. in. to cubic inches.
4. 9764 cu. ft. to cord ft.
5. 17 cu. yd. 12 cu. ft. to cu. in.
6. 27 cords, 6 cord ft. to cu. ft.
7. 637684 cu.in.to cu.yds.
8. 5768 cu. ft. to cords.
9. 6414596 cu.in.to cu.ft.
10. 6 cd. ft. 12 cu. ft. to cu. in.

75. Measure of Capacity

2 pints (pt.) . . .	=1 quart, or 1 qt.
4 quarts	=1 gallon, or 1 gal.
2 gallons	=1 peck, or 1 pk.
4 pecks	=1 bushel, or 1 bu.

NOTE 1.—The gallon, containing 10 pounds of distilled water, is the standard measure of capacity. Its capacity is 277.274 cubic inches. A cubic foot of water weighs 1000 oz. and contains $6\frac{1}{4}$ gal.

NOTE 2.—"The quart shall be one-fourth part of the gallon, and the pint shall be one-eighth part of the gallon."

"Two gallons shall be a peck, and eight gallons shall be a bushel."

NOTE 3.—The measure of capacity is used in measuring water, milk, oil, alcohol, molasses and other liquids, and grain, fruit, salt, lime, and roots.

NOTE 4.—In measuring *liquids* the peck and bushel are not used. These are used in measuring *dry articles*, as grain.

NOTE 5.—8 bushels make 1 quarter in Great Britain.

NOTE 6.—The following table shows the weight of a bushel of the article named:—

Lime - - - 80 lb.	Parsnips - 60	Buckwheat - 48 lb.
Bituminous coal 70 lb.	Beets - 60 lb.	Timothy seed 48 lb.
Beans - - 60 lb.	Wheat - 60 lb.	Hemp seed - 44 lb.
Clover seed - 60 lb.	Indian Corn 56 lb.	Castor Beans 40 lb.
Peas - - - 60 lb.	Rye - - 56 lb.	Malt - - 36 lb.
Potatoes - - 60 lb.	Flax seed 56 lb.	Oats - - - 34 lb.
Turnips - - 60 lb.	Onions - 50 lb.	Blue grass seed 14 lb.
Carrots - - 60 lb.	Barley - 48 lb.	

NOTE 7.—In measuring the capacity of cisterns and reservoirs, the barrel containing 31½ gallons, or the hogshead containing 63 gallons, is used.

NOTE 8.—The *wine gallon* contains 231 cubic inches.

NOTE 9.—6 wine gal. = 5 standard gal.

NOTE 10.—A gallon of pure water 62°F. weighs 10 lb.

INTRODUCTORY EXERCISE

1. Repeat the Measure of Capacity.
2. How many pints in 4 qt. 1 pt.?
3. How many bushels in 20 pk.? in 29 pk.?
4. How many gallons in 24 pt.? in 30 pt.? in 36 pt.?
5. How many pk. in 8 bu. 2 pk.? in 12 bu.? in 15 bu.?
6. In 2 gal. of milk, how many pints are there?
7. In 3 bu. of potatoes, how many gallons are there?

8. Which is heavier, 4 bu. of potatoes or 4 bu. of wheat?

9. Which is heavier, 5 bu. of peas or 8 bu. of castor beans?

EXERCISE 67

Reduce:

1. 7684 pt. to bushels, etc.
2. 84 gal. 3 qt. to pints.
3. 36 bu.3 qt.1 pt. to pints
4. 2695 pt. to gallons.
5. 17 qr. 3 bu. to pecks
6. 3685 lb. of wheat to bu.
7. 968 lb. of pure water to gal.
8. 96 wine gal. to standard gal.
9. 7860 lb. of onions to bu.
10. 2448 lb. of oats to bu.

76. Measure of Time

60 seconds (sec.) . . .	=1 minute, or 1 min.
60 minutes	=1 hour, or 1 hr.
24 hours	=1 day, or 1 da.
7 days	=1 week, or 1 wk.
12 calendar months or 365 days	=1 year, or 1 yr.
366 days	=1 leap year.

NOTE 1.—The number of days in each month may be remembered by means of the following lines:—

Thirty days have September,
April, June, and November;
February has twenty-eight alone—
All the rest have thirty-one;
But leap year coming once in four
February then has one day more.

NOTE 2.—The leap years are those that can be divided by 4 without a remainder: as, 1904, 1908, 1912, etc. But of the even hundreds, only those that can be divided by 400 are leap years. The year 1900 was not a leap year, but 2000 will be.

The civil day begins and ends at 12 o'clock midnight.

A.M. denotes time before noon; M. denotes noon; and P.M. denotes time after noon.

INTRODUCTORY EXERCISE

1. Repeat the table of Time Measure.
2. How many days in 3 weeks? in 5 weeks 3 days?
3. How many hours in 3 days? in 4 days 4 hrs.?
4. How many weeks in 84 days? in 45 days?
5. How many days in 48 hr.? in 75 hr.?
6. How many days in July, August, and Sept.?
7. How many days from 25th Jan. to 17th Feb.?
8. Name the first five leap years of this century.
9. How many seconds in 5 min.? in 7 min. 30 sec.?
10. How many minutes in 430 sec.? in 560 sec.?

EXERCISE 68

Reduce:

1. 17 hr. 15 min. to sec.
2. 2 da. 16 hr. to sec.
3. 36841 sec. to days.
4. 3678 min. to days.
5. 3 weeks to seconds.
6. 1 leap year to hours.
7. 425 hr. to weeks.
8. 55555 min. to days.
9. 1 wk. 1 hr. to seconds.
10. 168456 sec. to weeks.

77. Circular or Angular Measure

60 seconds (″) . . . = 1 minute, . or 1′.
60 minutes . . . = 1 degree, . . or 1°.
90 degrees . . . . = 1 quadrant, or right angle.
360 degrees . . . . = 1 circumference, or 1 C.

NOTE 1.—*Circular or Angular Measure* is used to measure arcs of circles, angles, and in determining latitude, longitude, direction, the position of vessels at sea, etc.

NOTE 2.—A degree of the circumference of the earth at the equator contains 60 geographical miles, or 69.16 statute miles.

INTRODUCTORY EXERCISE

1. Repeat the table of Circular Measure.
2. How many seconds in 5′? in 7′ 18″?
3. How many minutes in 7°? in 9° 42′?
4. How many minutes in 300″? in 450″?
5. How many degrees in 420′? in 500′?
6. How many degrees in 3 quadrants?
7. How many quadrants in 360°? in 180°?
8. How many minutes in 12° 15′? in 8° 56′?

EXERCISE 69

Reduce:

1. 29′ to seconds.
2. 568′ 19″ to seconds.
3. 768′ to degrees.
4. 76895″ to degrees.
5. 5° 17′ 18″ to seconds.
6. 2 C. 34° to seconds.
7. 1 C. 1° 1′ to seconds.
8. 456° 48″ to seconds.

78. Miscellaneous Table

12 units	= 1 dozen, or 1 doz.
12 dozen	= 1 gross, or 1 gro.
12 gross	= 1 great gross.
20 units	= 1 score, or 1 sco.
24 sheets	= 1 quire, or 1 qr.
20 quires	= 1 ream, or 1 rm.
196 lb. flour	= 1 barrel, or 1 bbl.
200 lb. pork	= 1 barrel, or 1 bbl.

INTRODUCTORY EXERCISE

1. How many units in 4 dozen? in 7 dozen?
2. How many units in 2 score? in 5 score?
3. How many units in 1 gross? in 3 gross?
4. How many sheets of paper in 2 quires? in 3 quires?

5. How many sheets in 1 ream? in 5 reams?
6. How many dozen in 96? in 120? in 144?
7. How many quires in 48 sheets? in 120 sheets?
8. How many score in 100 units? in 180 units?
9. How many dozen in 3 score? in 5 score?
10. How many sheets in 1 ream, 5 quires?

EXERCISE 70

Reduce:

1. 5768 lb. flour to barrels.
2. 3 rm. 7 qr. to sheets
3. 3 great gross 9 doz. to units.
4. 6847 lb. pork to barrels.
5. 75 sco. to dozen.
6. 115 doz. to scores.
7. 7684 to great gross, etc.
8. 3 bbl. 95 lb. flour to lb.
9. 5 bbl. 148 lb. pork to pounds.
10. 7869 sheets to rm., etc.

EXERCISE 71

1. Find the number of hours in February, 1902.
2. A farm is 36 chains long and 24 chains wide. How many yards long are the boundary fences?
3. Reduce 245 sq. yd. to square inches.
4. Express 36 bu. 2 pk. in quarts.
5. There are 6 cords and 80 cu. ft. in a pile of stones. How many cubic feet are there in it?
6. Reduce 5620 hours to weeks.
7. How many farthings are there in £34 17s. 6¼d.?
8. Express 17 cwt. 17 lb. as drams.
9. How many inches are there in 45 mi. 120 yd.?
10. Reduce 47° 50′ to seconds.
11. How much heavier is 80 bu. of buckwheat than 60 bu. of wheat?

EXERCISE 72

1. How many ounces do 34 bu. of barley weigh?

2. Find the price of 17 gal. of milk at 6 cents a quart.

3. Find the cost of 3 gross 9 dozen buttons at 9 cents a dozen.

4. A ditch is to be 2 mi. 540 yd. long. Find the cost of digging it at 25ct. per foot.

5. A man who steps a yard takes 69150 steps in walking from Hamilton to Toronto. How many miles is it from Hamilton to Toronto?

6. How many seconds are there in the month of August?

7. A farm is 2 mi. long and 780 yd. wide. How many yards of fence will be required to enclose it?

8. Find the cost of 24 gal. 1 qt. 1 pt. of molasses at 7ct. per pint.

9. A farmer sold 4444 lb. of barley. How many bushels did he sell?

10. Express 8476 lb. of peas in bushels.

11. Find the weight in tons, etc., of 745 cu. ft. of water.

12. If a man occupies 4 sq. ft., how many square yards will 3750 men occupy?

13. A merchant bought 17 t. of iron at $4.25 per cwt., and sold it at 6ct. per pound. How much did he gain?

14. A block of land is 3 mi. 450 yd. round it. How many feet is it round it?

15. Find the value of 3120 pt. of molasses at 50 ct. per gallon.

SECTION II. COMPOUND ADDITION

INTRODUCTORY EXERCISE

1. What kind of quantities are £6 and £4? 7 mi. and 9 mi.?

2. What kind of quantities are £6 4s. and 14s. 8d.?

3. Find the sum of £6 and £4; of 7 mi. and 9 mi.

4. Find the sum of £6 12s. and £4 10s.

79. The process of finding the sum of two or more similar compound quantities is *Compound Addition*.

Example 1. Find the sum of 768, 593, 897 and 979.

H.	T.	U.
7	6	8
5	9	3
8	9	7
9	7	9
29	31	27

H.	T.	U.
7	6	8
5	9	3
8	9	7
9	7	9
32	3	7

27 u. = 2 t. + 7 u.
31 t. + 2 t. = 3 h. + 3 t.
29 h. + 3 h. = 32 h.

Example 2. Find the sum of £7 6s. 8d., £5 9s. 3d., £8 9s. 7d., and £9 7s. 9d.

£	s.	d.
7	6	8
5	9	3
8	9	7
9	7	9
29	31	27

£	s.	d.
7	6	8
5	9	3
8	9	7
9	7	9
30	13	3

27d. = 2s. 3d.
31s. + 2s. = £1 13s.
£29 + £1 = £30.

EXERCISE 73

(1)

cwt.	lb.	oz.
20	87	11
16	12	66
17	22	15
19	43	13

(2)

yd.	ft.	in.
4	2	6
2	1	7
3	0	8
5	2	9

(3)

£	s.	d.
5	5	5
8	1	$7\frac{3}{4}$
2	0	$1\frac{1}{2}$
13	0	$11\frac{3}{4}$
6	6	6

(4)

bu.	pk.	qt.	pt.
10	1	1	1
2	3	6	0
5	2	3	1
8	3	1	1
15	2	4	0

(5)

yd.	ft.	in.
4	1	9
5	2	2
3	2	7
0	2	10
1	1	11

6. Find the sum of 1 wk. 2 da. 13 hr. 40 min. 30 sec. 2 wk. 6 da. 10 hr. 8 min. 3 sec.; 5 da. 22 hr. 55 min. 45 sec.; 4 hr. 1 min. 15 sec; and 1 wk. 2 da. 4 hr. 5 min.

7. Add together 4 yd. 2 ft. 8 in.; 3 yd. 5 in.; 2 yd. 1 ft. 6 in.; 4 in.; and 2 yd. 1 ft. 9 in.

8. A man walked 17 mi. 360 yd. on Monday; 21 mi. 840 yd. on Tuesday; 18 mi. 748 yd. on Wednesday; 16 mi. 1289 yd. on Thursday; 20 mi. 196 yd. on Friday; and 7 mi. 1348 yd. on Saturday. How far did he walk during the week?

9. A merchant has five piles of wood. In the first there are 89 cd. 100 cu. ft.; in the second, 119 cd. 84 cu. ft.; in the third, 248 cd. 68 cu. ft.; in the fourth 389 cd. 16 cu. ft.; and in the fifth, 548 cd. 112 cu. ft. How much wood does he own?

10. A farmer sold seven loads of wheat, the loads weighing as follows: 65 bu. 36 lb., 63 bu. 48 lb., 66 bu. 28 lb., 65 bu. 43 lb., 66 bu. 50 lb., 65 bu. 54 lb., 64 bu. 30 lb. How much wheat did he sell?

11. A farm consists of eight fields, their areas being as follows: 11 a. 3456 sq. yd. 6 sq. ft., 10 a. 2454 sq. yd. 3 sq. ft., 12 a. 4500 sq. yd., 13 a. 3650 sq. yd., 14 a. 7 sq. ft., 12 a. 1456 sq. yd. 8 sq. ft., 9 a. 784 sq. yd. 6 sq. ft., 15 a. 2705 sq. yd. 3 sq. ft. Find the area of the farm.

SECTION III.—COMPOUND SUBTRACTION

INTRODUCTORY EXERCISE

1. Find the difference between 18 da. and 12 da.; between 12 mi. and 9 mi.

2. From 12 da. 8 hr. take 8 da. 6 hr.

3. How much does 8 gal. exceed 2 gal. 3 qt.?

4. Take 3 lb. 8 oz. from 5 lb.

5. One board is 15 ft. long; another is 12 ft. 10 in. long. How much is one longer than the other?

6. A rectangular room is 8 yd. 1 ft. long and 5 yd. 2 ft. wide. How much does its length exceed its width?

80. The process of finding the difference between two quantities, when one or both are compound quantities, is *Compound Subtraction.*

Example 1. From 713 take 235.

H.	T.	U.		H.	T.	U.
7	1	3	=	6	10	13
2	3	5	=	2	3	5
				4	7	8

1 t. 3. u. = 13 u.
7 h. = 6 h. + 10 t.

Example 2. From 7 bu. 1 pk. 3 qt. take 2 bu. 3 pk. 5 qt.

bu.	pk.	qt.		bu.	pk.	qt.
7	1	3	=	6	4	11
2	3	5	=	2	3	5
				4	1	6

1 pk. 3 qt. = 11 qt.
7 bu. = 6 bu. + 4 pk.

EXERCISE 74

(1)

mi.	yd.	ft.
60	0	1
40	1	2

(2)

a.	sq.yd.	sq.ft.
69	10	3
10	15	7

(3)

mi.	yd.	ft.	in.
7	1	1	3
1	1	2	7

(4)

£	s.	d.
43	11	10
15	14	6

(5)

lb.	oz.	dr.
3	12	7
2	14	12

6. A farmer had 200 bu. of wheat, and sold 28 bu. 2 pk. 5 qt. 1 pt. to one man, and as much to another. How much remained?

7. From a barrel of water containing 54 gallons, a person took 12 gal. 3 qt. one day, and 9 gal. 2 qt. 1 pt. another. How much was left?

8. From 29 sq. yd. 128 sq. in. subtract 16 sq. yd. 5 sq. ft. 140 sq. in.

9. A grocer has 1 cwt. 18 lb. of sugar in one barrel, 96 lb. in another, and 1 cwt. 61 lb. in a third. After selling 1 cwt. 90 lb., how much will he have left?

10. A bicycle rider has a journey of 300 mi. to go. The first day he rides 75 mi. 48 rd.; the next 83 mi. 175 rd.; the next 68 mi. 163 rd. How far has he yet to ride?

EXERCISE 75

1. How much must be added to 5 a. 785 sq. yd. 5 sq. ft. to make the same 10 a.?

2. A speaker began a speech at 9 hr. 28 min. 40 sec. after noon and ended 11 hr. 4 min. 25 sec. after noon. How long did he speak?

3. The angles of a triangle contain 180°. One angle measures 36° 14′ 56″ and another 80° 56′. Find the third angle.

4. From a 12-acre field four lots were sold. The first contained 2400 sq. yd., the second 3216 sq. yd.,

the third 2525 sq. yd., and the fourth 2845 sq. yd. How much of the field remained unsold?

5. Find the number of seconds from 25 min. past 9 in the morning to 6 min. past 11 in the morning.

6. A farmer came to town with 25 bu. of potatoes. He sold 5 bu. 1 pk. 1 gal. to one man, 6 bu. 3 pk. to a second, 7 bu. 1 gal. to a third and 4 bu. 1 pk. 1 gal. to a fourth. What quantity had he left?

7. *A* bought 10 t. of coal, but his bin held only five loads. The first weighed 1984 lb., the second 1 t. 12 lb., the third 1 t. 247 lb., the fourth 1 t. 356 lb., and the fifth 1978 lb. How much coal has he yet to receive?

8. From 25 yd. of ribbon, a storekeeper sold to one 3 yd. 1 ft. 6 in., to another 5 yd. 2 ft. 3 in., and to a third 7 yd. How many yards remained?

9. A wood dealer had 125 cd. of wood. He sold 7 loads as follows:—The first measured 1 cd. 112 cu. ft., the second 1 cd. 60 cu. ft., the third 1 cd. 75 cu. ft., the fourth 1 cd. 15 cu. ft., the fifth 1 cd. 95 cu. ft., the sixth, 1 cd. 108 cu. ft., and the seventh 1 cd. 36 cu. ft. How much wood had he left?

10. A cistern is full and holds 1250 gal. of water; 120 cu. ft. are drawn out. How many gallons remain in the cistern?

11. *A* rode 400 mi. on his bicycle in six days. On Monday he rode 50 mi. 1250 yd. 2 ft. 6 in.; on Tuesday, 55 mi. 1 ft. 9 in.; on Wednesday, 60 mi. 360 yd. 2 in.; on Thursday, 72 mi. 1450 yd.; on Friday, 63 mi. 1375 yd. 1 ft. 6 in. How far did he ride on Saturday?

12. A wood merchant had 1000 cords of fire wood in stock. On Monday he sold 12 cd. 28 cd. ft.; on Tuesday, 42 cd. 78 cd. ft.; and on Wednesday, 57 cd. 80 cd. ft. How much fire wood had he left?

SECTION IV.—COMPOUND MULTIPLICATION

INTRODUCTORY EXERCISE

1. Multiply 5 a. by 7; 17 hr. by 4; 35 bu. by 5.

2. Multiply 2 hr. 8 min. by 7; 2 ft. 3. in by 3; 5 mi. 100 yd. by 7.

81. The process of finding the product of two numbers, one of which, the multiplicand, is a compound quantity, is *Compound Multiplication.*

Example 1. Multiply 327 by 12.

H.	T.	U.
3	2	7
		12
36	24	84

H.	T.	U.
3	2	7
		12
39	2	4

84 u.=8 t.+4 u.
24 t.+8 t.=3 h.+2 t.
36 h.+3 h.=39 h.

Example 2. Multiply 3 yd. 2 ft. 7 in. by 12.

yd.	ft.	in.
3	2	7
		12
36	24	84

yd.	ft.	in.
3	2	7
		12
46	1	0

84 in.=7 ft.+0 in.
24 ft.+7 ft.=10 yd.+1 ft.
36 yd.+10 yd.=46 yd.

Example 3. Multiply 3 da. 19 hr. 59 min. by 97.

da.	hr.	min.
3	19	59
		97
291	1843	5723

da.	hr.	min.
3	19	59
		97
371	18	23

5723 min.=95 hr. 23 min.
1843 hr. +95 hr.=80 da. 18 hr.
291 da.+80 da.=371 da.

EXERCISE 76

(1)

cwt.	lb.	oz.
18	16	9
		5

(2)

da.	hr.	min.	sec.
10	20	30	40
			7

3. What is the value of 39 oxen at £15 7s. 11½d. each?

4. What is the weight of 345 hogsheads of sugar, each weighing 14 cwt. 45 lb.?

5. If a man owning 5 farms of 120 a. 52 sq. rd. each, sells 450 a. 145 sq. rd., how much land has he left?

6. If 2 gal. 2 qt. 1 pt. leak out of a water pipe in 1 hr., what will be the waste in 1 leap year?

7. Suppose a person to walk, on an average, 3 mi. 80 rd. every morning, and 3 mi. 20 rd. every afternoon, how far will he walk in two weeks?

