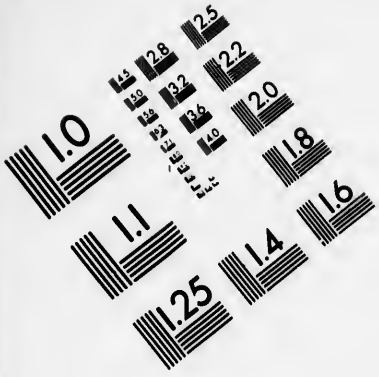
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2800000.0
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3600000.0
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5000000.0
5600000.0
6300000.0
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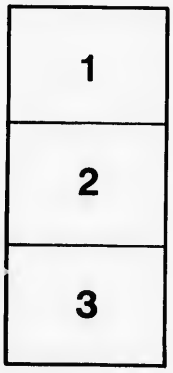


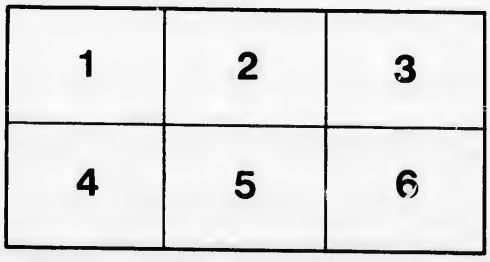


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# CANADIAN

# ARITHMETIC

## IN DECIMAL CURRENCY

WITH METRICAL TABLES

## FOR THE USE OF SCHOOLS

BY

J. H. RICHARDSON

APPROVED BY THE COUNCIL OF PUBLIC INSTRUCTION
IN OCT. 1870

QUEBEC
PRINTED AND PUBLISHED BY A. COTÉ & Cº
1871

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Entered according to Act of Parliament of Canada, in the year 1871, by Augustin Côté, at the office of the Minister of Agriculture.

# PREFACE.

THE object of the following treatise may be expressed in one word—UTILITY. The author has aimed to make the work practically useful: with this view, the rules are expressed clearly and concisely, illustrated by many examples which are carefully explained, and followed by numerous exercises, which will afford the pupil that practice by which alone expertness and accuracy in the management of numbers can be obtained, and by which the rules can be impressed on the memory of the pupils. It was thought best to leave the explanation of most of the rules to the teacher with the blackboard; and as impressions made on the mind by seeing, are more important and lasting than those made by any of the other senses, the instructor or educator should make a constant use of this faculty in communicating his instructions. It is, however, thought that the rules are so clear, and the explanations of the examples so simple, that the pupil will easily comprehend the process employed.

Of the exercises, some are proposed in purely abstract terms, being intended merely to afford practice to the learner in the rules; and many of the exercises will be found to furnish important facts in geography, history, &c., both interesting and instructive. The exercises are graduated so as to form a progressive course of instruction adapted to the different classes in a school; and miscellaneous questions are scattered through the work, which are recommended to be used as exercises when taking a review of the rules already mastered.

The metrical tables of money, weights and measures, with exercises thereon, are inserted at the end of the work; and teachers are recommended to introduce the system into their schools, it being already in use in many countries in Europe, and there can be no doubt that before many years have elapsed the metric system will be adopted as the standard throughout the commercial world.

Several exercises in mental arithmetic are inserted at the end of the book; and the teacher is recommended to begin at as early an age as possible to exercise his pupils in this important study, which will be found a most efficient means of cultivating the intellectual faculties of his scholars and improving their reasoning powers.

The problems are all new; and no exertions have been spared by the author to ensure the strictest accuracy in every part of the work.

J. H. RICHARDSON

1st June, 1870.

To Mr. JOSEPH RICHARDSON,
School Teacher, St. Dunstan.

Dear Sir,

I have found in your work a larger amount of information on the fundamental rules of Arithmetic, suited to the wants of schools, both as regards a text book adapted to the capacities of children, and as an efficient means of lessening the labour of the teacher, than in any other work on the same subject.

I commend your Arithmetic most heartily to the notice of teachers and others, interested in the education of children and youth, and I wish your excellent work a widely extended circulation.

With best wishes,
I am, dear Sir,
Yours truly,

F. E. JUNEAU,
*Inspector of Schools.*

# RICHARDSON'S

# CANADIAN ARITHMETIC

## NOTATION AND NUMERATION.

ARITHMETIC is the science which explains the properties, and shows the uses of numbers.

NUMBERS are expressions or characters that represent one or more things.

NOTATION is the art of expressing numbers by characters.

NUMERATION is the art of reading numbers expressed by characters.

Ten characters, called figures, are used for the expression of numbers.

The figures used in writing numbers are: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, called, respectively, one, two, three, four, five, six, seven, eight, nine, and zero, cipher, or naught.

Numbers higher than nine are expressed by two or more of these figures together, thus .

| | | |
|---|---|---|
| Ten | is written | 10. |
| Eleven | " | 11. |
| Twelve | " | 12. |
| Thirteen | " | 13. |
| Fourteen | " | 14. |
| Fifteen | " | 15. |
| Twenty | " | 20. |
| Twenty-three | " | 23. |
| One hundred and ten | " | 110. |
| One hundred and seventy | " | 170. |
| Two hundred and nine | " | 209. |
| Two hundred and twenty-six | " | 226. |

When a number consists of several figures, the first figure on the right hand is called the units' figure, the second figure from the right hand the tens' figure, the third figure from the right hand the hundreds' figure, the fourth figure from the right hand the thousands' figure, &c.

The cipher or zero alone is of no value; but when used with other figures, it changes their value. Thus, the figure 6 alone denotes 6; but by annexing one cipher, it becomes 60; by annexing two ciphers, it becomes 600, &c. The figures 65 denote sixty-five; but by inserting a cipher between, the value is changed to 605.

To facilitate the reading of numbers expressed by several figures, they are divided into periods of three figures each, beginning at the right hand. The first period of three figures on the right hand is called units, the second period thousands, the third period millions, the fourth period billions, the fifth period trillions, and so on, according to the following :—

NUMERATION TABLE.

| | Hundreds of quintillions. | Tens of quintillions. | Quintillions. | Hundreds of quadrillions. | Tens of quadrillions. | Quadrillions. | Hundreds of trillions. | Tens of trillions. | Trillions. | Hundreds of billions. | Tens of billions. | Billions. | Hundreds of millions. | Tens of millions. | Millions. | Hundreds of thousands. | Tens of thousands. | Thousands. | Hundreds. | Tens. | Units. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 21, | 20, | 19, | 18, | 17, | 16, | 15, | 14, | 13, | 12, | 11, | 10, | 9, | 8, | 7, | 6, | 5, | 4, | 3, | 2, | 1, |
| VII. Quintillions..... | | | | | | | | | | | | | | | | | | | | | |
| VI. Quadrillions..... | | | | | | | | | | | | | | | | | | | | | |
| V. Trillions..... | | | | | | | | | | | | | | | | | | | | | |
| IV. Billions..... | | | | | | | | | | | | | | | | | | | | | |
| III. Millions..... | | | | | | | | | | | | | | | | | | | | | |
| II. Thousands..... | | | | | | | | | | | | | | | | | | | | | |
| I. Units..... | | | | | | | | | | | | | | | | | | | | | |

The periods after quintillions are called sextillions, septillions, octillions &c., but it is seldom necessary in actual practice to express numbers exceeding millions.

In reading numbers it is necessary to remember the names of the periods.

Thus in reading the expression 472,536,000,704,006, by dividing the number into periods of three figures each, we find that there are five periods, the fifth period from the right hand being four hundred and seventy-two trillions, the fourth five hundred and thirty-six billions, there being no millions, the third period is occupied by ciphers, in the second period we have seven hundred and four thousand, and in the first period six. The whole number is therefore read, four hundred and seventy-two trillions, five hundred and thirty-six billions, seven hundred and four thousand and six.

The method given above by which numbers are divided into periods of three figures each, is that which is employed by the

French and Italians. It is strongly recommended for its simplicity, and it has been adopted in some English works. In most English works however, the periods are made to consist of six figures each; and as they have the same names as those in the table given above, (thousands however being limited to three places), the rules given above will be applicable in this method, if the periods are made to consist of six figures each, instead of three, and the second period be called millions, the third billions, &c., as in the following table. The answers to the exercises are given according to both methods.

OLD NUMERATION TABLE.

| | | |
|---|---|---|
| IV. Trillions..... | 24, | Hundreds of thousands of trillions. |
| | 23, | Tens of thousands of trillions. |
| | 22, | Thousands of trillions. |
| | 21, | Hundreds of trillions. |
| | 20, | Tens of trillions. |
| | 19, | Trillions. |
| III. Billions..... | 18, | Hundreds of thousands of billions. |
| | 17, | Tens of thousands of billions. |
| | 16, | Thousands of billions. |
| | 15, | Hundreds of billions. |
| | 14, | Tens of billions. |
| | 13, | Billions. |
| II. Millions..... | 12, | Hundreds of thousands of millions. |
| | 11, | Tens of thousands of millions. |
| | 10, | Thousands of millions. |
| | 9, | Hundreds of millions. |
| | 8, | Tens of Millions. |
| | 7, | Millions. |
| I. Units..... | 6, | Hundreds of thousands. |
| | 5, | Tens of thousands. |
| | 4, | Thousands. |
| | 3, | Hundreds. |
| | 2, | Tens. |
| | 1, | Units. |

### Exercise 1.

Write down in words or name the following numbers :—

1. 27 ; 63 ; 208 ; 365 ; 750 ; 932 ; 7605.
2. 5900 ; 10100 ; 25602 ; 200090 ; 402000.
3. 9300200 ; 27000042 ; 600007000 ; 123456789.
4. 5012300086 ; 702300000007.
5. 2600970400000 ; 900460000070004.
6. 70400006030002000 ; 500702300001.
7. 6009004003002005 ; 2002002020.
8. 2714683529123456742.

To write numbers in figures :—

*Rule.*—Beginning at the left hand side, place each significant figure in its corresponding period, and fill up any vacant places that may occur in any period with ciphers.

Example.—Write in figures the number thirty-seven millions, seven thousand and nine.

The first period is nine, the second seven thousand, and the third thirty-seven millions, therefore we write two ciphers in the first period and two in the second by which we obtain the number 37007009.

### Exercise 2.

Write down the following expressions in figures :—

1. Seventy four.
2. Two hundred.
3. Seven hundred and nine.
4. Two thousand and sixty-seven.
5. Four thousand and two.
6. One thousand eight hundred and sixty-nine.
7. Three thousand and six.
8. Nine thousand and sixty.
9. Five thousand seven hundred and two.
10. Fifteen thousand two hundred and thirty.
11. Thirty-nine thousand and seventy-four.
12. Six hundred and four thousand and nine.
13. Seven millions twenty thousand nine hundred and eight.
14. Two hundred and four millions seven hundred and sixty-five thousand seven hundred and ninety-two.
15. Ninety-seven billions six millions and thirty-four.
16. Two billions and seventy-nine.
17. Four hundred billions forty millions four thousand and four.

18. Sixteen billions sixteen millions sixteen thousand and sixteen.
19. Twenty-four trillions seven millions and ninety-six.
20. Three hundred and sixty-five trillions two hundred and forty-seven billions six hundred and thirty-nine millions five hundred and seventy-three thousand six hundred and ninety-four.

In Roman notation seven letters are used which with their values are:

| | | | |
|---|---|---|---|
| I. | One. | C. | One hundred. |
| V. | Five. | D. | Five hundred. |
| X. | Ten. | M. | One thousand. |
| L. | Fifty. | | |

Other numbers are expressed by combinations of these letters.

When a letter is repeated its value is repeated, but no letter should be repeated more then three times.

When a letter of a lower value is written after one of a higher, their values are added, and their sum is the value of the whole.

When a letter of a lower value is written before one of a higher, their values are subtracted, and the difference is the value of the whole: thus.

| | | | | | |
|---|---|---|---|---|---|
| I. | 1. | XX. | 20. | CD. | 400. |
| II. | 2. | XXX. | 30. | D. | 500. |
| III. | 3. | XL. | 40. | DC. | 600. |
| IV. | 4. | L. | 50. | DCC. | 700. |
| V. | 5. | LX. | 60. | DCCC. | 800. |
| VI. | 6. | LXX. | 70. | CM. | 900. |
| VII. | 7. | LXXX. | 80. | M. | 1000. |
| VIII. | 8 | XC. | 90. | MM. | 2000. |
| IX. | 9. | C. | 100. | MMM. | 3000. |
| X. | 10. | CC. | 200 | MMMD | 3500. |
| XIX. | 19. | CCC. | 300. | MDCCCLXX. | 1870. |

A dash placed over a number consisting of one or more letters, multiplies its value by 1000.

Thus CLX.=160, but $\overline{\text{CLX}}$.=160000.

EXERCISE 3.

Express the following numbers in figures:

IV, XIV, XX, VIII, XVI, XLV, LXXXI, CCCXVII, DCXLVIII, DCCC, CDVII, DLIV, CMXII, MCXX, MMDCCC, MD, $\overline{\text{XL}}$, $\overline{\text{LXXX}}$, $\overline{\text{X}}$M, $\overline{\text{XL}}$MMCXXVII, $\overline{\text{MM}}$, $\overline{\text{VII}}$, M$\overline{\text{X}}$VII, $\overline{\text{V}}$MMXLII, $\overline{\text{MD}}$CCCLXVIII.

EXERCISE 4.

Write the following numbers in Roman Numerals:
74, 47, 91, 83, 104, 692, 573, 896, 365, 144, 5270, 9650, 7408, 9005, 2560, 10724, 49650, 50070, 78964, 42763, 81796, 802764, 453000, 792800, 1702500, 3742568.

## SIMPLE ADDITION.

SIMPLE ADDITION teaches how to add together two or more quantities of the same denomination so as to make but one whole.

The quantities to be added are called the addends, the number which is equal to the addends taken together is called their sum.

The sign + called *plus* signifies that the quantities between which it stands are to be added together, thus 2 + 7 that is 2 and 7 added together are 9.

The sign = denotes that the quantities between which it stands are equal, as 3 + 2 + 4 = 9 that is the sum of 3, 2, and 4 is equal to 9.

ADDITION TABLE.

| 2 and | 3 and | 4 and | 5 and | 8 and | 9 and | 12 and |
|---|---|---|---|---|---|---|
| 1 are 3 | 1 are 4 | 1 are 5 | 1 are 6 | 1 are 9 | 1 are 10 | 1 are 13 |
| 2 — 4 | 2 — 5 | 2 — 6 | 2 — 7 | 2 — 10 | 2 — 11 | 2 — 14 |
| 3 — 5 | 3 — 6 | 3 — 7 | 3 — 8 | 3 — 11 | 3 — 12 | 3 — 15 |
| 4 — 6 | 4 — 7 | 4 — 8 | 4 — 9 | 4 — 12 | 4 — 13 | 4 — 16 |
| 5 — 7 | 5 — 8 | 5 — 9 | 5 — 10 | 5 — 13 | 5 — 14 | 5 — 17 |
| 6 — 8 | 6 — 9 | 6 — 10 | 6 — 11 | 6 — 14 | 6 — 15 | 6 — 18 |
| 7 — 9 | 7 — 10 | 7 — 11 | 7 — 12 | 7 — 15 | 7 — 16 | 7 — 19 |
| 8 — 10 | 8 — 11 | 8 — 12 | 8 — 13 | 8 — 16 | 8 — 17 | 8 — 20 |
| 9 — 11 | 9 — 12 | 9 — 13 | 9 — 14 | 9 — 17 | 9 — 18 | 9 — 21 |
| 10 — 12 | 10 — 13 | 10 — 14 | 10 — 15 | 10 — 18 | 10 — 19 | 10 — 22 |
| 11 — 13 | 11 — 14 | 11 — 15 | 11 — 16 | 11 — 19 | 11 — 20 | 11 — 23 |
| 12 — 14 | 12 — 15 | 12 — 16 | 12 — 17 | 12 — 20 | 12 — 21 | 12 — 24 |

Pupils should be continued at the above addition table and similar exercises until able to add with facility; for without practice in some such exercises the operation will be found to be tedious and difficult.

*Rule.* 1. Place the quantities to be added below one another so that units will stand under units, tens under tens, hundreds under hundreds, &c. 2. Then commencing at the right hand side, add together from the bottom the figures in the units column; if the sum does not exceed nine set down the figure; 3. But if the sum exceeds nine set down the right hand figure, and carry the remaining figure or figures, which is the number of tens in the number, to the next column; because ten in any column is equivalent only to one in the column immediately to the left of it. 4. Proceed in the same manner with each column to the last, the sum of which set down in full.

EXAMPLE. Add together 724, 40, 151, and 742.

| | |
|---|---|
| 724 | |
| 40 | First we arrange the quantities so that units |
| 151 | are under units, tens under tens. &c. Then |
| 742 | adding together the figures in the first column |
| 1657 sum | we set down 7 their sum under the units column, the sum of the second column is 15, we therefore set down 5, the right hand figure and carry 1 to the next column, the sum of which with 1 added to it is 16, which is set down in full. |

PROOF. 1. Begin at the top and add the several columns downwards, which should give the same result as by the rule, or,

2. Add together all the quantities except that in the top line, then to their sum add the quantity in the top line; and if the result is the same as that obtained by the rule the work may be considered correct.

EXERCISES.

| 1. | 2. | 3. | 4. | 5. |
|---|---|---|---|---|
| 7324 | 2706 | 64736 | 928764 | 5316742 |
| 8087 | 312 | 1734 | 235 | 7654321 |
| 2430 | 8964 | 83965 | 79638 | 8976 |
| 3607 | 2105 | 27 | 526435 | 27835 |

| 6.—pounds. | 7.—tons. | 8.—yards. | 9.—bushels. |
|---|---|---|---|
| 9264 | 746 | 729 | 3906 |
| 1835 | 957 | 463 | 9678 |
| 7499 | 843 | 397 | 2847 |
| 7863 | 562 | 865 | 3965 |
| 5298 | 479 | 279 | 1868 |
| 6314 | 843 | 768 | 2547 |
| 5701 | 247 | 496 | 9870 |

| 10.—inches. | 11.—days. | 12.—miles. | 13.—feet. |
|---|---|---|---|
| 9274 | 829 | 872 | 9864 |
| 3758 | 756 | 469 | 6957 |
| 9658 | 358 | 875 | 8972 |
| 2374 | 902 | 693 | 4659 |
| 4680 | 531 | 870 | 8729 |
| 7531 | 790 | 365 | 4596 |
| 9246 | 642 | 742 | 9872 |
| 3218 | 812 | 964 | 4658 |
| 4567 | 543 | 578 | 2907 |
| 5108 | 678 | 389 | 6784 |
| 3742 | 109 | 472 | 5972 |
| 6938 | 357 | 896 | 6578 |
| 2714 | 429 | 759 | 9834 |
| 2583 | 681 | 804 | 5786 |
| 9673 | 432 | 968 | 9672 |
| 6578 | 567 | 247 | 6584 |
| 5013 | 198 | 964 | 9327 |
| 5724 | 268 | 578 | 4685 |
| 1896 | 937 | 964 | 9307 |

14. Add together 7642 lbs.; 9763 lbs; 1869 lbs.; 9724 lbs.

15. Add together 2479 yds.; 248 yds.; 6002 yds.; 28 yds.; 906 yds.; 7592 yds

16. Find the sum of 90068 + 742 + 96742 + 87963 + 974 + 87568 + 93275 + 87563.

17. Find the sum of 2796824 + 87073064 + 90704609 + 72564902 + 78569204 + 304163874 + 987653792 + 74235862.

18. Find the sum of 9248 + 6702954 + 248 + 78524 + 965749 + 2463 + 3964872 + 18978 + 924642 + 365.

19. Find the sum of 9874 + 6948357 + 384 + 10754 + 92 + 786 + 2794 + 18965 + 742927 + 9784968.

20. Add together two thousand four hundred and seven; nine thousand eight hundred and sixty-four; four thousand and fifty-seven; eight thousand and four; nine hundred and sixty-eight.

21. Add together forty-six thousand nine hundred and seventy-four; two thousand, four hundred and fifty-six; nine hundred and seventy-two; seventy-eight; three hundred and sixty-five; four thousand eight hundred and ninety-six; fifty-seven thousand two hundred and thirty-nine.

22. Add together eight thousand eight hundred and eighty-eight; nine thousand and ninety-nine; seven thousand seven hundred and seven; six thousand six hundred and sixty; five hundred and ninety-eight; nine thousand nine hundred and ninety-nine; seventy-six.

23. Add together sixty thousand and sixty; nine thousand nine hundred and ninety; eighty-seven thousand seven hundred and ninety-four; fifty-two; three hundred and seventy-nine; seven hundred and four thousand seven hundred and four; ninety; seventy-seven thousand seven hundred and seventy-seven; six hundred and forty-eight.

24. The populations of the countries of North America are, Russian America sixty thousand, Danish America ten thousand; British America three millions five hundred thousand; United States thirty-one millions five hundred thousand; Mexico seven millions five hundred thousand; Central America two millions five hundred thousand; and the West India Islands three millions nine hundred thousand; what is the whole population?

25. A grocer receives for goods sold on monday $72; on tuesday $89; on wednesday $113; on thursday $68; on friday $91; and on saturday $86; what amount did he receive in the week?

26. A farmer sold 946 bushels of turnips the first three months of the year; 1127 bushels the second three months; 748 bushels the third three months; and 897 bushels the last three months; how many bushels did he sell in the year?

27. A gentleman travelled 180 miles by steamboat on monday; 114 miles by railroad on tuesday; and 27 miles on horseback on wednesday; how many miles did he travel in the three days?

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## SIMPLE SUBTRACTION.

Simple Subtraction teaches how to find the difference between two quantities of the same denomination.

The sign — called *minus*, when written between two numbers, signifies that the number which follows the sign, is to be subtracted from the number before it.

Thus 17 — 9, read seventeen minus nine, signifies that 9 is to be subtracted from 17.

*Rule.* 1. Write the less number below the greater with units under units, tens under tens, &c. 2. Beginning at the right

hand side, substract, if possible, each figure in the lower line from the one above it, and set down the remainder. 3. But if any figure in the lower line is greater than the one above it, add ten to the upper figure, subtract as before and carry one to the next figure in the lower line. 4. Because by carrying one to the lower figure, we increase the lower line as much as we increased the upper by adding ten, and thus the difference is the same as if neither had been increased.

PROOF 1. Add the remainder to the less of the given numbers, and if the sum is equal to the greater, the work may be considered correct; or,

2. Subtract the remainder from the greater of the given numbers, and if the difference is equal to the less, the work is correct.

EXAMPLE. 1. From 9386 take 4241,

9386
4241

5145 remainder.

9386 proof.

The numbers being arranged according to the rule, we say 1 from 6 and 5 remains, 4 from 8 and 4 remains, 2 from 3 and 1 remains, 4 from 9 and 5 remains, we thus find the remainder to be 5145.

PROOF. 1. Add 5145 the remainder to 4241 the less of the given numbers; and the sum is found to be 9386, the greater of the given numbers, which proves the correctness of the work.

By the second method, we subtract 5145 the remainder from 9386 the greater of the given numbers, and find the difference to be equal to the less, the work is therefore correct.

EXAMPLE 2. Find the difference between 73049 and 26586.

73049
26586

46463 remainder

73049 proof

Here we say 6 from 9 and 3 remains, then as in the next column as 8 is greater than 4, we add 10 to the upper figure and say 8 from 14 and 6 remains and carry 1 to 5 makes 6 which taken from 10 leaves a remainder 4, carry 1 to 6 makes 7, 7 from 13 and 6 remains, carry 1 to 2 makes 3, 3 from 7 and 4 remains; the whole remainder is therefore 46463.

EXERCISES.

| 1.—miles. | 2.—inches. | 3.—tons. | 4.—yards. |
|---|---|---|---|
| 361845 | 68794865 | 9287694 | 7920685 |
| 121432 | 12310213 | 3124132 | 2310213 |

| 5.—pounds. | 6.—dollars. | 7.—hours. | 8.—feet. |
|---|---|---|---|
| 1357960 | 7598764 | 3100450 | 60750012 |
| 869478 | 957829 | 801976 | 30170468 |

| | | | |
|---|---|---|---|
| 9.— 7963485 | — 6724185 | 15.— 3126428 | — 246804 |
| 10.— 7999816 | — 870908 | 16.—156938245 | — 75060458 |
| 11.—15280054 | — 8629071 | 17.— 87136924 | — 30271 |
| 12.—64259360 | — 4759643 | 18.— 1401506 | — 71352 |
| 13.— 5000000 | — 846921 | 19.— 7325184 | — 820694 |
| 14.— 7305030 | — 2501086 | 20.— 24150685 | — 4629507 |

21. From seven millions eight thousand, take two hundred and forty-seven thousand nine hundred and seventeen.

22. Take twenty-seven millions and five, from thirty-four millions.

23. Take seven hundred and ninety-four pounds, from four hundred thousand pounds.

24. Find the difference between 7 days and five thousand days.

25. What is the difference between eight millions eight thousand eight hundred; and forty thousand and seven.

26. A person paid 3740 dollars for a house, and spent 210 dollars in repairs, after which he sold it for 4500 dollars, what was his profit?

27. What is the difference between the length of the river Amazon, in South America, the largest river in the world which is about 4700 miles long; and the river St. Lawrence which with the lakes is about 2140 miles long?

28. America was discovered in the year 1492; Canada in 1535; the city of Quebec founded in 1608; Canada taken by Great Britain in 1629; city of Montreal founded 1642; Quebec taken from the French in 1759; Canada ceded to Great Britain in 1763; and invaded by the Americans in 1812. How many years elapsed between each of the above mentioned events, and the confederation of the British North American Provinces in 1867?

29. What number added to 7968, will amount to three millions three thousand and nine?

30. By how many square miles does America exceed Europe, the extent of America in square miles being 15500000, and of Europe 3800000 ?

31. A farmer has 960 bushels of potatoes, he sells 230 bushels to one person, and 176 bushels to another, how many bushels has he left ?

32. What is the difference between the value of two farms one being worth 3982 dollars, and the other 7960 dollars ?

33. The height of Mont Blanc, the highest mountain in Europe, is 15732 feet ; how much higher is Chimborazo, the highest mountain in America, its height being 21424 feet ?

34. The height of Lake Superior above the sea is 600 feet and of Lake Ontario 232 feet, how many feet higher above the sea is the former than the latter ?

35. North America in its widest part is 3500 miles across, and South America 3200 miles, what is the difference between the width of each and the isthmus of Panama which is in one part only 28 miles across ?

36. The distance of the sun from the earth is 95000000 of miles, and the distance of the moon from the earth is 237000 miles, how many miles further is the sun from the earth than the moon ?

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## SIMPLE MULTIPLICATION.

MULTIPLICATION teaches how to find the value of a number, repeated as many times as there are units in another number by which it is multiplied.

The number repeated in multiplication is called the *multiplicand.*

The number which shows how many times the multiplicand is to be repeated is called the *multiplier.*

The result obtained by multiplication is called the *product.*

The multiplicand and the multiplier are called *factors* of the product.

In simple multiplication the multiplicand is always a quantity of only one denomination.

A composite number is the product of two or more factors. Thus 72 is a composite number because it is the product of the factors, 6 and 12, 8 and 9, or 9, 2, and 4.

The sign × called the sign of multiplication, when written between two numbers, signifies that they are to be multiplied together. Thus 15 × 7 = 105, and is read fifteen multiplied by seven is equal to 105.

| Twice | 3 times | 4 times | 5 times | 6 times | 7 times |
|---|---|---|---|---|---|
| 1 are 2 | 1 are 3 | 1 are 4 | 1 are 5 | 1 are 6 | 1 are 7 |
| 2 — 4 | 2 — 6 | 2 — 8 | 2 — 10 | 2 — 12 | 2 — 14 |
| 3 — 6 | 3 — 9 | 3 — 12 | 3 — 15 | 3 — 18 | 3 — 21 |
| 4 — 8 | 4 — 12 | 4 — 16 | 4 — 20 | 4 — 24 | 4 — 28 |
| 5 — 10 | 5 — 15 | 5 — 20 | 5 — 25 | 5 — 30 | 5 — 35 |
| 6 — 12 | 6 — 18 | 6 — 24 | 6 — 30 | 6 — 36 | 6 — 42 |
| 7 — 14 | 7 — 21 | 7 — 28 | 7 — 35 | 7 — 42 | 7 — 49 |
| 8 — 16 | 8 — 24 | 8 — 32 | 8 — 40 | 8 — 48 | 8 — 56 |
| 9 — 18 | 9 — 27 | 9 — 36 | 9 — 45 | 9 — 54 | 9 — 63 |
| 10 — 20 | 10 — 30 | 10 — 40 | 10 — 50 | 10 — 60 | 10 — 70 |
| 11 — 22 | 11 — 33 | 11 — 44 | 11 — 55 | 11 — 66 | 11 — 77 |
| 12 — 24 | 12 — 36 | 12 — 48 | 12 — 60 | 12 — 72 | 12 — 84 |

| 8 times | 9 times | 10 times | 11 times | 12 times |
|---|---|---|---|---|
| 1 are 8 | 1 are 9 | 1 are 10 | 1 are 11 | 1 are 12 |
| 2 — 16 | 2 — 18 | 2 — 20 | 2 — 22 | 2 — 24 |
| 3 — 24 | 3 — 27 | 3 — 30 | 3 — 33 | 3 — 36 |
| 4 — 32 | 4 — 36 | 4 — 40 | 4 — 44 | 4 — 48 |
| 5 — 40 | 5 — 45 | 5 — 50 | 5 — 55 | 5 — 60 |
| 6 — 48 | 6 — 54 | 6 — 60 | 6 — 66 | 7 — 72 |
| 7 — 56 | 7 — 63 | 7 — 70 | 7 — 77 | 7 — 84 |
| 8 — 64 | 8 — 72 | 8 — 80 | 8 — 88 | 8 — 96 |
| 9 — 72 | 9 — 81 | 9 — 90 | 9 — 99 | 9 — 108 |
| 10 — 80 | 10 — 90 | 10 — 100 | 10 — 110 | 10 — 120 |
| 11 — 88 | 11 — 99 | 11 — 110 | 11 — 121 | 11 — 132 |
| 12 — 96 | 12 — 108 | 12 — 120 | 12 — 132 | 12 — 144 |

1. When th

*Rule* I.—1.
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e multiplier
oduct, belo
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the next, a
t to one in

XAMPLE 1.-
96 multipl
7 multipli

72 product

carry 6;
y 6; 7 tim
refore set d

1.—miles.
76945
2

2.—pounds.
793624
6

9.—7634 ×
10.—6310 ×
11.—5607 ×
12.—7328 ×

When the m
tors are high

*Rule* II.—Mu
ply the p
are three
factor, &c.

| 6 times | | 7 times | |
|---|---|---|---|
| 1 are | 6 | 1 are | 7 |
| 2 — | 12 | 2 — | 14 |
| 3 — | 18 | 3 — | 21 |
| 4 — | 24 | 4 — | 28 |
| 5 — | 30 | 5 — | 35 |
| 6 — | 36 | 6 — | 42 |
| 7 — | 42 | 7 — | 49 |
| 8 — | 48 | 8 — | 56 |
| 9 — | 54 | 9 — | 63 |
| 10 — | 60 | 10 — | 70 |
| 11 — | 66 | 11 — | 77 |
| 12 — | 72 | 12 — | 84 |

| times | | 12 times | |
|---|---|---|---|
| are | 11 | 1 are | 12 |
| — | 22 | 2 — | 24 |
| — | 33 | 3 — | 36 |
| — | 44 | 4 — | 48 |
| — | 55 | 5 — | 60 |
| — | 66 | 6 — | 72 |
| — | 77 | 7 — | 84 |
| — | 88 | 8 — | 96 |
| — | 99 | 9 — | 108 |
| — | 110 | 10 — | 120 |
| — | 121 | 11 — | 132 |
| — | 132 | 12 — | 144 |



1. When the multiplier does not exceed 12.

*Rule* I.—1. Place the multiplier under the units figure of the multiplicand, and draw a line below it. 2. Then beginning at the right hand side, multiply each figure in the multiplicand by the multiplier; set down the unit or right hand figure of each product, below the figure multiplied and carry the remaining figure or figures which is the number of tens in the product to the next, as in addition, ten in any column being equivalent to one in the column immediately to the left.

EXAMPLE 1.—Multiply 7896 by 7.

7896 multiplicand.
7 multiplier.
55272 product.

Place 7 the multiplier under 6 the right hand figure of the multiplicand, then 7 times 6 are 42, set down 2 and carry 4; 7 times 9 are 63 and 4 are 67, set down 7 and carry 6; 7 times 8 are 56 and 6 are 62, set down 2 and carry 6; 7 times 7 are 49 and 6 are 55 which is the last and is therefore set down in full, the whole product therefore is 55272.

EXERCISE 1.

| 1.—miles. | 2.—yards. | 3.—pounds. | 4.—inches. |
|---|---|---|---|
| 76945 | 73648 | 962847 | 831695 |
| 2 | 3 | 4 | 5 |
| **5.—pounds.** | **6.—dollars.** | **7.—minutes.** | **8.—cents.** |
| 793624 | 134856 | 473582 | 694273 |
| 6 | 7 | 8 | 9 |

| | | |
|---|---|---|
| 9.—7634 × 2 | 13.—79608 × 6 | 17.—32649 × 10 |
| 10.—6319 × 3 | 14.—25003 × 7 | 18.—78295 × 11 |
| 11.—5607 × 4 | 15.—16914 × 8 | 19.—32071 × 12 |
| 12.—7328 × 5 | 16.—32592 × 9 | 20.—68742 × 7 |

When the multiplier is a composite number, neither of whose factors are higher than 12.

*Rule* II.—Multiply the multiplicand by one of the factors, and multiply the product thus obtained by the second factor, if there are three factors, multiply the second product by the third factor, &c.

EXAMPLE 2.—Multiply 7384 by 54.

7384
9
66456
6
398736

The factors of the multiplier 54 being 9 and 6, we multiply the given number by 9 one of the factors, and the product by 6 the other factor which gives the whole product 398736.

When the multiplier is higher than 12 and not a composite number.

*Rule* III.—1. Place the multiplier under the multiplicand so that units will be under units, tens under tens, &c. 2. Multiply by each figure of the multiplier in succession, setting down the products, so that the right hand figure in each will be under the figure in the multiplier which produces it. 3. Then add the several products together and the sum will be the required product.

*Proof.*—Multiply the multiplier by the multiplicand and if the product is the same as that obtained by the rule the work is correct.

EXAMPLE 3. Multiply 864 by 43.

864
43
2592
3456
37152 product.

First we multiply by 3 and set down the first figure of the product under that figure, next we multiply by 4 and set down the first figure of the product under that figure, then adding together these partial products we obtain the whole product 37152.

When the multiplier or the multiplicand or both end in ciphers.

*Rule* IV. Multiply the significant figures leaving out the ciphers; and to the product annex the ciphers at the end of both factors.

EXAMPLE 4.—Multiply 740 by 23000,

740
23000
222
148
17020000

Here we multiply 74 by 23 and to the product annex 4 ciphers which gives the whole product.

EXAMPLE 5.—Multiply 3674 by 2008.

3674
2008
29392
7348
7377392

Set down the first figure of the first partial product under 8, and the first figure of the second partial product under 2, then adding together these partial products we obtain the required product 7377392.

EXERCICE 2.

| | | | | | |
|---|---|---|---|---|---|
| 1. | 7428 | × 63. | 18. | 53284 | × 7100. |
| 2. | 9205 | × 96. | 19. | 392605 | × 3060. |
| 3. | 7856 | × 36. | 20. | 746058 | × 70306. |
| 4. | 365 | × 84. | 21. | 7096804 | × 73040. |
| 5. | 3456 | × 56. | 22. | 8193620 | × 24106. |
| 6. | 287 | × 108. | 23. | 3480006 | × 30018. |
| 7. | 3625 | × 365. | 24. | 245600 | × 7600. |
| 8. | 2794 | × 872. | 25. | 81243 | × 834. |
| 9. | 6325 | × 704. | 26. | 716018 | × 9006. |
| 10. | 9637 | × 453. | 27. | 3576804 | × 204. |
| 11. | 73456 | × 500. | 28. | 4289654 | × 7056. |
| 12. | 26004 | × 796. | 29. | 936087 | × 8604. |
| 13. | 3648 | × 406. | 30. | 386790 | × 36500. |
| 14. | 4905 | × 3672. | 31. | 8927648 | × 750638. |
| 15. | 92876 | × 7005. | 32. | 2715906 | × 3724. |
| 16. | 78632 | × 2405. | 33. | 5816927 | × 30876. |
| 17. | 7013 | × 2064. | 34. | 8603059 | × 63489. |

35. What is the product of 27648 and 7962?

36 What is the product of 906874 and 27685?

37. Multiply seventy three millions sixty eight thousand nine hundred and fifty four; by seven thousand two hundred and fifty eight.

38. Multiply forty millions three hundred and sixty five thousand two hundred and sixty, by three hundred thousand five hundred and sixty four.

39. Multiply 2678 feet by 8 and the product will be the heig of mount Chimborazo.

40. How many yards are there in 763 pieces of cloth, ea piece containing 27 yards?

41. How many letters are there in a book, containing 4 pages, each page containing on an average 569 words, and ea word 7 letters?

42. There are 525960 minutes in a year, how many are the in 40 years?

43. A clock strikes 156 times in a day, how many times do it strike in a year?

44. If one barrel of flour cost 7 dollars, how many dolla would 1387 barrels cost?

45. How many panes of glass are there in a house in whi there are 7 rooms; each room containing 3 windows; and ea window 8 panes?

## SIMPLE DIVISION.

Division is the method of finding, how often one giv number is contained in another.

In division the number to be divided is called the *dividen*

The number by which we divide is called the *divisor*.

The number which shows how many times the divisor contained in the dividend is called the *quotient*.

The remainder is any number which may remain, after t division, when the divisor is not contained an exact numl of times in the dividend.

When the dividend expresses a quantity of one denominati the process is called *simple division*.

When the divisor does not exceed 12 the process is call *short division*; when the divisor exceeds 12 it is called *lo division*.

The sign ÷ called the sign of division, when placed betwe two numbers, signifies that the number that precedes the si is to be divided by the number after it.

### SHORT DIVISION.

*Rule* I.—1. Place the divisor to the left of the dividend s parating them with a line. 2. Find how often the divisor

contained in the first figure of the dividend, or, if not contained in the first, how often it is contained in the number expressed by the first two, or by the first three figures in the dividend, and set down the figure denoting the number of times. 3. If the divisor is not contained an exact number of times in the number divided, prefix the remainder to the next figure of the dividend, and divide the number thus obtained as the first, setting down the next figure of the quotient, and continue the process to the last figure of the dividend, when if there is a remainder set it down with the divisor written below.

PROOF. Find the product of the quotient and the divisor to which add the remainder if there is any; and if the product thus obtained is the same as the dividend, the work is correct.

EXAMPLE 1. Divide 54807 by 7.

7|54807

78294 quotient.
7

54807 proof.

First we set down 7, the divisor, to the left of the dividend; then as 7 is not contained in the first figure of the dividend, we divide it into 54, the number expressed by the first two figures, in this it is contained 7 times and 5 over, then the remainder prefixed to the next figure makes 58, in which 7 is contained 8 times and 2 over, then 7 into 20 twice and 6 over, and 7 into 67 nine times and 4 over, under which we write the divisor.

EXERCISE 1.

| | | | |
|---|---|---|---|
| 1. | 375064 ÷ 2. | 13. | 1425896 ÷ 5. |
| 2. | 736281 ÷ 3. | 14. | 638247 ÷ 7. |
| 3. | 9406307 ÷ 4. | 15. | 2468013 ÷ 9. |
| 4. | 123456789 ÷ 5. | 16. | 1357924 ÷ 11. |
| 5 | 6342587 ÷ 6. | 17. | 64289768 ÷ 4. |
| 6. | 1392684 ÷ 7. | 18. | 3725872 ÷ 12. |
| 7. | 2222222 ÷ 8. | 19. | 13926741 ÷ 8. |
| 8. | 7219634 ÷ 9. | 20. | 7326974 ÷ 6. |
| 9. | 6312725 ÷ 10. | 21. | 9387268 ÷ 7. |
| 10. | 111111111 ÷ 11. | 22. | 7134267 ÷ 9. |
| 11. | 5300026 ÷ 12. | 23. | 7248956 ÷ 6. |
| 12. | 748742 ÷ 3. | 24. | 6372485 ÷ 9. |

When the divisor is a composite number, none of whos factors is higher than 12.

*Rule* II.—1. Divide the dividend by one factor of the divis and divide the quotient by the other factor. 2. To find th correct remainder, multiply the last remainder by the first div sor and add the first remainder to the product.

Example 2. Divide 83794 by 54.

6|83794
9|13965—4 first rem.
1551—6 second rem
$1551\frac{4}{54}$ quotient

First, we divide by the factor 6 an obtain the quotient 13965, then w divide the quotient by 9 and obta the quotient 1551, with a remaind 6, this remainder is then multiplie by 6, the first divisor, and 4 the fir remainder, is added to the produ which makes 40 the true remainder, under which we write 5 the divisor.

Exercise 2.

| | | | | | |
|---|---|---|---|---|---|
| 1. | 739684 | ÷ 18. | 9. | 12345678 | ÷ 77. |
| 2. | 421963 | ÷ 27. | 10. | 74100632 | ÷ 63. |
| 3. | 5324061 | ÷ 54. | 11. | 3271496 | ÷ 108. |
| 4. | 9382685 | ÷ 99. | 12. | 53196482 | ÷ 132. |
| 5. | 537862 | ÷ 121. | 13. | 42953684 | ÷ 49. |
| 6. | 3625738 | ÷ 81. | 14. | 31274635 | ÷ 110. |
| 7. | 7248964 | ÷ 144. | 15. | 53926845 | ÷ 84. |
| 8. | 9326147 | ÷ 42. | 16. | 143690782 | ÷ 144. |

## LONG DIVISION.

*Rule* III.—1. Place the divisor to the left of the dividend, an leave a space to the right of the dividend for the quotient. Place in the quotient the figure which expresses the number times that the divisor is contained in the least number of figur to the left of the dividend. 3. Multiply the divisor by the figu in the quotient, write the product under the number divid and subtract. 4. To the remainder annex the next figure the dividend, place in the quotient the figure which express the number of times that the divisor is contained in the nu ber, and continue the process till the last figure of the divide is brought down, when if there is a remainder, place it aft the quotient and write the divisor below.

If when a figure has been brought down, the number to be divided is less than the divisor, place a cipher in the quotient, bring down the next figure in the dividend, and divide as before.

PROOF. Multiply the quotient by the divisor, and to the product add the remainder; if the result is equal to the dividend the work is correct.

EXAMPLE 3. Divide 12345 by 49.

49|12345 | 251$\frac{46}{49}$ quotient.
98 49

254 2305
245 1004

95 12345 proof
49

46 remainder.

First we place 49, the divisor to the left of 12345 the dividend, and write 2 in the quotient, 49 being contained twice in 123, then write 98, the product under the number divided, and subtract. To the remainder 25, annex 4, the next figure in the dividend; then 49 is contained 5 times in 254, leaving a remainder 9, to which we annex 5, the next figure in the dividend, place 1 in the quotient, and subtract, the remainder being 46. The quotient therefore is 251 $\frac{46}{49}$.

*Rule* IV. If the divisor ends in ciphers, leave them out, and cut off as many figures from the right of the dividend as there are ciphers in the divisor. Then proceed with the remaining figures according to Rule III, and to the remainder annex the figures cut off from the dividend, which will give the true remainder.

By proceeding according to the above rule the operation is shortened.

EXAMPLE 4. Divide 7423654 by 2900.

29,00|74236,54|2559$\frac{2554}{2900}$ quotient.
58

162
145

173
145

286
261

2554 remainder.

Here the two ciphers in the divisor, and the two figures at the end of the dividend being cut off, we proceed according to Rule III, the remainder is found to be 25 to which 54 is annexed, we thus obtain the true remainder 2554.

EXERCISE 3.

| | | | | | |
|---|---|---|---|---|---|
| 1. | 7235 ÷ | 27. | 20. | 39724685 ÷ | 296. |
| 2. | 95126 ÷ | 36. | 21. | 74289642 ÷ | 2745. |
| 3. | 425396 ÷ | 40. | 22. | 333333333 ÷ | 4268. |
| 4. | 729643 ÷ | 48. | 23. | 923746859 ÷ | 736. |
| 5. | 352864 ÷ | 59. | 24. | 2468013579 ÷ | 5396. |
| 6. | 153928 ÷ | 65. | 25. | 1357924680 ÷ | 742. |
| 7. | 325912 ÷ | 74. | 26. | 931642734 ÷ | 248. |
| 8. | 415236 ÷ | 82. | 27. | 1111111111 ÷ | 7463. |
| 9. | 596432 ÷ | 93. | 28. | 213964582 ÷ | 52376. |
| 10. | 702536 ÷ | 17. | 29. | 9173245863 ÷ | 715. |
| 11. | 430025 ÷ | 28. | 30. | 3926857962 ÷ | 8392. |
| 12. | 300000 ÷ | 70. | 31. | 7429638745 ÷ | 3256. |
| 13. | 896528 ÷ | 124. | 32. | 240006347 ÷ | 46823. |
| 14. | 235964 ÷ | 273. | 33. | 714000086 ÷ | 74053. |
| 15. | 4986327 ÷ | 365. | 34. | 3000000000 ÷ | 426. |
| 16. | 8296153 ÷ | 489. | 35. | 7070707070 ÷ | 5364. |
| 17. | 1738254 ÷ | 576. | 36. | 531724956 ÷ | 792. |
| 18. | 9326485 ÷ | 748. | 37. | 222244445 ÷ | 685. |
| 19. | 2196427 ÷ | 657. | 38. | 7139628745 ÷ | 256. |

39. Divide 95000000 by 704029.
40. What is the forty-seventh part of 726349 ?
41. If 81 apples are divided between 27 boys, how many apples would each boy receive ?
42. Divide 6745 dollars between 74 persons.
43. Divide 7468 by the product of 12 and 4.
44. If a steamship sails 2700 miles in 12 days, how many miles would that be per day ?
45. The area of Europe is 3800000 square miles, and the population 270000000, how many persons are there on an average to each square mile ?.
46. If a person walks 29 miles in a day, how many days would he take to walk 749 miles ?
47. Divide seventy eight billions by 869.
48. Divide ninety four trillions by seven millions and seventy four.

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## TABLES OF MONEY, WEIGHTS AND MEASURES.

In canadian decimal currency 100 cents make one dollar, marked $1.

The canadian coins are, a one cent piece, which is made of bronze, and is exactly 1 inch in diameter, and 100 weigh 1 lb. Avoirdupois, and five cent, ten cent, twenty five cent and fifty cent pieces which are silver.

## OLD CANADIAN CURRENCY.

| | | |
|---|---|---|
| 2 farthings | = 1 | half penny. |
| 4 farthings or 2 half pence | = 1 | penny, marked d. |
| 12 pence | = 1 | shilling, " s. |
| 20 shillings or 240 pence | = 1 | pound, " £ |

## UNITED STATES CURRENCY.

| | | |
|---|---|---|
| 10 mills | = 1 | cent, marked ct. |
| 10 cents | = 1 | dime, " d. |
| 10 dimes | = 1 | dollar, " $. |
| 10 dollars | = 1 | eagle, " E. |

## AVOIRDUPOIS WEIGHT.

| | | | |
|---|---|---|---|
| 16 drams | = 1 | ounce, | marked oz. |
| 16 ounces | = 1 | pound, | " lb. |
| 25 pounds | = 1 | quarter, | " qr. |
| 4 quarters | = 1 | hundred weight, | " cwt. |
| 20 hundred weight | = 1 | ton. | " T. |

This weight is used in weighing meat, groceries, grain, &c.

## TROY WEIGHT.

| | | | |
|---|---|---|---|
| 24 grains | = 1 | pennyweight, | marked dwt. |
| 20 pennyweights | = 1 | ounce, | " oz. |
| 12 ounces | = 1 | pound, | " lb. |

This weight is used in weighing gold, silver, jewels and liquors.

## APOTHECARIES' WEIGHT.

| | | | |
|---|---|---|---|
| 20 grains | = 1 | scruple, | marked scr. |
| 3 scruples | = 1 | dram, | " dr. |
| 8 drams | = 1 | ounce, | " oz. |
| 12 ounces | = 1 | pound, | " lb. |

Apothecaries and physicians use this weight, in mixing their medicines, but they buy and sell by avoirdupois weight.

## LONG MEASURE.

| | | | |
|---|---|---|---|
| 12 lines | = 1 | inch, | marked in. |
| 12 inches | = 1 | foot, | " ft. |
| 3 feet | = 1 | yard, | " yd. |
| 5½ yards | = 1 | rod, pole or perch, | " per. |
| 40 perches | = 1 | furlong, | " fur. |
| 8 furlongs | = 1 | mile, | " m. |
| 3 miles | = 1 | league, | " lea. |
| 60 geographical miles or 69½ British miles | = 1 | degree, | |

## CLOTH MEASURE.

| | | | | |
|---|---|---|---|---|
| 2¼ | inches | = 1 nail, | marked | na. |
| 4 | nails | = 1 quarter, | " | qr. |
| 3 | quarters | = 1 Flemish ell, | " | Fl. e. |
| 4 | quarters | = 1 yard, | " | yd. |
| 5 | quarters | = 1 English ell, | " | Eng. e. |
| 6 | quarters | = 1 French ell, | " | F. e. |

## SQUARE OR LAND MEASURE.

| | | | | |
|---|---|---|---|---|
| 144 | square inches | = 1 square foot, | marked | sq. ft. |
| 9 | square feet | = 1 square yard, | " | sq. yd. |
| 30¼ | square yards | = 1 square perch, | " | sq. per. |
| 40 | square perches | = 1 rood, | " | r. |
| 4 | roods | = 1 acre, | " | a. |
| 640 | acres | = 1 square mile, | " | sq. m. |

Square measure is used in measuring surfaces.

## CUBIC OR SOLID MEASURE.

| | |
|---|---|
| 1728 cubic inches, | = 1 cubic foot. |
| 27 cubic feet, | = 1 cubic yard. |
| 40 cubic feet of rough timber, or 50 cubic feet of hewn timber | = 1 ton. |
| 128 cubic feet of firewood | = 1 cord. |

## DRY MEASURE.

| | | | |
|---|---|---|---|
| 2 | pints | = 1 quart, marked | qt. |
| 4 | quarts | = 1 gallon, " | gal. |
| 2 | gallons | = 1 peck, " | pk. |
| 4 | pecks | = 1 bushel, " | bush. |
| 36 | bushels | = 1 chaldron, " | ch. |

This measure is used in measuring grain, fruit, &c.

## LIQUID MEASURE.

| | | | | |
|---|---|---|---|---|
| 4 | gills | = 1 pint, | marked | pt. |
| 2 | pints | = 1 quart, | " | qt. |
| 4 | quarts | = 1 gallon, | " | gal. |
| 31½ | gallons | = 1 barrel, | " | bar. |
| 2 | barrels or 63 gallons | = 1 hogshead, | " | hhdd. |
| 2 | hogsheads | = 1 pipe, | " | pipe, |
| 2 | pipes | = 1 tun, | " | tun. |

## TIME MEASURE.

| | | | |
|---|---|---|---|
| 60 | seconds | = 1 minute, marked | min. |
| 60 | minutes | = 1 hour, " | h. |
| 24 | hours | = 1 day, " | day. |
| 7 | days | = 1 week, " | wk. |

12 calendar months, or
13 lunar months, or
365 days.
} = 1 year.

Every fourth year contains 366 days, and is called a leap year. The following well known lines, show the number of days in each month.

Thirty days hath September,
April, June, and November,
February has twenty-eight alone.
And all the rest have thirty-one,
Except in leap year, when
February's days are twenty-nine.

## CIRCULAR MEASURE.

| | | |
|---|---|---|
| 60 seconds | = 1 minute | marked ′ |
| 60 minutes | = 1 degree | " ° |
| 30 degrees | = 1 sign | " S. |
| 12 signs or 360 degrees | = The circumference of a circle. | |

## MISCELLANEOUS TABLE.

| | |
|---|---|
| 12 articles | = 1 dozen. |
| 12 dozen or 144 articles | = 1 gross. |
| 20 articles | = 1 score. |
| 24 sheets of paper | = 1 quire. |
| 20 quires | = 1 ream. |
| 14 lbs. | = 1 stone. |
| 196 lbs. | = 1 barrel flour. |
| 200 lbs. | = 1 barrel pork. |
| 4 inches. | = 1 hand, used in measuring horses. |
| 6 feet | = 1 fathom. |
| 21 shillings | = 1 guinea. |

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# REDUCTION.

Reduction teaches how to change a given quantity of one or more denominations, to a quantity of the same kind, but of a different denomination, without altering its value.

When a quantity is to be reduced from a higher to a lower denomination it is called reduction *descending*.

When a quantity is to be reduced from a lower to a higher denomination, it is called reduction *ascending*.