8. What is the cost of 19 tons of lead at £2 17s. 9½d. per ton?

9. If a man travels 17 mi. 768 yd. in one day, how far would he travel in 38 days?

EXERCISE 77

1. If 1 acre will produce 27 bu. 3 pk. 6 qt. 1 pt. of corn, what will 98 acres produce?

2. If James takes 3 min. 15 sec. to read a page of a book, how long will it take him to read 17 such pages?

3. In a wood yard there are 7 piles of wood, each containing 57 cd. 68 cu. ft. How much wood is there in these seven piles?

4. A watch gains 1 min. 17 sec. in a day. How much will it gain in 14 days?

5. On a voyage a steamer sailed 15 mi. 680 yd. 2 ft. 3 in. each hour. The voyage lasted 6 days. How far did the steamer sail during this time?

6. Find the weight of 10 loads of hay, each load averaging 1 t. 5 cwt. 27 lb.

7. A farmer sold a load of 24 bags of wheat, each containing 2 bu. 15 lb. How much did he sell?

8. A wheel 11 ft. 3 in. in circumference turned 40832 times during a journey. How far was the journey?

9. A field of barley produced six loads, each load consisting of 35 bags, and each bag containing 2 bu. 8 lb. How much did the barley weigh?

10. A certain steamer burns 12 t. 5 cwt. 25 lb. of coal per day. How much will it burn in 125 days?

11. On one floor of an hotel there are 28 rooms, each room being 14 ft. 8 in. long by 10 ft. 5 in. wide. Find the length of the perimeters of the 28 rooms.

12. A cubic foot of water weighs 62 lb. 8 oz. From a tank containing 800 cu. ft. of water 1 t. 16 cwt. 18 lb. of water is run off. Find the weight of water remaining.

13. At what rate per hour is a carriage going when a wheel which is 12 ft. 10 in. in circumference makes 88 revolutions in 1 min.?

14. A Manitoba farmer has 250 a. to plough; he has had 4 teams ploughing for 30 days. If each team ploughed 2 a. 145 sq. yd. per day, how much remains to be ploughed?

SECTION V. COMPOUND DIVISION

INTRODUCTORY EXERCISE

1. Divide 18 a. by 6; £24 by 8; 60 min. by 12.

What kind of number is the quotient in each case?

2. Divide 18 a. 80 sq. rd. by 2; £24 16s. by 8; 60 min. 48 sec. by 12.

What kind of number is the quotient in each case?

3. Divide 18 a. by 3 a.; £24 by £8; 60 min. by 12 min.

In each case, what kind of number is the quotient?

4. At 2s. each, how many knives can be bought for 16s.?

5. At 1s. 6d., how many books can be bought for 6s.?

6. How many times can a pint measure be filled from two quarts?

Example 1. Divide £36 by 6.

H.	T.	U.
6)9	3	6
1	5	6

H.	T.	U.
6)6	30	36
1	5	6

Example 2. Divide 9 w. 3 da. 6 hr. by 6.

w.	da.	hr.
6)9	3	6
1	4	1

w.	da.	hr.
6)6	24	6
1	4	1

Example 3. Divide 80 da. 6 hr. 40 min. by 17.

```
  da. hr. min.   da. hr. min.
17)80  6   40   (4   17   20
   68
   12 da.
   24                80 da.÷17=4 da. and rem. 12 da.
  294                12 da. 6 hr.=294 hr.
   17                294 hr.÷17=17 hr. and rem. 5 hr.
  124
  119               5 hr. 40 min.=340 min.
    5 hr.           340 min.÷17=20 min.
   60
  340 min.
  340
```

Example 4. Divide £12 1s. 6d. by £1 6s. 10d.

$$\frac{\text{£12 1s. 6d.} = 2898\text{d.}}{\text{£1 6s. 10d.} = 322\text{d.}} = 9.$$

82. The process of finding the quotient when the Dividend is a compound number and the Divisor an abstract one, or when both Dividend and Divisor are denominate numbers, one or both being compound, is *Compound Division.*

EXERCISE 78.

(1)

```
  £    s.  d.
4)61   18  4
```

(2)

```
  t.   cwt.  lb.
7)112  16   66
```

3. Divide 4 gal. 2 qt. by 3.
4. Divide 40 cu. yd. 10 cu. ft. by 18.
5. Divide 78 mi. 18 yd. 1 ft. 4 in. by 8.
6. Divide 178 wk. 5 da. 12 hr. 27 min. 6 sec. by 7.
7. Divide 1157 lb. 4 oz. 11 dwt. 8 gr. by 83.
8. Divide 1330 cu. yd. 13 cu. ft. 1720 cu. in. by 49.
9. Divide 445 t. 15 lb. 13 oz. by 57.

EXERCISE 79

1. Divide £48 7s. 4d. by £6 11d.

2. Divide 69 bu. 3 pk. 6 qt. by 6 bu. 3 pk. 6 qt.

3. Divide 697 lb. 7 oz. by 60 lb. 10 oz.

4. Divide 80 bu. 2 pk. 4 qt. by 13 bu. 3 pk. 5 qt.

5. A farmer put up 1000 bushels of apples in 350 barrels of uniform size. How many bushels, etc., did each barrel contain?

6. How many jars, each containing 2 gal. 3 qt. 1 pt., can be filled from a tank holding 71 gal. 3 qt. 1 pt. of wine?

7. A drove of cattle ate 6 t. 19 cwt. 87 lb. of hay in a week. How long will 34 t. 19 cwt. 35 lb. last them?

8. If it takes 5 yd. 2 ft. 3 in. of cloth for a coat, how many coats can be made from 100 yd. of cloth, and how much will remain?

9. How many times will a wheel 12 ft. 6 in. in circumference turn in going 100 mi.?

EXERCISE 80

1. How many vessels, each holding 2 gal. 3 qt. 1 pt., can be filled out of a cask containing 106 gal. 1 qt. 1 pt.?

2. How much oftener will the fore wheel of a carriage which is 5 ft. 8 in. round, turn in a journey of 45 mi., than the hind one, which is 7 ft. 6 in. round?

3. *A* and *B* start from points 30 mi. 500 yd. apart to meet each other. When each has walked 4 hr., *A* at 3 mi. 368 yd. per hr., and *B* at 3 mi. 555 yd. per hour, how far are they still apart?

4. If sound travels at the rate of 1116 ft. per second, in what time will the sound of a cannon-shot 6 mi. off be heard?

5. How long will it take to count a million coins at the rate of 100 per minute?

6. If *A* walks 3 yd. 2 ft. per minute faster than *B*, in what time will he be 1 mi. ahead of *B*?

7. How many dozen bottles will be required to hold 84 gal. 2 qt. of beer, counting 6 bottles to the gallon?

8. The great bell at Moscow is said to weigh 443772 lb. How much is it heavier than St. Paul's, which weighs 5 t. 14 cwt. 74 lb.?

9. A train 480 ft. long runs past a post in 12 seconds. How many miles an hour is it running?

10. If both sides of a railroad are fenced with wire worth 3c. a rod, find the cost per mile, the fence being 5 wires high.

11. Find the value of the following:—

4320 lb. wheat at 67c. per bushel.
624 lb. timothy seed at $3.75 per bushel.
2184 lb. rye at 48c. per bushel.
2482 lb. oats at 35c. per bushel.

Tables used in special lines of business. (For reference only.)

83. Troy Weight

24 grains (gr.) . . .	=1 pennyweight,	or 1 dwt.
20 pennyweights . .	=1 ounce, . .	or 1 oz.
12 ounces	=1 pound, . .	or 1 lb.

NOTE 1.—This is used for weighing gold, silver, platinum, and precious stones, and articles made thereof.

NOTE 2.—7000 grains = 1 lb. Avoirdupois.
5760 " = 1 lb. Troy.
437½ " = 1 oz. Avoirdupois.
480 " = 1 oz. Troy.

NOTE 3.—The term *carat* is used to express the number of parts of pure gold in articles of jewellery. Thus, if 14 parts out of 24 parts are pure gold, and the remaining 10 parts are alloy, the gold is said to be 14 carats fine.

Carat also denotes a unit of weight for precious stones, about 3⅝ grains.

8′ Apothecaries' Weight. (Used only in dispensing)

20 grains (gr.) .	= 1 scruple . .	or 1 sc. or 1 ℈.
3 scruples .	= 1 dram . .	or 1 dr. or 1 ℥.
8 drams . .	= 1 ounce . . .	or 1 oz. or 1 ℥.
12 ounces . .	= 1 pound . .	or 1 lb. or 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.

Apothecaries' Measure; Fluids

60 minims (min.)	= 1 fluid drachm (fl. dr.)
8 drachms .	= 1 fluid ounce (fl. oz.)
20 ounces . .	= 1 pint (pt.)

CHAPTER IV

PROBLEMS INVOLVING THE PREVIOUS RULES

SECTION I. BILLS AND RECEIPTS

INTRODUCTORY EXERCISE

REGINA, August 25, 1914.

James Brown, Esq.

Bought of C. Meredith.

1914			$	c.
Jan.....	17	15 lb. Coffee at 32c.....	4	80
"	23	16 " Lard at 15c.....	2	40
Feb....	3	25 " Sugar at 13c.....	3	25
"	20	16 " Ham at 16c.....	2	56
			$13.	01

1. Examine this bill of goods.

(*a*) Where did the transactions take place?

(*b*) At what time did they take place?

(*c*) Who bought the goods?

(*d*) Who sold the goods?

(*e*) When was a bill of the goods sent to the buyer?

(*f*) What quantities of goods were bought and at what prices?

(*g*) What did the whole cost?

85. A bill of goods is called *an account*, and when sent to the buyer is said to be an *account rendered*.

PRINCE ALBERT, August 29, 1914.

William Jones, Esq.

Bought of H. Madill.

1914		$	c.
Jan. 21.....	10 yd. Cloth at $1.15	11	50
" 27.....	12 yd. Silk at 75c.....	9	00
Feb. 10.....	6 Hats at $1.75.	10	50
		$31	00

Sept. 4th, 1914.

Received Payment,
H. Madill.

2. (*a*) Point out points of resemblance between these two bills.

(*b*) In what other respects do they differ than in the time and nature of the transactions?

86. The second bill represents the form of a receipted account.

In business, Jones, the purchaser, is usually called the *Debtor*.

MOOSE JAW, Sept. 3, 1914.

John Smith, Dr.

To George Brown.

1914					$	c.
Jan...	1	To 75 lb. of Sugar at $0.12...	$9	00		
Feb..	2	" 47 yd. of Cloth at 3.25...	152	75		
					161	75
		Cr.				
Jan...	7	By 75 bu. of Corn at $0.78...	$58	50		
Feb...	2	" 43 bu. of Apples " 1.25..	53	75		
					112	25
					$49	50

Sept. 15th, 1914.

Received Payment,
George Brown.

3. Examine this bill.

(*a*) Where did the transactions take place?

(*b*) When did they take place?

(*c*) What goods did Smith buy?

(*d*) Who sold Smith the goods?

(*e*) Who bought goods from Smith?

(*f*) How much did Smith owe Brown after Feb. 2nd?

(*g*) When did Smith pay what he owed Brown?

4. Point out wherein these bills agree.

5. Point out other differences than in the parties, times, and nature of the transactions.

87. The third bill shows that the goods bought by Smith have been paid for in full.

Another method of showing that money has been paid is by a formal Receipt, similar to those given below:

Receipt in Full of Account

SASKATOON, MAY 11, 1914.

RECEIVED from Samuel Jones

Fifteen and 30/100..... ... Dollars

in full of account.

$15.30

Thomas Simpson

Receipt for Rent

NORTH BATTLEFORD, MAY 9, 1914.

RECEIVED from Edward Cunningham

Forty-five.... .... Dollars

for rent to date.

$45.00

William Reid.

EXERCISE 81

1. George Wright pays Thomas Thompson $38.40 in full of account May 30, 1914. Write the receipt that Thomas Thompson would give.

2. Peter Duncan pays William Creighton on March 31, 1914, $70 for rent of store for the month of March. Write the receipt.

88. A bill should show the place and time of each transaction; the buyer and the seller; the quantity and cost of each article; and any payments made.

89. *A Bill* is thus a written statement of goods sold or services rendered and payments, if any, made.

90. The purchaser, or person who receives money, goods, or services from another, is a *Debtor*.

91. The seller, or person who parts with money, goods, or services to another, is a *Creditor*.

EXERCISE 82

Make out bills for the following accounts, supplying dates:—

1. Mr. J. Jones bought of R. Walker 10 yd. silk at $2.50; 12 yd. flannel at 40c.; 16 yd. calico at 15c.

2. Mr. Brown bought of McClung & Bros. 10 lb. tea at 75c.; 18 lb. raisins at 18c.; 5 lb. rice at 10c.; 12 lb. butter at 21c.

3. James Taylor bought of Thomas Yellowlees 5 quires foolscap at 25c.; 1 Arithmetic at 25c.; 3 rolls wall paper at 45c.; 4 dolls at 25c.

4. David Montgomery bought of F. F. McArthur 20 lb. cotton at 11c.; 15 yd. print at 16c.; 12 yd. braid at 6c.; 3 pair gloves at 27c.; 26 yd. dress goods at 63c.; 1 hat at $5.25.

5. Robert Davey bought of Murdoch Bros. 18 bags salt at 75c.; 4 bbl. plaster at 98c.; 10 lb. coffee at 35c.; 1 chest tea, 18 lb., at 65c.; 48 grain bags at $3.60 a doz.

6. Levi Van Camp sold Wm. Burns & Co. 257 bu. wheat at 73c.; 475 bu. oats at 36c.; 45 bu. corn at 76c.; 175 bu. peas at 82c.; 367 bu. barley at 69c.

7. A. Thompson bought of A. Harrison 32 lb. sugar at 12c.; 11 lb. coffee at 35c.; 26 lb. soap at 8c.; 14 lb. rice at 9c.; 7 lb. fish at 15c.; 18 lb. crackers at 12c.

8. W. West bought of T. Brown 27 pairs calfskin boots at $4.50; 96 pairs gaiters at $3.25; 126 pairs overshoes at 91c.; 18 pairs slippers at 95c.; 75 pairs heavy boots at $2.75.

9. Mrs. Jones bought of R. Walker & Co. 25 yd. calico at 12c.; 12 spools cotton at 5c.; 16 yd. alpaca at 75c.; 17 yd. muslin at 18c.; 6 skeins tape at 2c.

10. Murdoch Bros. sold to Thos. Jones the following: 27 yd. calico at 13c.; 45 yd. muslin at 18c.; 16 yd. linen at 45c.; 17 yd. cambric at 15c.; and 9 handkerchiefs at 45c.; and took in exchange 12 bu. potatoes at 65c.; 3 bbl. apples at $3.25; 13 lb. butter at 35c.; and the remainder in cash. How much cash was paid? Make out a receipted bill.

11. James Brown bought a suit of clothes for himself at $25.75 and a dress for his wife for $18.50. He paid on account 56 lb. butter at 24c., 40 dozen eggs at 23c., 6 pair of chickens at 78c., and 5 turkeys at $1.35.

SECTION II. AGGREGATES AND AVERAGES

INTRODUCTORY EXERCISE

1. Mr. Smith brought home 16 marbles in one pocket and 24 in another. He divided them equally between his two boys. How many had he to divide? How many will each boy receive?

2. A boy rode 10 mi. on Monday; 12 mi. on Tuesday; and 17 mi. on Wednesday. How far did he ride altogether during these days? If he had ridden the same distance each day, how far must he have gone on Monday?

3. Find the sum of 7, 8, 0, 4, 5, and 6, and divide the sum by the number of quantities.

In the first example, 40 marbles is called the *aggregate* of 16 marbles and 24 marbles, and 20 marbles is the *average*.

In the second example, 39 miles is the *aggregate* of 10 mi., 12 mi., and 17 mi., and 13 mi. is the *average*.

In the third example, 30 is the *aggregate*, and 5 is the *average*.

92. The *Aggregate* of several quantities of the same kind is their sum.

93. The *Average* of several quantities is that quantity which substituted for each of them will produce an aggregate equal to that of the given quantities.

EXERCISE 83

Find the average of:—

1. 16, 18, 26, 30, 36, 42, 50, and 56.
2. 17, 0, 20, 30, 70, 100, 27, 9, and 17.
3. 120, 340, 560, 780, 320, and 840.

4. Five pupils obtained the following marks at an examination:—60, 36, 75, 21, and 80 respectively. What was their average mark?

5. There were 45 pupils at school on Monday; 43 on Tuesday; 47 on Wednesday; 45 on Thursday; and 40 on Friday. What was the average attendance for the week?

6. A man trolling caught four fish; the first weighed 12 lb. 8 oz.; the second, 4 lb. 10 oz.; the third, 7 lb. 3 oz.; and the fourth, 9 lb. 7 oz. Find their average weight.

7. The scores of a side at cricket were the following: 22, 14, 0, 3, 4, 3, 0, 18, 17, 5, and 11. Find the aggregate score and the average per man.

8. In a store, for a week, the sales were the following:—$375, $450, $540, $370, $285, and $722. Find the average sale each day.

9. A farmer sold 4 loads of wheat from a 10-acre field; the first weighed 54 bu. 16 lb.; the second, 57 bu. 37 lb.; the third, 56 bu. 25 lb.; and the fourth, 53 bu. 18 lb. What was the average weight of each load, and the average yield per acre?

10. Find the average of all the numbers of three digits that can be made with the figures, 4, 5, 6.

EXERCISE 84

1. The average weight of seven salmon was 9 lb. 5 oz. Find their aggregate weight.

2. The average rate of a train for five hours was 27 mi. 43 rd. Find the distance travelled during the five hours.

3. A grocer sold 5 lb. of tea at 75c. per pound and 2 lb. at 50c. per pound. What was the average price per pound?

4. Two purchases have been made of 15 lb. weight at $2.50 per pound, and 25 lb. at $1.80 per pound. What is the average price per pound?

5. A merchant sold 8 lb. of tea, 11 lb. of coffee, and 25 lb. of sugar, at an average of 15c. a pound. The tea was worth 30c. a pound, the coffee 25c. a pound, and the sugar 7c. a pound. Did he gain or lose, and how much?

6. *A* mixes 25 gal. of water with 125 gal. of vinegar, which cost him 40c. per gallon. How much must he charge per gallon so as to make a gain of $10?

7. I bought 300 bu. of wheat, part at 78c. per bushel and the rest at 72c. per bushel. The average cost was 76c. per bushel. How many bushels of each kind did I buy?

8. The aggregate weight of seven tubs of butter is 185 lb., and of eleven it is 286 lb. Find the average weight of the four tubs.

9. In a factory the foreman receives $15 per week; of the workmen each of three receives $12.50; each of five $10.50, and each of eleven $9. What is the average weekly wage per man?

10. In one year a lady read 13 books, containing 5942 pages. Three averaged 542 pages; four averaged 356 pages. Find the average number in the remainder.

11. On Monday *A* rode 23 mi. 1634 yd.; on Tuesday, 25 mi. 625 yd.; on Wednesday, 32 mi. 1347 yd.; and on Thursday, 27 mi. 34[illegible] yd. How far did he ride in the four days, and what was his average daily journey?

SECTION III. SHARING

EXERCISE 85

1. Divide \$7.25 between two boys, so that one may have 25c. more than the other.

2. Divide 113 marbles between two boys, so that one may have 9 more than the other.

3. Two books have between them 643 pages, and one has 107 pages more than the other. How many pages are there in each?

4. Two boys together weigh 122 lb. 1 oz., and one is 7 lb. 7 oz. heavier than the other. Find the weight of each.

5. Two farms contain together 226 a. 297 yd., and one is 1 a. 232 yd. larger than the other. Find the size of each farm.

6. Divide \$2.07 among *A*, *B*, and *C*, so that *B* may have 4c. more than *C*, who will have 34c. more than *A*.

7. Divide 72 marbles among *A*, *B*, and *C*, so that *B* may have 7 more than *A* and 10 less than C.

8. Three books have together 1000 pages; the first has 256 pages more than the second, and the second has 108 more than the third. How many pages has each?

9. Three times the sum of two numbers is 2997. and one is 43 more than the other. Find the numbers.

10. The perimeter of a rectangular field is 522 yd., and the length is 27 yd. greater than the breadth. Find the length and width of the field.