## REDUCTION OF DECIMAL CURRENCY.

Dollars are reduced to cents by annexing two ciphers. Thus $74 = 7400 cents, $936 = 93600 cents.

Cents are reduced to dollars by placing a dot or a short line between the second and third figures, from the right hand. The figures to the left of the dot or line expresses the number of dollars, and the figures to the right, the cents in the amount. Thus 47274 cents = $472.74, and 903865 cents = $9038.65.

### Exercise 1.

1. How many cents are there in seven dollars?
2. How many cents are there in ninety-four dollars?
3. How many cents are there in 19 dollars?
4. How many cents are there in $924.24?
5. Reduce $9642.58 to cents.
6. Reduce $42965.37 to cents.
7. Reduce $942.75 to cents.
8. Reduce 70428 cents, to dollars and cents.
9. Reduce 495064 cents, to dollars and cents.
10. Reduce 28605 cents, to dollars and cents.

To reduce old Canadian currency (pounds, shillings and pence) to decimal currency.

*Rule*—1. Multiply the pounds by 4 to reduce them to dollars; 2. Multiply the shillings by 20 to reduce them to cents; 3. Then multiply the farthings contained in the pence and farthings by $\frac{5}{12}$ to reduce them to cents. 4. Add the three products together and the sum will be the amount in dollars and cents.

The reason of this rule is that £1 = $4; 1s. = 20 cents, and 1 farthing = $\frac{5}{12}$ of a cent.

Example 4.—Reduce £47 : 14 : 7¾ to dollars and cents.

| | |
|---|---|
| £47 × 4 = | $188 |
| s 14 × 20 = | 2.80 |
| far 31 × 5 ÷ 12 = | $12\frac{11}{12}$ cents. |
| | $190.92$\frac{11}{12}$. Ans. |

First we multiply £47 by 4 and obtain $188, then multiply 14 shillings by 20 and obtain $2.80, then multiply 31 farthings by $\frac{5}{12}$ and obtain $12\frac{11}{12}$ cents, the sum of which is $190.92$\frac{11}{12}$, the dollars and cents contained in £47 : 14 : 7¾.

### Exercise 2.

1. How many dollars and cents are there in £18 : 9 : 6 ?
2. Reduce £17 : 14 : 1½ to dollars and cents.
3. Reduce £75 : 18 : 10 to dollars and cents.
4. Reduce £149 : 16 : 5¾ to dollars and cents.
5. How many dollars and cents are there in £256 : 9 : 8¼ ?
6. Reduce £243 : 19 : 6½ to dollars and cents.
7. How many dollars and cents are there in £764 : 8 : 7½ ?
8. How many dollars and cents are there in £394 : 16 : 8½ ?
9. Reduce £76 : 18 : 5 to dollars and cents.
10. Reduce £182 : 16 : 4½ to dollars and cents.
11. Reduce £826 : 9 : 11 to dollars and cents.
12. Reduce £248 : 4 : 9¾ to dollars and cents.

*To reduce dollars and cents to pounds, shillings and pence.*

*Rule.* 1. Divide the dollars by 4 to reduce them to pounds, and if there is a remainder reduce it to cents, and to them add the given cents, divide the number of cents thus obtained by 20 to reduce them to shillings, then divide the remaining cents by $\frac{5}{12}$ and reduce the farthings which will thus be obtained to pence.

Example 2. Reduce \$78.67½ to pounds, shillings and pence.

\$78 = £19. \$2 remainder.
2.67½ = s13. 7½ cents rem.
7½ = 18 farthings or d4½.

First we divide 78, the number of dollars by 4, the quotient is £19, then \$2 remaining with 67½ cents are 267½ cents, this divided by 20 = 13 shillings and 7½ cents over, which divided by $\frac{5}{12}$ = 18 farthings or d4½. The number of pounds, shillings and pence in \$78.67½ is therefore £19 : 13 : 4½.

### Exercise 3.

1. How many pounds, shillings and pence are there in \$74.56 ?
2. How many pounds, shillings and pence are there in \$742.90 ?
3. In \$987.65 how many pounds, shillings and pence are there ?
4. Reduce \$1746.24 to pounds, shillings and pence.
5. Reduce \$758.21 to old Canadian currency.
6. In \$9359.92 how many pounds, shillings and pence are there ?
7. How many pounds, shillings and pence are there in \$5264.48 ?
8. How many pounds, shillings and pence are there in \$279.65 ?

9. Reduce $794.42½ to old Canadian currency.
10. Reduce $1742.97½ to old Canadian currency.

## REDUCTION DESCENDING.

*To reduce a quantity to a lower denomination.*

*Rule.*—Multiply the highest given denomination by the number of the next lower denomination, which makes one of the higher; and if part of the quantity to be reduced be of the lower denomination add it to the product. Proceed thus with each product in succession, until the quantity is reduced to the required denomination.

EXAMPLE 3.—Reduce 49 acres to square yards.

49 acres.
4

196 roods.
40

7840 sq. perches
30¼

235200
1960

237160 sq. yards.

There being 4 roods in an acre, we first multiply the 49 acres by 4 which reduces them to roods, then multiply 196 the number of roods, by 40 which reduces them to sq. perches, and lastly multiply 7840 sq. perches by 30¼ which reduces them to square yards. Thus we find that the number of square yards in 49 acres is 237160.

EXAMPLE 4.—Reduce 23 cwt, 2 qrs., 17 lbs., 13 oz. to ounces.

| cwt. | qrs. | lbs. | oz. |
|---|---|---|---|
| 23: | 2: | 17: | 13. |

4

94 quarters.
25

487
188

2367 pounds.
16

14215
2367

37885 ounces.

Here we multiply the hundreds by 4 to reduce them to quarters, and add 2 the number of quarters in the quantity; next we multiply the quarters by 25 to reduce them to pounds and add 17 the number of pounds in the quantity; and lastly multiply the pounds by 16 the number of ounces in a pound and add 13 the ounces in the quantity which gives 37885 the number of ounces.

## REDUCTION ASCENDING.

*To reduce a quantity to a higher denomination.*

*Rule.*—1. Divide the given quantity by the number of the given denomination which it takes to make one of the next higher. Set down the remainder if there is any after the quotient; 2. divide the quotient by the number of that denomination contained in one of the next higher, and so on, until the required denomination is reached; and set down each remainder in order after the last quotient.

EXAMPLE 5.—Reduce 28964 gills to gallons.

| | | |
|---|---|---|
| 4 \| | 28964 | gills. |
| 2 \| | 7241 | pints. |
| 4 \| | 3620 | qts. 1 pt. |
| | 905 | gals., 0 qts. 1 pt. |

First we divide the given number of gills by 4 to reduce them to pints, then divide the pints by 2 to reduce them to quarts, and divide the quarts by 4 to reduce them to gallons, we thus find that in 28964 gills there are 905 gals. 1 pt.

EXAMPLE 6.—Reduce 73907 farthings to pounds, shillings, &c.

| | | |
|---|---|---|
| 4 \| | 73907 | farthings |
| 12 \| | 18476 | d. 3 far. |
| 20 \| | 1539 | s. 8d. |
| | £76 : | 19s. : 8¾d. |

EXERCISE 4.

*Reduction of old Canadian currency.*

1. Reduce £17 : 19 : 4 to pence.
2. ——— £128 : 14 : 7¾ to farthings.
3. ——— £ 742 : 18 : 9½ to farthings.
4. ——— £1084 : 11 : 2½ to farthings.
5. ——— 7968 shillings to pounds.
6. ——— 374285 pence to pounds.
7. ——— 72485 farthings to shillings.
8. ——— 73900714 farthings to pounds.

## REDUCTION.

### Exercise 5.

*Avoirdupois Weight.*

1. Reduce 235 tons to quarters.
2. ——— 56 cwt. 2 qrs. to pounds.
3. ——— 347 cwt. 3 qrs. 21 lbs. 3 oz to ounces.
4. ——— 213 cwt. 23 lbs. 4 oz to ounces.
5. ——— 964 quarters to tons.
6. ——— 70604 pounds to hundreds, &c.
7. ——— 20516 ounces to quarters.
8. ——— 702586 ounces to tons, &c.

### Exercise 6.

*Troy Weight.*

1. Reduce 24 lbs. to pennyweights.
2. ——— 17 lbs. 4 oz 3 dwts 4 grs. to grains.
3. ——— 3742 grains to ounces.
4. ——— 7409 grains to pounds, ounces &c.

### Exercise 7.

*Apothecaries Weight.*

1. Reduce 13 lbs. to scruples.
2. ——— 15 lbs. 7 oz 4 drs 2 scr 17 grs to grains.
3. ——— 394267 scruples to pounds, ounces &c.
4. ——— 7312648 grains to pounds, ounces &c.

### Exercise 8.

LONG MEASURE.

1. Reduce 49 feet 7 inches to lines.
2. ———43 perches 5 yards to inches.
3. ———7 miles 4 fur. 37 per. to perches.
4. ———657 lea. 2 m. 7 fur. 28 per. 4 yds. 2 ft. 7 in. to inches.
5. ———7489365 feet to furlongs.
6. ———2700005 yards to miles.
7. ———9263 lines to yards.
8. ———7359876 inches to leagues.

### Exercise 9.

CLOTH MEASURE.

1. Reduce 78 yards to nails.
2. ———19 yds. 2 qrs. 3 nls. to nails.
3. ———3429 nails to yards.

4. ————9274 nails to English ells.
5. ————468 yards to Eng. ells.
6. ————342 French ells to Eng. ells.

EXERCISE 10.

## SQUARE OR LAND MEASURE.

1. Reduce 36 sq. perches to square feet.
2. ————32 acres 3 r. 25 per. 17 yds. 5 ft. 121 in. to sq. inches.
3. ————93264 square feet to roods.
4. ————7500086 sq. inches to acres.

EXERCISE 11.

## LIQUID MEASURE.

1. Reduce 27 gallons to pints.
2. ————29 hhdds. 17 gals. 3 qts. 1 pt. 3 gills to gills.
3. ————796425 gills to barrels.
4. ————27435 pints to pipes.

EXERCISE 12.

## TIME MEASURE

1. Reduce 17 weeks 3 days to hours.
2. ————24 weeks 6 d. 21 h. 34 min. 46 sec. to seconds.
3. ————742913 seconds to days.
4. ————42000134 seconds to weeks.

EXERCISE 13.

1. In $7204.27 how many cents are there?
2. Reduce 764285 cents to dollars and cents.
3. How many dollars and cents are there in £724 : 19 : 6¾.
4. Reduce $3965.79 to pounds, shillings and pence.
5. How many farthings are there in £374 : 16 : 7¼ ?
6. Reduce 796427 farthings to pounds.
7. Reduce 7 tons 14 cwt. 3 qrs. 22 lbs. 13 oz. 11 drs. to drams.
8. Reduce 1111111111 drams to tons, hundreds, &c.
9. How many grains are there in 11 oz. 14 dwts. 13 grs. of gold?
10. Reduce 37096 grains of silver to pounds, ounces, &c.
11. In 7 lbs. 9 oz. 7 drs. 2 scr. how many scruples are there?
12. Reduce 73962 scruples to pounds, ounces, &c.
13. Reduce 7 leagues, 2 m. 32 per. to feet.
14. Reduce 12345678901 lines to leagues.

15. How many square inches are there in 40 acres, 2 r. 28 per. 24 sq. yds. 7 sq. feet 127 sq. inches?
16. Reduce 97286537 square inches to acres.
17. In 71 yds. 3 qrs. 2 nls. how many nails are there?
18. Reduce 735 nails to English ells.
19. How many gills are there in 19 hhdds. 41 gals. 3 qts. 1 pt.?
20. Reduce 73192 gills to gallons.
21. In 27 weeks 3 days 21 hours how many minutes are there?
22. Reduce 123045607 seconds to weeks, days, &c.
23. In 725 ten cent pieces, how many 25 cent pieces are there?
24. How many five cent pieces are there in 71 fifty cent pieces?
25. How many english ells are there in 45 yards?
26. How many yards are there in 80 french ells?
27. Reduce 34 english ells to flemish ells.
28. Reduce $37.25 to five cent pieces.
29. In 17 shillings how many two pences are there?
30. How many five pences are there in £7 : 10 : 5?
31. Reduce 36 sixpences to fourpences.
32. How many packages containing 5 lbs. each are there in 1 cwt. 2 qrs. 10 lbs. of tea?

## COMPOUND ADDITION.

The addition of quantities of the same kind but of more than one denomination, is called COMPOUND ADDITION.

*Rule.* Set down the quantities to be added so that the numbers in each column will be of the same denomination. 2. Add together the numbers in the first column to the right, and reduce the sum thus obtained to the next higher denomination, set down the remainder, if any, under the column added, and carry the quotient to the next column. 3. Proceed thus with each column to the last, which add as in simple addition.

EXAMPLE 1. Add together 87 cwt. 3 qrs. 24 lbs. 3 oz.; 243 cwt. 17 lbs. 15 oz.; 94 cwt. 2 qrs. 11 oz.; 128 cwt. 1 qr. 21 lbs.; and 139 cwt. 3 qrs. 14 lbs. 13 oz.

| cwt. | qrs. | lbs. | oz. | |
|---|---|---|---|---|
| 87 | 3 | 24 | 3 | |
| 243 | 0 | 17 | 15 | |
| 94 | 2 | 0 | 11 | |
| 128 | 1 | 21 | 0 | |
| 139 | 3 | 14 | 13 | |
| 694 | 0 | 3 | 10 | Ans. |

First we divide 42, the number of ounces in the first column by 16, set down the remainder 10 oz. under the first column, and carry 2 to the next column. The sum of the second column with 2 lbs. added is 78 lbs., this we divide by 25, and set down the remainder 3

lbs. and carry 3 qrs, the quotient, to the next column, the sum of the next column with 3 added is 12 qrs., which divided by 4 gives 3 cwt. without a remainder, we therefore place a cipher under that column and carry 3 to the next which is added as in simple addition. The whole sum therefore is 694 cwt. 3 lbs. 10 oz.

EXAMPLE 2.—Add together $7204.85 ; $10563.07 ; $7248.90 ; and $942.68.

| $ cts. | |
|---|---|
| 7204.85 | In adding dollars and cents proceed as in simple addition cutting off the two right hand figures which will be cents and the remaining figures dollars. |
| 10563.07 | |
| 7248.90 | |
| 942.68 | |
| $25959.50 Ans. | |

EXERCISES.

| 1 $ cts. | 2. £ s. d. | 3. cwt. qrs. lbs. oz. |
|---|---|---|
| 73[illegible].15 | 243 : 17 : 9 | 94 2 23 4 |
| 928..33 | 84 : 15 : 7¾ | 78 3 14 0 |
| 4275.94 | 976 : 9 : 10½ | 135 1 19 8 |
| 897.38 | 1348 : 14 : 11¾ | 79 0 14 3 |
| 2956.59 | 749 : 18 : 6 | 86 3 0 11 |
| 3724.48 | 248 : 13 : 10½ | 243 2 7 5 |
| 5963.72 | 9456 : 8 : 7¼ | 97 1 8 14 |

4. Find the sum of $963.17 ; $485.93 ; $978 05 ; $5326.47 ; $3247.86 ; $984.76 ; $596.34 ; and $4275.98.

5. Find the sum of 34 miles, 7 fur. 38 per. 4 yds. ; 7 fur. 21 p. 2½ yds. 2 ft. ; 27 m. 13 p. 2¾ yds. 1 ft. 7 in. ; 21 per. 2 ft. 9 in. ; 39 m. 5 per. 11 in. ; and 2 m 3 fur. 4½ yds. 9 in.

6. Required the amount of $7248.05 ; $324.96 ; $365.30 ; $7294.63 ; $8726.48 ; $679.84 ; $5986.77 ; $89.56 ; and $7694.37.

7. Add together £734 : 15 : 7 ; £896 : 19 : 8¾ ; £98 : 7 : 6 ; £2348 : 14 : 9¼ ; £3974 : 18 : 6¾ ; £265 : 18 : 7 ; £768 : 9 : 7 ; £79 : 16 : 8¾ ; and £9872 : 4 : 11.

8. Find the sum of $794.63 ; $9874.56½ ; $78.90½ ; $863.95 ; $94.07 ; $7942.18½ ; $1734.86 ; $3257.98 ; $704.37 ; $53.91 ; and $2976.54.

9. Add together 7 tons. 16 cwt. 21 lbs. ; 39 t. 3 qrs. 13 lbs. 4 oz. 9 drs ; 13 cwt. 2 qrs. 14 oz. ; 14 t. 9 cwt. 1 qr. 14 lbs. 13 oz. 15 drs. ; 18 t. 7 cwt. 3 qrs, 11 drs. ; 3 qrs. 7 lbs. 4 oz. 9 drs. ; 9 t. 6 cwt. 2 qrs. 24 lbs. 6 oz. 13 drs. ; 15 cwt. 3 qrs. 17 lbs. ; and 16 t. 9 cwt. 2 qrs. 10 oz.

10. Add together 37 weeks 6 days 14 hours; 4 d. 2 h. 34 sec.; 49 wks. 14 h. 47 min.; 29 w. 23 h. 34 min. 19 sec.; 11 h. 15 m. h. 27 min. 36 sec.; 4 d. 19 h. 19 min. 56 sec.; and 36 wks 6 d. 9 h. 57 m. 47 s.

11. Add together 17 acres 2 roods 31 sq. per. 13 sq. yds.; 24 a. 3 r. 27 per. 12 yds. 2 r. 14 per.; 9 a. 27 yds.; 28 a. 1 r. 34 per.; 2 r. 24 p. 19 yds.; and 39 a. 3 r. 36 p. 14 yds.

12. Add together 24 lbs 10 oz. 5 drs. 1 scr. 9 grs. 19 lbs. 8 oz. 7 drs. 12 grs.; 87 lbs. 2 scr. 14 grs.; 132 lbs. 11 drs. 1 scr. 11 grs.; and 28 lbs. 9 oz. 6 drs. 2 scr. 18 grs.

13. Find the sum of $728.53; $84.96; $1764.59; $9245.08; $98.72; $7694.39; $469.05; $9864.89; $7246.93; and $924.68.

14. Add together 17 yds. 2 qrs. 3 nls.; 29 yds 1 qr. 3 nls.; 84 yds. 1 nl.; 14 yds. 2 qrs. 3 nls.; 97 yds. 2 qrs. 3 nls.; and 7 yds. 3 qrs. 1 nl.

15. Find the sum of £964 : 13 : 5½; £89 : 9 : 4½; £384 : 17 : 5¼; £856 : 14 : 11¾; £247 : 18 : 6¾; £496 : 11 : 2; and £578 : 16 : 4½.

16. Find the sum of $96.75½; $284.16½; $736.14; $968.13¼; $1764.27½; $436 19; $4263.96; $742.37½; and $96.83.

17. Add together 27 gals. 2 qts. 1. pt. 3 gills; 42 gals. 3 qts. 2 g.; 54 gals. 1 qt. 1 pt. 3 g.; 21 gals. 1 pt. 1 g.; and 38 gals. 3 qts. 1 pt. 3 g.

18. Add together 17 lbs. 9 oz. 18 dwts. 23 grs.; 28 lbs. 18 dwts. 14 grs.; 9 lbs. 11 oz. 16 dwts. 19 grs.; 15 lbs. 7 oz. 13 dwts. 21 grs.; 11 lbs. 15 dwts. 9 grs.; and 8 lbs. 9 oz. 10 dwts. 11 grs.

19. Add together 284 cwt. 3 qrs. 24 lbs.; 87 cwt. 1 qr. 14 lbs.; 459 cwt. 2 qrs. 18 lbs.; 924 cwt. 2 qrs. 17 lbs.; 564 cwt. 3 qrs. 21 lbs.; 97 cwt. 1 qr. 9 lbs.; 175 cwt. 3 qrs. 14 lbs.; 736 cwt. 2 qrs. 19 lbs.; 367 cwt. 1 qr. 14 lbs.; and 42 cwt 3 qrs. 4 lbs.

20. Add together 54 miles 7 fur. 37 per. 4½ yds.; 37 m. 3 f. 19 p. 3½ yds.; 28 m. 5 f. 3¼ yds.; 128 m. 6 f. 31 p. 2¾ yds.; and 89 m. 7 f. 28 p. 4 yds.

21. Add together 7 acres 3 roods 24 per.; 4 a. 1 r. 17 p.; 19 a. 3 r. 29 p.; 84 a. 2 r. 36 p.; 78 a. 1 r. 34 p.; 127 a. 3 r. 27 and 86 a. 2 r. 18 per.

22. Find the sum of $739.16; $7428.94; $98.65; $4253.08; $724.96; $3685.72; $9463.87; $7483.19; and $8296.87.

23. Add together 74 yds. 2 ft. 9 in. 7 lines, 146 yds 2 ft. 11 in. 9 l.; 98 yds. 1 ft. 10 in. 11 l.; 56 yds. 2 ft. 8 in. 3 l.; 132 yds. 7 in. 8 l.; and 29 yds. 2ft. 6 in. 7 l.

24. Add together 17 days 19 hours 36 min. 14 sec.; 234 d. 23

h. 15 m. 14 s.; 78 d. 11 h. 53 m. 24 s.; 92 d. 20 h. 47 m. 38 s.; 185 d. 2 h. 39 m. 8 s.; and 47 d. 9 h. 28 m. 47 s.

25. Add together 61 gals. 1 qt. 1 pt. 3 gills; 24 gals. 3 qts. 2 g.; 48 gals. 2 qts. 1 pt. 3 g.; 96 gals. 2 qt. 1 pt. 2 g.; 37 gals. 2 g.; and 59 gals. 2 qts. 1 pt. 3 g.

26. Add together 7 tons 14 cwt. 2 qrs. 23 lbs.; 19 t. 18 cwt. 1 qr. 24 lbs.; 48 t. 11 c. 1 qr. 14 lbs.; 82 t. 17 c. 9 lbs.; and 13 t. 16 c. 2 qrs. 22 lbs.

---

## COMPOUND SUBTRACTION.

Compound Subtraction teaches how to find the difference between two quantities of the same kind but of more than one denomination.

*Rule* 1. Place the less quantity below the greater so that the numbers in each column will be of the same denomination. 2. Then beginning at the right hand subtract each number in the lower line from the one above it, but if any number in the lower line is greater than the one above it, add to the number in the upper line the number of units of that denomination contained in one of the next higher; then subtract, set down the remainder below, and carry one to the next higher denomination in the lower line; and proceed thus with all the columns to the last.

Proof. To the difference add the quantity in the lower line, and if the sum is equal to the quantity in the upper line, the work is correct.

Example 1. From 27 weeks 6 days 11 hours 37 min. take 18 w. 3 d. 6 h. 20 min.

| wks. | d. | h. | min. | |
|---|---|---|---|---|
| 27 | 6 | 11 | 37 | |
| 18 | 3 | 6 | 20 | |
| 9 | 3 | 5 | 17 | Ans. |
| 27 | 6 | 11 | 37 | Proof. |

In this example as each number in the lower line is less than the number of the same denomination in the upper line, it is only necessary to find the difference in each column as in simple subtraction, which shows the whole difference to be 9 weeks 3 days 5 hours 17 min.

EXAMPLE 2. Find the difference between 16 cwt. 2 qrs. 18 lbs. 6 oz. and 8 cwt. 3 qrs. 9 lbs. 7 oz.

| cwt. | qrs. | lbs. | oz |
|---|---|---|---|
| 16 | 2 | 18 | 6 |
| 8 | 3 | 9 | 7 |
| 7 | 3 | 8 | 15 Ans. |

Here 7 oz. being greater than 6 oz. we add 16 to the number in the top line which makes 22, then 7 from 22 leaves 15 which we set down, and carry 1 to 9 makes 10 which taken from 18 leaves 8, then three quarters being more than 2 qrs. we add 4 to the 2 in the top line which makes 6 then 3 from 6 leaves 3 qrs., and carry 1 to 8 makes 9 which taken from 16 leaves 7. The whole difference therefore is 7 cwt. 3 qrs. 8 lbs. 15 oz.

EXERCISES.

1.

| $ | cts. |
|---|---|
| 7962. | 54 |
| 1326. | 78 |

2.

| £ | s. | d. |
|---|---|---|
| 968 | 17 | 5½ |
| 289 | 8 | 7¾ |

3.

| cwt. | qrs. | lbs. |
|---|---|---|
| 128 | 2 | 17 |
| 96 | 3 | 22 |

4. From $111111.23 take $12345.67.

5. Find the difference between 14 tons 13 cwt. 2 qrs. 19 lbs. and 7 t. 6 cwt. 3 qrs. 14 lbs.

6. Required the difference between 69 wks. 3 d. 47 min 32 sec. and 24 wks. 4 d. 41 min. 56 sec.

7. From 17 yds. 3 qrs. 2 nls. take 8 yds. 3 qrs. 3 nls.

8. From $27463.07 take $9368.44.

9. From £365 : 16 : 4 take £198 : 13 : 4¼.

10. A person borrowed $12345.67 and paid on account $3456.78, how much does he still owe?

11. Find the difference between 348 gals. 2 qts. 1 pt. 2 gills. and 291 gals. 3 qts. 1 pt. 1 g.

12. Substract 246 miles 6 fur. 3 yds. 1 ft. from 684 m. 3 fur. 2½ yds. 2 ft.

13. From 96 acres 3 r. 23 per. 27 yds. 5 ft 111 in. take 71 a. 2 r. 37 per. 27 yds. 128 in.

14. A merchant bought 374 tons 14 cwt. 2 qrs. 17 lbs. of iron, and sold 248 t. 18 c. 3 qrs. 14 lbs., how much has he left?

15. Find the difference between 18 lbs. 6 oz. 4 drs. 2 scr. 14 grs. and 11 lbs. 9 oz. 4 drs. 2 scr. 8 grs?

16. A vessel with its cargo is worth $100000.70, the value of the cargo is $12345.92 what is the value of the vessel?

17. From 96 yds. 2 ft. 6 in. 7 lines take 48 yds. 2 ft. 6 in. 8 l.

18. From 1174 tons take 963 tons 7 cwt. 2 qrs. 20 lbs. 9 oz. 7 drs.

19. From 963 acres take 74 a. 3 r. 29 p. 17¼ yds. 6 ft. 128 in.

20. From 7 hhds. 29 gals. take 3 hhds. 18 gals. 3 qts. 1pt.

21. Find the difference between the Julian year of 365 days 6 hours, and the true year of 365 days 5 h. 48 m. 50 sec.

22. The latitude of the city of Quebec is 46° 48' 30" north, and that of Montreal 45° 31' north, required the difference?

## COMPOUND MULTIPLICATION.

COMPOUND MULTIPLICATION teaches how to multiply a quantity of more than one denomination.

When the multiplier does not exceed 12.

*Rule.*—1. Find the product of the first number on the right hand, and the multiplier, divide this by the number of that denomination which makes one of the next higher, set down the remainder and add the quotient to the product of the multiplier and the number of the next higher denomination; and proceed thus with each denomination to the last.

EXAMPLE 1.—Multiply 72 cwt. 2 qrs. 15 lbs. by 9.

| cwt. | qrs. | lbs. | |
|---|---|---|---|
| 72 | 2 | 15 | |
| | | 9 | |
| 653 | 3 | 10 | Ans. |

First we multiply 15 lbs. by 9, then divide 135 lbs., the product, by 25, the number of lbs. in a quarter, set down 10 lbs., the remainder, and carry 5 qrs. to the next product; then 9 times 2 are 18 and 5 added are 23 qrs., which we divide by 4 set down 3 the remainder and carry 5; 72 multiplied by 9 = 648 and 5 added makes 653. The whole product is therefore 653 cwt. 3 qrs. 10 lbs.

EXERCISE 1.

1. 16 cwt 3 qrs. 17 lbs. 5 oz. × 2.
2. £294 : 17 : 9¾ × 3.
3. $79648.39 × 4.
4. 27 miles 3 fur. 27 per. 2½ yds. × 5
5. 56 gals. 3 qts. 1 pt. × 6.
6. 39 acres 2 r. 18 per. 9 yds × 7.
7. $829568.09 × 8.
8. 19 tons 14 cwt. 2 qrs. 23 lbs. × 9.
9. £794 : 18 : 7½ × 10.
10. $369085.63 × 11.
11. 23 weeks 6 days 9 h. 27 sec. × 12.
12. 243 cwt. 1 qr. 17 lbs. 13 oz. × 7.
13. 7 lbs. 6 oz. 2 scr. 19 grs. × 11.
14. $96428075.69 × 8.
15. 39 acres 2 r. 25 per. 23 yds. 8 ft. × 12.

16. 142 yds. 3 qrs. 2 nls. × 9.
17. 36 tons 9 cwt. 2 qrs. 14 lbs. × 3.
18. 274 gals. 2 qrs. 1 pt. 3 gills × 5.
19. $8973658.54 × 4.
20. 4 cwt. 2 qrs. 7 oz. 7 drs. × 6.

To multiply by a composite number neither of whose factors exceeds 12.

*Rule.*—Multiply the given quantity by one factor, multiply the product by the next, and multiply the second product by the third factor if there be so many. The last product will be the one required.

EXAMPLE.—Multiply 14 cwt. 2 qrs. 23 lbs. by 56.

| cwt. | qrs. | lbs. | |
|---|---|---|---|
| 14 | 2 | 23 | |
| | | 8 | |
| 117 | 3 | 9 | Here the factors are 8 and 7, we therefore multiply the quantity by one of the factors as 8; and multiply the product by 7 the other factor. |
| | | 7 | |
| 824 | 3 | 13 | Ans. |

EXAMPLE 3.—Multiply £63 : 5 : 2¾ by 252.

| £ | s. | d. | |
|---|---|---|---|
| 63 | 5 | 2¾ | |
| | | 7 | |
| 442 | 16 | 7¼ | In this example the factors are 7, 6, and 6 we therefore multiply the given quantity by one of the factors as 7, the product by another 6, and the second product by 6 which gives the required amount. |
| | | 6 | |
| 2656 | 19 | 7½ | |
| | | 6 | |
| 15941 | 17 | 9 | Ans. |

EXERCISE 2.

1. $739278.56 × 14.
2. £896 : 14 : 7¾ × 15.
3. $394065. 97 × 16.
4. 74 cwt. 3 qr. 14 lbs. 11 oz. × 18.
5. 56 acres 2 r. 35 per. 27 yds. × 20.
6. 36 yds. 3 qrs. 2 nls. × 21.
7. 27 wks. 6 days 7 hours 24 min. 26 sec. × 22.
8. 12 lbs. 5 oz. 7 drs. 2 scr. 10 grs. × 24.
9. 7 lea. 2 m. 6 fur. 31 per. 4 yds. × 25.
10. $2968745.68 × 27.

11. £396 : 14 : 9½ × 28.
12. 8 tons. 16 cwt. 2 qrs. 13 lbs. 6 oz. 5 drs. × 30.
13. 48 gals. 3 qts 1 pt. 3 gills. × 32.
14. $7496876.48 × 33.
15. 42 wks. 3 days 17 h. 14 min. 28 sec. × 36.
16. 24 yds. 2 ft. 11 in. 7 lines × 45.
17. 37 acres 3 r. 29 per. 22½ yds. × 48.
18. $785965. 38 × 56.
19. 6 lbs. 3 oz. 6 drs. 2 scr. 13 grs. × 63.
20. 24 cwt. 1 qr. 24 lbs. 7 oz. 12 drs. × 72.
21. 74 miles 6 fur. 37 per. 4 yds. 2 ft. × 75.
22. $9687428. 79 × 120.
23. 94 gals. 3 qts. 1 pt. 2 gills × 128.
24. 7 bush. 3 pks. 1 gal. 3 qts. 1 pt. × 147.
25. 49 wks. 2 days 19 h. 12 sec. × 560.
26. 8 yds. 2 qrs. 3 nls. × 220.
27. 17 acres 2 r. 29 per. 28 sq. yds. 8 sq. ft. × 98.
28. $5976.84 × 147.
29. 23 bush. 2 pks. 2 qts. 1 pt. × 1000.
30. 19 cwt. 2 qrs. 18 lbs. 13 oz. 14 drs. × 504.

When the multiplicand exceeds 12 and is not a composite number.

*Rule.*—When the multiplier does not exceed 100.

Multiply the multiplicand by 10, and the product by the number of tens, to this add the amount of the multiplicand multiplied by the number of units, and the sum will be the required product.

When the multiplier exceeds 100 and is less then 1000.

Multiply the multiplicand by 10, the product by 10, and the last product by the number of hundreds; and to the last product add the amount of the first product multiplied by the number of tens, and the amount of the given multiplicand multiplied by the number of units.

EXAMPLE 4.—Multiply 6 cwt. 2 qrs. 9 lbs., by 47.

| cwt. | qrs. | lbs. | |
|---|---|---|---|
| 6 | 2 | 9 | × 7 |
| | | 10 | |
| 65 | 3 | 15 | |
| | | 4 | |
| 263 | 2 | 10 | |
| 46 | 0 | 13 | |
| 309 | 2 | 23 | Ans. |

Here the multiplier 47 not being a composite number, we multiply by 10, the product by 4, and to this product add 46 cwt. 13 lbs. the product of the given multiplicand and 7, which gives the whole product 309 cwt. 2 qrs. 23 lbs.

EXAMPLE 5.—Multiply 3 cwt. 2 qrs. 8 lbs., by 765.

| cwt. | qrs. | lbs. | |
|---|---|---|---|
| 3 | 2 | 8 | × 5 |
| | | 10 | |
| 35 | 3 | 5 | × 6 |
| | | 10 | |
| 358 | 0 | 0 | |
| | | 7 | |
| 2506 | 0 | 0 | |
| 214 | 3 | 5 | |
| 17 | 3 | 15 | |
| 2738 | 2 | 20 | Answer. |

EXAMPLE 6.—Multiply £26 : 13 : 6¾ by 2348.

| £ | s. | d. | |
|---|---|---|---|
| 26 | 13 | 6¾ | × 8 |
| | | 10 | |
| 266 | 15 | 7½ | × 4 |
| | | 10 | |
| 2667 | 16 | 3 | × 3 |
| | | 10 | |
| 26678 | 2 | 6 | |
| | | 2 | |
| 53356 | 5 | 0 | |
| 8003 | 8 | 9 | |
| 1067 | 2 | 6 | |
| 213 | 8 | 6 | |
| £62640 | 4 | 9 | Answer. |

EXERCISE 3.

1. $796485 : 69 × 74.
2. £263 : 17 : 4½ × 89.
3. $8794. 26 × 95.
4. 61 cwt. 2 qrs. 19 lbs. 7 oz. × 97.
5. 7 lea. 2 m. 7 fur. 31 per. 4 yds. × 123.
6. 27 yds. 3 qrs. 2 nls. × 117.
7. 9 lbs. 8 oz. 6 drs. 2 scr. × 139.

8. 73 acres 2 r. 26 per. 18 yds. × 147.
9. $7964.78 × 237.
10. 42 lbs. 9 oz. 17 dwts. 19 grs. × 253.
11. 7 tons. 14 cwt. 1 qr. 10 lbs. × 246.
12. 9 weeks 6 d. 18 h 42 min. × 298.
13. £84 : 6 : 9¾ × 2756.
14. 34 gals. 3 qts. 1 pt. 3 gills. × 759.
15. 7 bush. 3 pks. 1 gal. 2 qts. × 365.
16. 3 per. 4 yds. 2 ft. 7 in. 11 lines × 1700.
17. 3 qrs. 23 lbs. 14 oz. 12 drs. × 476.
18. $895.08 ×649.
19. 4 acres 2 r. 29 per 26 yds. × 583.
20. 5 days 18 h. 36 min. 19 sec. × 897.
21. 3 fur. 21 per 4 yds. 2 ft. × 958.
22. £24 : 11 : 7½ × 3428.
23. 27 yds. 2 qrs. 3 nls. × 249.
24. 36 lbs. 11oz. 17 dwts. 3 grs. × 352.
25. $649.73 × 716.
26. 14 cwt. 2 qrs. 13 lbs. × 641.
27. 9 gals. 3 qts. 1 pt. 2 gills. × 742.
28. 13 bush. 2 pks. 1 qt. 1 pt. × 256.
29. 7 weeks 4 d. 22 h. 13 sec. × 493.
30. 3 qrs. 24 lbs. 14 oz. 6 drs. × 658.

Find the amount of

| | | | | $ cts |
|---|---|---|---|---|
| 14 lbs. of sugar | at | 11 | cents per lb. | |
| 5 lbs. of coffee | " | 35 | " " | |
| 4 lbs. of tea | " | 78 | " " | |
| 7 lbs. of rice | " | 9 | " " | |
| 3 lbs. of raisins | " | 12½ | " " | |
| | | | | $7.41½ |

Find the amount of

| | | | |
|---|---|---|---|
| 7 yds. of cloth | at | $2.70 | cts. per yard |
| 8 yds. of flannel | " | 65 | " " |
| 12½ yds. of cotton | " | 16 | " " |
| 3 pairs of gloves | " | 95 | " per pair. |
| 11 yds. of linen | " | 26 | " per yard. |
| | | | $31.81 |

Find the amount of

| | | | |
|---|---|---|---|
| 5 geographies | at | 75 | cts. each. |
| 7 grammars | " | 24 | " " |
| 6 arithmetics | " | 42½ | " " |
| 4 Histories of Canada | " | 90 | " " |
| 3 algebras | " | $1.09 | " " |
| | | | $14.85 |

Find the amount of

| | | |
|---|---|---|
| 9 yds. of satin | at $2.20 | cts. per yard. |
| 11 yds. of muslin | " 48 | " " |
| 17 pairs of kid gloves | " $1.18 | " per pair. |
| 8½ yds. of cloth | " $3.15 | " per yard. |
| 26 yds. of cotton | " 19 | " " |
| | | $76.8 |

## COMPOUND DIVISION.

COMPOUND DIVISION teaches how to divide a quantity consisting of more than one denomination.

When the divisor does not exceed 12.

*Rule.*—1. Place the divisor to the left of the dividend. 2. Then divide the first denomination to the left by it, set down the quotient, and if there is a remainder reduce it to the next lower denomination, and add to it the number of the same denomination in the dividend. 3. Divide the number thus obtained as before, set down the quotient, and proceed thus to the lowest denomination, or until there is no remainder.

PROOF.—Multiply the quotient by the given divisor, and if the product is equal to the given dividend the work is correct.

EXAMPLE 1.—Divide 27 cwt. 2 qrs. 8 lbs. by 7.

| 7 \| | cwt. 27 | qrs. 2 | lbs. 8 |
|---|---|---|---|
| | 3 | 3 | 19 Ans. |
| | | | 7 |
| | 27 | 2 | 8 proof. |

Operation 27 ÷ 7 = 3 and 6 over; we therefore set down 3 and reduce 6 the remainder to quarters then 24 the number of quarters, and 2 the quarters in the quotient make 26, 26 ÷ 7 = 3 quarters which we set down, and a remainder 5 which reduced is 125 lbs., this with 8 lbs. makes 133 which divided by 7 is 19 lbs. without a remainder. The whole quotient therefore is 3 cwt. 3 qrs. 19 lbs.

When the divisor is a composite number neither of whose factors exceeds 12.

*Rule.*—Resolve the divisor into factors. Divide by one of the factors as in Rule I, divide the result by another, and so on until all the factors are used.

EXAMPLE 2.—Divide 144 weeks 6 days 14 hours by 72.

| | w. | d. | h. | | |
|---|---|---|---|---|---|
| | 144 | 6 | 14 | | |
| 2 | 24 | 1 | 2 | 20 | |
| | 2 | 0 | 2 | 11 | 40 Ans. |

Here the factors being 6 and 12, we divide the given quantity by one of the factors as 6, and the result by 12 the other factor.

EXERCISE 1.

1. $7396874.53. ÷ 2.
2. £963 : 7 : 4. ÷ 3.
3. 7 tons 12 cwt. 1 qr. 17 lbs. 8 oz. ÷ 4.
4. 68 gals. 3 qts. 1 pt. 3 gills ÷ 5.
5. 91 acres 2 r. 29 per. 26 yds. 8 ft. ÷ 6.
6. 793 yds. 2 qrs. 3 nls. ÷ 7.
7. 13 lea. 2 m. 7 fur. 37 per. ÷ 8.
8. $946874.25. ÷ 9.
9. 734 cwt. 2 qrs. 14 lbs. 13 oz. 8 drs. ÷ 10.
10. 36 per. 4 yds. 2 ft. 9 in. ÷ 11.
11. 734 gals. 2 qts. 1 pt. 2 gills ÷ 12.
12. 468 bush. 3 pks. 1 gal. 1 pt. ÷ 14.
13. £9648 : 17 : 8¾ ÷ 18.
14. 4263 yds. 3 qrs. 2 nls. ÷ 63.
15. 927 acres 2 r. 19 per. 28 yds. 7 ft. ÷ 56.
16. 234 lbs. 7 oz. 4 drs. 2 scr. 16 grs. ÷ 96.
17. 426 cwt. 3 qrs. 12 lbs. ÷ 108.
18. 426 lbs. 19 dwts. 17 grs. ÷ 180.
19. $76498705.36 ÷ 154.
20. 365 wks. 5 days 17 h. 56 min. 48 sec. ÷ 144.
21. 926 gals. 3 qts. 1 pt. 3 gills. ÷ 147.
22. £1097 : 3 : 4½ ÷ 243.
23. 963 bush. 2 pks. 1 gal. 1 pt. ÷ 198.
24. 9364 cwt. 2 qrs. 19 lbs. 1 oz. 10 drs. ÷ 363.
25. 793 miles 7 fur. 36 per. 5 yds. 2 ft. ÷ 648.
26. 749 eng. ells. 3 qrs. 2 nls. ÷ 294.
27. $9400037.04 ÷ 648.
28. 279 acres 3 r. 8 per. 7 yds. ÷ 81.
29. 463 wks. 6 d. 23 h. 41 min. 36 sec. ÷ 512.
30. 734 qrs. 18 lbs. 15 oz. 14 drs. ÷ 594.

When the divisor exceeds 12 and is not a composite number.

*Rule.*—Divide each denomination as in rule 1, and write the quotient to the right of the dividend.

EXAMPLE.—Divide 635 tons. 4 cwt. 3 qrs. by 89.

| t. | cwt. | qrs. | t. | c. | q. |
|---|---|---|---|---|---|
| 89\|635 | 4 | 3 | 7 | 2 | 3 Ans. |
| 623 | | | | | |
| 12 | | | | | |
| 20 | | | | | |
| 244 | | | | | |
| 178 | | | | | |
| 66 | | | | | |
| 4 | | | | | |
| 267 | | | | | |
| 267 | | | | | |

Operation, $89 \times 7 = 623$, and $635 - 622 = 1$ this being reduced to hundreds and 4 cwt. adde is 244 in which 89 is contained twice and 6 remaining, then 66 cwt. reduced to qrs. and qrs. added is 267 in which 89 is contained exact 3 times. The quotient is therefore 7 tons. 2 cw 3 qrs.

EXERCISE 2.

1. \$739648.65 ÷ 13.
2. £428 : 19 : 6 ÷ 17.
3. 942 cwt. 1 qr. 4 lbs. 5 oz. ÷ 19.
4. 274 gals. 1 qt. 1 pt. 3 gills. ÷ 23.
5. 326 miles 7 fur 33 per. 2½ yds. ÷ 39.
6. 728 yds. 3 qrs. 2 nls. ÷ 47.
7. \$896472.55 ÷ 59.
8. 396 wks. 5 d. 17 h. 57 min. 36 sec. ÷ 69.
9. 764 lbs. 11 oz. 4 drs. 2 scr. 17 grs. ÷ 74.
10. 3976 cwt. 2 qrs. 19 lbs. 13 oz. 13 drs. ÷ 313.
11. 4796 m. 3 fur. 18 per. 4 yds. 2 ft. ÷ 1027.
12. £7964 : 18 : 9 ÷ 233.
13. 9698 gals. 3 qts. 1 pt. 2 gills. ÷ 2746.
14. 7685 acres 3 r. 28 per. 27 yds. 2 ft. 52 in. ÷ 1964.
15. 3786 tons. 19 cwt. 2 qrs. 16 lbs. 11 oz. 8 drs. ÷ 365.
16. If 137 lbs. of sugar cost \$15.07 what will one pound cost?
17. If \$79647.74 be equally divided among 93 persons what will be the share of each?
18. What will one pound of tea cost, if a chest containing 38 lbs. cost \$23.40?
19. If a person spends \$963.60 in a year, how much would that be on an average per day?
20. If 127 gals. of molasses cost \$27.13 how much will that be per gallon?

When the divisor and dividend are both quantities of more than one denomination, the answer being so many times.

*Rule.*—Reduce both the divisor and dividend to the lowest terms contained in either; and proceed as in simple division.

EXAMPLE 4.--Divide 14 yds. 2 ft. 9 in. 11 lines by 3 yds. 1 ft.

14 yds. 2 ft. 9 in. 11 lines = 6455 lines.
3 yds. 1 ft. = 1440 lines.

1440 | 6455 | 4 $\frac{695}{1440}$ Ans.
5760

$\frac{695}{1440}$ Remainder.

Here by reduction we find that there are 6455 lines in the dividend, and 1440 in the divisor. Then dividing 6455 by 1440 we obtain the quotient 4 $\frac{695}{1440}$

EXERCISE 3.

1. Divide 248 gals. 2 qts. 1 gill by 34 gals. 1 pint.
2. How many suits of clothes can be made out of 226 yds. 3 qrs. 2 nls. of cloth each suit containing 7 yds. 2 qrs. 1 nl.?
3. How many apples at 12½ cents per dozen may be bought for $5.
4. How many times will a carriage wheel turn in going from Lake Beauport to Quebec, a distance of 12 miles, the circumference of the wheel being 12 ft. 6 in.?
5. To how many persons may £60 : 15 : 6 be distributed, giving to each £4 : 13 : 6?
6. How many silver spoons, each 4 oz. 8 dwts., may be made out of 5 lbs.?
7. How many lbs. of coffee, at 1s. 1d. per lb., may be bought for £1 : 3 : 6?
8. How many stoves each weighing 2 cwt. 1 qr. may be made out of 1 cwt. 1 qr. of iron?
9. Into how many parcels of tea each 2 lbs. 7 oz. might a chest containing 70 lbs. 11 oz. be divided?
10. How many ducats, each 4s. 9d. are contained in £231 : 16?
12. If a cwt. of flour is worth $3.24, how much may be bought for $220.
12. A plate of gold cost £161 : 17 : 6, at £4 : 7 : 6 per ounce troy, what was its weight?
13. How many boards, 2 in. 6 lines wide, can be made out of a piece of square timber 1 ft. 8 in. thick?
14. How many steps will a person take in walking 7 miles, reckoning each step at 2 ft. 4 in.?
15. How many hogsheads of sugar are there in 5 tons. 12 cwt. 12 lbs. 8 oz. each hhdd. containing 9 cwt. 3 qrs.?
16. How many yards of cloth at $3.78 per yard may be bought for $56?

In arithmetical operations it is often necessary to multiply and divide by fractions; we therefore give the following examples, which may with propriety be introduced here, as every such operation requires both multiplication and division.

EXAMPLE 5.—Multiply £7 : 18 : 9 by $4\frac{3}{4}$.

| £ | s. | d. | |
|---|---|---|---|
| 7 | 18 | 9 | |
| | | | $4\frac{3}{4}$ |
| 31 | 15 | 0 | |
| 5 | 19 | $0\frac{3}{4}$ | $=\frac{3}{4}$ of multiplicand. |
| £37 | 14 | $0\frac{3}{4}$ | |

We first multiply by 4 the whole number, then for $\frac{3}{4}$, in a separate place we multiply £7 : 18 : 9 the multiplicand by 3, and divide the product by 4, which gives the result £5 : 19 : $0\frac{3}{4}$, this added to £31 : 15 the product of 4, gives £37 : 14 : $0\frac{3}{4}$ the product.

EXAMPLE 6.—Divide £37 : 14 : $0\frac{3}{4}$ by $4\frac{3}{4}$.

| $4\frac{3}{4}$ / 4 | £ | s. | d. | |
|---|---|---|---|---|
| | 37 | 14 | $0\frac{3}{4}$ | |
| | | | 4 | |
| 19 | 150 | 16 | 3 | £7 : 18 : 9 Ans. |
| | 133 | | | |
| | 17 | | | |
| | 20 | | | |
| | 356 | | | |
| | 19 | | | |
| | 166 | | | |
| | 152 | | | |
| | 14 | | | |
| | 12 | | | |
| | 171 | | | |
| | 171 | | | |

Multiply 4 the whole number in the divisor by 4 the denominator of the fraction and to 16 the product add 3 the numerator the result is 19 by which we divide £150 : 16 : 3 the product of £37 : 14 : $0\frac{3}{4}$ the dividend and 4, we thus obtain £7 : 18 : 9 the quotient.

## EXERCISE 4.

1. £28 : 19 : $8\frac{3}{4}$ × $9\frac{1}{2}$.
2. £ 4 : 11 : $6\frac{3}{4}$ × $17\frac{1}{2}$.
3. £ 4 : 2 : 6 × $4\frac{1}{2}$.
4. £ 7 : 16 : $7\frac{1}{2}$ × $7\frac{3}{4}$.
5. £ 64 : 17 : $7\frac{1}{4}$ ÷ $6\frac{1}{4}$.
6. £847 : 12 : $5\frac{1}{2}$ ÷ $47\frac{1}{2}$.
7. £408 : 0 : $10\frac{1}{2}$ ÷ $43\frac{3}{5}$.
8. £ 7 : 3 : $2\frac{1}{4}$ ÷ $21\frac{3}{4}$.

## MISCELLANEOUS QUESTIONS.

1. Reduce $73968 42 to cents.
2. Reduce 81690703 cents to dollars.
3. Add together $347.49; $276.53; $794.65; $3721.19; $486.83; and $2356.29.
4. From $1000.17 take $374.82.
5. Multiply $946 28 by 365.
6. Divide $4296.18 between 11 persons.
7. Divide $37240.07 by 821.
8. Reduce 17 tons 19 cwt. 1 qr. 14 lbs. to pounds.
9. Reduce 71693284 drams Avoirdupois, to tons, hundreds, &c.
10. Add together 19 lbs. 7 oz. 5 drs. 19 grs.; 14 lbs. 5 drs. 2 scr. 14 grs.; 28 lbs. 9 oz. 7 drs. 2 scr.; 14 lbs. 11 oz. 2 drs. 1 scr. 14 grs.; and 11 lbs. 6 drs. 1 scr. 18 grs.
11. From 271 cwt. 1 qr. 14 lbs. 9 oz. 13 drams, take 3 qrs. 19 lbs. 15 oz. 14 drs.
12. Multiply £763 : 19 : 4¾ by 12.
13. Multiply 32 yds. 2 qrs. 3 nls. by 276.
14. Divide 764 miles 3 fur. 26 per. 3 yds. by 9.
15. Divide 965 cwt. 1 qr. 24 lbs. 14 drs. by 74.
16. Reduce 13074 grains Troy to lbs.
17. Reduce £742 : 19 : 6 to dollars and cents.
18. Reduce $7346.25 to pounds, shillings and pence.

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## SIMPLE PROPORTION.

Simple proportion teaches how to find a fourth number that shall have the same proportion to the third of three given numbers, that the second has to the first.

The ratio of one quantity to another is the quotient obtained by dividing the first by the second.

Thus the ratio of 32 to 8 is 4, the ratio of 24 to 8 is 3, the ratio of 17 to 5 is $3\frac{2}{5}$ and the ratio of 23 to 6 is $3\frac{5}{6}$.

The ratio of one quantity to another is expressed by writing a colon (:), between them; or by writing them as a fraction.

The first of the terms in a ratio is called the antecedent, and the second the consequent.

The first and fourth terms of a proportion are called the extremes; and the second and third the means, thus, in the proportion

As 20 : 15 : : 60 to 45,

20 and 45 are the extremes, and 15 and 60 the means.

In any proportion the product of the extremes is equal to the product of the means.

Thus in the proportion, as 12 : 9 : : 36 : 27. The product of 12 and 27 the extremes, is equal to the product of 9 and 36 the means.

To find the fourth proportional multiply the second and third terms together, and divide the product by the first term.

EXAMPLE.—Find a fourth proportional to 7, 21, and 9.

$$21 \times 9 = 189$$
$$189 \div 7 = 27 \text{ Ans.}$$

EXERCISE 1.

Find the fourth proportional to

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | 9, | 3, and 15. | | 7. | 14, | 19, and 28. |
| 2. | 8, | 24, and 13. | | 8. | 36, | 47, and 54. |
| 3. | 6, | 15, and 4. | | 9. | 92, | 68, and 23. |
| 4. | 10, | 15, and 6. | | 10. | 29, | 116, and 14. |
| 5. | 27, | 135, and 3. | | 11. | 75, | 18, and 25. |
| 6. | 48, | 32, and 16. | | 12. | 12, | 90, and 48. |

*Rule.*—1. Write the three given quantities in succession, so that the term which is of the same kind as the required answer shall be in the third place. 2. If the answer is to be greater than the third term; set down the greater of the other two terms in the second place; but if the answer is to be less than the third term, set down the smaller of the other two terms in the second place. 3. Then multiply the second and third terms together and divide by the first. 4. When the first or second term is a quantity of more than one denomination, reduce both to the lowest denomination contained in either.