EXERCISE 86

1. Divide 150 marbles between two boys, so that one may have 4 times as many as the other.

2. Divide \$200 between A and B, so that for every \$3 that A gets, B shall get \$2.

3. Divide \$1260 between two men, so that when the first receives \$5 the second may receive \$4.

4. Divide \$500 among A, B, and C, so that when A gets \$5, B may get \$6, and C \$9.

5. Divide 63c. among A, B, and C, so that B may have twice as much, and C 6 times as much as A.

6. Divide \$1.15 between A and B, so that B may have 15c. more than three times as much as A.

7. A, B, and C together have \$157. B has \$4 more than twice as much as A, and C \$3 more than three times as much as A. How much has each?

8. \$3.90 is made up of twice as many 5-cent pieces and three times as many 10-cent pieces as 25-cent pieces. How many are there of each?

9. A mixture of 189 bu. of wheat and barley is made as follows:—The quantity of barley is 27 bu. more than twice the quantity of wheat. How many bushels of each kind are there?

10. A box contains 350 marbles, red, blue, and green. There are 212 red and blue and 250 blue and green. How many of each kind are there?

11. Three men together chopped 112 cords of wood; B chopped 9 cd. 103 c. ft. more than A, and 126 c. ft. less than C. How much did each chop?

12. Divide \$291.90 among A, B, C, and D, so that B may have \$19.50 more than A, but \$10.40 less than C, who will have \$9.60 less than D.

SECTION IV. SIMPLE MEASUREMENTS

I. SQUARE AND RECTANGLE

EXERCISE 87

1. Draw a rectangle 6 in. by 5 in. and find its perimeter.

2. Find the perimeter of a table 4 ft. 6 in. long by 3 ft. 4 in. wide.

3. How many boards, each 12 ft. long, will it take to make a fence 4 boards high round a lot 40 yd. long and 28 yd. wide?

4. How much will it cost to enclose a mile square of land with wire at 2c. per yd., the fence being seven wires high?

5. How much will it cost to fence a rectangular farm 240 rd. long and 80 rd. wide, at $1.75 per rod?

6. A box is 2 ft. long, 1 ft. 6 in. wide, and 1 ft. deep. Find the total length of the edges of the box.

7. A rectangular floor is twice as long as wide, and is 60 ft. in perimeter. Find its dimensions.

8. The perimeter of a rectangular room is 64 ft., and it is 4 ft. longer than wide. Find its dimensions.

9. A rectangular hall is 5 ft. more than twice as long as it is wide; its perimeter is 82 feet. Find its dimensions.

EXERCISE 88

Find the area of the rectangles having the following dimensions:

1. 8 ft. by 12 ft.
2. 6 ft. 6 in. by 14 ft.
3. 21 ft. by 25 ft.
4. 2 yd. 2 ft. by 7 yd.
5. 17 yd. by 20 yd. 2 ft.
6. 19 ft. 7 in. by 24 ft.

7. What will it cost to plaster a room 16 ft. long, 14 ft. wide, and 9 ft. high, at 17c. a square yard?

8. How many acres are there in a rectangular field 30 rd. long and 22 rd. wide?

9. How many bricks 8 in. long and 4 in. wide, laid flat, are required to make a walk 78 ft. long and 4 ft. wide?

10. Find the surface of a pane of glass measuring $37\frac{1}{2}$ in. long and 23 in. wide.

EXERCISE 89

1. A rectangle 16 ft. long contains 168 sq. ft. Find its width.

2. The top of a table 2 ft. 3 in. wide contains 6 sq. ft. 108 sq. in. Find its length.

3. A rectangular surface contains 16 sq. ft. If it is 6 ft. long, find its width.

4. Find the perimeter of a rectangular plot 27 yd. long which contains 240 sq. yd.

5. A rectangular room is 13 ft. 6 in. wide and its floor contains 24 sq. yd. Find its length.

6. It costs $43.75 to cover a floor with linoleum at $1.25 per square yard. The room is 21 ft. long. How wide is it?

7. There are 1056 sq. ft. in the walls of a rectangular room 28 ft. long and 16 ft. wide. How high is the room?

8. A box 3 ft. long and 2 ft. 4 in. wide has 27 sq. ft. 48 sq. in. in its surface. How deep is the box?

9. The walls of a room contain 84 sq. yd. The room is 12 ft. high. Find the perimeter of the room.

II. CARPETING A ROOM

94. Carpet is sold by the linear yard. It is usually 27 or 36 inches wide. As we have to match carpet, the number of yards for a room must be determined by calculating the number of strips necessary, remembering that the carpet dealer will not cut a strip lengthwise.

EXERCISE 90

1. A room is 18 yards long and 13 yards wide. Determine the number of strips (a) running lengthwise; (b) running cross-wise, the carpet being 36 inches wide. Also determine the number of yards necessary. Draw a diagram.

(a) There will be 13 strips, 18 yards long=234 yards.

(b) There will be 18 strips, 13 yards long=234 yards.

2. In (1) suppose carpet was 27 inches wide, determine the number of strips in each case and the number of yards of carpet required.

(a) There will be $\frac{13 \times 36}{27} = 17\frac{1}{3}$ or 18 strips required, each 18 yards long.

(b) There will be $\frac{18 \times 36}{27} = 24$ strips required, each 13 yards long.

In (a) how much will have to be turned under?

3. How many yards of carpet 27 in. wide will be required for rooms whose dimensions are:

(1) 27 ft. by 21 ft.?
(2) 15 ft. by 12 ft.?
(3) 18 ft. by 24 ft.?
(4) 26 ft. by 36 ft.?

Find the cost of carpeting rooms whose dimensions are:

4. 18 ft. by 20 ft., with carpet 3 ft. wide, at $1.20 a yard.

5. 20 ft. by 24 ft., with carpet 30 in. wide, at 90c. a yd.

6. 15 ft. by 17 ft. 6 in. with carpet 3 ft. wide, at $1 a yd.

7. How many strips of carpet 36 in. wide are needed for a room 21 ft. x 15 ft., (1) if the strips run lengthwise; (2) if they run crosswise?

8. How many strips of carpet 27 in. wide are needed for a square room 18 ft. long?

9. A rectangular room is 40 ft. wide. How many strips of oilcloth 60 in. wide are needed to cover it, the strips running lengthwise of the room?

10. A rectangular room is 22 ft. 6 in. long and 18 ft. wide. Find the cost of covering it with oilcloth at 95c. per sq. yd.

11. It costs $57.60 to carpet a room 16 ft. wide with carpet 27 in. wide, at $1.20 per yd. Find the length of the room.

12. Find the cost of carpeting a stairway having 14 steps, each having a 7-inch rise and a 10-inch tread, the carpet to cost $1.10 a yard, two extra yards being allowed the landing.

III. PLASTERING, PAINTING, ETC.

95. In plastering it is usual to consider the walls as entire, since it is more difficult to plaster around doors and windows. Painting and kalsomining, however, are generally reckoned by the square yard.

EXERCISE 91

1. How many square yards of plastering are there in the ceiling of a rectangular room 18 ft. by 16 ft.?

2. How many square yards of plastering are there in the walls and ceiling of a rectangular room 22 ft. by 18 ft. and 12 ft. high?

3. Find the cost of plastering the walls of a rectangular room, 30 ft. by 24 ft. and 15 ft. high, at 21c. per sq. yard.

4. It costs $11.04 to plaster the ceiling of a rectangular room 24 ft. long, at 33c. per sq. yd. Find the width of the room.

5. A room is 26 ft. long, 18 ft. wide, and 12 ft. high; it has 3 doors, each 7 ft. by 4 ft., and 4 windows, each 6 ft. by 3 ft. A base-board a foot wide runs round the room. Find the area of the plaster (1) in the walls; (2) in the walls and ceiling.

6. At 25c. per sq. yd. find the cost of plastering the walls and ceiling of a rectangular room 24 ft. by 21 ft. and 12 ft. high, making no allowance for deductions.

7. How much would the cost of plastering the room in the last example be reduced if there are 3 doors 8 ft. by 4 ft. and 3 windows 7 ft. by 4 ft.?

8. It costs $108 to plaster the walls of a hall 15 ft. high at 27c. per sq. yd. Find the perimeter of the hall.

9. At 35c. per square yard find the cost of plastering the walls of a rectangular room 25 ft. by 20 ft. and 10 ft. high, there being 2 doors 7 ft. by 5 ft., 3 windows 6 ft. by 3 ft. and 1 window 5 ft. by 4 ft., deducting for windows and doors.

IV. PAPERING

96. Papering is much like carpeting, it being necessary to match patterns. In practice, the exact cost of papering a room is seldom determined. The approximate cost is given, making a liberal allowance for matching and for doors and windows, etc.

Wall paper is sold in single rolls 8 yards long or in double rolls 16 yards long. It is usually 18 inches wide. Fractional parts of a roll are not sold and the dealer will not cut a strip lengthwise. Borders are sold by the linear yard.

A paper hanger usually measures around a room making a deduction for the doors and windows. If the paper is 18 inches wide, two vertical strips are required for each yard of the distance. No allowance for matching the pattern is necessary for the first strip. In the succeeding strip the size of the pattern somewhat determines the allowance for matching.

EXERCISE 92

1. How many yards of paper 18 in. wide will be required for a room 20 ft. long, 15 ft. wide, and 9 ft. high?

2. How many square ft. of plain paper will be required for a room 18 ft. 9 in. long, 15 ft. 3 in. wide, and 8 ft. high?

3. How many yards of paper 18 inches wide will paper the ceiling of a rectangular room 24 ft. by 21 ft.?

4. Find the cost of papering the walls and ceiling of a room 30 ft. by 24 ft. and 12 ft. high, with paper 18 in. wide, at 25c. per roll of 8 yd.

5. How many rolls of paper 18 in. wide will paper the walls and ceiling of a rectangular room 27 ft. by 18 ft. and 12 ft. high?

6. Find the cost of papering the walls of an irregular shaped room, the walls being 50 ft., 20 ft., 40 ft., and 50 ft. long, and the room 18 ft. high, with paper 18 in. wide, at 25c. per single roll.

7. How much cheaper is it to paper the walls of a room 14 ft. 8 in. by 12 ft. 9 in. with double rolls that give 7 strips each than with single rolls that give 3 strips each, if 9 strips are allowed for openings, the price per roll being 15c., per double roll 30c.?

8. How many yards of paper 21 in. wide are required for the walls of a room 25 ft. by 20 ft. and 10 ft. high, there being 2 doors 7 ft. by 5 ft. and 3 windows 6 ft. by 3 ft., and no waste of paper?

INTRODUCTORY EXERCISE

1. Find the area of a rectangular surface 1 ft. by 1 ft.; 2 ft. by 1 ft.; 5 ft. by 2 ft.?

2. What is the area of a face of a board 6 ft. long and 1 ft. wide?

3. How many square feet are there in the face of a board 12 ft. long and 2 ft. wide?

V. MEASURING LUMBER

97. Lumber is measured by *the board foot*, which is 1 ft. long, 1 ft. wide, and 1 in. thick. Lumber less than an inch thick is reckoned as if it were 1 in. thick. Thus, a board 16 ft. long, 1 ft. wide, and $\frac{1}{2}$-inch thick is sold for 16 ft., board measure.

Lumber more than an inch thick is sold by the number of feet, board measure, to which it is equivalent. Thus, a plank 16 ft. long, 1 ft. wide, and 2 in. thick, contains 32 ft., board measure.

EXERCISE 93

Find the number of board feet in the following:

1. A board 12 ft. long, 10 in. wide, and 1 in. thick.

2. A board 18 ft. long, 9 in. wide, and 1 in. thick.

3. A board 16 ft. long, 10 in. wide, and 3 in. thick.

4. A board 18 ft. long, 16 in. wide, and $\frac{1}{2}$-in. thick.

5. How many feet, board measure, are there in 13 planks 16 ft. long, 9 in. wide, and 4 in. thick?

6. How many feet, board measure, are there in 100 scantlings 18 ft. long, 4 in. wide, and 4 in. thick?

7. How much lumber will be required to fence a rectangular lot 66 ft. by 120 ft. with a close board fence 6 ft. high?

8. A pile of lumber consists of 540 boards, each 16 ft. long, 12 in. wide, and 3 in. thick. How many board feet are there?

9. How many board feet are there in a load consisting of 50 pieces 18 ft. long, 8 in. wide, and 3 in. thick, and 100 pieces 16 ft. long, 9 in. wide, and $\frac{1}{4}$-in. thick?

10. Find the cost of 1000 planks 12 ft. long, 10 in. wide, and 3 in. thick, at \$24 per thousand.

11. Find the cost of 500 scantlings 16 ft. long, 4 in. wide, and 3 in. thick, at \$20 per thousand.

12. Find the cost of the lumber for fencing a rectangular farm 880 yd. long and 880 yd. wide, with boards 6 in. wide, 5 boards high, at \$15 per thousand.

VI. ROOFING

INTRODUCTORY EXERCISE

1. Observe the roof of a house covered with shingles or slates.

Describe how the shingles are laid.

How many rows of shingles are there usually in the lowest course?

2. If possible, measure the length of shingle exposed to the weather.

3. Observe a bunch of shingles.

How are they packed together?

How many layers are there on each end?

4. Measure the width of a bunch of shingles.

5. If a shingle is 4 in. wide, how many shingles are there in one row? in 25 rows? in 50 rows? in the bunch?

98. Shingles are considered to average 4 in. in width, and are generally laid 4 in., 4½ in., or 5 in. to the weather. For convenience they are put up in bunches consisting of 25 layers on each side, 20 in. wide. Thus there are 5 shingles in a layer and 250 in a bunch. Four bunches of shingles laid 4 inches to the weather cover 100 sq. ft., or a *square*.

EXERCISE 94

Find the number of shingles to cover the following:—

1. A rectangular surface 24 ft. by 12 ft., the shingles being laid 4 in. to the weather.

2. A rectangular surface 36 ft. by 15 ft., the shingles being laid 5 in. to the weather.

3. A rectangular surface 40 ft. by 16 ft., the shingles being laid 4 in. to the weather.

4. The two sides of the gable roof of a barn 40 ft. long, and each slope being 16 ft. 8 in. wide, the shingles being laid 5 in. to the weather.

5. How many thousand shingles are needed for a barn with a gable roof 50 ft. long, and each slope being 20 ft. wide, the shingles being laid 4 in. to the weather?

6. It requires 96 bunches of shingles to cover a gable roof 64 ft. long. How wide is each slope, the shingles being laid 4 in. to the weather?

7. It requires 18 bunches of shingles to cover a gable roof 25 ft. long. How wide is each slope, the shingles being laid 5 in. to the weather?

8. At 15c. per square foot, what will a tin roof for a building 36 ft. long and 19 ft. 6 in. wide cost?

9. What will be the difference in cost between a gravel roof at 40c. per sq. yd., and a tin roof at 10c. per sq. ft., the roof being 45 ft. long and 16 ft. wide?

10. Find the cost of tinning a porch roof 32 ft. long 7 ft. 6 in. wide, at 12c. per sq. ft.

EXERCISE 95

Find the cubic content of the rectangular solids whose dimensions are:—

1. 8 ft., 6 ft., 5 ft.
2. 2 ft. 6 in., 5 ft. 4 in., 7 ft.
3. 3 ft., 7 ft. 6 in., 8 ft. 4 in.
4. 2 ft., 3 ft. 6 in., 5 ft.

5. How many bricks will be required to build a wall 45 ft. long, 20 ft. high, and 15 in. thick, each brick being 8 in. long, 4 in. wide, and 3 in. thick? (No allowance to be made for mortar.)

6. What will it cost to put a stone foundation under a barn 36 ft. long by 24 ft. wide, at $2 a cubic yard, the wall being 7 ft. high and 2 ft. thick?

7. The length and breadth of a tank are 60 ft. and 42 ft., respectively. Find the depth in order that it may contain 840 cu. yd.

8. The breadth and thickness of a beam are 20 in. and 15 in., respectively. Find the length of a piece which contains 10 cu. ft.

9. How many cords of wood are there in a pile 50 ft. long, 16 ft. high, and 5 ft. wide?

10. How many cubic feet are there in a tank 9 ft. 6 in. long, 5 ft. 3 in. wide, and 3 ft. 4 in. deep?

VII REVIEW EXERCISES

EXERCISE 96

1. A farmer gave $43.50 for sheep, at the rate of $7.25 for 3 sheep. How many did he buy?

2. If 18 chickens cost $4.20, how much will 3 chickens cost?

3. A merchant bought 9 pieces of cloth, each containing 50 yd., for which he paid $2317.50. What was the cost of a single yard?

4. A banker has $20000 in cash; he pays for 50 shares of stock, at $97.50 a share, and 100 shares at $110 a share. How many shares, at $41.25 each, can he buy with the remainder of his money?

5. I owe $276 and paid $17.25 on it. How many times must I pay such a sum to cancel the debt?

6. I retail envelopes at 12c. a pack, gaining 3c. on each pack of 24. What did they cost me per thousand?

7. A grocer sold 9760 lb. of flour at $1.25 per 100 lb. What was the amount of the sale?

8. Messrs. Smith & Co. burn in their store, in a year, 62560 cu. ft. of gas. What is their gas bill for a year, at $1.50 per 1000 ft.?

9. A man bought a quantity of coal for $250, and by retailing it at $5.75 a ton, he gained $37.50. How many tons did he buy?

10. The charge of sending a telegram to a certain place is 40c. for 10 words and 5c. for each additional word. What would a despatch of 24 words cost me?

11. A father divided his property worth $4767 among his three sons, A, B, and C, in such a way that A got as much as B and C together, and B and C shared alike. What was C's share?

12. If the continued product of 275, 376, 484, and 196 be divided by $77\times28\times47\times55$, what will be the quotient?

13. A merchant expended $547.40 for cloth. He sold a certain number of yards for $522, at $1.45 a yard, and gained on what he sold $108. How many yards did he buy, and how much did he gain per yard on the cloth he sold?

14. A farmer exchanged 390 bu. of wheat worth $1.20 a bushel for an equal number of bushels of barley at 75c. a bushel, and oats at 42c. a bushel. How many bushels of each did he receive?

15. John Turner has manufactured in 4 years 7740 pairs of shoes, making each successive year 250 pairs more than the year before. How many pairs did he manufacture the first year?

CHAPTER V

FACTORS, CANCELLATION, MEASURES AND MULTIPLES

SECTION I. FACTORS

INTRODUCTORY EXERCISE

1. Divide the numbers 2, 4, 6, 8, and 10 each by 2.

2. What is the remainder in each case?

99. A number which is exactly divisible by 2 is an *even* number.

3. Write down five other even numbers.

4. Divide the numbers 3, 5, 7, 9, and 11 by 2.

5. What is the remainder in each case?

100. A number which is not exactly divisible by 2 is an *odd* number.

6. Write down five other odd numbers.

7. What two whole numbers other than 1 and the number itself will, when multiplied together, make 4? 6? 9? 10? 15?

101. Numbers like 4, 6, 9, 10, and 15, that can be formed by multiplying together two or more integral numbers, each greater than 1, are called *Composite Numbers*.

8. Find five composite numbers greater than 15.

9. What are the only two whole numbers which, multiplied together, will produce 2? 5? 7? 11? 13?

102. Numbers like 2, 5, 7, 11, and 13, that cannot be produced by multiplying together two or more integral numbers, each greater than 1, are called *Prime Numbers*.

103. The numbers that, multiplied together, produce a composite number, are called the *factors* of that number.

10. Find five prime numbers greater than 13.

11. Three is a factor of 6, 9, 12, 15, 24, or 33. Find the other factor in each case.

12. Five is a factor of 15, 20, 25, 35, 55, or 60. Find the other factor in each case.

13. Given one factor of a number, how is the other factor found?

104. A *factor* of a number is an *exact divisor* of that number.

DIVISIBILITY OF NUMBERS

There are various tests of divisibility of Numbers which may be easily illustrated. The following are perhaps the most useful:—

105. A number is divisible by 2 if the units are so divisible or if it ends in 0. Thus, in 84 or 80+4 must be divisible by 2 if 4 is so divisible because 80 is divisible by 2.

106. A number is divisible by 5 if it ends in 0 or 5.

107. A number is divisible by 3 if the sum of its digits is so divisible. Thus, 612 is divisible by 3. The sum of the digits is 9 which is divisible by 3.

108. A number is divisible by 4 if the number represented by the two right hand figures is so divisible.

109. A number is divisible by 6 if it is even and the sum of its digits is divisible by 3.

110. A number is divisible by 8 if the number represented by the three right hand figures is so divisible.

111. A number is divisible by 9 if the sum of its digits is so divisible.

EXERCISE 97

1. Which of the following numbers are exactly divisible by 2, 4, or 8:—880, 3027, 1356, 5214, 2005, 4144, 125474, 1000, 3087, 4044, 1296?

2. Which of the following are divisible by 5:—3127, 4203, 5125, 4300, 1003, 41250, 3225, 4527?

3. Which of the following are divisible by 3, 6 or 9: 1236, 8228, 1239, 7117, 4344, 21476, 203640, 212486?

PRIME FACTORS

112. The **Prime Factors** of a number are the prime numbers which, when multiplied together, will produce it; thus, 2, 2, and 3 are the prime factors of 12.