PROOF. Multiply the answer by the first term, and if the product is the same as the product of the second and third terms the work may be considered correct.

EXAMPLE.—1. If 3 lbs. of sugar cost 33 cents what will 5 lbs. cost at the same rate?

lbs. lbs. cts.
As. 3 : 5 : : 33
5
3 | 165
55 cents.

Here as the answer is to be in cents we write 33 cents in the third place then as 5 lbs. will cost more than 3 lbs. we write 5 lbs. in the second place; then dividing 165 the product of the second and third terms by 3 we obtain the answer 55 cents.

EXAMPLE 2.—If 28 cwt. 1 qr. 9 lbs. of sugar cost $430 what will 21 cwt. 3 qrs. cost?

cwt. qr. lbs. cwt. qrs. $
As. 28 1 9 : 21 3 : : 430
4 4
113 87
25 25
574 435
226 174
2834 2175
430
65250
8700
2834 | 935250 | $330.01 Ans.
8502
8505
8502
3000
2834
166 remainder.

In this example the first and second terms are reduced to lbs. the lowest denomination contained in either. Then dividing $ 935250, the product of the second and third terms, by 2834 the pounds in the first term we obtain $330 the first part of the answer, then reducing the remainder to cts. we obtain the second part which is 1 cent the whole answer therefore is $330.01 and 166 remainder.

EXAMPLE 3. If 17 lbs. 4 oz. of tea cost $14, how many pounds may be bought for $24 at the same rate?

| $ | $ | lbs. | oz. |
|---|---|---|---|
| As. 14 | : 24 : : | 17 | 4 |

16

106
17

276
24

1104
552

14 | 6624 | 16 | 473 oz. 2 drs.
56

102
98

44
42

2
16

32
28

4 rem.

29 lbs. 9 oz. 2 drs. Ans.

Here we reduce the third term to ounces, and proceed as in example 2.

The same result would be obtained by multiplying 17 lbs. 4 oz. by 24 as in compound multiplication and dividing the product by 14.

EXERCISE 2.

1. If 39 lbs. of coffee cost $9.75 what will 86 lbs. cost at the same rate?
2. If 167 acres of land cost $278 what will 93 acres cost?
3. What will 72 bushels of oats cost, if 13 bushels can be bought for $6.50?
4. If 37 men can do a piece of work in 35 days, in how many days can 59 men do the same work?
5. How much wine may be bought for $374.16, if 28 gallons cost $43?
6. What must be paid for 57 cwt. 2 qrs. 19 lbs. of sugar if 37 cwt. 1 qr. 23 lbs. cost $274?
7. How many miles will a person travel in 29 days, at the rate of 71 miles 5 fur. 30 per. in 3 days?

8. If 74 yards of cloth cost $210.17 what will 98 yds. cost at the same rate?

9. If 176 cwt. 3 qrs. 11 lbs. of flour be bought for £194 : 2 : 5, how much may be bought for £304 : 9 : 2?

10. How many men will be required to do a piece of work in 39 days, which 74 men can do in 48 days?

11. What will 378 lbs. 9 oz. of tea cost at 75 cents per lb.?

12. If 273 barrels of flour cost $1849.18, what must be paid for 146 barrels at the same rate?

13. At 19 cents per lb. what would 74 pounds of cheese cost?

14. What is the value of 19 cords of firewood at £1 : 2 : 3 per cord?

15. If 43 gallons of brandy cost $136 what must be paid for 148 gallons at the same rate?

16. If the rent of a house be $100 per annum, how much would that be for 7 months?

17. At the rate of $7.36 for 2 yards of cloth, what would 13 yds. 3 qrs. 3 nls. cost?

18. If a steamship sails 3700 miles in 13 days, how many miles would that be on an average per day?

19. If 19 cwt. of cod fish cost $31, how much would 43 cwt. 3 qrs. cost at the same rate?

20. If 5 gallons of coal oil cost $2.13 how many gallons may be bought for $76.91?

21. A person spends on an average $7.38 per week, how much is that per annum?

22. What will 7 hogsheads of sugar cost each weighing 13 cwt. 3 qrs. 21 lbs. at $9.13 per cwt?

23. If 34 yards of linen cost $14.25, how much must be paid for 2 yds. 1 qr. 3 nls.?

24. If a pole 7 feet high throws a shadow of 6 ft. 2 in. what is the height of a steeple which throws a shadow of 173 ft. 4 in.?

25. If 56 men can reap a field of wheat in 13 days, how many men would it take to reap the same field in 11 days?

26. A bankrupt owes $8472.94, but the value of his effects is only sufficient to pay 83 cents in the dollar, what is the value of his effects?

27. If a regiment of soldiers consisting of 954 men, occupying a besieged town, has provisions sufficient to last them 13 weeks, how long will the provisions last if 375 of the soldiers are removed?

28. How many days would a person take to travel a certain distance walking 7 hours each day, if he can travel the same distance in 23 days walking 11 hours each day?

29. A ship has provisions sufficient to last a crew of 27 men for 14 weeks, how long will the same provisions last if the crew is increased to 33 men?

30. A grocer bought 7 chests of tea, each chest containing 31 lbs. 14 oz. how much must he pay for the whole at 63 cents per lb ?

31. What is the cost of 36 cwt. 2 qrs. 1 lb. of sugar, if 3 cwt. 3 qrs. 17 lbs. cost £7 : 16 : 4 ?

32. If 11 lbs. 6 oz. 7 drs. Apothecaries weight cost $78.16, what will 32 lbs. 4 drs cost at the same rate ?

33. What would the tax on $6243.14 amount to at the rate of 2 cents on the dollar ?

34. If 11 men put up 5 acres 2r. 4 per. of a fence in 4 days, how many days would they take to put up 3 acres 1 r. 9 per ?

35. A bankrupt owes $7596.15, his effects are worth $4557.69, how much can he pay for each dollar he owes ?

36. If 49 barrels of flour cost $337, how many barrels may be bought for $1011 ?

37. What would be the cost of 27 lbs. 3 oz. of coffee if 3 lbs. 7 oz. cost 89 cents ?

38. What will 37 yds. 2 qrs. 1 nl. of cloth cost, at the rate of £2 : 14 : 6 for 4 yards ?

39. If the yearly rent of 73 acres, 2r. 20 per. is £59 : 14 · 6, what will be the rent on 38 acres 1 r. 29 per ?

40. How much cloth at $3.27 per yard, would be equal to 72 yards at $2.53 per yard ?

41. If the carriage of 27 cwt for 73 miles is $15, how many cwt. might be carried the same distance for $34.25 ?

42. What cost 74 cwt. 3 qrs. 20 lbs. of sugar at the rate of $7.96 per 117 lbs ?

43. How much wine at $9.53 per 3 gals. 1 qt. may be bought for $79.64 ?

44. How much must be paid for a hogshead of sugar containing 13 cwt. 1 qr. 12 lbs, if a hogshead containing 15 cwt. 3 qrs. 17 lbs. cost $139 ?

45. If 2 lbs. of tea cost $2.70 what will 93 lbs. cost at the same rate ?

46. If 17 bushels of wheat cost $19.75, how many bushels may be bought for $237 ?

47. If 19 gals. 1 qt. of whiskey cost $12.73, what must be paid for 78 gals. at the same rate ?

48. At $27.50 per 100 lbs. coffee what will 3 lbs. cost ?

49. If 73 lbs. butter cost $14.25 what is that per pound ?

50. What cost 79 cwt of flour at the rate of £1 : 2 : 3 per 97 lbs. ?

51. If a pole 11 feet 7 in. high throws a shadow of 8 ft. 9 in. what would be the length of the shadow thrown by a steeple 137 feet high ?

52. What cost 17 gals. 2 qts. of molasses at the rate of 36 cents per gallon ?

53. How many miles can a person walk in 37 days at the rate of 40 miles 4 fur. in 3 days ?

54. If a steamship sails 2450 miles in 9 days 6 hours, how many miles would that be on an average per day ?

55. If 7 cwt. 3 qrs. 15 lbs. of sugar cost $96, how much would that be per cwt ?

56. If $26 is charged for the carriage of 49 cwt., a distance of 180 miles, what would be the charge for the carriage of 76 cwt. 3 qrs. the same distance ?

57. Bought a hogshead of sugar weighing 14 cwt. 2 qrs. for $128, how much would that be for each 12½ lbs. contained in the hogshead ?

58. How much will 24 yds. 3 qrs. 2 nls. of calico cost, at the rate of 27½ cents for 3 yds. 1 qr. 2 nls. ?

59. How many days would it take a person to walk from Quebec to Montreal, the distance being 180 miles, travelling at the rate of 63 miles 2 fur. in 4 days ?

60. If 390 acres 3 r. 20 per. of land cost $964, what will 78 acres 2 r. cost at the same rate ?

61. What is the value of 24 oz. 17 dwts. 13 grs. of silver, at $1. 35 per ounce ?

62. What cost 178 cwt. 2 qrs. 14 lbs. of flour at $4.17 per cwt ?

63. If 173 lbs. 8 oz. of coffee cost $49.35, at what rate per lb. must it be sold, to make a profit of $8.17 on the whole ?

64. At the rate of $36.18 for 9 cwt. 2 qrs. of flour, what must be paid for 75 cwt. 1 qr. ?

65. If a ditch 3 acres 2 r. 18 per. in length is dug by 14 men in 5 days, how many days would the same number of men take to dig a ditch 7 acres 1 r. 14 per. in length ?

66. If 26 acres 1 r of land cost $156, what will 74 acres 2 r. 20 per. cost at the same rate ?

67. If 67 cwt. 2 qrs. 14 lbs. of flour cost $210, how much must be paid for 26 cwt. 3 qrs. 9 lbs. ?

68. If 37 cwt. 1 qr. of sugar cost $333, what will 49 cwt. 2 qrs. 12 lbs. cost at the same rate ?

69. What will the assessment on 74 acres of land amount to, if the assessment on 724 acres is $17.24 ?

70. How many men can finish a piece of work in 78 days, which 204 men can do in 123 days ?

71. If 47 men finish a piece of work in 63 days, in how many days would 86 men finish the same piece of work ?

72. How many cwt. of flour at $4 per cwt., should be given in exchange for 29 cwt. 3 qrs. of sugar at $9.50 per cwt. ?

73. If a person travelling 11 hours per day finish a journey in 23 days, in how many days will he travel the same distance walking 9 hours per day ?

74. From 37 yds 2 qrs. 3 nls. take 9 yds. 3 qrs. 1 nl. and find the value of the remainder at $7.50 per 2 yds 1 qr.

75. If the carriage of 3 cases of dry goods each weighing 4 cwt. 2 qrs. 4 lbs. cost $7.40, what must be paid for the carriage of 7 cases each weighing 3 cwt. 3 qrs. 18 lbs. ?

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## COMPOUND PROPORTION.

Compound proportion is the equality of the ratio of two quantities to another ratio, the antecedent and consequent of which are respectively the products of the antecedents and consequents of two or more ratios.

*Rule.*—1. Set down the quantity which is of the same kind as the answer in the third place. 2. Set down each pair of corresponding terms as in simple proportion first reducing them to the lowest denomination contained in either. 3. Then multiply the continual product of all the consequents by the third term; and divide the result by the continual product of all the antecedents; and the quotient will be the required answer.

The work may be very much shortened by dividing an antecedent and any consequent, by any number that will divide both without leaving a remainder, and using the results of the division in place of the original numbers.

EXAMPLE.—If the carriage of 80 cwt. 180 miles cost $4.80, what must be paid for the carriage of 60 cwt. 200 miles.

$$\left.\begin{array}{r} 80 : 60 \\ \text{As } 180 : 200 \end{array}\right\} :: \begin{array}{r} \$ \text{ cts.} \\ 4\ 80 \end{array}$$

$$\begin{array}{r} 14400 : 12000 \\ 480 \\ \hline 960000 \\ 48000 \\ \hline 14400 \mid 5760000 \mid \$4.00 \text{ Ans.} \\ 57600 \\ \hline 00 \end{array}$$

Here we write $4.80 in the third place. Then as the carriage of 60 cwt. is less than the carriage of 80 cwt. we place 80 cwt. in the first place and 60 cwt. in the second, and as the carriage for 200 miles will cost more than for 180 miles, we place 180 miles in the first and 200 miles in the second place. Then dividing 5760000 the product of the consequents and the third term by 14400 the product of the antecedents we obtain the answer $4.00.

It will be found more convenient to reduce by cancelling all the terms as much as possible, as will be seen in the following example which is the same as that given above with the terms reduced.

$$\left.\begin{array}{c} 2 \\ 3 : 5 \\ \hline 6 \quad 5 \end{array}\right\} :: \begin{array}{r} \$ \text{ cts.} \\ 4\ 80 \\ 5 \\ \hline 6 \mid 24\ 00 \\ \hline \$4\ 00 \text{ Ans} \end{array}$$

First we cancel 60 a consequent, and write 3 in place of the antecedent 180 in which 60 is contained exactly 3 times, then we set down 2 in place of 80 and 5 in place of 200, 40 being contained exactly twice in the antecedent 80 and 5 times in the consequent 200. Then multiplying $4.80 the third term by 5 and dividing by 6, we obtain $4.00, as in the first example.

EXERCISES.

1. If 15 men in 12 days mow 60 acres of grass, how many acres can be mowed by 24 men in 15 days?

2. What must be paid for the carriage of 190 cwt. for 150 miles, if the carriage of 73 cwt. for 80 miles cost $5?

3. If 18 horses eat 70 bushels of oats in 10 days, how many bushels will 48 horses eat in 25 days?

4. If $134 pay 17 men for 8 days work, how much will be required to pay 13 men for 6 days work?

5. If a wall 7 feet in height and 72 feet in length is built by 57 men in 18 days, working 8 hours daily, what length of wall 6 feet high can be built by 94 men in 15 days working 10 hours daily?

6. What will be the gain on $1400 for 74 days if the gain on $2075 for 96 days is $58?

7. If a garrison of 1750 men has provisions sufficient to last 27 days, allowing 16 ounces per day to each man, how many days will the same provisions last if the garrison is increased to 1900 men, the allowance to each man being reduced to 12 ounces per day?

8. If 15 men in 8 days earn $130, how many dollars will 39 men earn at the same work in 26 days?

9. If a trench 390 feet long, 10 feet deep, and 5 feet wide, be dug by 40 men in 18 days, how many men will it take to dig a trench 740 feet long, 13 feet deep and 6 feet wide in 25 days?

10. If a person travels 207 miles in 8 days walking 11 hours per day, how many miles will he travel in 17 days walking 9 hours per day?

11. If the value of 60 yards of cloth $1\frac{1}{2}$ yd. wide is $112, what would be the value of 124 yards of the same kind of cloth $1\frac{1}{4}$ yard wide?

12. If the carriage of 29 cwt. 210 miles cost $4, how many cwt. might be carried 190 miles for $13?

13. If $760 gain $20 in 7 months, how many dollars would gain $37 in 6 months?

14. If 24 men do a piece of work in 32 days working 10

hours per day, in how many days will 17 men do the same work, working 9 hours per day ?

15. If 23 horses eat 125 bushels of oats in 10 days, how many days will 148 bushels serve 17 horses ?

16. If a person walking 11 hours daily travels 190 miles in 8 days, in how many days would he travel 340 miles walking 7 hours each day ?

17. If a family of 4 persons spends $340 in 5 months, how much will a family of 8 persons spend in 14 months ?

18. If 5 men chop 28 cords of firewood in 4 days, how many men will it take to chop 98 cords in 7 days ?

19. If 23 acres of wheat can be reaped by 27 men in 4 days, how many acres can 33 men reap in 9 days ?

20. If 14 horses plough 21 acres of land in 8 days working 9 hours each day, in how many days will 36 horses plough 29 acres working 10 hours each day ?

21. If 14 pieces of cloth, each piece containing 29 yds, 3 quarters wide cost $247, how much must be paid for 12 pieces of the same kind of cloth each piece containing 34 yards, 5 quarters wide ?

22. If the wages of 11 men for 5 days work is $60, what will the wages of 17 men amount to for 7 days work ?

23. If 6 horses in 8 days plough 9 acres of land, in how many days will 13 horses plough 27 acres ?

24. If 36 men can dig a trench 24 yards long and 4 feet wide in 17 days working 9 hours each day, how many men would be required to dig a trench 39 yards long and 3 feet wide in 20 days working 10 hours each day ?

25. If the carriage of 3 hhdds of sugar each weighing 17 cwt for 63 miles cost $8.20, what must be paid for the carriage of 8 hhdds, each weighing 15 cwt. 1 qr. for 59 miles ?

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## GREATEST COMMON MEASURE.

A measure of a number is any number that will divide it exactly without leaving a remainder. Thus 3, 4, 9, 12, and 36 are measures of 36.

A common measure of two or more numbers is any number by which each of them may be exactly divided without leaving a remainder.

The greatest common measure of two or more numbers is the highest number by which each may be exactly divided without leaving a remainder.

Thus 2, 4, 5, 10 are common measures of 20 and 40, but 20 is their greatest common measure.

To find the greatest common measure of two numbers.

*Rule.*—Divide the greater number by the less; if there is a remainder divide the less by it, and proceed thus dividing the last divisor by the last remainde until nothing remains. The divisor which leaves no remainder will be the greatest common measure.

EXAMPLE.—Find the greatest common measure of 355 and 775.

```
355 | 775 | 2
      710
      ---
   65 | 355 | 5
          325
          ---
    30 | 65 | 2
           60
           --
     5 | 30 | 6
           30
           --
```

First we divide 775 the greater number by 355 the less, this leaves a remainder 65, by which we divide 355 the less number, the next remainder is 30 by which we divide 65 the last divisor. Then dividing 30 the last divisor by 5, we find that 5 is the greatest common measure it being contained exactly 6 times in 30.

EXERCISES.

Find the greatest common measure of the following numbers.

1. 315 and 725.
2. 93 and 123.
3. 724 and 1248.
4. 968 and 8724.
5. 1325 and 6495.
6. 81 and 738.
7. 1254 and 964.
8. 5696 and 1334.
9. 1023 and 1581.
10. 6785 and 2345.
11. 118 and 576.
12. 348 and 3144.

## LEAST COMMON MULTIPLE.

A common multiple of two or more numbers is any number that can be divided by each of the given numbers without leaving a remainder.

The least common multiple of two or more numbers is the lowest number that can be divided by each of the given numbers without leaving a remainder.

To find the least common multiple of two or more given numbers.

*Rule* I.—1. Set down the given numbers in a line and cancel any that are exactly contained in any of the others. 2. Find a

number that will measure as many as possible of the remaining numbers, by which divide all the numbers which it measures in the line, and set down the quotient and all the undivided numbers in the next line. 3. Cancel any numbers in this line that are exactly contained in any other number, and thus proceed with each successive line until no number greater than unity can be found which will measure two or more numbers in the last line. 4. Then multiply together all the numbers in the last line and all the divisors, and the product will be the least common multiple.

NOTE.—Be careful to use a divisor that will measure at least as many of the numbers as any other divisor would, otherwise the multiple found may not always be the least possible.

EXAMPLE.—Find the least common multiple of

6, 8, 4, 18, 12, 20, and 15.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | (6) | 8 | (4) | 18 | 12 | 20 | 15 |
| 3 | | 4 | | 9 | 6 | 10 | 15 |
| 2 | | 4 | | 3 | (°) | 10 | (5) |
| | | 2 | | 3 | | 5 | |

$5 \times 3 \times 2 \times 2 \times 3 \times 2 = 360$ Ans.

First we set down the numbers in a line, then on inspection we find that 6 and 4 are exactly contained in 12, they are therefore cancelled, and seeing that no other number will measure as many of the remaining numbers as 2 we therefore take 2 as divisor, then setting down the quotients and the undivided numbers we take 3 as divisor and set down the quotients and undivided numbers in the next line, we then cancel 2 and 5 which are contained in 4 and 10, and multiplying together the remaining numbers we obtain the L. C. M. 360.

To find the L. C. M. otherwise.

*Rule* II.—1. Set down the given numbers and cancel any that are exactly contained in any of the others. 2. Divide the remaining numbers by any number that will exactly divide one of them; and set down in the next line the quotients of any numbers which it exactly measures; the quotients obtained by dividing any of the undivided numbers by the highest factor common to it and the divisor; and the undivided numbers. 3. Proceed thus with each line until no number greater than

unity can be found that will measure two or more numbers in the last line. 4. Then multiply together all the divisors and the numbers in the last line, and the product will be the L. C. M.

EXAMPLE 2.—Find the least common multiple of 6, 8, 4, 18, 12, 20, 15.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15 \| | (6) | 8 | (4) | 18 | 12 | 20 | 15 |
| 8 \| | | 8 | | 6 | (4) | (4) | |
| | | | | 3 | | | |

$15 \times 8 \times 3 = 360$ Ans.

In this example we use the same numbers as in the first. First we cancel the numbers 6 and 4 each of which is exactly contained in 12, then using 15 one of the uncancelled numbers as divisor and seeing that 3 is the highest factor common to 15 the divisor and the numbers 18 and 12, we divide them by 3 and set down the quotients 6 and 4, we also divide 20 by 5 it being the highest factor common to the divisor and 20, and set down 4 the quotient and 8 the undivided number in the next line. Next we cancel 4 and 4 which are each contained in 8, and using 8 as divisor, we divide 6 by 2, the highest factor common to 8 and 6 and set down 3 the quotient. Then the product of the divisors 15 and 8 and the undivided number 3 gives the L. C. M. 360.

EXERCISES.

Find the L. C. M. of

1. 3, 5, 7 and 9.
2. 2, 4, 6, 8 and 10.
3. 17, 9, 27, 18 and 11.
4. 16, 2, 4, 8, 5 and 9.
5. 9, 16, 5, 3, 27 and 28.
6. 18, 4, 17, 13 and 6.
7. 9, 2, 8, 7, 5 and 4.
8. 6, 3, 5 and 24.
9. 12, 24, 48 and 80.
10. 18, 36, 14, 19 and 6.
11. 36, 92, 7, 4, 8 and 9.
12. 2, 3, 4, 9, 7, 5 and 8.
13. 28, 44, 96, 38, 17, 42 and 58.
14. 9, 11, 17, 19, 21, 23 and 25.
15. 7, 2, 9, 15, 18, 37 and 46.
16. 18, 27, 94, 108, 62, 13 and 15.

## VULGAR FRACTIONS.

A fraction is a quantity which represents one or more of the equal parts into which any quantity may be divided; or a fraction expresses the division of the numerator by the denominator.

A vulgar fraction is expressed by two numbers or terms, one of which is written above the other and separated by a line.

The denominator is written below the line and expresses the number of equal parts into which the quantity is divided.

The numerator is written above the denominator and shows the number of these parts expressed by the fraction.

Thus seven tenths, written $\frac{7}{10}$, signifies that a quantity is divided into 10 equal parts, and that seven of these parts are taken.

There are six kinds of vulgar fractions, viz.:

Proper, improper, mixed, simple, compound and complex.

A Proper fraction is one, in which the numerator is less than its denominator, as $\frac{3}{7}$, $\frac{2}{3}$, $\frac{9}{16}$.

An Improper fraction is one in which the numerator is not less than its denominator, as $\frac{5}{3}$, $\frac{8}{7}$, $\frac{16}{13}$.

A Mixed number consists of a whole number with a fraction annexed, as $27\frac{3}{8}$, $48\frac{16}{18}$ $75\frac{9}{11}$.

A Simple fraction expresses one or more of the equal parts into which a unit is divided, as $\frac{4}{5}$.

A Compound fraction expresses one or more of the equal parts into which another fraction is divided, as $\frac{4}{5}$ of $\frac{3}{8}$, $\frac{3}{7}$ of $\frac{9}{11}$, $\frac{1}{4}$ of $\frac{6}{7}$ of $\frac{3}{4}$.

A complex fraction is one, which has a fraction either in its numerator, or in its denominator, or in both, $\frac{\frac{3}{7}}{8}$, $\frac{9\frac{1}{3}}{\frac{4}{5}}$, $\frac{2\frac{3}{8}}{\frac{3}{4}}$.

If the numerator and the denominator of a fraction be both multiplied or both divided by the same number the value of the fraction is not changed.

A fraction is multiplied by any number, either by multiplying its numerator, or by dividing its denominator by that number.

## REDUCTION OF VULGAR FRACTIONS.

To reduce a fraction to its lowest terms.

*Rule* I.—Divide the numerator and the denominator of the fraction by their greatest common measure.

*Rule* II.—Divide the numerator and the denominator by any number that will exactly measure both; divide the quotients thus obtained in the same way; and continue the process until no number greater than unity can be found that will measure both.

EXAMPLE.—Reduce $\frac{216}{288}$ to its lowest terms.

72 | $\frac{216}{288}$ | $\frac{3}{4}$ Ans. By rule 1 we divide 216 the numerator and 288 the denominator by 72 their greatest common measure and find that $\frac{3}{4}$ is the lowest terms.

12 | $\frac{216}{288}$ | 6 | $\frac{18}{24}$ | $\frac{3}{4}$ Ans. By rule 2 we divide 216 the numerator and 288 the denominator by 12, and $\frac{18}{24}$ the result by 6 which gives $\frac{3}{4}$ the lowest terms.

EXERCISE 1.

Reduce the following fractions to their lowest terms.

1. $\frac{9}{15}$
2. $\frac{126}{198}$
3. $\frac{483}{630}$
4. $\frac{1248}{3872}$
5. $\frac{1240}{3472}$
6. $\frac{2268}{9072}$
7. $\frac{1386}{3773}$
8. $\frac{7744}{8064}$
9. $\frac{816}{6192}$
10. $\frac{18}{198}$
11. $\frac{4068}{14774}$
12. $\frac{93210}{114680}$

To reduce an improper fraction to a whole or mixed number.

*Rule.*—Divide the numerator by the denominator and the result will be the whole or mixed number required.

EXAMPLE 1. Reduce $\frac{63}{20}$ to a mixed number.

$63 \div 20 = 3\ \frac{3}{20}$ Ans.

EXAMPLE 2. Reduce $\frac{1456}{11}$ to a mixed number.

$1456 \div 11 = 132\ \frac{4}{11}$ Ans.

EXERCISE 2.

Reduce the following fractions to whole or mixed numbers.

1. $\frac{208}{7}$
2. $\frac{72}{12}$
3. $\frac{9486}{11}$
4. $\frac{12240}{123}$
5. $\frac{8845}{5773}$
6. $\frac{12445}{6241}$
7. $\frac{8216}{8136}$
8. $\frac{11064}{1103}$
9. $\frac{326421}{97}$
10. $\frac{111111}{6}$
11. $\frac{7821485}{32}$
12. $\frac{6666666}{99}$

To reduce a mixed number to an improper fraction.