INTRODUCTORY EXERCISE

1. What are the prime factors of 12? 16? 15? 18? 35?
2. What are the prime factors of 21? 25? 27? 32? 34?
3. What are the prime factors of 30? 36? 42? 45? 60?
4. Name the prime numbers from 16 to 53; from 53 to 101.
5. What prime factor is found in both 6 and 9?
6. What prime factor is found in both 20 and 26?
7. What prime factor is common to 12 and 30? 21 and 28?

8. What prime factor is common to 35 and 50? 14 and 70? 33 and 99? 42 and 48? 26 and 39?

9. To resolve a number into its prime Factors.

Example 1. Find the prime factors of 105.

$$\begin{array}{r} 3)105 \\ 5)35 \\ 7 \end{array}$$

EXERCISE 98

Find the prime factors of:—

1.	48	6.	160	11.	855
2.	72	7.	325	12.	1155
3.	81	8.	429	13.	1250
4.	108	9.	270	14.	1024
5.	175	10.	800	15.	1375

EXERCISE 99

What prime factors are common to:—

1. 50 and 70?
2. 81 and 96?
3. 40 and 54?
4. 27 and 72?
5. 72 and 112?
6. 63 and 147?
7. 120 and 600?
8. 315 and 525?
9. 500 and 600?
10. 360 and 480?

EXERCISE 100

1. Write the numbers less than 50 of which 7 is a factor.

2. Write the numbers between 200 and 300 of which 13 is a factor.

3. Make a list of numbers from 1 to 40 that have 5 for a factor.

4. What is the right-hand figure of the numbers which have 5 for a factor?

5. Make a list of numbers from 1 to 130 that have 9 for a factor.

6. Find the sum of the digits of each of the numbers selected in example 5 and divide each result by 9. What is the remainder in each case?

7. Write the odd numbers between 20 and 40.

8. Write down all numbers less than 144 of which 11 is a factor.

9. Find the largest factor other than the number itself of each of the following numbers:—18, 42, 729, 579, 913.

SECTION II. CANCELLATION

INTRODUCTORY EXERCISE

1. Divide 24 by 6.

   Divide both 24 and 6 by 2. Find how many times the quotient 12 contains the quotient 3.

   In this example, what is the effect upon the answer of dividing both divisor and dividend by 2?

2. Divide 105 by 35.

   Divide both 105 and 35 by 5. Find how many times the quotient 21 contains the quotient 7.

   In this example, what is the effect upon the answer of dividing both divisor and dividend by 5?

3. What is the effect upon the result of rejecting equal factors from both divisor and dividend?

118. The process of shortening operations in division by rejecting or *cancelling* equal factors common to both dividend and divisor, is *Cancellation*.

Example 1. Divide $18\times36\times48$ by $24\times54\times12$.

$$\frac{\overset{1}{18}\times\overset{3}{36}\times\overset{2}{48}}{\underset{1}{24}\times\underset{3}{54}\times\underset{1}{12}}=\frac{1\times3\times2}{1\times3\times1}=\frac{1\times1\times2}{1\times1\times1}=2.$$

EXERCISE 101

1. Divide $16\times4\times5$ by $8\times2\times10$.
2. Divide $7\times96\times6$ by $14\times3\times8$.
3. Divide $9\times7\times16\times16$ by $21\times32\times2$.
4. Divide $27\times12\times14$ by $9\times4\times7$.
5. Divide $72\times45\times140$ by $18\times24\times35$.
6. Divide $24\times32\times36\times144$ by $64\times108\times8$.
7. How many yards of muslin, worth 12c. a yard, may be bought for 16 lb. of butter, worth 15c. a pound?
8. How many bushels of potatoes at 75c. a bushel must a farmer give for 36 yd. of carpet worth $1.50 a yard?
9. A tailor bought 12 pieces of cloth, each containing 22 yd., worth $2.25 a yard; he made 27 suits of clothes. How much must he get per suit so as not to lose?
10. If a farmer exchanged 75 bu. of wheat at 72c. a bushel for cloth at 40c. a yard, how many yards does he get?
11. Three pieces of cloth containing 30 yd. each, worth $5 a yard, were exchanged for 5 pieces of cloth containing 45 yd. each. What was the second kind worth per yard?

SECTION III. THE HIGHEST COMMON FACTOR

INTRODUCTORY EXERCISE

1. With what lengths of stick can a distance of 6 ft. be exactly measured? One of 9 ft? One of 8 ft? One of 5 ft.?

2. What units will measure 12 lb.? 15 lb.? 20 lb.?

3. What units of measure are common to both $12 and $15? to $20 and $25? to $20 and $30?

4. What lengths of stick will exactly measure 24 ft. or 30 ft.? 20 ft. or 25 ft.? 24 ft. or 28 ft.?

5. What are all the measures of 15? of 16? of 18? of 20?

6. What are all the factors of 15? of 16? of 18? of 20?

7. Compare the measures of a number with its factors.

8. Find all the common measures of 24 and 30; of 24 and 32; of 24 and 36.

INTRODUCTORY EXERCISE

Name a common factor:—

1. Of 6 and 9.
2. Of 12 and 10.
3. Of 27 and 24.
4. Of 16 and 20.
5. Of 12 and 18.
6. Of 16 and 40.

What is the highest common factor:—

7. Of 12 and 10?
8. Of 20 and 15?
9. Of 25 and 50?
10. Of 24 and 72?
11. Of 24 and 12?
12. Of 72 and 144?

114. A number that will exactly divide each of two or more numbers, is a *Common Factor* of these numbers.

115. The largest number that will exactly divide each of two or more numbers, is the *Highest Common Factor* (H.C.F.) or Greatest Common Measure, (G.C.M.) of these numbers.

Name a common factor:—

13. Of 12 and 35.
14. Of 15 and 28.
15. Of 24 and 35.
16. Of 36 and 55.
17. Of 28 and 45.
18. Of 55 and 56.

116. Numbers that have no common factor other than one, are said to be *Prime to one another.*

Example 1. Find the highest common factor of 24, 36 and 54.

The following method is the one commonly adopted for small numbers:—

The prime factors of 24 are: $2\times2\times2\times3$.

The prime factors of 36 are: $2\times2\times3\times3$.

The prime factors of 60 are: $2\times2\times3\times5$.

The common factors are: 2, 2, 3.

The H.C.F. is $2\times2\times3=12$.

EXERCISE 102

Find the H.C.F. or G.C.M. by using prime factors of:—

1. 24 and 90.
2. 36 and 84.
3. 48 and 128.
4. 65 and 143.
5. 42 and 189.
6. 15, 20, 30.
7. 16, 20, 24.
8. 24, 96, 80.
9. 28, 56, 42.
10. 30, 50, 60.
11. 84, 126, 210.
12. 120, 240, 72.
13. 44, 110, 77.
14. 75, 300, 450.

The method of finding the H.C.F. by factors is tedious when the numbers are large and the factors are not readily detected.

To find the H. C. F, when the numbers are large, by the method of successive divisions,

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

52)91(1
52
39)52(1
39
13)39(3
39

This depends on the following principle:—

Any number that will divide two other numbers will divide their sum or difference.

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 lesser.*

(2) *Divide the lesser 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.*

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.

In finding the H. C. F. by the method of successive divisions emphasis should be placed upon the mechanical process and not upon the understanding of the process.

EXERCISE 103

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. 1435, 1084 and 2135.
10. 14385, 20391 and 49287.

EXERCISE 104

1. A man has two logs which he wishes to cut into boards of equal length; one is 24 ft. and the other is 16 ft. long. What is the greatest length into which the boards can be cut?

2. What is the greatest equal length into which two trees can be cut, one being 105 ft. in length and the other 84 ft.?

3. Three pieces of carpet, of 48 yd., 64 yd., and 80 yd., respectively, if cut into the longest possible equal lengths, will exactly fit a parlor floor, each piece being the length of the parlor. How long is the parlor?

4. A grocer has 136 qt. of strawberries, and 52 qt. of plums which he wishes to put into boxes, each box to hold the same number of quarts and the largest number possible. How many quarts may be put into each box?

5. A certain school consists of 132 pupils in the lower school, and 99 in the upper school. How might each of these be divided so that the whole school should be distributed into equal sections?

6. Jack has 475 lb. of sugar and Tom has 817 lb. to put up into parcels of the same weight. Find the fewest number of parcels each must put up.

7. Find the largest number that will divide 661, 876, and 1004, leaving as remainders 10, 15, and 17, respectively.

8. Two journeys of 945 mi. and 864 mi. are portioned into equal daily distances. Find the daily journey.

9. Two cisterns are of 4672 gal. and 5088 gal., respectively. Find the largest barrel capable of measuring both cisterns.

10. A farmer has two farms, 640 rd. by 480 rd., and 680 rd. by 560 rd., respectively. He desires to lay them out in square fields of the largest side possible. Find the length of the side in yards.

11. A farmer has three fields containing 24 a., 30 a., and 42 a. He wishes to cut them into smaller fields of an equal number of acres each. How large will the fields be and how many will there be if they are the largest possible?

12. Three pieces of lead, weighing respectively 24 oz., 32 oz., and 40 oz., were cast without waste into balls of equal weight and as heavy as possible. What was the weight of each ball?

SECTION IV. LEAST COMMON MULTIPLE

1. What number is three times 5? four times 7? eight times 9?

117. A *Multiple* of a given number is a number which is one or more times that number. Thus, 15 is a multiple of 5, 28 is a multiple of 7, and 72 is a multiple of 9.

2. Write down the first eight multiples of 3, 5, 6, 7, 8, 9 and 11.

Why are these numbers multiples of 3, 5, 6, 7, 8, 9 and 11?

3. The following is a list of the first 15 multiples of 2, 3 and 4 respectively:—

2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30.

3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45.

4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60.

Which of the multiples of 2 are also multiples of 3?

What multiples have 2, 3 and 4 in common? These multiples, 12, 24, 36, and 48 are called *Common Multiples* of 2, 3, and 4.

Which of these four common multiples is the least? This multiple 12, is called the *Least Common Multiple* of 2, 3, and 4.

118. A *Common Multiple* of two or more numbers is a number which is one or more times each of the given numbers.

119. The *Least Common Multiple* (L. C. M.) of two or more numbers is the least number which is one or more times each of the given numbers.

Example 1. Find the L. C. M. of 15, 24, 36, and 42.

Solution:—$15=3\times5$. $36=2\times2\times3\times3$.
$24=2\times2\times2\times3$. $42=2\times3\times7$.

The L. C. M. of these numbers must be a number which will contain all the prime factors of each of the numbers. There must be three 2's because there are that many in 24. There must be two 3's because there are that many in 36. There must be a factor, 5, as it is in 15, and a factor 7, as it is in 42. Hence the L. C. M. of these numbers will be $2\times2\times2\times3\times3\times5\times7=2520$.

EXERCISE 105

Find by using the prime factors the L. C. M. of:—

1. 16, 12, 18.
2. 8, 24, 36.
3. 9, 54, 72.
4. 30, 60, 35.
5. 32, 64, 56.
6. 960, 720, 840.

The common method of showing the factors and of finding the L. C. M. of two or more numbers is as follows:—

2)15, 24, 36, 42
2)15, 12, 18, 21
3)15, 6, 9, 21
5, 2, 3, 7

Here 2, 2, 3, are the prime factors common to two or more of the numbers, and 5, 2, 3, 7 are the factors not common.

L. C. M. $=2\times2\times3\times5\times2\times3\times7=2520$.

Find how many times the L. C. M. of 15, 24, 36, and 42 contains each of the numbers.

EXERCISE 106

Find the L. C. M.:—

1. Of 15, 10 and 5.
2. Of 20, 10 and 30.
3. Of 9, 12 and 18.
4. Of 10, 25 and 30.
5. Of 24, 30 and 36.
6. Of 5, 9, 12 and 15.
7. Of 12, 15, 18 and 24.
8. Of 22, 55, 77 and 110.
9. Of 15, 30, 42 and 72.
10. Of 21, 54, 56 and 84.

SECTION V. EXERCISES

EXERCISE 107

1. What is the least number which, divided by 8, by 12, or by 14, gives in each case the remainder 5? 173

2. What is the least sum of money for which I can purchase sheep at $6, or cows at $28, or horses at $150 a head? $2100

3. What is the least number of bushels of wheat that would make an exact number of full loads for three drays hauling, respectively, 24 bu., 30 bu., or 36 bu. a load? 360 bu.

4. What is the least number of cents with which you could buy an exact number of lemons at 6c. each, or oranges at 8c., or bananas at 10c., or pineapples at 16c.? $2.40

5. How many bushels would fill a number of barrels each containing 3 bu., or a number of sacks, each containing 4 bu., or a number of casks, each containing 14 bu., the quantity to be the same in each case, and the smallest possible? 84

6. What must be the capacity of a cask which can be emptied exactly by measures of 3 pt., 1 qt., 2 qt. 1 pt., 3 qt. 1 pt., and 1 gal.? 105 gal.

7. What is the least size of a farm that may be divided into 13-acre lots, 14-acre lots, or 21-acre lots? 546 ac.

8. Find the least capacity of a cistern so that it could be filled in an exact number of minutes by each of three pipes which supply 42 gal., 63 gal., or 147 gal. per minute. 5880 gal.

EXERCISE 108

1. A farmer sold 4 loads of apples, each containing 15 bbl., and each barrel 3 bu., at 60c. a bushel. He received as payment 6 bbl. of pork, each weighing 200 lb. What was the pork worth a pound? 9c.

2. The product of two numbers is 152368, and 7 times one of them is 2996. What is the other one? 356

3. How many rails will enclose a field 7163 ft. long by 3315 ft. wide, provided the fence is straight, 6 rails high, the rails of equal length, and the longest that can be used? 13'-rails 4836 rails.

4. A farmer exchanged 9 tubs of butter, each containing 56 lb., worth 25c. per pound, for 4 chests of tea, each containing 42 lb. What was the tea worth per pound? 75·4

5. What is the smallest sum of money with which I can buy sheep at $5 each, cows at $24 each, oxen at $54 each, or horses at $135 each? $1080

6. Divide the continued product of 51, 72, 144, 972, and 750 by the continued product of 9, 17, 18, 24, 36, and 45. 3600

7. Find the least number which, divided by 1595, 2530, or 3168, will leave the same remainder, 719. 1086335719

8. The following are the prime factors of a number: 2, 2, 3, 5, 5, 7, 11, 11, 13, 19, 89, and 227. Find the number. 126183339 8100

9. State the rule for finding the H. C. F. of two numbers, and find the H. C. F. of 1287000 and 504504. 4

10. The fore and hind wheels of a carriage are 12 and 16 feet in circumference. Find the least number of revolutions of each that will give the same length.
4 & 3 in going 48 ft.

CHAPTER VI

FRACTIONS

SECTION I. DEFINITIONS AND REDUCTIONS

1. A FRACTION AND ITS TERMS

INTRODUCTORY EXERCISE

1. If 12c. are divided equally between Jack and Tom, how many cents will each receive? What part of the money does each receive? How do you find the half of 12c.?

2. Draw a line 8 in. long and divide it into two equal parts. How many inches are there in each part? What part of the whole line is in each part? How do you find the half of 8 in.?

3. Find the half of 18 in.; of 24 in.; of 36 in.; of 16 acres; of 38 acres; of $46.

4. How is the half of anything found? How do you divide anything into halves? How many half feet are there in 1 ft.? half dollars in $1? half inches in 1 in.?

5. Find the sum of one-half of $18, one-half of $24, and one-half of $40.

6. Add together one-half of 26 acres, one-half of 42 acres, one-half of 100 acres, and one-half of 48 acres.

7. From one-half of 16 acres take one-half of 10 acres.

8. From $15 take the sum of one-half of $6 and one-half of $10.

9. How much is 5 times one-half of 18 lb.?

10. How often is one-half of 12 mi. contained in 48 mi.?

INTRODUCTORY EXERCISE

1. Divide a line 8 in. long into 4 equal parts.

2. How many inches are there in each part?

3. What part of the whole line is each part?

4. What part of the whole line is one of the parts? two of the parts? three of the parts? four of the parts.

5. Find the quarter of 12 in.; of 16 in.; of 24 a.; of 40 acres.

6. How is the quarter of anything found? How do you divide anything into quarters? How many quarter-dollars are there in 1 dollar? quarter ft. in 1 ft.? quarter-inches in 1 in.

7. Divide a circle into fourths, or quarters.

8. Fold a sheet of paper into fourths, or quarters, having the folds run lengthwise. Fold a sheet of paper into fourths, having the folds run crosswise.

9. Find the sum of one-fourth of $20, and one-fourth of $36.

INTRODUCTORY EXERCISE

1. Divide a 12 in. line into halves by a line.

Divide it into quarters by shorter lines.

How many inches are there in half the whole line? in one quarter the whole line?

2. Compare half the whole line with one-quarter of it.

3. Compare one-fourth of the whole line with one-half of it.

4. How many fourths are there in one-half the line?

5. Compare the half of $36 with the quarter of $36.

6. Compare the half of 20 in. with the quarter of 20 inches.

7. Find the sum of one-fourth of $20, and one-half of $30.

8. From one-half of 40 bushels take one-fourth of 36 bushels.

9. To one-fourth of 12 inches add one-half of 12 inches.

INTRODUCTORY EXERCISE

1. Draw a line 12 in. long and divide it into three equal parts. What is the length of each part? What part of the whole line is each part? What part of the whole line are two of the equal parts? three of the equal parts?

2. Draw a square 6 in. long, and divide it into thirds.

3. Draw a rectangle 9 in. long and 3 in. wide, and divide it into thirds.

4. Find one-third of $15; of 24 hr.; of 30 a.; of 18 qt.

5. How is the third of anything found? how do you divide anything into thirds? how many thirds of a dollar are there in 1 dollar? thirds of a foot in 1 ft.? thirds of a yard in 1 yd.?

6. Find two-thirds of $9; of 12 hr.; of 15 pens; of 21 yd.

7. Find one-third of $12, and compare it with one-fourth of $12.

8. Compare one-third of 18 bu. with one-half of 18 bu.

9. Find the sum of one-third of $12, one-third of $18, and one-third of $24.

10. Find the sum of one-third of 36 in. and two-thirds of 36 in.?

INTRODUCTORY EXERCISE

1. Divide a line 12 in. long into halves; then into thirds; and then into quarters.

How does one-half the line compare with one-third of it? one-third with one-quarter of it?

2. How many halves are there in the line? How many thirds? How many quarters?

3. Find the sum of two-thirds of 12 pens, three-quarters of 16 pens, and one-half of 8 pens.

4. From one-third of $21 take three-quarters of $8.

5. If a line is divided into three equal parts, what is one of the equal parts called?

6. If a line is divided into four equal parts, what is one of the equal parts called?

7. If a line is divided into five equal parts, what is one of the equal parts called? two of them? three of them? four of them? five of them?

8. What is the name of one of the equal parts when a line is divided into 6 equal parts? into 8 equal parts? into 10 equal parts?

9. A whole thing is equal to how many halves of it? to how many thirds of it? to how many fourths of it? to how many eighths of it? to how many twelfths of it?

10. Find the difference in length between three-eighths of a line 16 in. long, and three-fourths of the same line.

11. State how to obtain the following parts of anything:—One-half, one-quarter, two-quarters, three-quarters, one-third, two-thirds, one-fifth, three-fifths.

120. Such portions of a thing are called fractions of that thing. Hence a **fraction** of anything is *one* or *more* of the equal parts into which it has been divided.

Fractional Units Resulting from Division

In Section I Chapter II we called attention to *Abstract Units* and *Concrete Units*, or *Number* and *Quantity*. In *Addition*, *Subtraction* and *Multiplication* the operation can always be completely performed, and the resulting numbers of quantities are of the same kind as those appearing in the processes. That this is not always true of *Division* will be seen in the following example:—

Example 1. If 13 apples be divided among 4 girls, how many apples will each receive? Each girl will receive one-fourth of 13 apples.

In dividing the apples among the 4 girls we see that each girl receives 3 apples and that one apple remains. If the division is carried on each girl will receive one-fourth of the remaining apple so that each will receive 3 apples and one-fourth of an apple whichmay be expressed $3\frac{1}{4}$ apples. Read three and one-fourth apples.

We have in this example a quantity $\frac{1}{4}$ apple and as the concrete unit is 1 apple, and $\frac{1}{4}$ the measure of the quantity $\frac{1}{4}$ apple it is therefore a number. Such a quantity is called a *Fractional unit*, and such numbers $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, etc., *Fractional numbers*, or fractions to distinguish them from whole numbers such as 2, 3, 4, 6, etc.

Example 2. If 15 apples were divided among 4 girls, how many apples should each receive? Each girl will receive one-fourth of 15 apples.

Each girl, then, receives 3 apples and 3 apples still remain to be divided up. When this is done each girl will receive 3-fourths of an apple in addition to what she already has, making $3\frac{3}{4}$ apples, read three and three-fourths apples. $\frac{3}{4}$ apples is then a *fractional number* or a *fraction*.

(The above examples should be illustrated concretely.)

EXERCISE 109

1. Find $\frac{1}{2}$ of 15, 19, 17, 21, 25, 23.
2. Find $\frac{1}{3}$ of 19, 23, 28, 35, 38, 31.
3. Find $\frac{1}{4}$ of 17, 21, 27, 33, 35, 49.
4. Find $\frac{1}{5}$ of 38, 43, 56, 64, 59, 62.
5. Find $\frac{1}{6}$ of 74, 65, 68, 53, 71, 68.
6. Find $\frac{1}{8}$ of 99, 91, 87, 75, 63, 52.
7. Find $\frac{1}{10}$ of 89, 102, 74, 69, 84, 53.
8. Find $\frac{1}{12}$ of 87, 53 ft. 109 in., 48 pounds.

INTRODUCTORY EXERCISE

1. What is the unit in 4? in 8 bu.? in 12 in.? in 5 mi.?

In these numbers the unit is a whole, and these are called *whole or integral numbers*.

2. What is the unit in 5-sixths? in 3-fourths? in 4-fifths of an inch? in 3-eighths of a mile?

In these numbers the unit is fractional and *the numbers are fractions*.

3. What determines whether a number is whole or fractional?

What is the unit and what kind of a number is:—

4. 6 in?
5. 9 mi.?
6. 9-twelfths of an inch?
7. 4-fifths of a dozen?
8. 3-quarters of an hr.?
9. 25?

A fractional unit is expressed by placing 1 above a short line and the number which shows into how many equal parts the prime unit is divided below the line.

Thus: 1-fourth is written $\frac{1}{4}$; 1-eighth in., $\frac{1}{8}$ in.

10. Write in figures the fractional units in 1-sixth; 5-ninths; 7-twelfths of a mi.; 5-twelfths of a foot.

The fraction is expressed by writing the number showing how many fractional units are to be considered above the line in the place of 1. Thus: 3-fourths is written $\frac{3}{4}$; 5-eighths, $\frac{5}{8}$.

11. Express the following:—5-sixths; 4-ninths of a min.; 7-twelfths of a foot.

121. The number written below the line, which expresses into how many equal parts the prime unit is divided, is called the *Denominator*, or *name-giver*.

122. The number written above the line, which expresses how many of the fractional units are included in the fraction, is called the *Numerator*, or *number teller*.

Read the following, and state what each part of the fraction tells:—

12. $\frac{1}{4}$ in. 14. $\frac{5}{16}$ lb. 16. $\frac{8}{9}$ 18. $\frac{5}{13}$
13. $\frac{2}{3}$ yd. 15. \$$\frac{1}{3}$ 17. $\frac{6}{7}$ mi. 19. \$$\frac{7}{8}$

Write in numerals:—

20. Five-sixths of a ft.
21. Five-ninths of an hr.
22. Seven-twelfths.
23. Three-fourths of a mi.

Express in words:—

24. $\frac{7}{8}$ 27. $\frac{1}{3}$ hr. 30. $\frac{1}{9}$ week.
25. $\frac{5}{6}$ 28. $\frac{2}{3}$ 31. $\frac{3}{11}$ mi.
26. $\frac{3}{7}$ mi. 29. $\frac{5}{12}$ yd. 32. $\frac{4}{5}$

INTRODUCTORY EXERCISE

Find the value of the following:—

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

II. PROPER FRACTIONS, IMPROPER FRACTIONS, AND MIXED NUMBERS

INTRODUCTORY EXERCISE

1. (*a*) Name the units in the following:—$\frac{1}{2}$ apple, $\frac{1}{3}$., $\frac{3}{4}$ lb., \$$\frac{2}{5}$, $\frac{5}{7}$ lb., $\frac{1}{8}$ hr.

(*b*) How does the value of each fraction compare with that of the primary unit?

(*c*) How does the numerator of each fraction compare with the number expressing its denominator?

123. Fractions in which the numerator is less than the denominator, are *Proper Fractions*.

2. Name all the proper fractions with the following denominators:—3, 4, 5, 6, and 8.

3. (*a*) Name the units in each of the following:—$\frac{2}{2}$, $\frac{3}{3}$, $\frac{4}{4}$, apple, \$$\frac{5}{5}$.

(*b*) How does each fraction compare with its unit in value?

(*c*) Compare the numerator of each fraction with its denominator.

4. (*a*) Compare the value of the following fractions with that of the primary unit:—$\frac{3}{2}$, $\frac{4}{3}$, $\frac{5}{3}$, $\frac{5}{4}$ ft., \$$\frac{6}{5}$.

(*b*) Compare the numerator of each with its denominator.

124. Fractions in which the numerator is equal to or greater than the denominator, are *Improper Fractions*.

5. Name three improper fractions having 4 for denominator; having 5 for denominator.

6. John had \$1; his father gave him \$$\frac{1}{2}$ more. How much had he altogether? How is \$1$\frac{1}{2}$ found?

7. A man bought 4 a. of land from *A* and $\frac{3}{4}$ a. from *B*. How much land did he buy? How is $4\frac{3}{4}$ a. found from 4 a. and $\frac{3}{4}$ a.?

8. Express the sum of 6 and $\frac{2}{3}$; of 4 and $\frac{5}{8}$; of 3 and $\frac{2}{5}$.

125. Numbers like $6\frac{2}{3}$, $4\frac{5}{8}$, and $3\frac{2}{5}$, consisting of a whole number and a fraction, are called *Mixed Numbers*.

9. Using the numbers 4 and 7, and the fractions $\frac{3}{4}$, $\frac{1}{3}$, and $\frac{2}{7}$, form as many mixed numbers as possible.

10. Arrange the following fractions into three classes as proper fractions, improper fractions, or mixed numbers:

$\frac{5}{3}$, $2\frac{1}{4}$, $\frac{3}{7}$, $\frac{4}{5}$, $\frac{9}{4}$, $2\frac{3}{5}$, $3\frac{1}{7}$, $\frac{22}{7}$, $\frac{7}{12}$, $\frac{5}{12}$, $\frac{12}{5}$, $2\frac{2}{5}$.

III. REDUCTION OF WHOLE OR MIXED NUMBERS TO IMPROPER FRACTIONS

INTRODUCTORY EXERCISE

1. (*a*) How many pints are there in 3 quarts?
(*b*) How many halves of a foot are there in 3 ft.? in 5 ft.? in 7 ft.?

2. (*a*) How many pints are there in 3 quarts 1 pt.?
(*b*) How many half-feet are there in 3 ft. and $\frac{1}{2}$ ft.?

3. (*a*) How many quarts are there in 6 gal. 3 qt.?
(*b*) How many quarters are there in $\$6\frac{3}{4}$?

4. How many inches are there in 5 ft. 8 in.?
(*b*) How many twelfths are there in $5\frac{8}{12}$?

Reduce $8\frac{3}{4}$ to fourths:—

Since 1 = 4 fourths.

8 = 8 times 4 fourths = 32 fourths.

$8\frac{3}{4}$ = 32 fourths + 3 fourths = 35 fourths = $\frac{35}{4}$.

EXERCISE 110

Reduce to improper fractions:—

1. $4\frac{1}{2}$	5. $4\frac{5}{9}$	9. $16\frac{1}{8}$
2. $5\frac{1}{4}$	6. $7\frac{2}{3}$	10. $24\frac{3}{8}$
3. $7\frac{3}{8}$	7. $8\frac{3}{10}$	11. $18\frac{1}{7}$
4. $7\frac{5}{6}$	8. $5\frac{7}{12}$	12. $20\frac{7}{12}$

13. How are mixed numbers reduced to improper fractions?

14. A man divided $\$8\frac{3}{4}$ equally among 5 boys. How many quarter dollars did each receive?

15. How many lots, each containing $\frac{3}{8}$ a., would $7\frac{1}{8}$ a. make?

IV. REDUCTION OF IMPROPER FRACTIONS TO WHOLE OR MIXED NUMBERS

EXERCISE 111

1. How many yards are there in 6 ft.? in 15 ft.?

2. How many feet are there in $\frac{8}{3}$ ft.? in $\frac{16}{3}$ ft.?

3. How many dollars are there in $\$\frac{20}{4}$? in $\frac{20}{4}$? in $\frac{41}{4}$?

4. How many units are there in $\frac{8}{2}$? in $\frac{12}{3}$? in $\frac{130}{6}$?

5. How many dollars will be needed to give each of 25 boys $\$\frac{1}{4}$?

6. How many units are there in $\frac{22}{5}$? in $\frac{17}{4}$? in $\frac{27}{5}$? In $\frac{7}{6}$.

Reduce the following fractions to whole or mixed numbers:—

7. $\frac{10}{5}$	10. $\frac{20}{3}$	13. $\frac{103}{7}$	16. $\frac{305}{12}$
8. $\frac{31}{6}$	11. $\frac{102}{6}$	14. $\frac{117}{9}$	17. $\frac{443}{11}$
9. $\frac{45}{7}$	12. $\frac{70}{6}$	15. $\frac{423}{10}$	18. $\frac{327}{19}$

V. REDUCTION TO LOWEST TERMS

INTRODUCTORY EXERCISE

1. Draw a line 8 in. long and divide it into fourths.

How many inches are there in each quarter of the line?

By shorter cross lines, divide the line into eighths.

How many inches are there in each eighth of the line?

How many eighths of the line are equal to one-quarter of it?

How does the quarter of the line compare with an eighth of it?

How does an eighth of that line compare with the quarter of it?

How many eighths are there in two-quarters?

2. Divide a line 6 in. long into halves and also into sixths. How many inches are there in half the line? in one-sixth of it?

How does half the line compare with one-sixth of the line?

How does one-sixth of the line compare with one-half of the line?

3. Divide a line 6 in. long into thirds and also into sixths.

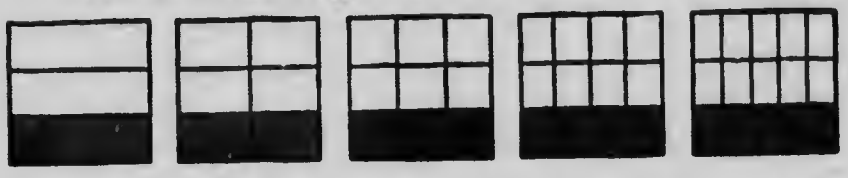
How many inches are there in one-sixth of the line? in one-third of the line?

How does one-third of the line compare with one-sixth of it?

How does one-sixth of the line compare with one-third of it?

4. How many ninths are there in one-third? in two-thirds?

Examine these diagrams to determine the following:



5. How many twelfths are there in one-third? in two-thirds?

6. How many twelfths are there in one-sixth? in two-sixths? in three-sixths? in four-sixths?

7. How many fifteenths are there in one-third? in two-thirds?

8. Show that 5-fifteenths are equal to 1-third; that 4-twelfths are equal to 1-third.

9. Prove $\frac{1}{3}=\frac{4}{12}$, $\frac{2}{3}=\frac{10}{15}$; $\frac{3}{5}=\frac{9}{15}$.

10. Compare $\frac{1}{4}$ with $\frac{1}{8}$; $\frac{1}{2}$ with $\frac{1}{6}$; $\frac{1}{3}$ with $\frac{1}{6}$; $\frac{1}{3}$ with $\frac{1}{9}$.

11. What has been done to both terms of $\frac{1}{4}$ to produce $\frac{3}{8}$? of $\frac{1}{2}$ to produce $\frac{3}{6}$? of $\frac{1}{3}$ to produce $\frac{2}{6}$? of $\frac{1}{3}$ to produce $\frac{3}{9}$? of $\frac{1}{3}$ to produce $\frac{4}{12}$?

12. What is the effect upon the value of a fraction of multiplying both its terms by the same number?

INTRODUCTORY EXERCISE

1. How many twelfths are there in $\frac{1}{2}$? In $\frac{2}{2}$? In $\frac{3}{2}$? In $\frac{1}{3}$? In $\frac{2}{3}$? In $\frac{3}{3}$? In $\frac{1}{4}$? In $\frac{2}{4}$? In $\frac{3}{4}$? In $\frac{4}{4}$? In $\frac{1}{6}$? In $\frac{5}{6}$?

2. In $\frac{2}{3}$, by what number must the denominator be multiplied to produce 12?

3. So that the value of $\frac{2}{3}$ may not be changed, by what number must both terms be multiplied to produce twelfths?

4. By what number must both terms of $\frac{3}{4}$ be multiplied to produce eights? twentieths? twenty-eights?

5. Insert numerators in the following:—

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

6. Insert denominators in the following:—

$\frac{1}{4} = \frac{2}{\quad}$; $\frac{3}{5} = \frac{10}{\quad}$; $\frac{5}{6} = \frac{20}{\quad}$; $\frac{3}{8} = \frac{9}{\quad}$.

7. To what fraction, with one for numerator, is each of the following equal?

$\frac{2}{4}$? $\frac{2}{6}$? $\frac{3}{6}$? $\frac{3}{12}$? $\frac{4}{12}$? $\frac{6}{12}$? $\frac{3}{9}$?

8. What has been done to both numerator and denominator of $\frac{2}{4}$ to produce $\frac{1}{2}$? of $\frac{2}{6}$ to produce $\frac{1}{3}$? of $\frac{3}{9}$ to produce $\frac{1}{3}$? of $\frac{3}{12}$ to produce $\frac{1}{4}$?

9. What is the effect upon the value of a fraction of dividing both terms by the same number?

126. Hence, **the value of a fraction is not changed by multiplying or dividing both its terms by the same number.** This is the fundamental principle of fractions.

10. Reduce $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ to twelfths, and $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{6}$ each to twenty-fourths.

11. Reduce $\frac{3}{12}$, $\frac{5}{20}$, and $\frac{21}{28}$ each to fourths, and $\frac{3}{9}$, $\frac{4}{12}$, and $\frac{5}{15}$ each to thirds.

EXERCISE 112

1. What integral factor greater than one is common to the numerator and denominator in the following:—

$\frac{6}{8}$, $\frac{9}{15}$, $\frac{8}{9}$, $\frac{12}{18}$, $\frac{2}{8}$, $\frac{20}{25}$, $\frac{14}{18}$, $\frac{20}{24}$, $\frac{15}{28}$?

127. A fraction, such as $\frac{9}{15}$, $\frac{8}{9}$, $\frac{14}{18}$, or $\frac{15}{28}$, whose numerator and denominator are prime to each other, is in its *lowest terms*.

2. Which of the following fractions are in their lowest terms:—$\frac{8}{9}$, $\frac{8}{12}$, $\frac{12}{25}$, $\frac{9}{14}$, $\frac{9}{15}$, $\frac{12}{18}$, $\frac{16}{18}$, $\frac{21}{28}$?

Example 1. Reduce the following fractions to their lowest terms:—

3. $\frac{4}{8}$	6. $\frac{9}{12}$	9. $\frac{11}{22}$	12. $\frac{14}{16}$
4. $\frac{12}{18}$	7. $\frac{8}{20}$	10. $\frac{14}{21}$	13. $\frac{11}{33}$
5. $\frac{8}{12}$	8. $\frac{10}{15}$	11. $\frac{18}{30}$	14. $\frac{14}{16}$

VI. REDUCTION TO COMMON DENOMINATOR

INTRODUCTORY EXERCISE

1. Which is the greater, and by how much, 6 gal. or 23 qt.? 4 yd. or 13 ft.? 2 lb. or 35 oz.?

2. Before quantities can be compared, in what unit must they be expressed?

3. Arrange the following fractions into groups having the same denominator:—

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

128. Fractions which have the *same number for denominator*, are said to have a *common denominator*.

4. Write four fractions with 9 for a common denominator; three with 10 for a common denominator.

5. What is the fractional unit in $\frac{3}{4}$? In $\frac{7}{8}$? In what common fractional unit can $\frac{3}{4}$ and $\frac{7}{8}$ be expressed to compare them?

6. Change $\frac{1}{2}$ and $\frac{5}{6}$ to fractions having a common fractional unit or common denominator.

7. (*a*) Reduce $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{7}{8}$ to equivalent fractions having the least common denominator.

(*b*) What is the number 8 with regard to 2, 4, and 8?

(*c*) By what were the terms of $\frac{1}{2}$ multiplied to produce eighths?

(*d*) By what were the terms of $\frac{3}{4}$ multiplied to produce eighths?

(*e*) What principle is used in reducing $\frac{1}{2}$ to eighths? $\frac{3}{4}$ to eighths?

Example 2. Reduce $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{7}{8}$ to equivalent fractions with least common denominator.

L. C. M. of 4, 6, 8 = 24.

$$\frac{3}{4} = \frac{6 \times 3}{6 \times 4} = \frac{18}{24}$$

$$\frac{5}{6} = \frac{4 \times 5}{4 \times 6} = \frac{20}{24}$$

$$\frac{7}{8} = \frac{3 \times 7}{3 \times 8} = \frac{21}{24}$$

EXERCISE 113

Reduce to equivalent fractions having the least common denominator:—

1. $\frac{3}{4}$, $\frac{5}{12}$
2. $\frac{1}{3}$, $\frac{7}{12}$
3. $\frac{7}{8}$, $\frac{5}{16}$
4. $\frac{2}{3}$, $\frac{3}{4}$
5. $\frac{2}{3}$, $\frac{3}{4}$
6. $\frac{3}{4}$, $\frac{5}{6}$
7. $\frac{7}{8}$, $\frac{5}{12}$
8. $\frac{7}{10}$, $\frac{3}{4}$
9. $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$
10. $\frac{2}{3}$, $\frac{5}{6}$, $\frac{11}{12}$
11. $\frac{1}{2}$, $\frac{7}{8}$, $\frac{5}{6}$
12. $\frac{5}{6}$, $\frac{1}{3}$, $\frac{7}{12}$

13. Arrange the following fractions in ascending order of magnitude:—$\frac{2}{3}$, $\frac{1}{3}$, $\frac{5}{6}$, $\frac{3}{4}$; $\frac{1}{2}$, $\frac{1}{3}$, $\frac{3}{4}$ $\frac{5}{6}$; $\frac{2}{3}$, $\frac{3}{4}$, $\frac{7}{8}$, $\frac{5}{6}$.

14. Arrange the following fractions in descending order of magnitude:—$\frac{2}{3}$, $\frac{5}{6}$, $\frac{3}{4}$; $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{6}$; $\frac{5}{6}$, $\frac{5}{8}$, $\frac{3}{4}$.

15. Which is the greatest, and which the least, of the following:—

$\frac{2}{3}$, $\frac{3}{4}$ and $\frac{4}{5}$? $\frac{3}{4}$, $\frac{4}{5}$ and $\frac{5}{6}$? $\frac{2}{3}$, $\frac{7}{12}$ and $\frac{5}{8}$?

16. Which is greater, $\frac{5}{7}$ or $\frac{7}{9}$? $\frac{7}{10}$ or $\frac{3}{4}$?

17. Express the fractions in each of the following groups in the same denomination: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$; $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$.

SECTION II. ADDITION OF FRACTIONS

INTRODUCTORY EXERCISE

1. What is the sum of 2 apples, 3 apples, and 5 apples?

2. What is the sum of 2 elevenths, 3 elevenths, and 5 elevenths?

3. How many ninths are $\frac{2}{9}$, $\frac{4}{9}$, $\frac{1}{9}$, and $\frac{7}{9}$?

4. James paid $\$\frac{1}{8}$ for a slate, $\$\frac{3}{8}$ for a Reader, and $\$\frac{4}{8}$ for an Arithmetic. How much did he pay for all?

5. Jane bought $\frac{3}{4}$ of a yard of ribbon at one time and $\frac{7}{8}$ of a yard at another time. How much did she buy at both times?

$\frac{3}{4}=\frac{6}{8}$, and $\frac{6}{8}+\frac{7}{8}=\frac{13}{8}=1\frac{5}{8}$ She, therefore, bought $1\frac{5}{8}$ yards.

6. A farmer sold $\frac{1}{3}$ of his grain to one man, and $\frac{1}{6}$ of it to another. How much did he sell altogether?

$\frac{1}{3}=\frac{6}{30}$, and $\frac{1}{6}=\frac{5}{30}$; $\therefore \frac{1}{3}+\frac{1}{6}=\frac{6}{30}+\frac{5}{30}=\frac{11}{30}$.

7. If I pay $\frac{1}{4}$ of a dollar for butter, $\frac{3}{8}$ of a dollar for eggs, and $\frac{1}{2}$ a dollar for cheese, how much do I pay for all?