*Rule.* Multiply the whole number by the denominator of the fraction, and to the result add the numerator, below which write the given denominator.

EXAMPLE 1. Reduce $9\frac{6}{11}$ to an improper fraction.

$9 \times 11 = 99$ and $99 + 6 = 105$ $\therefore$ $\frac{105}{11}$ Ans.

EXAMPLE 2. Reduce $19\frac{4}{8}$ to an improper fraction.

$19 \times 8 = 152$, and $152 + 4 = 156$ $\therefore$ $\frac{156}{8}$ Ans.

EXERCISE 3.

Reduce the following mixed numbers to improper fractions.

1. $9\frac{11}{12}$
2. $11\frac{124}{1001}$
3. $786\frac{225}{300}$
4. $47\frac{79}{84}$
5. $111\frac{283}{2468}$
6. $274\frac{12}{28}$
7. $93\frac{27}{56}$
8. $204\frac{29}{607}$
9. $509\frac{7}{16}$
10. $365\frac{1901}{2715}$
11. $28\frac{12}{32}$
12. $96\frac{84}{11}$

To reduce a compound fraction to a simple one.

*Rule.* Multiply all the numerators together for a new numerator, and all the denominators for a new denominator.

If there are any mixed numbers in the compound fraction they must be reduced to improper fractions.

EXAMPLE. Reduce $\frac{1}{4}$ of $\frac{2}{5}$ of $\frac{8}{9}$ to a simple fraction.

$$\frac{1 \times 2 \times 8}{4 \times 5 \times 9} = \frac{16}{180} = \frac{4}{45} \text{ Ans.}$$

First we multiply together 1, 2, and 8 the numerators by which we obtain a new numerator 16, then we multiply 4, 5, and 9 together and obtain a new denominator 180, which makes the simple fraction $\frac{16}{180}$, and this reduced to its lowest terms is $\frac{4}{45}$, the required simple fraction.

NOTE.—If any term of the compound fraction be a mixed number, it must first be reduced to an improper fraction.

EXERCISE 4.

Reduce to simple fractions.

1. $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$.
2. $\frac{9}{11}$ of $\frac{2}{3}$ of $\frac{7}{10}$ of $\frac{2}{3}$.
3. $\frac{2}{7}$ of $\frac{3}{5}$ of $\frac{4}{9}$ of $\frac{1}{3}$ of $\frac{2}{5}$.
4. $\frac{6}{7}$ of $\frac{3}{7}$ of $\frac{9}{11}$ of $\frac{4}{5}$.
5. $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{8}{10}$.
6. $\frac{1}{4}$ of $\frac{4}{5}$ of 2 of $1\frac{1}{3}$ of $\frac{4}{11}$.
7. $\frac{4}{7}$ of $\frac{1}{2}$ of $\frac{4}{5}$ of $\frac{3}{8}$ of $\frac{1}{9}$.
8. $\frac{2}{15}$ of $\frac{3}{18}$ of $\frac{16}{17}$ of 2 $\frac{18}{19}$.
9. $\frac{10}{11}$ of $1\frac{3}{10}$ of 2 $\frac{14}{15}$ of $\frac{3}{7}$.
10. $\frac{2}{17}$ of $\frac{3}{6}$ of $\frac{3}{8}$ of $\frac{7}{12}$ of $\frac{8}{10}$.
11. $\frac{7}{8}$ of $\frac{3}{5}$ of $3\frac{1}{10}$ of 6.
12. $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$ of $\frac{6}{7}$ of $\frac{7}{8}$.

To reduce any number of fractions to equivalent fractions having a common denominator.

*Rule* 1.—Find the least common multiple of the denominators of the given fractions, this will be the common denominator 2. Divide the common denominator by the first of the given denominators, and multiply the quotient by the first of the given numerators, and the result will be the first of the required numerators below which write the common denominator. The other numerators will be found in the same way.

EXAMPLE.—Reduce $\frac{2}{3}$, $\frac{3}{7}$, $\frac{4}{9}$, $\frac{3}{5}$ to equivalent fractions having a common denominator.

First we find the last common multiple of the denominators 3, 7, 9, 5 which is 315, then,

$315 \div 3 = 105$ and $105 \times 2 = 210$ the first numerator.
$315 \div 7 = 45$ and $45 \times 3 = 135$ the second numerator.
$315 \div 9 = 35$ and $35 \times 4 = 140$ the third numerator.
$315 \div 5 = 63$ and $63 \times 2 = 126$ the fourth numerator.

Then writing 315 the common denominator below each of these we have the required fractions $\frac{210}{315}$, $\frac{135}{315}$, $\frac{144}{315}$ and $\frac{126}{315}$.

EXERCISE 5.

Reduce the following fractions to equivalent fractions having a common denominator.

1. $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}$.
2. $\frac{5}{6}, \frac{6}{7}, \frac{7}{8}, \frac{8}{9}, \frac{9}{10}$.
3. $\frac{10}{11}, \frac{11}{12}, \frac{12}{13}, \frac{13}{14}$.
4. $\frac{3}{5}, \frac{9}{16}, \frac{7}{11}, \frac{9}{20}, \frac{17}{18}$.
5. $\frac{4}{7}, \frac{3}{8}, \frac{4}{9}, \frac{6}{7}, \frac{2}{3}$.
6. $\frac{2}{11}, \frac{4}{17}, \frac{2}{7}, \frac{4}{15}, \frac{5}{9}$.
7. $\frac{7}{8}, \frac{4}{19}, \frac{11}{20}, \frac{16}{17}, \frac{19}{21}$.
8. $\frac{4}{13}, \frac{2}{16}, \frac{7}{18}, \frac{4}{27}$.
9. $\frac{23}{38}, \frac{25}{39}, \frac{15}{50}, \frac{17}{28}, \frac{19}{34}$.
10. $\frac{8}{27}, \frac{4}{31}, \frac{11}{30}, \frac{12}{41}$.
11. $\frac{19}{64}, \frac{1}{13}, \frac{19}{26}, \frac{7}{11}, \frac{4}{13}$.
12. $\frac{16}{29}, \frac{13}{54}, \frac{29}{36}, \frac{11}{18}, \frac{14}{17}$.

To reduce a complex fraction to a simple one.

*Rule.*—Multiply together the outside numbers or extremes for a new numerator, and the middle numbers or means for a new denominator.

If there are any mixed numbers they must first be reduced to improper fractions.

EXAMPLE. Reduce $\frac{3\frac{3}{11}}{2\frac{1}{2}}$ to a simple fraction.

$$\frac{3\frac{3}{11}}{2\frac{1}{2}} = \frac{\frac{36}{11}}{\frac{5}{2}} = \frac{36 \times 2}{11 \times 5} = \frac{72}{55} \text{ Ans.}$$

EXERCISE 6.

Reduce the following complex fractions to equivalent simple ones.

1. $\frac{\frac{3}{4}}{7}$
2. $\frac{9}{\frac{2}{5}}$
3. $\frac{\frac{2}{7}}{\frac{3}{4}}$
4. $\frac{2\frac{1}{2}}{\frac{2}{3}}$
5. $\frac{\frac{3}{7}}{6\frac{1}{9}}$
6. $\frac{6\frac{1}{3}}{7\frac{2}{5}}$
7. $\frac{\frac{2}{9}}{1\frac{1}{17}}$
8. $\frac{\frac{5}{8}}{\frac{9}{7}}$
9. $\frac{3\frac{4}{9}}{6}$
10. $\frac{7}{6\frac{5}{11}}$
11. $\frac{93\frac{1}{4}}{6\frac{3}{7}}$
12. $\frac{\frac{7}{11}}{7\frac{1}{3}}$

To reduce a fraction from one denomination to another.

*Rule.* If the fraction is to be reduced from a lower to a high denomination multiply the denominator, if from a higher to lower denomination multiply the numerator, as in reduction whole numbers.

EXAMPLE 1.—Reduce $\frac{4}{5}$ of an ounce to the fraction of a poun

$$\frac{4}{5}\text{ oz.} = \frac{4}{5 \times 16} = \frac{4}{80} = \frac{1}{20}\text{ lbs.}$$

Here the reduction being from ounces to lbs. we multiply th denominator by 16.

EXAMPLE 2. Reduce $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ of a day to the fraction of minute.

$$\frac{2}{3}\text{ of }\frac{3}{4}\text{ of }\frac{4}{5} = \frac{24}{60} = \frac{2}{5}\text{ of a day.}$$

$$\text{then } \frac{2 \times 24 \times 60}{5} = \frac{2880}{5} = 576\text{ minutes.}$$

EXERCISE 7.

1. Reduce $\frac{4}{717}$ of a cwt to the fraction of a pound.
2. Reduce $\frac{5}{6}$ of an oz. to the fraction of a quarter.
3. Reduce $\frac{7}{11}$ of a minute to the fraction of a day.
4. Reduce $\frac{9}{11}$ of $\frac{3}{4}$ of a mile to the fraction of a perch.
5. Reduce $\frac{2}{348}$ of a week to the fraction of an hour.
6. Reduce $\frac{4}{5}$ of $\frac{5}{6}$ of $\frac{6}{7}$ of a foot to the fraction of a line.
7. Reduce $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{8}{9}$ of a rod to the fraction of an acre.
8. Reduce $\frac{3}{14}$ of $\frac{9}{11}$ of $\frac{7}{16}$ of an English ell to the fraction of a nail.
9. Reduce $\frac{4}{9}$ of $\frac{18}{23}$ of a gallon to the fraction of a gill.
10. Reduce $\frac{9}{10}$ of $\frac{16}{19}$ of $\frac{13}{14}$ of a lb. to the fraction of a ton.

To reduce a given quantity to the fraction of another given quantity.

*Rule.*—Reduce both quantities to the lowest denomination contained in either. Then write the quantity which is to be the fraction of the other as numerator, and the other quantity as denominator.

EXAMPLE.—What fraction of 4 days 11 hours 15 min., is 2 days 9 hours?

$$\left.\begin{array}{l} 2\text{ d. } 9\text{ h.} = 3420\text{ min.} \\ 4\text{ d. } 11\text{ h. } 15\text{ m.} = 6435\text{ min.} \end{array}\right\} \frac{3420}{6435} = \frac{76}{143}\text{ Ans.}$$

Here we reduce both quantities to minutes, and thus obtain 3420 for numerator, and 6435 for denominator, which reduced to its lowest terms is $\frac{76}{143}$

### Exercise 8.

1. What fraction is 3 qrs. 2 lbs. of 2 cwt. 1 qr. 11 lbs.?
2. Reduce 7s 10½d to the fraction of £3 : 7 : 6.?
3. What fraction of 17 dollars is 28 cents?
4. What fraction of 2 weeks is 3 hours 17 min.?
5. What fraction is 3 yards of 17 yds. 2 qrs. 3 nls.?
6. Reduce 2 qts. 1 pt. to the fraction of 7 gals. 1 qt. 3 gills.
7. Reduce 7 fur. 30 per. to the fraction of 2 miles, 1 fur. 17 perches.
8. What fraction is 2 oz. 17 dwts. of 9 oz. 3 dwts. 11 grs.?
9. Reduce 7 inches to the fraction of 4 yds. 2 ft. 3 in. 8 lines.
10. Reduce 1 cwt 8 oz. to the fraction of 7 cwt. 1 qr.

To express the value of a fraction in the denominations contained in the integer.

*Rule.*—Consider the numerator as so many of the given denomination, and divide by the denominator.

Example 1.—Find the value of $\frac{4}{5}$ of a cwt.

4 cwt. ÷ 5 = 3 qrs. 5 lbs.

Here we divide the numerator considered as 4 cwt. by 5 and obtain the quotient 3 qrs. 5 lbs. the value of $\frac{4}{5}$ of a cwt.

Example 2.—What is the value of $\frac{3}{7}$ of 2 chaldrons 1 bush. 3 pks.

2 ch. 1 Bush. 3 pks. × 3 = 6 ch. 5 b. 1 pk.
and 6 ch. 5 b. 1 pk. ÷ 7 = 31 b. $2\frac{3}{7}$ pks.

Here we multiply 2 ch. 1 bush. 3 pks. by 3 the numerator and divide the product 6 ch. 5 b. 1 pk. by 7 the denominator which gives the result 31 bush. $2\frac{3}{7}$ pks. the required value.

### Exercise 9.

Find the value of

1. $\frac{5}{8}$ of a cwt.
2. $\frac{3}{7}$ of a bushel.
3. $\frac{2}{3}$ of $\frac{4}{5}$ of an acre.
4. $\frac{2}{5}$ of $\frac{3}{10}$ of a £
5. $\frac{6}{7}$ of $\frac{8}{11}$ of $\frac{1}{4}$ of a mile.
6. $\frac{7}{11}$ of $\frac{9}{10}$ of a yd long mea
7. $\frac{4}{5}$ of $\frac{3}{8}$ of $2\frac{1}{3}$ of a lb Apoth.
8. $\frac{2}{5}$ of $\frac{5}{9}$ of a chaldron.
9. $\frac{3}{7}$ of $\frac{5}{9}$ of 7 bushels 3 pks.
10. $2\frac{3}{4}$ of $1\frac{2}{9}$ of $\frac{3}{8}$ of 17 gals 3 gills.
11. $\frac{2}{11}$ of $7\frac{1}{8}$ of 7 miles 6 fur. 32 per.
12. $\frac{3}{20}$ of $\frac{3}{7}$ of $2\frac{3}{4}$ of 4 acres 2r. 17 per.
13. $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of 3 cwt. 2 qrs. 22 lbs.
14. $\frac{4}{5}$ of $\frac{5}{6}$ of $\frac{6}{7}$ of 17 hours 29 m 53 s.

## ADDITION OF FRACTIONS.

*Rule.*—Reduce the given fractions to others having a common denominator, add the numerators together for a new numerator, and below their sum write the common denominator.

If the result is an improper fraction reduce it to a wh... or mixed number.

If any of the given quantities are mixed numbers, add ... fractions first and to the sum add the whole numbers.

If any of the quantities to be added are compound or comp... fractions, reduce them to simple ones.

EXAMPLE 1.—Add together $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{6}{7}$

$$\frac{2}{3} + \frac{3}{4} + \frac{5}{6} + \frac{6}{7} = \frac{56}{84} + \frac{63}{84} + \frac{70}{84} + \frac{72}{84}$$

$$\text{then } \frac{56 + 63 + 70 + 72}{84} = \frac{261}{84} = 3\frac{3}{28} \text{ Ans.}$$

First we reduce the given fractions to others having a co... mon denominator, then adding together 56, 63, 70 and 72 ... new numerators and writing below the sum 84 the comm... denominator we have the fraction $\frac{261}{84}$ which reduced to ... mixed number is $3\frac{3}{28}$.

EXAMPLE 2.—Add together $4\frac{6}{41}$, $17\frac{4}{10}$, and $3\frac{11}{42}$.

$$\frac{6}{41} + \frac{4}{10} + \frac{11}{42} = \frac{672}{1722} + \frac{328}{1722} + \frac{451}{1722}$$

$$\text{then } \frac{672 + 328 + 451}{1722} = \frac{1451}{1722}$$

and $4 + 17 + 3 + \frac{1451}{1722} = 24\frac{1451}{1722}$ Ans.

In this example we first add together the fractional parts as in Example 1st and to the result add the whole numbers.

EXERCISE 10.

Find the value of

1. $\frac{9}{16} + \frac{10}{17} + \frac{11}{18}$.
2. $\frac{1}{2} + \frac{2}{3} + \frac{3}{4} + \frac{4}{5}$.
3. $\frac{5}{6} + \frac{6}{7} + \frac{7}{8} + \frac{8}{9} + \frac{9}{10}$.
4. $\frac{17}{28} + \frac{18}{77} + \frac{23}{28} + \frac{25}{48}$.
5. $\frac{2}{7} + \frac{3}{14} + \frac{4}{21} + \frac{5}{28} + \frac{6}{35}$.
6. $\frac{3}{7} + \frac{9}{14} + \frac{7}{16} + \frac{5}{18} + \frac{5}{21} + \frac{3}{28} + \frac{4}{27}$.
7. $\frac{4}{17} + \frac{3}{9} + \frac{5}{24} + \frac{3}{34}$.
8. $\frac{17}{18} + \frac{2}{23} + \frac{14}{9} + \frac{17}{28}$.
9. $\frac{2}{3}$ of $\frac{3}{4} + \frac{4}{5}$ of $\frac{5}{6} + \frac{6}{7}$ of $\frac{7}{8} + \frac{8}{9}$ of $\frac{9}{10}$.
10. $2\frac{4}{9} + \frac{3}{10} + 7\frac{9}{18}$.
11. $10\frac{4}{9} + 7\frac{8}{27} + 18\frac{17}{18}$ [illegible].
12. $6\frac{8}{17} + 234\frac{21}{34} + \frac{16}{27}$ [illegible].
13. $19\frac{26}{27} + 6\frac{3}{4} + 7\frac{9}{10} + 2$ [illegible] $\frac{8}{18}$.

14. $19\frac{1}{2}$ of $\frac{2}{7} + \frac{13}{14}$ of $\frac{6}{7}$.
15. $\frac{7}{8}$ of $\frac{8}{9} + \frac{7}{8} + 8\frac{7}{15}$ of $\frac{9}{11}$.
16. $3\frac{7}{10} + 7\frac{9}{11} + 4\frac{2}{11} + \frac{7}{15} + \frac{18}{25}$ of $\frac{7}{9}$.
17. $\dfrac{\frac{3}{4}}{8} + \dfrac{\frac{1}{6}}{\frac{2}{3}} + \dfrac{\frac{4}{5}}{\frac{8}{15}}$
18. $\dfrac{8\frac{3}{4}}{6\frac{1}{2}} + \dfrac{9\frac{2}{7}}{8\frac{3}{11}} + \dfrac{16\frac{1}{5}}{9\frac{3}{7}}$
19. $\frac{2}{7}$ of $\dfrac{4\frac{5}{6}}{6} + \dfrac{2}{2\frac{3}{4}}$
20. $\dfrac{3\frac{4}{5}}{5\frac{2}{3}}$ of $\dfrac{6\frac{1}{7}}{7\frac{3}{8}} + \dfrac{\frac{5}{6}}{3}$ of $\dfrac{2\frac{5}{9}}{4\frac{2}{5}}$

## SUBTRACTION OF FRACTIONS.

*Rule.*—Reduce the fractions to others having a common denominator. Subtract the numerator of the subtrahend from that of the minuend, and set down the difference with the common denominator written below it. If there are whole numbers find the difference as in simple subtraction. If in the subtraction of mixed numbers the new numerator of the subtrahend is greater than that of the minuend, subtract it from the common denominator, to the difference add the numerator of the minuend, and carry one to the whole number of the subtrahend.

EXAMPLE 1.—From $\frac{11}{12}$ take $\frac{3}{10}$.

$$\frac{11}{12} - \frac{3}{10} = \frac{55}{60} - \frac{18}{60} = \frac{55-18}{60} = \frac{37}{60} \text{ Ans.}$$

EXAMPLE 2.—From $17\frac{8}{17}$ take $9\frac{11}{12}$.

$$17\frac{8}{17} - 9\frac{11}{12} = 17\frac{96}{204} - 9\frac{187}{204} = 7\frac{113}{204} \text{ Ans.}$$

Having reduced the fractions to others having a common denominator we find that 187 the numerator of the subtrahend is greater than 96 that of the minuend, we therefore subtract it from 204 the common denominator, add 96 to the difference, and carry 1 to 9 the whole number, which subtracted from 17 leaves 7, to which the fractional remainder is annexed making $7\frac{113}{204}$.

### EXERCISE 11.

Find the value of

1. $\frac{21}{25} - \frac{8}{15}$
2. $\frac{16}{57} - \frac{13}{60}$
3. $\frac{2}{3} + \frac{4}{5} - \frac{3}{7}$
4. $\frac{4}{5}\frac{2}{3} + \frac{6}{7} - \frac{13}{29}$
5. $24\frac{1}{7} - \frac{3}{4}$
6. $29\frac{3}{8} - 17\frac{4}{9}$
7. $123\frac{2}{11} - 96\frac{16}{19}$
8. $4\frac{3}{16}$ of $\frac{7}{8} - 2\frac{4}{17}$
9. $18\frac{7}{12} - (2\frac{5}{7} + 3\frac{2}{3})$
10. $8\frac{6}{17} - 3\frac{2}{11}$ of $1\frac{5}{6}$
11. $\dfrac{9\frac{1}{2}}{10\frac{2}{3}} - \dfrac{6\frac{1}{4}}{7\frac{3}{5}}$
12. $4\frac{1}{3}$ of $\dfrac{16\frac{1}{2}}{11\frac{3}{8}} - \frac{2}{7}$ of $\dfrac{16\frac{1}{4}}{17\frac{3}{4}}$

## MULTIPLICATION OF FRACTIONS.

*Rule.*—If any of the quantities are mixed numbers redu
them to improper fractions, or if compound fractions redu
them to simple ones, and multiply the numerators together f
a new numerator, and the denominators for a new denominat
If the result is an improper fraction reduce it to a mixed nu
ber.

The work may be contracted by dividing a numerator a
any denominator by any number that measures both, and u
the results in their place.

EXAMPLE 1.—Multiply $\frac{5}{9}$ by $\frac{6}{8}$

$$\frac{5}{9} \times \frac{6}{8} = \frac{30}{72} = \frac{5}{12} \text{ Ans.}$$

EXAMPLE 2.—Multiply together $3\frac{4}{7}$, $2\frac{1}{9}$ and $\frac{7}{12}$

$$3\frac{4}{7} \times 2\frac{1}{9} \times \frac{7}{12} = \frac{25}{7} \times \frac{19}{9} \times \frac{7}{12}$$

and $\frac{25}{7} \times \frac{19}{9} \times \frac{7}{12} = \frac{475}{108} = 4\frac{43}{108}$ Ans.

First we reduce the mixed numbers to improper fraction
then cancelling 7 in the first denominator and 7 in the thi
numerator we multiply together 25 and 19 which gives t
numerator 475, and 9 and 12 which gives the denominator 10
then reducing the improper fraction $\frac{475}{108}$ we obtain the answ
$4\frac{43}{108}$.

### EXERCISE 12.

Find the value of

1. $\frac{7}{1} \times \frac{8}{9}$
2. $\frac{3}{4} \times \frac{2}{3} \times \frac{3}{8}$
3. $\frac{7}{16} \times \frac{8}{17} \times \frac{3}{4} \times 8$
4. $2\frac{3}{5} \times 4\frac{6}{7} \times 5\frac{2}{3}$
5. $8\frac{9}{16} \times 4\frac{8}{15}$
6. $3\frac{4}{7} \times 4 \times 5\frac{6}{11}$
7. $\frac{1}{2} \times \frac{2}{3} \times \frac{3}{4}$
8. $\frac{9}{28} \times \frac{8}{21}$
9. $\frac{4}{5} \times \frac{5}{6} \times \frac{6}{7}$
10. $\frac{9}{11} \times \frac{2}{3} \times \frac{3}{4}$
11. $\frac{8}{13} \times \frac{9}{11} \times \frac{4}{5}$
12. $(\frac{2}{7} + \frac{3}{4}) \times (\frac{4}{5} + \frac{6}{7})$
13. $(\frac{4}{5} - \frac{2}{7}) \times (\frac{8}{9} - \frac{3}{5})$
14. $\frac{7}{8} \times \frac{8}{9} \times \frac{9}{10} \times 1\frac{1}{2}$
15. $6\frac{4}{9} \times 2\frac{3}{5} \times 5\frac{6}{7}$
16. $\frac{2}{7} \times 4 \times 8\frac{1}{2} \times \frac{\frac{3}{7}}{6}$
17. $(2\frac{1}{3} + 4\frac{2}{5}) \times (7\frac{3}{8} - 2\frac{3}{7}) \times$
18. $1\frac{2}{28} \times 1\frac{7}{54} \times \frac{18}{\frac{3}{4}}$
19. $\frac{3}{8} \times \frac{5}{8} \times \frac{5}{9} \times \frac{7\frac{4}{5}}{39}$
20. $(3\frac{4}{5} + \frac{6}{7} + \frac{3}{8}) \times (8\frac{1}{5} - 4$

## DIVISION OF FRACTIONS.

*Rule.*—Reduce mixed numbers to improper fractions and compound fractions to simple ones Invert the terms of the divisor and proceed as in multiplication.

EXAMPLE 1.—Divide $1\frac{3}{15}$ by $\frac{4}{11}$

$$1\tfrac{3}{15} \div \tfrac{4}{11} = \tfrac{18}{15} \times \tfrac{11}{4} = \tfrac{198}{60} = 2\tfrac{23}{60} \text{ Ans.}$$

EXAMPLE 2.—Divide $2\frac{1}{4}$ of $3\frac{6}{11}$ by $\frac{7}{15}$ of $4\frac{3}{8}$

$$2\tfrac{1}{4} \text{ of } 3\tfrac{6}{11} \div \tfrac{7}{15} \text{ of } 4\tfrac{3}{8} = \tfrac{9}{4} \text{ of } \tfrac{39}{11} \div \tfrac{7}{15} \text{ of } \tfrac{35}{8} = \tfrac{351}{44} \div \tfrac{245}{152}$$
$$= \tfrac{351}{44} \times \tfrac{152}{245} = \tfrac{53352}{10780} = 4\tfrac{2856}{2695} \text{ Ans.}$$

EXERCISE 13.

Find the value of

1. $\frac{7}{9} \div \frac{2}{3}$
2. $8\frac{1}{7} \div 6\frac{2}{5}$
3. $\frac{14}{29} \div \frac{12}{17}$
4. $9\frac{6}{13} \div 11\frac{2}{17}$
5. $7\frac{5}{9} \div 2\frac{4}{7}$
6. $9\frac{1}{2} \div 11\frac{4}{5}$
7. $\frac{7}{11} \div \frac{9}{13}$
8. $6\frac{4}{9} \div \frac{5}{8}$ of $\frac{3}{5}$
9. $(12\frac{3}{5} + \frac{1}{7}) \div (9\frac{3}{4} - \frac{6}{7})$
10. $(7\frac{4}{5} \times \frac{8}{9}) \div \frac{16}{17}$
11. $\frac{13}{14} \div (\frac{9}{10} + \frac{1}{3})$
12. $\frac{17}{18}$ of $\frac{2}{3} \div \frac{9}{10}$ of $\frac{11}{12}$
13. $4\frac{7}{8} \div 9\frac{2}{3}$
14. $7\frac{1}{2} \div (\frac{2}{3} + \frac{3}{4})$
15. $9\frac{3}{5} \div 2\frac{3}{4} \div \frac{7}{8}$
16. $1\frac{1}{24} \div 2\frac{3}{8}$
17. $(2\frac{1}{4} + 7\frac{2}{3} - \frac{3}{5}) \div 3\frac{6}{7}$
18. $(\frac{2}{3} \times \frac{3}{4}) \div (\frac{4}{5} \times \frac{5}{6}) \div \dfrac{2\frac{2}{3} \text{ of } \frac{2}{3}}{\frac{3}{4} \text{ of } 4\frac{3}{7}}$
19. $4\frac{5}{9} \div \dfrac{7\frac{3}{10}}{4}$
20. $8\frac{3}{11} \div 5\frac{1}{9} \div \dfrac{6\frac{1}{11} \times 3\frac{1}{8}}{\frac{2}{3} \times 2\frac{2}{9}}$

## DECIMAL FRACTIONS.

A decimal fraction is a fraction that has for its denominator 10, 100, 1000, 10000, &c.

In decimals the denominator is omitted and a dot called the decimal point is placed to the left of the numerator.

Thus $\frac{3}{10}$ is written ·3, $\frac{74}{100}$ is written ·74.

When the number of figures in the numerator is less than the number of ciphers in the denominator, as many ciphers must be prefixed to the numerator as will make the number of figures in it equal to the number of ciphers in the denominator.

Thus $\frac{25}{1000}$ is written ·025, $\frac{25}{10000}$ is written ·0025.

To multiply a decimal by 10, remove the decimal point one place towards the right hand; by 100 two places, by 1000 three places, &c.

Thus ·0056 × 10 = ·056; 0056 × 100 = ·56; ·0056 × 1000 = 5.6.

To divide a decimal by 10, remove the decimal point one place towards the left hand; by 100 two places; by 1000 three places, &c.

Thus $28{\cdot}54 \div 10 = 2{\cdot}854$; $28{\cdot}54 \div 100 = {\cdot}2854$; $28{\cdot}54 \div 1000 = {\cdot}02854$.

Ciphers annexed at the end of a decimal do not change its value.

Thus ${\cdot}7$, ${\cdot}70$, ${\cdot}700 = \frac{7}{10}, \frac{70}{100}, \frac{700}{1000}$ which all have the same value.

A decimal which cannot be exactly expressed and in which one or more of the figures are continually repeated, is called a repeating or circulating decimal.

The figure or number repeated is called a repeater or period.

The continual repetition of a period consisting of several figures, is expressed by writing the period once and placing a dot over the first figure and another over the last; or if but one figure is to be repeated by placing a dot over it.

Thus ${\cdot}344$ &c. is written ${\cdot}3\dot{4}$, ${\cdot}345645$ &c. is written ${\cdot}\dot{3}45\dot{6}$

A pure repeating or circulating decimal is one in which the repeating period commences with the first figure after the decimal point · thus ${\cdot}\dot{4}$, ${\cdot}3\dot{2}\dot{4}$ are pure circulating decimals.

A mixed repeating or circulating decimal is one which has one or more figures or ciphers between the repeating period and the decimal point. Thus ${\cdot}24\dot{7}$, ${\cdot}3\dot{4}16\dot{3}$ are mixed circulating decimals.

In reading a decimal fraction as ·0000471 we find that it is in the denomination of millions, it is therefore read, four hundred and seventy-one ten millionths; 43·0047 is read forty-three and forty-seven ten thousandths.

### Exercise 1.

Express the following decimal fractions in words.

| | | |
|---|---|---|
| 1. ·36 | 5. ·00072 | 9. 71042·560 |
| 2. ·064 | 6. 34·506. | 10. 92,006507. |
| 3. ·207 | 7. 309·64 | 11. ·00000000724 |
| 4. ·652 | 8. ·000063. | 12. 671·408263. |

In writing a decimal fraction, as nine thousand seven hundred and twenty-three ten millionths, we find that three ciphers are required to make up the difference between the 4 figures of the given number and the decimal point, the decimal is therefore written ·0009723.

### Exercise 2.

Write down the following fractions:

1. Forty-six thousandths.

2. Nine hundred and eighty ten thousandths.
3. Six hundred and forty millionths.
4. Eighty-four thousand and seven hundred millionths.
5. Three thousand five hundred and six trillionths.
6. Four hundred and eight millionths.
7. One hundred and seven thousand six hundred trillionths.
8. Ninety-six thousand ten billionths.
9. Twenty thousand and sixty-four hundred billionths.
10. Seven hundred and two hundred thousandths.

## ADDITION OF DECIMAL FRACTIONS.

*Rule.*—Arrange the numbers to be added so that the decimal points will be directly under each other, and proceed as in simple addition.

If any of the numbers contain repeating or circulating decimals repeat them to as many places as may be judged necessary.

EXAMPLE.—Add together $38 \cdot 4\dot{9}\dot{6}$, $9 \cdot 3684$, $\cdot 70134$, $19 \cdot 7\dot{4}\dot{8}$, and $8 \cdot 63$.

$38 \cdot 496969$
$9 \cdot 3684$
$\cdot 70134$
$19 \cdot 748484$
$8 \cdot 63$

$76 \cdot 94519$

Here we continue the first and fourth numbers, then adding as in simple addition we obtain the sum $76 \cdot 94519$.

### EXERCISE 3.

Find the value of

1. $2 \cdot 43 + 7 \cdot 9638 + \cdot 7\dot{2} + 1 \cdot 9654 + 23 \cdot \dot{8}4\dot{5}$.
2. $79 \cdot 642 + \cdot 014 + 71 \cdot 63495 + \cdot 63 + 1 \cdot 7\dot{4} + \cdot 982 + 6 \cdot 491$.
3. $94 \cdot 026 + \cdot 87 + \cdot 085 + 6 \cdot 9\dot{5}\dot{4} + 10 \cdot 869 + \cdot 7406$.
4. $\cdot 928 + 34 \cdot 71695 + \cdot 7\dot{1}\dot{8} + 9 \cdot 7015$.
5. $96 \cdot 7\dot{4} + \cdot 9863 + \cdot 7\dot{1}\dot{2} + 19 \cdot 04\dot{2} + 365 \cdot 98 + 4 \cdot 307$.
6. $\cdot 7\dot{4}\dot{2}805 + 12 \cdot \dot{9}\dot{3} + \cdot 9\dot{8}\dot{1} + \cdot 3\dot{4} + 91 \cdot 64\dot{2}$.
7. $33\dot{4} \cdot 205 + \cdot 7\dot{3}\dot{6} + 7 \cdot 964085 + \cdot 36 + 41 \cdot 6\dot{8}$.
8. $71\dot{2} \cdot 8\dot{4} + \cdot 96 + \cdot 73014 + 25 \cdot \dot{6}\dot{3} + \cdot 98 + 94 \cdot 60\dot{8}$.

## SUBTRACTION OF DECIMAL FRACTIONS.

*Rule.*—Set the less number below the greater, placing the decimal points below each other, and proceed as in simple subtraction

EXAMPLE. From 24·64 take 9·7961.

24·6444
9·7961
14·8483

Here we continue the repeating decimal and find the difference as in simple subtraction.

EXERCISE 4.

Find the value of

1. 4·231 — 2·964.
2. 19·48 — ·68742.
3. 1·372 — ·96834.
4. 4·9542 — ·26875.
5. 234·736 — 79·489.
6. 14·5603 — 9·493.
7. 11·68014 — ·732.
8. 2·863 — 1·93478.
9. 7·245 — ·976387.
10. 4·35964 — 2·178.

## MULTIPLICATION OF DECIMAL FRACTIONS.

*Rule.*—Multiply as in multiplication of whole numbers, and mark off in the product as many decimal places as are contained in both factors. When there are not as many decimal places in the product as are contained in both factors, fill up the deficiency by prefixing ciphers.

EXAMPLE 1. Multiply 24·8 by ·23.

24·8
·23
744
496
5·704 Ans.

Here we multiply as in whole numbers, and mark off 3 places of decimals in the product, there being 2 figures to the right of the decimal point in one factor and one in the other.

EXAMPLE. 2. Multiply ·27 by ·3.

·27
·3
·081 Ans.

In this example there being 2 decimal places in one factor and one in the other and the product containing but 2 figures we prefix a cipher to make up the third.

EXERCISE 5.

Find the value of

1. ·3 × ·48.
2. ·24 × ·57.
3. ·749 × ·638.
4. 9·49 × ·67.
5. 8·63 × 5·34.
6. 28·76 × 6·48.
7. 2·4 × ·06 × 3·4.
8. ·07 × ·14 × 2·6.
9. ·34 × 2·1 × ·9.
10. ·9 × 2·3 × ·19.
11. 6·2 × ·06 × ·706.
12. ·63 × 8·01 × 6.

## DIVISION OF DECIMAL FRACTIONS.

*Rule.* 1.—If the divisor does not contain as many decimal places as the dividend, annex as many ciphers as will make the number of decimal places equal. In the same way if the dividend does not contain as many decimal places as the divisor, annex as many ciphers as will make them equal. 2. Then divide as in division of whole numbers and the quotient will be a whole number. 3. If when all the figures in the dividend have been used there is a remainder, annex ciphers and continue the division until nothing remains, or until the quotient has been continued as far as may be judged necessary.

EXAMPLE 1. Divide 324·5 by 6·25.

625) 32450 (51·92 Ans.

| |
|---|
| 3125 |
| 1200 |
| 625 |
| 5750 |
| 5625 |
| 1250 |
| 1250 |

Here there are two decimal places in the divisor and but one in the dividend, we therefore annex a cipher, then dividing as in whole numbers and placing the decimal point in the quotient after the last figure in the dividend has been used we annex ciphers and obtain the quotient 51·92.

EXAMPLE 2. Divide 2·428 by ·6.

6)0, 2428 (4·046

| |
|---|
| 2400 |
| 2800 |
| 2400 |
| 4000 |
| 3600 |
| 400. |

In this example we annex two ciphers to the divisor, then dividing as in whole numbers we obtain the answer 4·046.

### EXERCISE 6.

Find the value of

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | 9·163 | ÷ | ·49. | 9. | 269·4 | ÷ | ·75. |
| 2. | 37·5 | ÷ | 3·84. | 10. | 174·2 | ÷ | 7·5. |
| 3. | 87·4284 | ÷ | ·24. | 11. | 907·14 | ÷ | ·9123. |
| 4. | 75·993 | ÷ | 13·54. | 12. | 3·78102 | ÷ | 1·06. |
| 5. | 3·9184 | ÷ | 3·16. | 13. | 2035·46 | ÷ | 8·68. |
| 6. | 1466·31 | ÷ | 1·85. | 14. | 6·764 | ÷ | 3·653. |
| 7. | 96·4 | ÷ | 12·67. | 15. | 17·4296 | ÷ | 7·96. |
| 8. | 68·64 | ÷ | ·704. | 16. | 104.365 | ÷ | ·79. |

## REDUCTION OF DECIMALS.

To reduce a vulgar fraction to a decimal.

*Rule.*—Divide the numerator by the denominator, annexing ciphers to the numerator until the number of decimal places judged necessary is reached and prefix a point to the quotient.

EXAMPLE 1. Reduce $\frac{3}{4}$ to a decimal.

$$\begin{array}{r|l} 4 & 300 \\ \hline & \cdot 75. \end{array}$$

By annexing a cipher to the dividend it becomes 30 in which 4 is contained 7 times leaving a remainder 2, we therefore set down 7 in the quotient, then annexing another cipher 4 into 20 goes 5 times, then prefixing a point to the quotient, we have ·75 the answer.

EXAMPLE 2. Reduce $\frac{1}{75}$ to a decimal.

$$\begin{array}{r} 75)\ 100\ (\cdot 01\dot{3} \\ 75 \\ \hline 250 \\ 225 \\ \hline 25 \end{array}$$

In this example by annexing a cipher the dividend becomes 10 in which the divisor is not contained, we therefore place a cipher in the quotient and prefix a point, then annexing another cipher the dividend becomes 100 in which the divisor is contained once, we therefore set down 1 in the quotient, and annex a cipher to 25 which becomes 250 in this 75 is contained 3 times leaving a remainder 25 which being the same as the previous remainder it is evident that the last figure in the quotient would be continually repeated, and a point is therefore placed over it.

### EXERCISE 7.

Reduce the following vulgar fractions to decimals.

| | | | |
|---|---|---|---|
| 1. $\frac{3}{8}$ | 5. $\frac{167}{240}$ | 9. $\frac{213}{34}$ | 13. $\frac{5}{26}$ |
| 2. $\frac{3}{64}$ | 6. $\frac{5}{512}$ | 10. $\frac{2748}{77}$ | 14. $\frac{30}{49}$ |
| 3. $\frac{11}{60}$ | 7. $\frac{9}{10}$ | 11. $\frac{8}{11}$ | 15. $\frac{32617}{243}$ |
| 4. $\frac{2}{9}$ | 8. $\frac{1}{44}$ | 12. $\frac{9}{16}$ | 16. $\frac{24}{7939}$ |

---

To reduce a finite decimal to its equivalent vulgar fraction.

*Rule.*—Write the decimal for numerator; and a unit with as many ciphers annexed as there are figures in the decimal. thus $\cdot 83 = \frac{83}{100}$

## DECIMAL FRACTIONS.

To reduce a pure periodical decimal to its equivalent vulgar fraction.

*Rule.*—Write the period for numerator and as many 9's as there are figures in the period for denominator.

Thus. $\cdot\dot{4} = \frac{4}{9}$; $\cdot\dot{2}\dot{8} = \frac{28}{99}$; $\cdot\dot{4}5\dot{6} = \frac{456}{999} = \frac{152}{333}$.

To reduce a mixed periodical decimal to its equivalent vulga fraction.

*Rule.*—Subtract the finite part of the mixed repeating decimal from the whole, and write the remainder as numerator; and for denominator write as many 9's as there are figures in the period, with as many ciphers annexed as there are figures in the finite part.

EXAMPLE. Reduce $\cdot 32\dot{6}4\dot{8}$ to its equivalent vulgar fraction.

$32648 - 32 = 32616$ the numerator; then for denominator we write three 9's with two ciphers annexed, there being three figures in the repeating part of the decimal and two in the finite part. The denominator is therefore 99900.

Therefore $\cdot 32\dot{6}4\dot{8} = \frac{32616}{99900} = \frac{302}{925}$. Ans.

EXERCISE 8.

Express the following decimals as vulgar fractions.

| | | | |
|---|---|---|---|
| 1. $\cdot 6$ | 6. $\cdot \dot{3}$ | 11. $16\cdot \dot{3}4\dot{8}$ | 16. $\cdot 12\dot{4}\dot{3}$ |
| 2. $\cdot 7\dot{4}$ | 7. $\cdot 6\dot{4}$ | 12. $9\cdot 6\dot{3}$ | 17. $\cdot 314\dot{2}\dot{5}$ |
| 3. $\cdot 02\dot{1}$ | 8. $\cdot 9\dot{2}\dot{3}$ | 13. $\cdot 54\dot{1}$ | 18. $\cdot 64\dot{7}$ |
| 4. $\cdot 432$ | 9. $\cdot 1\dot{2}3426\dot{}$ | 14. $\cdot 36\dot{2}$ | 19. $6\cdot 43\dot{6}$ |
| 5. $6\cdot 009$ | 10. $\cdot 764\dot{2}$ | 15. $\cdot 54\dot{2}3$ | 20. $21\cdot 24\dot{3}1$ |

---

To reduce a given quantity to the decimal of another given quantity.

*Rule.*—Divide the number in the lowest denomination in the given quantity by the number which makes one of the next higher, annex the quotient to the quantity in the next higher denomination, and divide by the number of that denomination which makes one of the next higher, and proceed thus until the required denomination is reached, the last quotient will be the required decimal.

EXAMPLE 1. Reduce 15s 9¾d. to the decimal of a pound.

4 ) 3
12 ) 9·75
20 ) 15·8125
·790625 Ans.

First we divide 3 farthings by 4, which reduces it to ·75 of a penny, prefixing 9 pence to this and dividing by 12 we obtain ·8125 the decimal of a shilling, then prefixing 15 shillings to this we obtain ·790625 the decimal of a pound.

When the given quantity is to be reduced to another given quantity of the same kind but of different denominations.

*Rule.*—Reduce the quantities to a vulgar fraction, and reduce the vulgar fraction to a decimal.

EXAMPLE 2. Reduce 3 roods 18 per. to the decimal of 1 acre 2 roods.

$$\frac{3\text{r } 18\text{ per}}{1\text{a } 2\text{ r}} = \frac{138\text{ per}}{240\text{ per}} = \frac{23}{40} = 23 \div 40 = 575 \text{ Ans.}$$

EXERCISE 9.

1. Reduce 2 qrs 8 lbs to the decimal of a cwt.
2. Reduce 120 days 9 hours to the decimal of a year.
3. Reduce 5 fur. 3 per. to the decimal of a mile.
4. Reduce 1 foot 6 in. to the decimal of a yard.
5. Reduce 16s 11½d to the decimal of a pound.
6. Reduce 1 pint 3 gills to the decimal of a gallon.
7. Reduce 16 dwts 21 grs to the decimal of a lb.
8. Reduce 35 min. 30 sec. to the decimal of a day.
9. Reduce 4 cwt 1 qr 20 lbs to the decimal of a ton.
10. Reduce 2 qrs 3 nls to the decimal of a yard.
11. Reduce £3 : 17 : 6½ to the decimal of £6 : 10 : 4.
12. Reduce 3 qrs 3 lbs 1 oz 7 drs to the decimal of a cwt.
13. Reduce 29 perches to the decimal of 2 miles 7 fur.
14. Reduce 27 min. 25 sec. to the decimal of 12 hours 30 min.
15. Reduce 3 qrs 15 lbs to the decimal of 2 cwt. 1 qr. 24 lbs.

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To find the value of a given decimal.

*Rule.* 1.—Multiply the given decimal by as many of the next lower denominations as make one of the given denomination and point off as many of the decimal places in the product as there are in the given decimal. 2. Reduce the decimal part of the product to the next lower denomination, and so on to the lowest, and the numbers to the left of the decimal points will be the required value.

EXAMPLE. Find the value of ·1315 of a day.

| | |
|---|---|
| ·1315 | First we multiply ·1315 the given decimal by 24 the number of hours in a day, then point off four figures, the number in the given decimal, multiply ·1560 the number to the right of the decimal point by 60 the number of minutes in an hour, point off four figures and multiply ·3600 the number to the right of the de- |
| 24 | |
| 3·1560 hours. | |
| 60 | |
| 9.3600 min. | |
| 60 | |
| 21·6000 | |

3 h 9 min 21 sec. Ans.

cimal point by 60 the number of seconds in a minute. We thus find that the value of ·1315 of a day is 3 h 9 m 21·6 sec.

EXERCISE 10.

Find the value of

1. ·4315 of a cwt.
2. ·0274 of a day.
3. ·63248 of a furlong.
4. 3.528 of a lb Troy.
5. ·73125 of a £.
6. ·175 of a rood.
7. ·0348 of a bushel.
8. 2·875 of a yard.
9. ·613 of an acre.
10. 4·5063 of lb avoir du poids.
11. ·0568 of a gallon.
12. ·749 of a mile.
13. ·268 of a cwt.
14. ·9163 of a sq yard.
15. ·775 of a gallon.
16. ·39525 of a ton.

## PROPORTION OF FRACTIONS.

Arrange the terms according to the rule given for proportion; and multiply and divide as in multiplication and division of fractions.

EXAMPLE. If $\frac{4}{7}$ of a yard cost 80 cents what must be paid for 12 $\frac{2}{5}$ yards.

As $\frac{4}{7}$ yd : 12 $\frac{2}{5}$ yd : : \$0.80 or with the second term reduced to an improper fraction.

As $\frac{4}{7}$ yd : $\frac{62}{5}$ yds : : \$0.80 then $\frac{80}{1} \times \frac{62}{5} \times \frac{7}{4} = \frac{34720}{20}$ cents.
= \$17.36. Ans.

EXERCISES.

1. If 8 men do a piece of work in 2 $\frac{2}{7}$ days in how many days will 10 men do it?
2. What will 4 $\frac{7}{8}$ yds of cloth cost at the rate of \$4.70 for 1 $\frac{3}{8}$ yds?
3. How much sugar may be purchased for \$43.20, if $\frac{4}{7}$ cwt cost \$3.25?
4. If 3 $\frac{1}{2}$ cwt of flour cost \$9.30 what must be paid for 7 $\frac{3}{5}$ cwt?
5. If 17 $\frac{2}{3}$ lbs of cheese cost £1 $\frac{1}{3}$ what will 13 $\frac{9}{11}$ lbs cost?
6. What will 2 $\frac{4}{5}$ yds of cloth cost at the rate of \$28 $\frac{2}{3}$ for 7 $\frac{3}{5}$ yds?
7. How many gallons of vinegar may be bought for \$17.42 if 11·3 gals cost \$5.50?
8. If 28·5 yds of cloth cost \$112.90, what must be paid for 37·25 yds at the same rate?
9. How many pounds of coffee may be bought for \$13.24 if 28·2 lbs cost \$7.75?
10. If 24·25 cwt of sugar cost \$13 what will 3·28 cwt cost at the same rate?

11. What must be paid for fencing 9·35 acres at the rate of $12.50 for 3·4 acres?

12. What will be the value of 130.4 lbs of tea, if the value of 14·25 lbs is $11.50?

## MISCELLANEOUS QUESTIONS.

1. Find the greatest common measure of 734 and 1968.
2. Reduce £29 : 13 : $4\frac{1}{2}$ to dollars and cents.
3. From $2\frac{2}{3} \times (\frac{3}{4} + \frac{4}{5})$ take $\frac{7}{12} \div \frac{3}{11}$.
4. Add together £147 : 14 : $4\frac{1}{2}$, £98 : 7 : $6\frac{1}{4}$, £11 : 14 : $8\frac{1}{4}$, and £24 : 17 : $9\frac{3}{4}$, and from the sum take $743.18.
5. Divide $(7\frac{1}{3} + \frac{3}{8}) - (\frac{2}{5} \times \frac{3}{7})$ by $\frac{5}{8}$ of $\frac{2}{3}$.
6. Find the least common multiple of 7, 9, 16, 8, 14, 12.
7. Reduce $\frac{17}{104}$, $\frac{19}{36}$, $\frac{11}{48}$, and $\frac{14}{15}$ to equivalent fractions having a common denominator.
8. Reduce 7 cwt 3 qrs 21 lbs to ounces.
9. Reduce 2 miles 7 fur 18 per 2 ft to inches.
10. Reduce 4278986 sq inches to roods &c.
11. Reduce 14964 grains Apoth. to lbs &c.
12. From 17391 ounces take 1 cwt 3 qrs 17 lbs.
13. How many times is 234 contained in $425 \times 76$?
14. Reduce $(\frac{3}{8} \times \frac{14}{5\frac{1}{3}}) + (17 \times \frac{2}{3})$ to nine places of decimals.
15. Multiply $73.56 by 29, to the product add $48.35 and divide the result by 13.
16. From the sum of $\cdot 164 + 93\cdot 4 + 9\cdot 207$ take 2·49346.
17. Divide the sum of $2\cdot 91 + \cdot 493 + \cdot 96 + 17\cdot 29$ by 4·23017.
18. Multiply the result of $42\cdot 96 \div 14\cdot 638$ carried to four places of decimals by ·24.
19. What is the value of $\frac{2}{3} \times (\frac{3}{4} + \frac{2}{5})$ of $496 13.
20. From $\frac{2}{11}$ of 1 mile 2 per take $\frac{3}{8}$ of a furlong.
21. Find the sum of $\$234.17\frac{2}{3} + \$924.18\frac{3}{4} + \$1246.32\frac{1}{2} + \$347.24\frac{1}{7} + \$240.63\frac{3}{5} + \$792.18\frac{3}{8}$.
22. What is the difference between $\$1396.42\frac{3}{8}$ and $\$962.37\frac{4}{7}$?
23. Find the value of $\$7264.48\frac{5}{9} - \$3628.72\frac{6}{7}$.
24. From $\$3294.63\frac{2}{9} + \$742.06\frac{1}{7}$ take $\$2468.71\frac{2}{5} - \$856.37\frac{4}{11}$.
25. Multiply $\$365.84\frac{7}{10}$ by 11.
26. Find the value of $\$9264.23\frac{2}{5} - \$748.61\frac{3}{8} \times 9$.

## PRACTICE.

Practice teaches how to find the value of a given quantity of goods at a given rate by the method of aliquot parts.

An aliquot part is a quantity which is contained an exact number of times in a given quantity.

Thus. 2 qrs. is an aliquot part of a cwt., and 10 cents is an aliquot part of a dollar.

## TABLE OF ALIQUOT PARTS.

| Of a dollar. | Of a ton. | Of a cwt of 100 lbs. | Of £ 1. |
|---|---|---|---|
| cents. | | qrs. lbs. | |
| 50 = ½ | 10 cwt = ⅒ | 2 or 50 = ½ | 10s = ½ |
| 33⅓ = ⅓ | 5 " = ¼ | 1 or 25 = ¼ | 6s 8d = ⅓ |
| 25 = ¼ | 4 " = ⅕ | 20 lbs = ⅕ | 5s = ¼ |
| 20 = ⅕ | 2½ " = ⅛ | 12½ lbs = ⅛ | 3s 4d = ⅙ |
| 16⅔ = ⅙ | 2 " = 1/10 | | 2s 6d = ⅛ |
| 12½ = ⅛ | 1 " = 1/20 | Of a qr. of 28 lbs. | 2s = 1/10 |
| 10 = 1/10 | | | 1s 8d = 1/12 |
| 8⅓ = 1/12 | Of a cwt of 112 lbs. | 14 lbs = ½ | 1s 3d = 1/16 |
| 6¼ = 1/16 | | 7 " = ¼ | 1s = 1/20 |
| 5 = 1/20 | qrs. lbs. | 4 " = 1/7 | |
| 4 = 1/25 | 2 or 56 = ½ | 3½ " = ⅛ | Of a shilling. |
| 2½ = 1/40 | 1 or 28 = ¼ | 2 " = 1/14 | |
| 1¼ = 1/80 | 14 lbs = ⅛ | 1 " = 1/28 | 6d = ½ |
| | 7 lbs = 1/16 | | 4d = ⅓ |
| | 4 lbs = 1/28 | | 3d = ¼ |
| | 3½ lbs = 1/32 | | 2d = ⅙ |
| | | | 1½d = ⅛ |
| | | | 1d = 1/12 |

When the given quantity consists of one denomination.