8. What is the sum of $\frac{1}{4}$ and $\frac{1}{5}$? Of $\frac{1}{6}$ and $\frac{1}{4}$?

9. What is the sum of $\frac{1}{2}$ and $\frac{1}{3}$? Of $\frac{1}{2}$ and $\frac{2}{5}$?

10. Find the sum of $\$2\frac{1}{2}$ and $\$3\frac{1}{3}$; of $\$4\frac{1}{4}$ and $\$3\frac{1}{3}$.

11. How much is $4\frac{1}{4}$ bu.$+3\frac{1}{2}$ bu.? $5\frac{1}{3}$ yd.$+4\frac{1}{2}$ yd.?

EXERCISE 114

Add together the following fractions:—

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

Simplify the following:—

13. $2\frac{1}{4}+3\frac{1}{3}+4\frac{5}{6}$.

14. $5\frac{2}{3}+3\frac{3}{4}+5\frac{7}{12}$.

15. $4\frac{5}{6}+3\frac{4}{9}+7\frac{1}{18}$.

16. $2\frac{1}{4}+3\frac{5}{8}+7\frac{5}{12}$.

EXERCISE 115

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

2. If A spends $\frac{1}{3}$ of his money on Monday, and $\frac{3}{8}$ of it on Tuesday, what part of it does he spend in the two days?

3. John had 6-fourths of a dollar, and was given 3-fourths of a dollar. How much money had he then?

4. Mr. Smith bought three loads of coal. The first weighed $1\frac{1}{2}$ t., the second $1\frac{1}{4}$ t., and the third $1\frac{5}{12}$ t. How much coal did he buy?

5. John rode $15\frac{1}{8}$ mi. on Monday, $12\frac{2}{3}$ mi. on Tuesday, and $14\frac{1}{4}$ mi. on Wednesday. How far did he ride during the three days?

6. Mrs. Search bought $3\frac{1}{4}$ yd. of silk at one store, $3\frac{3}{8}$ yd. at a second, and $3\frac{2}{3}$ yd. at a third. How much silk did she buy at the three stores?

7. Four remnants of calico measured as follows:— The first piece, $1\frac{1}{4}$ yd.; the second, $2\frac{1}{2}$ yd.; the third $1\frac{2}{3}$ yd.; and the fourth $2\frac{7}{8}$ yd. How much was in the four pieces?

8. How much is $1\frac{1}{2}+3\frac{3}{4}+7\frac{7}{8}+15\frac{1}{16}$?

9. How far is it round a rectangular field $42\frac{1}{4}$ rd. long and $28\frac{3}{8}$ rd. wide?

10. A woman sold $12\frac{1}{2}$ lb. of butter on Monday, $15\frac{1}{4}$ lb. on Tuesday, $13\frac{1}{3}$ lb. on Wednesday, and $15\frac{2}{5}$ lb. on Thursday. How much did she sell during these four days?

SECTION III. SUBTRACTION OF FRACTIONS

INTRODUCTORY EXERCISE

1. John has 7 marbles, James has 4. How many marbles has John more than James?

2. John has $\frac{7}{12}$ of a dollar, James has $\frac{4}{12}$ of a dollar. How much has John more than James?

3. How much less is $\frac{3}{8}$ than $\frac{7}{8}$? $\frac{3}{8}$ than $\frac{5}{8}$? $\frac{3}{8}$ than $\frac{8}{8}$?

4. John has $\frac{1}{3}$ of an apple, James has $\frac{1}{4}$ of an apple. How much has John more than James?

$\frac{1}{3} = \frac{4}{12}$, and $\frac{1}{4} \frac{3}{12}$; $\therefore \frac{1}{3} - \frac{1}{4} = \frac{4}{12} - \frac{3}{12} = \frac{1}{12}$.

5. A boy spent $\frac{1}{2}$ of his money for a coat and $\frac{1}{4}$ of it for a hat? How much had he left?

6. If John spends $\frac{1}{2}$ of his money on Monday and $\frac{1}{3}$ of it on Tuesday, what part of his money has he left?

7. How much change will a person receive out of a ten-dollar bill after paying for an article which cost $\$4\frac{3}{8}$?

8. After spending $\frac{2}{5}$ of his money on a suit of clothes, *A* has \$24 left. How much money had he at first?

EXERCISE 116

Find the difference between:—

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

EXERCISE 117

1. Simplify $\frac{1}{2} - \frac{1}{3} + \frac{1}{4} - \frac{1}{8} + \frac{5}{12}$.

2. William earned $\$12\frac{3}{8}$. This was $\$2\frac{3}{4}$ more than John earned. How much did John earn? How much did both earn?

3. From a bin containing $96\frac{3}{4}$ bu. of wheat, $59\frac{7}{8}$ bu. were sold. How many bushels remained in the bin?

4. *A* can dig a garden in $12\frac{3}{8}$ da.; *B* can dig it in $1\frac{7}{8}$ da. less. How long does it take *B* to dig the garden?

5. A rectangular lot is $36\frac{1}{2}$ rd. long and $24\frac{5}{8}$ rd. wide. How much longer than wide is the lot?

6. By how much does the sum of $1\frac{1}{2}$, $2\frac{1}{3}$, and $3\frac{1}{4}$ differ from the sum of $2\frac{1}{4}$, $3\frac{1}{3}$, and $4\frac{1}{8}$?

7. In one day, *A* rode $47\frac{1}{4}$ mi. from his home and returned $13\frac{5}{8}$ mi. How far is he still from home?

SECTION IV. MULTIPLICATION AND DIVISION OF FRACTIONS

I. TO MULTIPLY A FRACTION BY A WHOLE NUMBER

INTRODUCTORY EXERCISE

1. If 5 cents are multiplied by 3, what is the product?

2. If 3 sevenths are multiplied by 5, what is the product? 3-sevenths ($\frac{3}{7}$) multiplied by 5=15 sevenths ($\frac{15}{7}=2\frac{1}{7}$).

3. How much will 5 pairs of ducks cost at $\$\frac{3}{4}$ a pair?

4. How much will 10 yd. of cloth cost at $\$\frac{1}{4}$ a yard?

5. If it requires $\frac{3}{4}$ of a yd. of cloth to make a vest, how many yards will it require to make 8 vests?

6. If a man earns $\$\frac{1}{8}$ in 1 da., how much will he earn at the same rate in 10 da.?

7. If a hat cost $\$\frac{5}{8}$, how much will 12 hats cost?

8. If a barrel of flour cost $\$8\frac{3}{4}$, what will 5 barrels cost?

Multiply the fractional and integral parts separately, and add the products.

Example 1. Multiply $\frac{3}{10}$ by 5.

Since 3 apples multiplied by 5 = 15 apples,
so 3 tenths ($\frac{3}{10}$) multiplied by 5 = 15 tenths ($\frac{15}{10}$).

$$\therefore 5 \times \tfrac{3}{10} = \tfrac{15}{10} = \tfrac{5 \times 3}{10}$$

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

EXERCISE 118

Multiply:—

1. $\frac{7}{18}$ by 9.
2. $\frac{8}{15}$ by 3.
3. $\frac{9}{14}$ by 7.
4. $1\frac{1}{2}$ by 6.
5. $2\frac{1}{4}$ by 5.
6. $3\frac{1}{5}$ by 7.
7. $2\frac{1}{2}$ by 11.
8. $3\frac{3}{4}$ by 6.
9. $5\frac{2}{3}$ by 9.
10. Find the cost of 5 gal. of molasses at $37\frac{1}{2}$c. per gal.
11. At $\$1\frac{1}{4}$ a day, how much does a man earn in 4 weeks of 6 days each?
12. What is the cost of 36 doz. eggs at $36\frac{1}{2}$c. a dozen?

II. TO DIVIDE A FRACTION BY A WHOLE NUMBER

INTRODUCTORY EXERCISE

1. If 8 apples are divided by 4, what is the quotient?
2. If 8 ninths are divided by 4, what is the quotient?
3. Divide $\frac{8}{9}$ by 2; $\frac{6}{11}$ by 3; $\frac{16}{17}$ by 8.
4. If 3 books cost $\frac{6}{10}$ of a dollar, how much will 1 book cost?
5. If 3 caps cost $\frac{9}{10}$ of a dollar, how much will 1 cap cost?
6. William had $\frac{9}{12}$ of an orange, and divided it equally among 3 of his schoolmates. What part of an orange did he give to each?
7. Using the diagram on page 166—find $\frac{1}{2}$ of $\frac{1}{3}$
   $\frac{1}{3}$ of $\frac{1}{3}$; $\frac{1}{4}$ of $\frac{1}{3}$; $\frac{1}{5}$ of $\frac{1}{3}$; $\frac{1}{2}$ of $\frac{2}{3}$; $\frac{1}{3}$ of $\frac{2}{3}$;
   $\frac{1}{4}$ of $\frac{2}{3}$; $\frac{1}{5}$ of $\frac{2}{3}$; $\frac{3}{4}$ of $\frac{2}{3}$; $\frac{3}{5}$ of $\frac{4}{3}$ and $\frac{4}{5}$ of $\frac{2}{3}$.

8. Find $\frac{1}{3}$ of $\frac{1}{4}$; $\frac{1}{5}$ of $\frac{1}{7}$; $\frac{1}{5}$ of $\frac{4}{7}$; $\frac{1}{6}$ of $\frac{5}{7}$; $\frac{1}{12}$ of $\frac{7}{9}$.

9. If $\frac{8}{9}$ of a ton of coal be divided among 5 persons, how much does each person receive?

10. A lady divided $\frac{3}{5}$ of a pound of candy equally among 4 boys. How much did each boy receive?

EXERCISE 119

Divide:

1. $\frac{15}{16}$ by 3.
2. $\frac{12}{13}$ by 4.
3. $\frac{9}{10}$ by 3.
4. $2\frac{2}{3}$ by 2.
5. $8\frac{4}{5}$ by 4.
6. $9\frac{6}{7}$ by 3.
7. $12\frac{2}{3}$ by 4.
8. $16\frac{7}{8}$ by 8.
9. $15\frac{3}{5}$ by 5.

10. If 5 yd. of cloth cost $\$2\frac{3}{4}$, find the cost of 1 yd.

$\$2\frac{3}{4}=\$\frac{11}{4}$.

Cost of 5 yd. $=\$\frac{11}{4}$.

Cost of 1 yd. $=\frac{1}{5}$ of $\frac{11}{4}=\$\frac{11}{20}$.

11. If a man can reap $22\frac{3}{4}$ a. of wheat in 7 da., how much could he reap in 1 da.?

12. If a man can cut $15\frac{3}{4}$ cords of wood in 7 da., how many cords could he cut in 1 da.?

III. TO MULTIPLY A WHOLE NUMBER OR A FRACTION BY A FRACTION

1. If a yard of muslin cost 12c., how much will $\frac{1}{3}$ of a yard cost?

2. If a man earns \$60 a month, how much will he earn in $\frac{1}{6}$ of a month?

3. If a ton of hay cost \$25, how much will $\frac{1}{5}$ of a ton cost?

Cost of 1 ton $=\$25$;

Cost of $\frac{1}{5}$ ton $=\frac{1}{5}$ of $\$25=\$5$;

Cost of $\frac{4}{5}$ ton $=4\times\$5=\$20=\frac{4}{5}$ of $\$25=\$20$.

4. If a house cost \$800 and a barn $\frac{3}{4}$ as much, how much does the barn cost?

5. If $\frac{1}{8}$ of \$50 is 8 times the cost of a shawl, what does the shawl cost?

6. *A* rode $4\frac{2}{3}$ hr. on his wheel at the rate of 9 mi. per hour. How far did he ride?

7. Find the cost of $7\frac{1}{2}$ lb. of raisins at 16c. per pound.

8. If a yard of cloth cost \$3, find the cost of $8\frac{2}{3}$ yd.

9. If it takes 80 min. to reap an acre of wheat, how long will it take to reap $10\frac{1}{2}$ a.?

EXERCISE 120

1. Draw a rectangle 3 in. long by 1 in. wide, and find $\frac{2}{3}$ of it.

How many square inches are there in $\frac{2}{3}$ of it?

2. Draw a rectangle twice as long (6 in. long) and 1 in. wide, and find $\frac{1}{3}$ of it.

How many square inches are there in $\frac{1}{3}$ of it?

Compare $\frac{2}{3}$ of a rectangle with $\frac{1}{3}$ of a rectangle twice as large.

3. How many inches are there in $\frac{3}{4}$ of a foot?

How many inches are there in $\frac{1}{4}$ of 3 ft.?

Compare $\frac{3}{4}$ of 1 ft. with $\frac{1}{4}$ of 3 ft.

4. By drawing rectangles show that $\frac{1}{3}$ of $1 = \frac{1}{3}$ of 4.

5. Compare $\frac{2}{3}$ of \$1 with $\frac{1}{3}$ of \$3.

6. In finding $\frac{1}{3}$, or $\frac{1}{4}$, or $\frac{1}{8}$ of a number, what operation is necessary?

7. What does every fraction indicate with reference to the relation of the numerator and denominator?

8. What is meant by \$5×3? 5-sevenths×3? $\frac{5}{7}\times 3$?

9. What is meant by 5-sevenths×$\frac{3}{4}$? Here we see that it is necessary to extend the ordinary meaning of multiplication, and interpret this to mean $\frac{3}{4}$ of $\frac{5}{7}$, i.e., 3 times $\frac{1}{4}$ of $\frac{5}{7}$.

Now $\frac{5}{7}=\frac{20}{28}$; then $\frac{1}{4}$ of $\frac{5}{7}=\frac{1}{4}$ of $\frac{20}{28}=\frac{5}{28}$.

Therefore $\frac{3}{4}$ of $\frac{5}{7}=3\times\frac{5}{28}=\frac{15}{28}=\frac{3\times 5}{4\times 7}$.

$$= \frac{\text{The Product of the Numerators.}}{\text{The Product of the Denominators.}}$$

129. Hence, *The product of two fractions is found by multiplying the two numerators together for the numerator, and the two denominators together for the denominator, of the product.*

EXERCISE 121

Simplify:—

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

EXERCISE 122

Simplify:—

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

In a similar way it may be shown that the product of more fractions than two is found by multiplying all the numerators together for the numerator, and all the denominators together for the denominator, of the product.

NOTE.—Whole numbers may be regarded as fractions with unity for denominators.

EXERCISE 123

NOTE.—Cancel the factors common to the numerators and the denominators.

Find the value of

1. $\frac{5}{6} \times 18$
2. $\frac{8}{9} \times 45$
3. $\frac{5}{8} \times 43$
4. $\frac{7}{10} \times 124$
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. $\frac{15}{16} \times \frac{56}{65} \times \frac{91}{72}$
10. $\frac{16}{21} \times \frac{9}{25} \times \frac{35}{24}$
11. $\frac{9}{10} \times \frac{16}{27} \times \frac{35}{48}$
12. $\frac{31}{2} \frac{12}{78} \times \frac{80}{91} \times \frac{7}{9}$

IV. TO DIVIDE A WHOLE NUMBER OR A FRACTION BY A FRACTION

INTRODUCTORY EXERCISE

1. How many parcels of sugar, each containing 3 lb., can you make out of 24 lb.?

2. How often is 3 lb. contained in 24 lb.?

3. If 24 apples are divided equally among 6 boys, how many apples will each boy receive?

4. How often is 6 apples contained in 24 apples?

5. When both *dividend* and *divisor* are concrete numbers, what kind of a number is the quotient? Give examples.

6. How often is 4 ninths ($\frac{4}{9}$) contained in 8 ninths ($\frac{8}{9}$)?

7. How often is 2 fifths ($\frac{2}{5}$) contained in 12 fifteenths ($\frac{12}{15}$)?

Reduce the fractions to equivalent ones having a common denominator.

8. How often is $\frac{2}{10}$ contained in $\frac{5}{4}$?

9. At $\frac{2}{10}$ of a dollar each, how many caps can I buy for $\$\frac{4}{5}$?

10. If a pound of coffee costs $\$\frac{1}{7}$, how much can be bought for $\$1\frac{1}{4}$?

Example. Divide $\frac{2}{3}$ by $\frac{3}{5}$.

$\frac{2}{3} = \frac{10}{15}$, and $\frac{3}{5} = \frac{9}{15}$

Since 10 apples divided by 9 apples $= \frac{10}{9}$,

so 10 fifteenths ($\frac{10}{15}$) divided by 9 fifteenths ($\frac{9}{15}$) $= \frac{10}{9}$,

$$\therefore \frac{2}{3} \div \frac{3}{5} = \frac{10}{15} \div \frac{9}{15} = \frac{10}{9}$$

$$= \frac{2 \times 5}{5 \times 3} = \frac{2}{3} \times \frac{5}{3}$$

= dividend multiplied by divisor inverted.

EXERCISE 124

Divide:—

1. 10 by $\frac{2}{3}$.
2. 12 by $\frac{3}{4}$.
3. 15 by $\frac{5}{7}$.
4. $\frac{3}{4}$ by $\frac{3}{8}$.
5. $\frac{2}{3}$ by $\frac{5}{6}$.
6. $\frac{3}{5}$ by $\frac{3}{4}$.
7. $2\frac{1}{2}$ by $3\frac{1}{3}$.
8. $3\frac{1}{4}$ by $4\frac{1}{2}$.
9. $2\frac{2}{3}$ by 4.

EXERCISE 125

1. If $\frac{3}{4}$ of a yard of cloth cost 24c., what would a whole yard cost?

2. At $\$1\frac{7}{9}$ per bu., how many bushels of wheat can be bought for $\$42\frac{2}{3}$?

3. If a ton of coal is worth $\$6\frac{2}{5}$, how many tons can be bought for \$890?

4. If a bushel of apples cost $\$2\frac{1}{4}$, how many bushels could be bought for $\$50\frac{3}{4}$?

5. If a man earns $\$7\frac{7}{8}$ in a week, how long will it require him to earn $\$20\frac{3}{4}$?

6. A man divided $30\frac{1}{3}$ lb. of flour among the poor, giving to each $2\frac{1}{3}$ lb. How many persons were there?

7. If an errand boy earns $\$5\frac{5}{8}$ in a week, how long will it require him to earn $\$20\frac{1}{4}$?

8. A man raised $93\frac{3}{4}$ bu. of wheat on $8\frac{1}{3}$ a. of land. How many bushels per acre was that?

SECTION V.—REVIEW EXERCISES

EXERCISE 126

Reduce:

1. 6 to tenths.
2. 7 to eighths.
3. 9 to halves.
4. 13 to fourths.
5. 16 to fifths.
6. 11 to sixths.

Reduce to improper fractions:

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

Reduce to integers or mixed numbers:—

13. $\frac{44}{4}$
14. $\frac{42}{7}$
15. $\frac{88}{8}$
16. $\frac{96}{12}$
17. $\frac{437}{10}$
18. $\frac{625}{50}$

Reduce to their lowest terms:—

19. $\frac{28}{77}$
20. $\frac{16}{56}$
21. $\frac{60}{64}$
22. $\frac{72}{144}$
23. $\frac{840}{1120}$
24. $\frac{648}{720}$

Reduce to fractions having the least common denominators.

25. $\frac{2}{3}$, $\frac{7}{9}$, $\frac{3}{4}$.
26. $\frac{2}{7}$, $\frac{3}{9}$, $\frac{3}{14}$.
27. $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$.
28. $\frac{1}{9}$, $\frac{2}{3}$, $\frac{5}{6}$, $\frac{7}{12}$, $\frac{5}{36}$.

EXERCISE 127

NOTE.—In adding mixed numbers add the whole numbers, and then the fractions. Do not reduce them to improper fractions.

Simplify:—

1. $\frac{3}{4}+\frac{2}{3}$.
2. $\frac{4}{5}+\frac{1}{2}$.
3. $\frac{5}{7}+\frac{3}{5}$.
4. $\frac{4}{5}+\frac{3}{8}+\frac{2}{3}$.
5. $2\frac{1}{2}+7\frac{1}{4}+9\frac{3}{4}$.
6. $2\frac{3}{5}+3\frac{5}{56}+1\frac{5}{7}$.
7. $92\frac{5}{8}+93\frac{3}{10}+112\frac{1}{4}$.
8. $119\frac{2}{7}+196\frac{3}{8}+495\frac{31}{56}$.
9. $\frac{7}{11}-\frac{5}{33}$.
10. $\frac{2}{3}+4\frac{3}{5}-\frac{3}{4}$.
11. $\frac{11}{14}-\frac{4}{21}$.
12. $\frac{12}{15}-\frac{7}{30}$.
13. $9\frac{1}{16}-4\frac{7}{8}$.
14. $8\frac{5}{12}-3\frac{5}{16}$.
15. $112\frac{1}{3}-90\frac{7}{12}$.

EXERCISE 128

Find the value of:—

1. $\frac{7}{8}$ of $8\frac{4}{5}$.
2. $\frac{6}{8}$ of $1\frac{5}{16}$.
3. $\frac{2}{3}$ of $\frac{9}{4}$.
4. $\frac{3}{7}$ of $\frac{1}{6}$ of 14.
5. $\frac{4}{5}$ of $\frac{1}{16}$ of $4\frac{1}{8}$.
6. $\frac{3}{7}$ of $\frac{33}{35}$ of $1\frac{1}{7}$.

Simplify:—

7. $\frac{9}{11}\times 12$.
8. $\frac{7}{25}\times 15$.
9. $\frac{3}{14}\times 18$.
10. $72\times\frac{3}{8}$.
11. $9\frac{1}{2}\times\frac{3}{4}$.
12. $7\frac{3}{8}\times\frac{16}{25}$.

Divide:—

13. $\frac{5}{6}$ by $\frac{5}{12}$.
14. $\frac{9}{10}$ by $\frac{7}{10}$.
15. $\frac{5}{12}$ by 15.
16. 22 by $\frac{11}{2}$.
17. $9\frac{1}{2}$ by $\frac{5}{8}$.
18. $4\frac{5}{8}$ by $\frac{2}{3}$.

19. Find the value of the following:—$6\frac{1}{4}$ lbs. of fish at 16 cents, 3 lbs. of rice at $12\frac{1}{2}$ cents; $1\frac{1}{2}$ lb. of figs at $22\frac{3}{4}$ cents. How much change should I receive out of a $5 bill?

20. If $9\frac{1}{2}$ pounds of butter cost $1.90, what will $13\frac{3}{4}$ pounds cost?

21. If $\frac{5}{8}$ of a yard of silk cost 75 cents, what will $\frac{3}{4}$ of a yd. cost?

22. If $\frac{7}{8}$ of a cord of wood cost $4.20, what will $3\frac{1}{2}$ cords cost?

23. A farmer received at different times the following sums of money:—$3\frac{1}{2}$, $8\frac{3}{4}$, $9\frac{7}{10}$, $12\frac{1}{5}$. How much did he receive altogether?

24. A plate of glass $37\frac{1}{8}$ inches by $23\frac{1}{4}$ inches was set in a picture frame that covered $\frac{3}{8}$ inches from each edge. Find the dimensions of the glass not covered by the frame.

CHAPTER VII

DECIMALS

Section I. Definition and Numeration

1. Draw a rectangle 10 inches long and one inch wide and divide it into ten equal parts. What is one of these equal parts called? what are 4 of these called? 7 of them?

2. If anything is divided into 10 equal parts, what are the parts called? what is the fractional unit?

Note.—The teacher may illustrate these drawings on the blackboard, using colored chalk to indicate the various parts.

3. Draw a square ten inches to a side and divide each side into ten equal parts. Mark off a rectangle equal to one-tenth of the square.

4. Divide the rectangle into ten equal parts. What part of the whole square is one-tenth of the rectangle?

$\frac{1}{10}$ of $\frac{1}{10}$ of the square $= \frac{1}{100}$ of the square.

5. Mark off $\frac{1}{100}$ of the square. Draw a heavy line around $\frac{25}{100}$ of the square; $\frac{50}{100}$ of the square; $\frac{18}{100}$ of the square.

6. Suppose one of the squares which represents one-hundredth of the square be divided into ten rectangles. What part of the whole square is one rectangle?

$\frac{1}{10}$ of $\frac{1}{100}$ of the square $= \frac{1}{1000}$ of the square.

What part would six of the rectangles represent? 8 of the rectangles?

130. $\frac{1}{10}$ is written .1.

$\frac{1}{100}$ is written .01.

$\frac{1}{1000}$ is written .001.

Similarly we write .4 for $\frac{4}{10}$; .7 for $\frac{7}{10}$; .03 for $\frac{3}{100}$; .25 for $\frac{25}{100}$; .50 for $\frac{50}{100}$; .18 for $\frac{18}{100}$; .006 for $\frac{6}{1000}$; and .008 for $\frac{8}{1000}$, and 4.124 for $4\frac{124}{1000}$.

131. Fractions like .7; .25; and .124 are called *Decimal fractions;* while fractions like $\frac{2}{3}$; $\frac{3}{4}$; $\frac{5}{6}$ are called *common*, or *vulgar fractions*.

132. The denominator of a decimal fraction is never expressed but is always understood. For brevity decimal fractions are usually called *Decimals*. Instead of writing the denominator, the numerator only is written with a period (.) before it:—

Thus, $\frac{8}{10}$ is written .8

$\frac{35}{100}$ is written .35

$\frac{3}{100}$ is written .03

$3\frac{413}{1000}$ is written 3.413.

133. The period or *point* placed before the decimal is called the *decimal point.* It separates the fractional part from the whole number.

134. The *first* place to the right of the decimal point is that of *tenths*; the *second* place is that of hundredths; the *third*, that of thousandths, etc.

Thus, $41.343 = 41 + \frac{3}{10} + \frac{4}{100} + \frac{3}{1000}$.

Hence it appears that decimals are simply an extension of the ordinary system of notation and numeration.

135. Noughts *affixed* to a decimal have no effect on its value, that is .4; .40; and .400 are all equal, for:

$.4 = \frac{4}{10}$.

$.40 = \frac{40}{100} = \frac{4}{10}$.

$.400 = \frac{400}{1000} = \frac{4}{10}$.

EXERCISE 129

1. How many tenths make a unit?

2. How many tenths in 1.1?

3. If the unit is 10 inches what length of line is represented by 1.1 units? by 3.2 units? by 4.9 units? 8.7 units?

4. Read 7.3; 2.8; 1.7; 21.5; 50.4.

5. Write in figures five-tenths; eight-tenths; two and four tenths; thirty and three tenths.

6. How many inches in a line 1.5 ft. long? 2.5 ft. long?

7. How many hundredths in one-tenth? in two-tenths? in one?

8. One-tenth is equivalent to how many hundredths?

9. Fill in the numerators in the following:—

$.1 = \frac{\quad}{100}$; $.3 = \frac{\quad}{100}$; $.7 = \frac{\quad}{100}$.

10. Write the following as decimals:—

$\frac{3}{100}$; $\frac{5}{100}$; $\frac{9}{100}$; $\frac{18}{100}$; $\frac{78}{100}$.

11. In the number 111.111 name the places from left to right.

EXERCISE 130

Read or write in words the following:—

1. .3, .7., .45, .75, .03, .01.

2. .234, .024, .008, .201, .607.

3. 4.3, 6.7, 8.45, 9.83, 14.02, 13.01.

4. 12.003, 13.096, 11.111, 100.001, 1000.01.

5. 19.19, 19.019, 203.203, 400.004.

6. 3000.3, 300.03, 30.003, 101.11, 100.09.

Write in figures the following:—

7. Seven tenths; three, and nine-tenths; five, and nine hundredths; five thousandths.

SECTION II. ADDITION

Example 1. What is the sum of 3.7, 14.035, 81.64, and .716?

$$\begin{array}{r} 3.7 \\ 14.035 \\ 81.64 \\ .716 \\ \hline 100.091 \end{array}$$

136. Since we can add numbers of the same name only, we write the addends so that units will be under units, tenths under tenths, etc. This is always the case when the points range in the same straight line. Then, beginning at the lowest order, we add as if the figures were integers and place the decimal point in the sum before the tenths.

EXERCISE 131

(1)	(2)	(3)	(4)
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:—

5. 4.5+70.63+1.079+25.
6. .126+3.05+.07+.528+7.093.
7. 111.306+.0317+2.793+.007.
8. 470.05+72.701+3.0315+413.2658.
9. 12.3987+4.1462+.02063+13+10.962.
10. Simplify 36+7.8+70.84+.006.

SECTION IV SUBTRACTION

Example 1. From 17.13 take 1.907.

$$\begin{array}{r} 17.13 \\ 1.907 \\ \hline 15.223. \end{array}$$

EXERCISE 132

(1)	(2)	(3)
From 7.46	36.56	7.01
Take 2.28	9.78	1.23

(4)	(5)	(6)
From 9.6	3.07	7.
Take 3.25	1.846	2.456

7. From 8 take 3.45 and from 7.01 take 3.645.

8. Simplify 6−2.45; 15.1−.008; 3.6−2.475.

9. Find the difference between 17.643 and 25.

10. How much does one hundred, and seven tenths exceed ninety six, and four hundred and five thousandths?

EXERCISE 133

1. From the sum of 7.4 and 9.06 take 8.975.

2. Simplify 7.84−2.9+8.06+37−5.765.

3. Simplify 10.01+8.008+.06−5.35−4.786.

4. *A*, who owned 85.7 a. of land, sold at one time 13.125 a. and at another 16.004 a. How many acres had he left?

5. From the sum of 8.7 and 13.5 take their difference.

6. Find the difference between the following pairs of numbers:—36 and 24.709; 12 and 18.875; 50 and 69.78.

7. A person owned nine-tenths of a farm and sold eight hundred and seventy-five thousandths of it. How much has he left?

8. Find the least number which added to the sum of .12, 2.1, .07, and 8 will make 20.

9. Find the value of $9-2.75-3.5+8.006-9.67$.

10. The average of five numbers is 12.465. Find the difference between their aggregate and .100.

EXERCISE 134

1. How much does .012 lack of being a whole number?

2. Fourteen hundredths of a farm is sown to oats; .065 to barley; .315 of it is unbroken, and the rest is in wheat. How much of the farm is in wheat? if there is 100 acres in the farm, how many acres are there in oats, in barley, in wheat, uncleared?

3. Take the sum of 6; .05; .008 from 10.

4. From three, and three thousandths take one, and fourteen hundredths.

5. Add together: thirteen thousandths; two, and nine hundredths; one hundred and one hundredth; two thousand, and two thousandths.

6. A man walked 2.4 miles west, then 3.45 miles west; then 4.2 miles east. In what direction, and how far is he from where he started?

7. A rectangle is 18.065 inches long, and 13.582 inches wide. What is its perimeter? how much is the length greater than the width?

8. The three sides of a triangle are 18.003 ft., 21.165 ft. and 15.007 ft. What is the perimeter of the triangle?

SECTION IV. MULTIPLICATION

To Multiply Decimals

Example 1. Multiply .7 by .9.

Since $.7 = \frac{7}{10}$ and $.9 = \frac{9}{10}$:

$\therefore\ .9 \times .7 = \frac{9}{10} \times \frac{7}{10} = \frac{63}{100} = .63.$

Example 2. Multiply .731 by .06.

Since $.731 = \frac{731}{1000}$ and $.06 = \frac{6}{100}$:

$\therefore\ .06 \times .731 = \frac{6}{100} \times \frac{731}{1000} = \frac{4386}{100000} = .04386.$

Example 3. Multiply 3.76 by 2.4.

Since $3.76 = \frac{376}{100}$ and $2.4 = \frac{24}{10}$;

$\therefore\ 2.4 \times 3.76 = \frac{24}{10} \times \frac{376}{100} = \frac{9024}{1000} = 9.024.$

137. Hence, *To multiply decimals, multiply as in the case of integers and mark off from the right of the product as many decimal places as there are decimals in the factors.*

SECTION V. MULTIPLICATION

EXERCISE 135

Multiply the following:—

1.	75 5	4.	7.5 5	7.	.75 5
2.	.08 7	5.	.49 7	8.	9.4 6
3.	7.36 19	6.	8.09 95	9.	7.64 36

10. State a rule for multiplying a number by 10 and also for multiplying by 100.

11. Find the cost of 79 articles at \$3.055 each.

12. To .006 add the difference between .034 and 3.4, and multiply the result by 247.

EXERCISE 136

Multiply:—

1. $400 by .8; $140 by .45; $360 by .30.

2. $500 by .75; $300 by .25; $375 by .24.

3. In a flock of 700 sheep .01 of them were black. How many were black?

4. In a class of 60 pupils .45 of them were boys. How many girls were in the class?

5. Of 420 pupils who wrote on their examinations .25 of them failed. How many passed?

6. From the sum of .3, .04 and .008 take .003 and multiply the remainder by .35.

SECTION VI. DIVISION

Example 1. Divide 42.32 by 4.

$$4\overline{)42.32}$$
$$10.58$$

Divide as in ordinary division.

EXERCISE 137

Divide the following:—

1.	64 by 2.	6.4 by 2.	.64 by 2.
2.	96 by 4.	.96 by 4.	.096 by 4.
3.	8.4 by 7.	.84 by 7.	.084 by 7.
4.	7.55 by 5.	7.055 by 5.	.075 by 5.

Example 2. Divide 31.3 by 8.

Since the value of a decimal is not altered by affixing zeros to it, add zeros to the decimal and divide as in ordinary division until there is no remainder.

$$8\overline{)31.3000}$$
$$3.9125$$

5. 74.25 by 4.	6. 9.34 by 8.	7. 18.21 by 5.
8. 312.04 by 16.	9. 31.041 by 9,	10. 407.792 by 11.

EXERCISE 138

1. (*a*) Divide 32 by 8; 42 by 7; 54 by 9.

(*b*) In each example, multiply both divisor and dividend by 10; perform the division and compare the quotients with those obtained in (*a*).

(*c*) What is the effect upon the answer of multiplying both divisor and dividend by 10?

2. (*a*) Divide 24 by 6; 35 by 7; 72 by 9.

(*b*) In each example, multiply both divisor and dividend by 100; perform the division and compare the quotients with those obtained in (*a*).

(*c*) What is the effect upon the quotient of multiplying both divisor and dividend by 100?

Example 1. Divide 9 by .3.

$$.\frac{9}{3} = \frac{10 \times 9}{10 \times 3} = \frac{90}{3} = 30.$$

Divide the following:—

3. 32 by 8	9. 32 by .8	15. 32 by .08.
4. 6.4 by 8.	10. 3.6 by .9	16. .36 by .09.
5. 1.2 by .6	11. 1.2 by .06	17. .12 by .06.
6. 10.5 by .5	12. 10.5 by .05	18. 1.05 by .05.
7. 8 by .16	13. .8 by .16	19. 8 by .016.
8. 3.5 by 5	14. 3.5 by .5	20. 3.5 by .05.

21. Find the cost of 2.6 yd. of cloth at $3.5 per yard.

22. How many bushels of oats, at $.375 per bu., can be bought for $13.125?

23. Find the cost of 8384 feet of boards at $53.25 per M.

24. Find the freight charges on 3846 lb. at $.875 per hundred.

CHAPTER VIII

PERCENTAGE

SECTION I. DEFINITION

INTRODUCTORY EXERCISE

1. Draw a square $2\frac{1}{2}$ in. long, and divide it into 100 small squares.

2. Mark off 10 one-hundredths of the large square; 20 one-hundredths; 25 one-hundredths; 50 one-hundredths.

3. Show .01 of the large square; .03 of it; .07 of it; .10 of it; .25 of it; .50 of it.

188. Another name for *hundredths* is **per cent.** The symbol for per cent. is %.

4. Mark 1 per cent. or 1% of the large square; 3 per cent. or 3% of it; 7 per cent. or 7% of it; 10 per cent. or 10% of it; 20 per cent. or 20% of it.

5. What per cent. of a number is .01 of it? .05 of it? .09 of it? .10 of it? .25 of it? .4 of it? .5 of it?

6. Express the following as hundredths:—

3%; 7%; 10% 15%; 20%; 25%.

7. Find .02 of \$100; .05 of \$100; 12 of \$100; .12 of \$200.

8. Find 2% of \$100; 5% of \$100; 12% of \$100; 12% of 9200.

9. Find 5% of \$40; 7% of \$300; 6% of \$350; 20% of 65 a.

10. Express the following (1) as common fractions, (2) as decimals:—

3 p. c.	17 p. c.	13 p. c.	19 p. c.
10 p. c.	20 p. c.	25 p. c.	50 p. c.
$12\frac{1}{2}$ p. c.	$16\frac{2}{3}$ p. c.	$8\frac{1}{3}$ p. c.	$33\frac{1}{3}$ p. c.

11. What per cent. of a number is equal to each of the following fractional parts of it:—$\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{3}{4}$, $\frac{4}{5}$?

EXERCISE 139

1. Draw a line 12 in. long. Cross off 25% of it; $33\frac{1}{3}$% of it; 50% of it; 75% of it.

2. Describe a circle and mark off 100% of it; 50% of it; $12\frac{1}{2}$% of it.

3. Find 25% of 24 hr., of 36 men; of \$60; of 84 pages.

4. Draw a rectangle 5 in. by 2 in. Mark off 20% of it; 40% of it; 50% of it; 60% of it.

5. Express the following as hundredths:—

5%, 10%, 25%, 50%, 60%.

6. Express the following as fractions in their lowest terms:—

25%, $33\frac{1}{3}$%, 50%, 20%, 40%.

7. A pupil had 20 examples to work and did 100% of them correctly. How many did he do correctly?

8. A farmer had 450 bu. of wheat and sold 60% of it. How many bushels did he sell?

9. If a dozen apples cost 12c., for how much must they be sold to gain 25%?

10. A man bought a cart for \$25 and sold it at a loss of 20%. How much did he get for it?

11. Of what number is 12 ten per cent? 8 twenty-five per cent.?

12. Find 10% of 60 men; of \$200; of 45a.; of 185 lb.

SECTION II. SIMPLE APPLICATIONS OF PER CENT.

EXERCISE 140

1. A man having a journey to make has gone $\frac{1}{4}$ of the distance. What per cent. of the journey is still to be made?

2. Out of a 5-gallon keg of molasses, 3 gal. have been used. What per cent. of the molasses remains?

3. A grocer bought sugar at 4c. per lb., and sold it at 5c. per lb. What per cent. of his outlay did he gain?

4. A merchant bought cloth at $2.25 per yd., and sold it at $3 per yd. What per cent. did he gain on his outlay?

5. A merchant bought wheat at 60c. per bu., and sold it at a gain of 20%. Find the selling price.

6. A drover sold cattle at $27.50 per head, at a gain of 25% on the cost price. Find the cost price.

7. What per cent. of the months have 30 days?

8. 7 per cent. of a number is 21. Find the number.

9. In a school of 250 pupils, 20% were absent. How many were present?

EXERCISE 141

1. Find $33\frac{1}{3}\%$ of $120; of 60 mi.; of 43.5 lb.

2. Seven per cent. of a number is 49. Find it.

3. 25 mi. is $12\frac{1}{2}\%$ of the distance from *A* to *B*. How far is it between *A* and *B*?

4. A drover purchased 375 head of cattle and sold 40% of them. How many remained?

5. A man bought a house for $8500 and sold it to gain 8%. How much did he receive for it?

6. What number increased by 40% of itself becomes 896?

7. What number diminished by 40% of itself becomes 840?

8. *A* has $80 in his purse and spends $25. What per cent. of his money did he spend?

9. By selling flour at an advance of 20%, $1.10 is gained on each barrel. Find the cost per barrel.

EXERCISE 142

1. A boy attends $15\frac{1}{2}$ days of the 20 school days during the month of May. What is his percentage of attendance for the month?

2. A boy receives 64 marks out of a total of 75 marks. What per cent of the total number of marks did he receive?

3. A girl spells correctly 112 words out of a total of 115 words. What per cent of the words did she spell correctly?

4. Express:—

(1) 5%, 10%, 15%, 20%, 25%, 75% as decimals.

(2) .5; .525; .625 as percentage.

(3) 20%; 25%; 30%; 50%; $33\frac{1}{3}$% as fractions in their lowest terms.

5. A farm costing $4400 was sold at a gain of 18%. For how much did the farm sell?

6. A horse costing $88 sold at a loss of 40%. For how much did it sell?

7. A man bought a harness for $15 and sold it for $20. Find his gain per cent.

8. A man lost 25% of his money, and after losing 10% of the remainder had $750 left. How much had he at first?

9. A boy gained 20% by selling a ball for 90 cents. What did the ball cost him?

1. If I lend you $500, and you have to pay me $1 for the use of each $100 per year, how much will I receive for 1 year?

2. How much must you pay for the use of $600 for 1 year, if you have to pay $2 for the use of each $100 per year, or 2 cents for each dollar? If you have to pay $3? $4? $8?

SECTION III. SIMPLE INTEREST

139. The sum paid for the *use* of money is called **Interest.**

140. The money on which the *interest* is paid is called the **Principal.**

141. The number of dollars paid for the use of $100 1 year is called the **Rate per cent.**

NOTE.—When the *rate per cent.* is stated without the mention of any length of time, the time is understood to be one year.

Example 1. What is the interest on $250 for 1 year at 6 per cent.?

Interest on $100 for 1 year = $6;

" $1 " = $\frac{6}{100}$;

" $250 " = $\frac{250 \times 6}{100}$; = $15.00

When a man borrows money he pays for the use of it a certain rate per cent. of the amount borrowed. Considering this, another solution is arrived at as follows:—

The interest for one year is 6% or $\frac{6}{100}$ of $250.

EXERCISE 143

1. Find the interest on \$340 for 1 year at 4%.
2. Find the interest on \$540 for 1 year at 6%.
3. Find the interest on \$84 for 1 year at 8%.
4. Find the interest on \$212.50 for 1 year at 6%.
5. Find the interest on \$96.00 for 1 year at 7%.
6. Find the interest on \$88.80 for 1 year at $7\frac{1}{2}$%.
7. Find the interest on \$75.40 for 1 year at $6\frac{1}{4}$%.
8. Interest is charged at the rate of 8% on over due accounts. What will a man whose account of \$78.30 is a year overdue, have to pay?
9. A man borrowed \$7540 for 1 year, viz:—\$1220 at 6%; \$1320 at 8%; \$3000 at $6\frac{1}{2}$%; and the remainder at $7\frac{1}{2}$%. How much interest has he to pay at the end of the year?
10. A family of five children have to divide equally the interest of \$296000 at 8%. How much does each receive each year?

EXERCISE 144

Example 2. What is the interest on \$450 for six years at 5 per cent.

The interest on \$100 for 1 year = \$5
The interest on \$1 for 1 year = $\$\frac{5}{100}$
The interest on \$1 for 6 years = $\$\frac{5}{100} \times 6$
The interest on \$450 for 6 years = $\$\frac{5 \times 6 \times 450}{} = \$135$.

This may be more briefly stated thus:—
The interest on \$450 for 1 year = 5% or $\frac{5}{100}$ of \$450
The interest on \$450 for 6 years = $6 \times \frac{5}{100}$ of \$450 = \$135

Or
The interest for 1 year = .05 of \$450
The interest for 6 years = $6 \times .05$ of \$450 = \$135.

Example 3. Money is worth 6%. Find the interest on \$600 for 1 year; ½ year; 3 yrs. 6 mos.; 73 days.

The interest on \$600 for 1 year = 6% or $\frac{6}{100}$ of \$600 = \$36
The interest on \$600 for ½ year = ½ of \$36 = \$18
The interest on \$600 for $3\frac{1}{2}$ years = $3\frac{1}{2} \times \$36 = \$126$.
The interest on \$600 for 73 days or $\frac{1}{5}$ yr. = $\frac{1}{5}$ of \$36 = \$7.20

EXERCISE 145

1. Find the interest on \$124 for 2 years at 4%.
2. Find the interest on \$175 for 292 days at 6%.
3. Find the interest on \$345 for 30 days at $7\frac{1}{2}$%.
4. Find the interest on \$365 for 80 days at 7%.
5. Find the interest on \$73 for 146 days at 8%.
6. Find the interest on \$292 for 1 year 73 days at 6%
7. Find the interest on \$584 for 90 days at 8%.

142. When money is borrowed, the written promise to pay it back again is called a *Promissory Note.* A promissory note is usually written as follows:—

\$300.00 WEYBURN, MAY 22, 1914

One year after date, for value received, I promise to pay to Henry Smith, or order the sum of Three Hundred Dollars, with interest at five per cent.

JOHN JONES.

Who borrowed the money?
To whom is he to pay it?
When is the note due?
How much will have to be paid then?

Make out and sign a promissory note for \$25 payable to the order of William Harvey in 6 months with interest at 6%. Find the interest.

CHAPTER IX

SUPPLEMENTARY EXERCISES

EXERCISE 146

SECTION I. NUMERATION AND NOTATION

Write the following in words:

1.	4859,	4059,	4509,	4590,	4009.
2.	6078,	7068,	8706,	7608,	6708.
3.	9100,	9011,	9001,	1900,	1090.
4.	36789,	37689,	38769,	39876,	36897.
5.	70008,	70800,	70809,	78009,	70890.
6.	75806,	75086,	70586,	78056,	58760.
7.	90005,	95000,	95555,	55090,	50905.
8.	730601,	900005,	905050,	190076,	910000.

EXERCISE 147

Write in figures the following numbers:—

1. One hundred and forty-nine; three hundred and eight; nine hundred and seventy-four.

2. Two hundred; four hundred and twenty; six hundred and ninety-four.

3. 7 hundreds, 3 tens, and 5 units; 9 hundreds and six tens; 4 hundred and 6 units.

4. Six thousand and six; four thousand three hundred; nine thousand and eighty.

5. Forty thousand and four; forty-four thousand four hundred; ninety thousand and ninety.

6. Ninety-nine thousand; ninety-nine thousand nine hundred; ninety thousand nine hundred.

7. Nine thousand and ninety; ninety-nine thousand and nine; ninety-nine thousand and ninety-nine.

8. In the number 1,904, 526,738 give the place value of each figure as 8 units, 3 tens, 7 hundreds and so on. Give the name of each period as 738 units and so on.

EXERCISE 148

1. What is the smallest number that can be expressed by three figures? what is the greatest?

2. What is the greatest and what the least number that can be formed with seven figures?

3. Read the following numbers:—

789, 643, 965 and 987, 000, 108.

Why are commas used in these numbers?

4. Write the numbers next above 27999, 301999, 899999.

5. Write the numbers next below 50000, 89909, 479900.

6. Five million, five thousand and fifty.

Three hundred million, three thousand three hundred.

Five hundred million, and six.

7. Write in Roman Numerals:—

19, 24, 49, 84, 99, 44, 39, 94, 187, 208, 781, 962, 999, 444, 409, 904.

Write in figures:—

8. DLV, MDCIV, MDCCCXIX, MXC, MCMII.

9. Write in Roman numerals the largest number that can be expressed by three figures.

SECTION II. ADDITION AND SUBTRACTION

EXERCISE 149

Find the sum:—

1. Of 6472+8733+4633+4854+569+8674.
2. Of 2762+8756+9783+4578+432+9876.
3. Of 1617+8743+7284+9621+978+8465.
4. Of 2650+4062+8705+9030+999+2897.
5. Of 5005+6007+7583+4783+785+8764.
6. Of 27845+67832+74281+68432+3687+9699.
7. Of 47823+68421+70070+60504+5467+79.
8. Of 1[illegible]7+6434+7805+66782+4987+8768.
9. Of 10+8756+405+66782+9+17+874+78.

EXERCISE 150

Add vertically and horizontally:—

								TOTALS
1.	496	542	768	369	458	763	645	897	
2.	79	847	8	649	387	85	964	75	
3.	800	947	684	596	769	384	725	888	
4.	677	846	785	369	678	845	527	987	
5.	847	468	587	639	784	487	784	879	
6.	784	45	587	495	954	687	387	297	
7.	9	784	549	768	567	309	97	809	
8.	687	587	495	328	875	760	748	980	
9.	584	748	945	832	758	607	478	895	
10.	783	847	796	598	589	385	835	538	
11	967	758	697	859	785	796	967	679	
12.	548	49	976	895	875	679	761	452	
13.	796	893	967	964	857	773	282	257	
14.	384	389	694	946	469	74	478	691	
15.	547	839	804	407	496	396	396	964	

EXERCISE 151

1. Find the sum of 892 and the next seven numbers.

2. Find the sum of \$1010 and the next ten numbers.

3. What is the difference between 100° above zero and 62° below zero?

4. How much must be added to three hundred thousand and seventy nine to make a million?

5. *A* has \$375, *B* has twice as much as *A* and \$84 more. *C* has \$90 less than three times as much as *A* and *B* together. And *D* has \$16 more than all the other three together. How much less than ten thousand dollars have they all?

6. The remainder is 323025 and the subtrahend is 612. Find the minuend.

7. Regina is 357 miles west of Winnipeg and Montreal 1425 miles east of Winnipeg. How far is it from Regina to Montreal?

8. A man deposited in the bank at various times during the month of May:—\$196; \$212.40; \$319.35; \$113.75; \$113.24; \$413.60; \$217.35; \$719 and \$417.80. He drew out at different times \$312.60; \$117.20; \$119.38 \$415.60; \$92.25; \$119.75 and \$75.60. How much money remained in the bank to his credit?

9. Take 309 from each of the following numbers:—7008; 4106; 1009; 3006; 3125; 3119; and 400. Add the remainders.

10. What number taken from 9,000,000 will leave 719,306 as remainder?

11. The minuend is 100,000; the remainder is 1007. Find the subtrahend.

SECTION III. MULTIPLICATION AND DIVISION

EXERCISE 162

Multiply:—

1.	5675	4.	2983	7.	6857
	172		698		469
2.	$175.27	5.	$482.92	8.	$507.64
	325		823		806
3.	6789654	6.	896563	9.	654123
	67321		96013		70094

Divide:—

10. 1554÷37	13. 5593÷49	16. 14985÷666
11. 20273÷97	14. 17094÷777	17. 89687÷808
12. $1309.00÷29.75	15. 6822÷36	18. 80091÷809

EXERCISE 163

1. How much can a man earn in 144 days, if he can earn $48 in 24 days?

2. If 17 horses cost $1802, how much will 9 horses cost?

3. A man bought a number of sheep at the rate of 3 for $18. How many did he buy for $3648?

4. How many times must 1874 be added to itself to make a total of 163038?

5. The product of 75 by 43 is 3225. How much must be added to it to obtain the product of 77 by 43?

6. A drover bought 79 oxen at $42 each; he sold 25 at $40 each. For how much per head must he sell the rest so as to gain $544 on the whole transaction?

7. If 13 houses cost $16250, what will 25 houses cost?

8. What is the smallest number which subtracted from 57696 will make it divisible by 178?

9. A grain-dealer shipped 9000 bushels of wheat at a freight rate of 11 cents a bushel. He sold the wheat at 75 cents a bushel, gaining $1530 on the total cost. How much did the wheat cost him per bushel?

10. A postmaster is allowed $1.20 on every $20 worth of stamps sold. How much will he make on a sale of 5000 two-cent stamps and 2000 one-cent stamps?

11. Add together the sum, difference, product, and quotient of the two numbers 825 and 9318375.

12. I bought a farm of 136 acres for $8568, and sold 93 acres of it at $75 an acre, and the remainder for what it cost. How much did I gain by the bargain?

13. If 38 acres of land cost $11172, how many acres can be bought for $107310?

14. How many bushels of wheat, at 125 cents per bushel, should be exchanged for 250 pounds of sugar, at 8 cents per pound?

15. Fifteen men can husk 1095 bushels of corn in a day. How many bushels can 27 men husk?

16. Bought a farm for $35380, and having made improvements valued at $3420, I sold one-half of it for $21750, at $75 an acre. How many acres did I purchase, and at what price per acre?

17. I bought a farm of 150 acres for $12000; I sold 29 acres at $95 an acre, 75 at $112 an acre, and the rest at $96 an acre. What did I gain by this transaction?

18. Two ships 3120 miles apart approach each other the one sailing at the rate of 146 miles a day, and the other at 127 miles. How far will they be apart at the end of 9 days?

SECTION IV. DENOMINATE NUMBERS

EXERCISE 154

Reduce:—

1. 7s. 8d. to pence
2. £1 3s. to farthings.
3. 7145d. to £., etc.
4. 6185 s. to £., etc.
5. £10 0s. 6d. to pence.
6. £2 6s. 8d. to pence.
7. 2 t. 81 lb. to ounces.
8. 5 lb. 6 oz. to ounces.
9. 21645 oz. to cwt., etc.
10. 76385 oz. to tons, etc.
11. 3cwt. 8lb. 5oz. to ounces
12. 51649 lb. to tons, etc.
13. 1 mi. 9 rd. to inches.
14. 76452 in. to mi., etc.
15. 2 rd. 1 yd. to feet.
16. 16752 in. to fathoms.
17. 1997 sq. rd. to acres, etc.
18. 3 sq. rd. 2 sq. ft. to inches.
19. 8439 cu. in. to feet.
20. 7689 cu. ft. to cords.
21. 7 da. 16 hr. to seconds.
22. 7684 pts. to bushels, etc.
23. 84 gal. 3 qts. to pints.
24. 36 bu. 3 qt. 1 pt. to pts.
25. 3685 lb. of wheat to bu.
26. 785693 sec. to weeks, etc.
27. 78 da. 9 min. to secs.
28. 1576 cu. ft. to cords.
29. £24 15s. 6d. to dollars and cents.

EXERCISE 155

(1)

lb.	oz.	dwt.
17	9	16
25	6	12
72	11	13
57	10	19

(2)

cwt.	lb.	oz.
20	87	11
16	66	12
17	22	15
19	43	13

(3)

rd.	yd.	ft.	in.
17	4	2	6
21	2	1	7
23	3	0	8
25	5	2	9

4. Find the sum of 1 wk. 2 da. 13 hr. 40 min. 30 sec. 2 wk. 6 da. 10 hr. 8 min. 3 sec.; 5 da. 22 h. 55 min. 45 sec.; 4 h. 1 min. 15 sec.; and 1 wk. 2 da. 4 h. 5 min.

5. Add together 10 rd. 4 yd. 2 ft. 8 in., 1 rd. 3 yd. 5 in.; 8 rd. 2 yd. 1 ft. 6 in.; 1 rd. 4 in.: and 2 yd. 1 ft. 9 in.

Subtract:—

(6)

yr.	mo.
3	1
1	2

(7)

mi.	rd.	yd.
60	0	0
40	39	1

(8)

a.	sq. rd.	sq. yd
69	25	10
10	38	15

9. A farmer had 200 bu. of wheat, and sold 28 bu. 2 pk. 5 qt. 1 pt. to one man, and as much to another; how much remained?

10. From a barrel of coal oil containing 54 gallons, a person drew 12 gal. 3 qt. one day, and 9 gal. 2 qt. 1 pt. another; how much was left?

EXERCISE 156

Multiply:—

(1)

cwt.	lb.	oz.
18	16	
		5

(2)

lb.	oz.	dwt.	gr.
16	8	15	17
			3

(3)

da.	h.	min.	sec.
10	20	30	40
			7

4. What is the value of 39 oxen at £15 7s. 11½d. each?

5. What is the weight of 345 hogsheads of sugar, each weighing 14 cwt. 45 lb.?

6. What is the weight of one dozen spoons, each weighing 1 oz. 2 dwt. 16 gr.?

Divide:—

(7)

£	s.	d.
4)61	18	4

(8)

lb.	oz.	dwt.	gr.
6)76	10	14	12

(9)

t.	cwt.	lb.
7)112	16	66

10. Divide 4 gal. 2 qt. by 141.

11. Divide 40 cu. yd. 10 cu. ft. by 18.

12. Divide 69 bu. 3 pk. 6 qt. by 6 bu. 2 [illegible] qt.

13. Divide 697 lb. 7 oz. by 60 lb. 10 oz

SECTION V. COMMON AND DECIMAL FRACTIONS

EXERCISE 157

1. Which of the following are decimal fractions and which common fractions:

$\frac{5}{100}$; $\frac{3}{8}$; .106; 4.325; $\frac{9}{10}$; $\frac{1}{2}$; $\frac{4}{7}$?

2. Add:—$\frac{3}{4}+\frac{5}{8}+\frac{9}{10}+\frac{6}{16}+2$.

3. Add:—$4\frac{5}{8}+3\frac{2}{3}+19\frac{5}{16}+37\frac{1}{2}\frac{1}{4}+112\frac{3}{4}\frac{5}{8}$.

4. Divide $417\frac{2}{3}$ by 9; $3204\frac{5}{8}$, by 12; $31006\frac{1}{4}$ by 6000.

5. Divide $\frac{3}{8}$ by $\frac{3}{5}$; $\frac{7}{8}$ by 3; $\frac{9}{16}$ by $3\frac{3}{4}$; $\frac{5}{6}$ by $\frac{1}{3}$; 3 by $\frac{5}{16}$; $3\frac{1}{2}$ by $4\frac{5}{8}$; 5 by $\frac{1}{8}$; $9\frac{1}{8}$ by 225.

6. Simplify: $\frac{9\frac{5}{12}}{16\frac{7}{12}}$; $\frac{9\frac{1}{8}}{120}$; $\frac{218}{191\frac{3}{5}}$; $\frac{923\frac{3}{4}}{964\frac{3}{4}}$.

7. Multiply:—$37\frac{3}{4}$ by 12; $938\frac{1}{7}$ by 14; $312\frac{5}{8}$ by 18; $307\frac{2}{3}$ by 18; $438\frac{5}{8}$ by 16.

8. Simplify:—$(1\frac{2}{3}+4\frac{1}{2}+5\frac{5}{8}+9\frac{3}{4})-(\frac{1}{8}+\frac{1}{8}+5\frac{1}{2})$.

EXERCISE 158

1. Divide $\frac{5}{12}$ by $2\frac{3}{8}$; $\frac{7}{15}$ by 12 and $3\frac{1}{2}$ by $1\frac{4}{7}$.

2. Add:—.8; .06; .004; and divide the result by 86.4

3. Multiply .0068 by one hundred and six ten-thousandths.

4. Express as fractions:—.7; .006; .336; and .125.

5. Multiply $3869\frac{25}{48}$ by 144.

6. Find the value of:—$\frac{3}{8}$ of \$9.60+$\frac{3}{4}$ of \$42+$\frac{2}{3}$ of 60 cents.

7. Add:—$\frac{3}{4}$ of 12 oz.+$\frac{3}{7}$ of 43 lbs. 12 oz.+$\frac{2}{3}$ of 82 lb. 11 oz.

8. Reduce to their lowest terms:—

(a) $\frac{189}{231}$; $\frac{525}{735}$; $\frac{242}{352}$; $\frac{935}{700}$; $\frac{1632}{2040}$; $\frac{272}{408}$.

9. Find the value of:—

(a) $\frac{9}{10}$ of $\frac{11}{12}$ of $1\frac{1}{2}$ of $\frac{9}{10}$ of $1\frac{7}{11}$.

(b) $\frac{1}{12} \times 2\frac{7}{11} \times \frac{9}{10} \times 1\frac{3}{27} \times 1\frac{1}{2}$.

10. Subtract:—$\frac{11}{30}$ from $\frac{13}{21}$; $3\frac{1}{3}$ from $10\frac{7}{8}$; $119\frac{1}{4}$ from $160\frac{1}{8}$.

11. A man's daily wages are $\$3\frac{1}{8}$ per day, and his daily expenses are $\$1\frac{3}{4}$. How much will he save in 3 weeks?

12. A man earns $\$3\frac{1}{8}$ per day and spends $\$1\frac{7}{8}$ per day. In how many days will he save enough to buy a suit of clothes worth $\$16\frac{1}{8}$?

13. A miller wishes to put 39 bush. of wheat into bags each bag containing $2\frac{1}{8}$ bush. How many bags will be required?

14. Arrange:—$\frac{3}{7}$; $\frac{9}{8}$; $\frac{7}{15}$; $\frac{13}{25}$; and $\frac{7}{3}$ of $\frac{9}{15}$ in order of magnitude.

15. Date, fill, foot and receipt the following bills, inserting the address of some purchaser and some dealer whom you know.

(*a*) Bill for meat:—$3\frac{1}{2}$ lb. of steak at 18c., $14\frac{1}{2}$ lb. fish at 20c., $14\frac{1}{4}$ lb. beef at 20c., 1 turkey, 8lb. at 17c. a lb.

(*b*) Bill for dry goods:—7 yds cotton at 10c., 6 hdkfs at 25c., 3 pairs kid gloves at $1.25, 12 yds. flannel at $12\frac{1}{2}$c, 8 yds. muslin at 20c.

(*c*) Bill for groceries:—4 lb. coffee at 32c., 4 lb. tea at 50c., 7 lb. lard at 8c., $3\frac{1}{2}$ lb. butter at 35c., 8 lb. 4 oz. cheese at 16c., 3 qt. currants at 7c., 2 doz. eggs at 31c., $\frac{1}{2}$ gal. coal oil at 40c.

16. A freight car is 8′x34′ and the interior is 7′ high. If it is filled with grain to a height of $5\frac{1}{2}$ feet, what is the weight of the grain at 60 lb. to the bushel, allowing $1\frac{1}{8}$ cubic feet to the bushel?

SECTION VI. PERCENTAGE AND INTEREST

EXERCISE 159

1. A dealer bought $844.80 worth of shoes and sold them at a profit of 25%. How much did he gain? If he failed to collect 10% of this profit, how much did he really make?

2. If a man saves $150 out of a salary of $1200, what per cent. of his salary does he save?

3. A boy in a store receives $10 a week. He spends 25% of it for board, 10% of the remainder for clothes and $2 in other ways. If he saves the remainder, how much will he save in a year (52 weeks)?

4. A grocer buys a crate of eggs containing forty dozen eggs at 15c. per dozen. He dropped the crate and broke 6 dozen. For how much per dozen must he sell the remainder in order to gain 25% on the whole transaction?

5. How much is the interest on $742.25 for one year at 6%? For ½ a year? For 2 years 6 mos.? For 3 mos.?

6. A man borrowed $250 on Jan. 15, 1907, at 6%. He paid principal and interest on Nov. 15, 1907. How much did he pay?

7. A man bought 15 head of cattle on Feb. 1, 1907, at $40 per head, giving his promissory note at 6%. He paid it on the 16th of the following April. How much did he pay?

8. What is the exact interest on $1850 from July 5th to Sept. 5th at 5%?

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