EXAMPLE 1. Find the value of 28 lbs of tea at 50 cents per lb.

| | lbs. | |
|---|---|---|
| 50 = ½ | 28 | It is evident that the value of 28 lbs at $1 per lb would be $28, therefore the value of 28 lbs at 50 cents must be half that sum or $14. |
| | $14 Ans. | |

EXAMPLE 2.—Find the value of 246 yards at $1.80 per yard.

| | | |
|---|---|---|
| 50 cts. = ½ | 246 | at $1.80. |
| 25 " = ½ | 123 | value at 50 cts. |
| 5 " = ⅕ | 61.50 | value at 25 cts. |
| | 12.30 | value at 5 cts. |
| | $ 442.80 Ans. | |

Here we add together $246 the value of 246 yds. at $1, $123 the value of 246 yds. at 50 cts. per yd., $61.50 the value of 246 yds. at 25 cts. per

yd., and $12.30 the value of 246 yds. at 5 cts. per yd.; and thus obtain the amount of 246 yds. at $1, 50 cts., 25 cts. and 5 cts.: or taken together $1.80 per yd.

EXAMPLE 3.—Find the value of 1234¼ lbs. at $4.85 per lb.

| | | | |
|---|---|---|---|
| 50 cts. = ½ | 1234¼ at $4.85. | | |
| | 4 | | |
| | 4936 | value at $4. | |
| 25 cts. = ¼ | 617 | value at 50 cts. | |
| 10 cts. = ⅕ | 308.50 | value at 25 cts. | |
| | 123.40 | value at 10 cts. | |
| | 1.21¼ | value of ¼ of a lb. | |
| | $5986.11¼ Ans. | | |

Here we multiply 1234 by 4 and obtain the value at $4, then find the value of 1234 lbs. at 85 cts. by taking aliquot parts thus 50 cts. = ½ of $1, 25 cts. = ½ of 50 cts., 10 cts. = ⅕ of 50 cts., and to the results add $1.21¼ the value of ¼ of a lb. at $4.85 which gives the value of 1234¼ lbs. at $4.85 viz. $5986.11¼.

EXAMPLE 4.—Required the value of 246 cwt. at £3 : 2 : 4 per cwt.

| | | | |
|---|---|---|---|
| 2s. = 1/10 | 246 | | |
| | 3 | | |
| | 738 | value of 246 cwt. at £3. | |
| 4d. = ⅙ | 24 | 12 — of ——— | at 2s. |
| | 4 | 2 — of ——— | at 4d. |
| | $ 766 14 Ans. | | |

EXERCISE 1.

Find the value of

1. 746 lbs. at $0.87½.
2. 475 lbs. at $0.75.
3. 1234 lbs. at $1.46.
4. 6387 yds. at $1.57½.
5. 286 yds. at $2.78.
6. 954 yds. at $4.56.
7. 354 cwt. at $24.50.
8. 2468 at $314.18.
9. 7694½ at $87.26.
10. 4283¾ at $96.54.
11. 4256⅔ at $220.15.
12. 796½ at $76.94.
13. 1357 7/11 at $156.13.
14. 784 2/10 at $96.35.
15. 495 at £2 : 11 : 8.
16. 5324 at 11s. 6d.
17. 948 at £3 : 7 : 9.
18. 3576 1/11 at £7 : 9 : 6½.
19. 2459⅔ at £9 : 3 : 8.
20. 1268⅛ at £2 : 9 : 4.
21. 3274 at $1.35.
22. 498 3/11 at 2s. 11½d.
23. 4956⅞ at $234.56.
24. 864⅜ at £13 : 16 : 4¾.
25. 1274 5/16 at $1.28.
26. 3724 at $1.17.
27. 3469 7/13 at $1.12½.
28. 224 at £3 : 5 : 6.
29. 235 at £2 : 7 : 9.
30. 2485 1/15 at $19.45.

When the given quantity consists of more than one denomination.

EXAMPLE 1. What is the value of 240 cwt. 2 qrs. 15 lbs. 12 oz. at $7.40 per cwt?

| | | $ cts. | | |
|---|---|---|---|---|
| 2 qrs. = | ½ | 7.40 | | |
| | | 240 | | |
| | | 29600 | | |
| | | 1480 | | |
| | | 1776·00 | value of 240 cwt. | |
| 12½ lbs. = | ¼ | 3 70 | — | 2 qrs. |
| 2½ lbs. = | ⅕ | 925 | — | 12½ lbs |
| 8 oz. = | ⅛ | 185 | — | 2½ lbs |
| 4 oz. = | ½ | 37 | — | 8 oz. |
| | | 18 | — | 4 oz. |
| | | $1780.86 | Ans. | |

In this example we multiply $7.40 the value of 1 cwt. by 240 and obtain $1776 the value of 240 cwt. Then taking parts for the remainder and adding we obtain $1780.86 the value of 240 cwt. 2 qrs. 15 lbs. 12 oz. at $7.40 per cwt.

EXAMPLE 2. What is the value of 12 tons. 10 cwt. 2 qrs. 14 lbs. of hay at $14.10 per ton. allowing 112 lbs to the cwt?

| | | $ cts. | | |
|---|---|---|---|---|
| 10 cwt. = | ½ | 14.10 | | |
| | | 12 | | |
| | | 169.20 | value of 12 tons. | |
| 2 qrs. = | 1/20 | 7.05 | — | 10 cent. |
| 14 lbs. = | ¼ | 352 | — | 2 qrs. |
| | | 88 | — | 14 lbs. |
| | | $176.69 | Ans. | |

EXAMPLE 3. What will 3 qrs. 12½ lbs. of sugar cost at £2 : 15 : 6 per cwt.

| | | £ s. d. | | |
|---|---|---|---|---|
| 2 qrs. = | ½ | 2 15 6 | | |
| 1 qr. = | ½ | 1 7 9 | value of 2 qrs. | |
| 12½ lbs. = | ½ | 13 10½ | — | 1 qr. |
| | | 6 11¼ | — | 12½ lbs. |
| | | £2 8 6¾ | Ans. | |

EXERCISE 2.

Find the value of

1. 17 cwt. 2 qrs. 14 lbs. at $24.56 per cwt.
2. 38 cwt. 3 qrs. 12½ lbs. at $220.16 per cwt.
3. 31 tons. 12 cwt. 1 qr. 20 lbs. at $14.21 per ton.
4. 3 qrs. 17 lbs. 14 oz. at $29.36 per cwt.
5. 374 miles 2 fur. 21 per. at $48.05 per mile.
6. 34 wks. 4 days at $9.48 per week.
7. 4 chaldrons 21 bush 3 pks. at $3.50 per chaldron.

8. 324 acres 2 r. 24 per. at $23.75 per acre.
9. 48 gals. 3 qts. 1 pt. 2 gills at $3.26 per gal.
10. 17 lbs. 8 oz. 5 drs. Apoth at $7.14 per lb.
11. 17 cwt. 2 qrs. 23 lbs. at £2 : 7 : 4 per cwt.
12. 96 acres 14 perches at £4 : 18 per acre.
13. 54 gals. 3 qts. 1 pt. at £ 1 : 3 : 6½ per gallon.
14. 17 weeks 3½ days at £1 : 17 : 8 per week.
15. 346 yds. 3 qrs. 2nls. at $3.65 per yard.
16. 345 cwt. 1 qr. 18¾ lbs. at £2 : 9 : 8¼ per cwt.
17. 14 miles 7 fur. 30 per at $32.85 per mile.
18. 258 cwt. 3 qrs. 24 lbs. at £4 : 7 : 9½ per cwt.
19. 243 lbs. 14 oz. 12 drs. at $2.78 per lb.
20. 136 days 7 hours at $1.37½ per day.
21. 74 cwt. 18 lbs. at $38.54 per cwt.
22. 28 fur. 35 per. 2¾ yds. at £2 : 9 : 3 per furlong.
23. 117 cwt. 13 lbs. at $11.16 per cwt.
24. 76 gals. 1 qt. 1 pt. at $1.95 per gallon.
25. 3 qrs. 24 lbs. 8 oz. at $10.14 per cwt. of 112 lbs.
26. 9 weeks 2 days at $7.28 per week.
27. 27 days 14 hours at $1.24 per day.
28. 90 acres 2 r. 16 per. at $14.28 per acre.
29. 230 gals. 3 qts. 1 pt. at $2.70 per gallon.
30. 190 cwt. 2 qrs. 13 lbs. at $14.28 per cwt.

## TARE AND TRET.

Gross weight is the weight of any goods, together with the weight of the case, bag, or barrel in which they are packed.

Tare is the weight of the case, bag, or barrel in which goods are packed.

Tret is an allowance generally made for waste in goods.

The net weight is what remains after the tare and tret have been deducted from the gross weight.

EXAMPLE.—What is the net weight of 46 cwt. 2 qrs. of flour, tare 6 lbs. per cwt., tret 3 lbs. per cwt.

| | cwt. | qrs. | lbs. |
|---|---|---|---|
| Gross | 46 | 2 | 0 |
| Tare | 2 | 3 | 4 |
| | 43 | 2 | 21 |
| Tret | 1 | 1 | 6 |
| Net weight | 42 | 1 | 15 |

Here the tare on 46 cwt 2 qrs at 6 lbs. per cwt. is found to be 2 cwt. 3qrs. 4 lbs. which deducted from the gross weight leaves 43 cwt. 2 qrs. 21 lbs., then the tret on this at 3 lbs. per cwt. is 1 cwt. 1 qr. 16 lbs. which being deducted leaves the net weight 42 cwt. 1 qr. 15 lbs

In the above example and in the following exercises the net weight is found as nearly as possible without reduction to ounces.

EXERCISES.

Find the net weight of

1. 26 cwt. 2 qrs. 12 lbs., tare 15 lbs. per cwt.
2. 7 chests tea each weighing 194 lbs., tare 16 lbs. per chest.
3. 7 hhdds. of sugar the gross weight being 93 cwt. 2 qrs., tare 3 qrs. 12 lbs. per hhdd.
4. 13 barrels rice each weighing 2 cwt. 1 qr. 9 lbs., tare 1 qr. 9 lbs. per barrel.
5. 120 cwt. 2 qrs. 12 lbs. flour, tare 8 lbs. per cwt., tret 3 lbs. per cwt.
6. 4 hhdds each weighing 13 cwt. 1 qr. 14 lbs., tare 2 qrs. 11 lbs per hhdd.
7. 19 bags indian meal each weighing 1 cwt. 3 qrs. 9 lbs., tare 4 lbs per bag.
8. 124 cwt. 2 qrs. gross, tare 9 lbs. per cwt., tret 4 lbs. 26 per cwt.
9. 2[illegible] barrels sugar each 1 cwt. 3 qrs. 14 lbs. gross, tare 14 lbs. per cwt.
10. 7 hhdds tobacco each 3 cwt. 1 qr. 2 lbs. gross, tare 2 qrs. 19 lbs. per hhdd.
11. 9 casks butter each weighing 2 qrs. 15 lbs., tare 14 lbs. per cask, tret 3½ lbs. per cwt.
12. 17 cwt. 24 lbs. of flour, tare 11 lbs. per cwt., tret 4 lbs. per cwt.
13. 42 bags rice each 1 cwt. 3 qrs. 23 lbs. gross, tare 8 lbs. per bag.
14. 14 hogsheads of sugar each 11 cwt. 2 qrs. 7 lbs. gross, tare 40 lbs. per hhdd., tret 2½ lbs. per cwt.
15. 96 cwt. 1 qr. 17 lbs. of flour, tare 12 lbs. per cwt., tret 3 lbs. per cwt.

## COMMISSION, INSURANCE, AND BROKERAGE.

Per cent or percentage means a certain rate per 100.

Thus if a merchant sells a quantity of goods, his gain is said to be 5, 7, or 8 per cent, according as his profit is $5, $7, or $8 on each $100 worth of goods sold.

Commission is the percentage charged by an agent or commission merchant for buying or selling goods, collecting accounts, &c., for another.

Insurance is a contract by which a company on being paid a certain sum or percentage called the premium, engages to pay to the owners of certain property such as houses, ships, merchandise, &c., a certain sum, in case of the destruction of the property by fire or other accident.

Brokerage is the percentage charged by a broker for negociating bills, buying or selling stocks, &c.

To compute the commission, insurance, or brokerage on a given sum at a given rate per cent.

*Rule.*—Multiply the amount by the given rate per cent, divide the product by 100, and the result will be the commission, insurance or brokerage.

EXAMPLE 1.—What is the commission on \$248 at $7\frac{1}{2}$ per cent?

$\$ 248 \times 7\frac{1}{2} = \$1860.$

and $\$1860 \div 100 = \$18.60$. Ans.

EXAMPLE 2.—What is the premium of insurance on \$4560 at $2\frac{1}{8}$ per cent?

$\$4560 \times 2\frac{1}{8} = \$9690.$

and $\$9690 \div 100 = \$96.90$. Ans.

EXAMPLE 3.—What is the brokerage on \$2740 at $2\frac{1}{4}$ per cent?

$\$2740 \times 2\frac{1}{4} = \$6165.$

and $\$6165 \div 100 = \$61.65$. Ans.

EXERCISES.

1. What is the commission on \$724 at $9\frac{1}{2}$ per cent?
2. What is the commission on \$2648 at $2\frac{1}{4}$ per cent?
3. Required the commission on \$9428.18 at $4\frac{1}{3}$ per cent.
4. Find the commission on \$487.66 at $5\frac{3}{4}$ per cent.
5. What is the commission on \$14724.60 at $\frac{5}{8}$ per cent?
6. To what does the commission on \$7428.40 amount at $12\frac{1}{2}$ per cent?
7. Required the commission on \$15680 at $14\frac{1}{4}$ per cent.
8. A commission merchant sells goods to the amount of \$2460.80 what is his commission at $8\frac{3}{4}$ per cent?
9. If an agent purchases goods for a merchant to the amount of \$8964.20 what is his commission at $11\frac{1}{4}$ per cent?
10. What is the brokerage on \$942 at 6 per cent?
11. Required the brokerage on \$2724.40 at $4\frac{3}{4}$ per cent.
12. Find the brokerage on \$10748.50 at $4\frac{1}{8}$ per cent.
13. To what does the brokerage on \$7964.80 amount at $7\frac{1}{2}$ per cent?
14. At $3\frac{2}{3}$ per cent, what is the brokerage on \$984.60?
15. What is the brokerage on \$18965.50 at $2\frac{3}{4}$ per cent?
16. Find the brokerage on \$872 at $7\frac{1}{4}$ per cent.
17. At $4\frac{1}{2}$ per cent, what is the brokerage on \$3129?
18. To what does the brokerage amount on \$10000 at $7\frac{1}{4}$ per cent?
19. What is the premium of insurance on \$2740 at 2 per cent?
20. What premium of insurance must be paid at the rate of $2\frac{1}{4}$ per cent on property valued at \$7460?
21. What is the insurance on \$748 at $2\frac{1}{8}$ per cent?
22. At $2\frac{3}{8}$ per cent, what premium of insurance must be paid on a house worth \$7450?

23. What premium of insurance must be paid on merchandise worth $1089\frac{1}{4}$ at $1\frac{3}{4}$ per cent?

24. What must be paid for insuring a house and furniture valued at $12724.50 at $1\frac{5}{8}$ per cent?

25. If a vessel with its cargo is worth $35000, what premium of insurance must be paid at $2\frac{3}{5}$ per cent?

26. What is the premium of insurance on a house and barn worth $9428.50 at $1\frac{5}{8}$ per cent?

27. Required the premium of insurance on $10074 at $2\frac{1}{2}$ per cent.

28. At $12\frac{1}{4}$ per cent, what is the commission on $20742?

29. To what does the brokerage on $2248 amount at $4\frac{3}{8}$ per cent?

30. What is the premium of insurance on goods worth $12480.50 at $2\frac{1}{4}$ per cent?

## STOCK.

The capital of any Company or institution as Railroad companies, Insurance companies, Banks, &c., is called its stock.

Stock is divided into portions called shares.

Stocks are said to be at par when they sell at the original cost, above par or at a premium when they sell for more than the original costs, and below par or at a discount when they sell for less than the original cost.

Thus if a $100 share sells for $100 it is at par, if for more than $100 it is above par or at a premium, and if for less than $100 it is below par or at a discount; as if a $100 share sells at a premium of 9 per cent its value is $100 + $9 = $109, if at a discount of 9 per cent its value is $100 — $9 = $91.

To find the value of a given amount of stock.

*Rule.*—Multiply the given amount of stock by the value of $100 worth, and divide the product by 100.

Example 1.—What is the value of $720 stock at 8 per cent discount?

$$\$720 \times 92 = \$66240.$$
$$\text{and } \$66240 \div 100 = \$662.40 \text{ Ans.}$$

Example 2.—What is the value of $250 stock when it is selling at a premium of 6 per cent.

$$\$250 \times \$106 = 26500.$$
$$\text{and } \$26500 \div \$100 = \$265.00 \text{ Ans.}$$

To find what amount of stock may be purchased for a given sum.

*Rule.*—Divide the product of the given sum and 100 by the value of $100 stock.

EXAMPLE 3.—How much stock can be purchased for $2000, when it is selling at a premium of 12 per cent?

$2000 × 100 = 200000.

and $200000 ÷ $112 the value of $100 at 12 per cent = $1785.71⅐

EXERCISES.

1. What is the value of $2400 stock at a premium of 9 per cent.
2. When stock is selling at a premium of 7½ per cent what amount may be purchased for $790?
3. When stock is selling at 10 per cent below par what is the value of $2740 stock?
4. When stock is 24 per cent above par what is the value of $9240 stock?
5. What amount of stock may be purchased for $980, when it is selling at a premium of 18 per cent?
6. What is the value of $7160 stock at 8 per cent above par?
7. When stock is selling at a premium of 11 per cent, how much may be purchased for $5200?
8. If stock is selling at 9 per cent below par what is the value of $1200?
9. What is the value of $9450 stock at 7½ per cent discount?
10. How much stock can I purchase for $10000 when it is selling at a premium of 16¼ per cent?
11. When stock is 14 per cent below par what is the value of $7428 stock?
12. What is the value of $4650 stock at 12 per cent discount?

## INTEREST.

Interest is the sum allowed for the use of money, and is reckoned at a certain rate per cent.

The sum of money lent is called the principal; and the sum of the principal and interest is called the amount.

Thus if $100 is borrowed for 1 year at 5 per cent interest the amount at the end of a year will be $100 + $5 = $105.

Interest is either simple or compound.

### SIMPLE INTEREST.

When interest is charged on the principal only it is called simple interest.

To find the interest on a given sum for one or more years.

*Rule.*—Multiply the principal by the rate per cent, divide the product by 100, and the result will be the interest for one year. The interest for any number of years is found by multiplying the interest for one year by the number of years for which the interest is required.

EXAMPLE 1.—What is the interest on $248.70 for 1 year at 5 per cent.

$248.70 × 5 = $1243.50
and $1243.50 ÷ 100 = $12.435 Ans.

EXAMPLE 2. What is the interest on $280 for 3 years at 6½ per cent per annum?

$280 × 6½ = $1820.
Then $1820 ÷ 100 = $18.20 Interest for 1 year.
And $18.20 × 3 = $54.60 Interest for 3 years.

EXERCISE 1.

Find the interest on

1. $356 for 1 year at 7 per cent.
2. $2540 for 1 year at 5 per cent.
3. $964 for 2 years at 5½ per cent.
4. $3248.50 for 3 years at 4½ per cent.
5. $7384.65 for 2 years at 6 per cent.
6. $948.30 for 1 year at 5¾ per cent.
7. $8450 for 2½ years at 9 per cent.
8. $1248 for 4 years at 6¼ per cent.
9. $842 for 2¼ years at 7⅛ per cent.
10. $2146.50 for 1¾ years at 10 per cent.
11. $11248 for 1 year at 6 per cent.
12. $789 for 1 year at 6⅜ per cent.
13. $214.60 for 1 year at 7½ per cent.
14. $928 for 2½ years at 6 per cent.
15. $398.40 for 3 years at 5½ per cent.
16. $3460 for 1 year at 4⅛ per cent.
17. $864.90 for 2 years at 9 per cent.
18. $1654 for 1 year at 3⅜ per cent.
19. $792 for 1 year at 7½ per cent.
20. $1245.50 for 2½ years at 6 per cent.

---

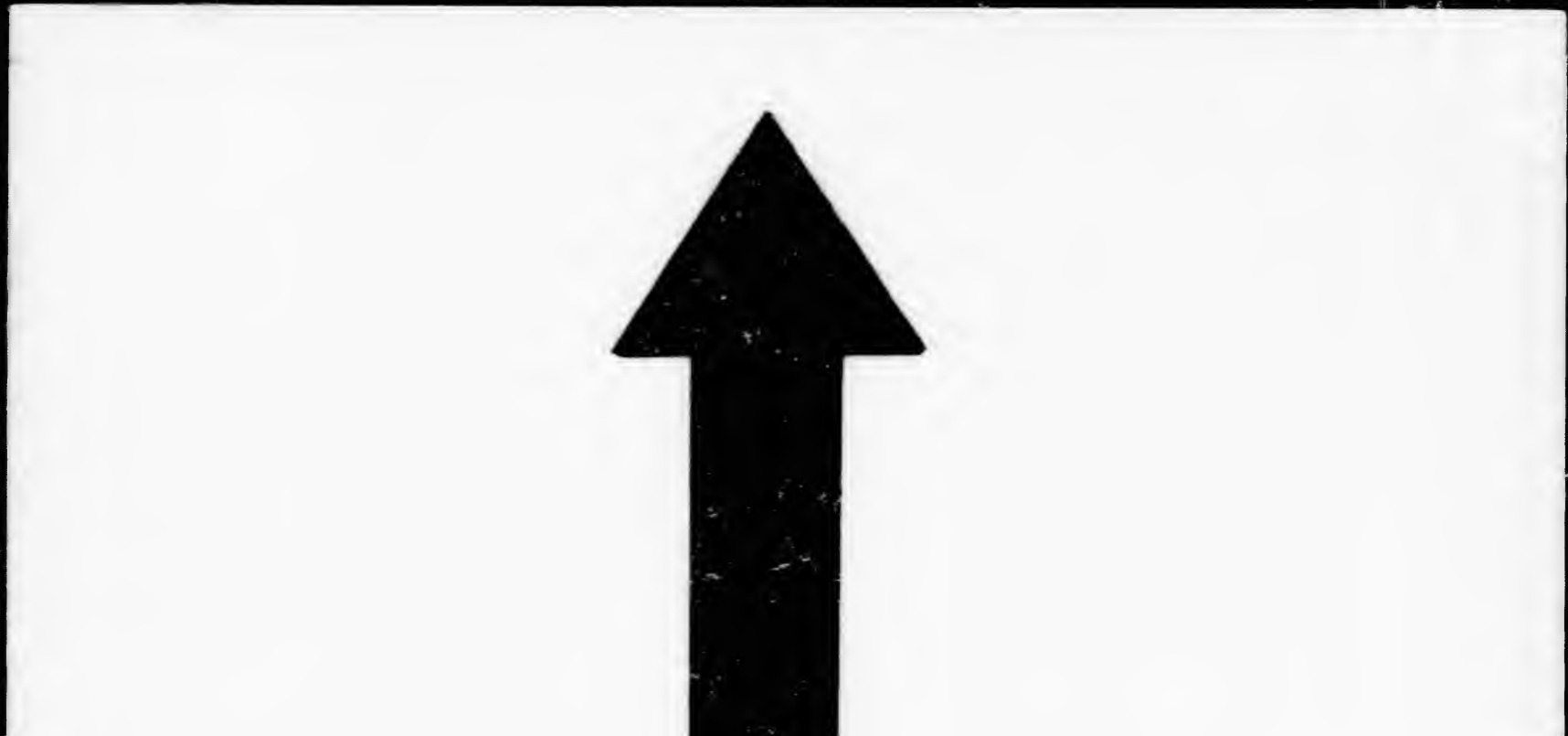
To find the interest on a given sum when the time consists of years and months.

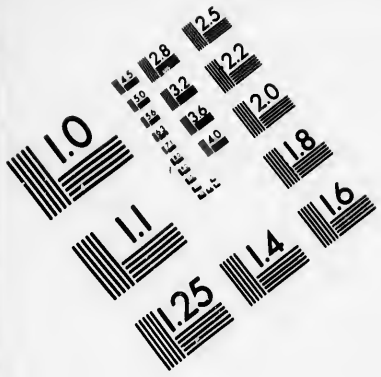
*Rule*.—Find the interest for the given number of years by rule 1; and for the months by aliquot parts as in practice.

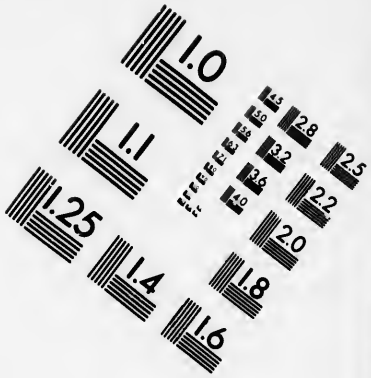
EXAMPLE 3.—Find the interest on $560 for 2 years and 5 months, at 6 per cent per annum.

$560 × 6 = $3360.
and $3360 ÷ 100 = $33.60 Interest for 1 year.

| | | | | |
|---|---|---|---|---|
| 4 months = | ⅓ | $33.60 Interest for 1 year. | | |
| | | 2 | | |
| | | 67.20 | — | 2 years. |
| month = | ¼ | 11.20 | — | 4 months. |
| | | 2.80 | — | 1 month. |
| | | $81.20 Ans | | |



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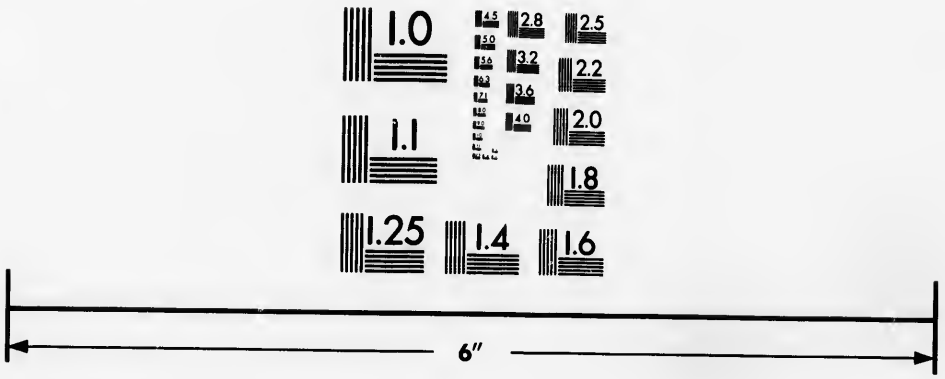


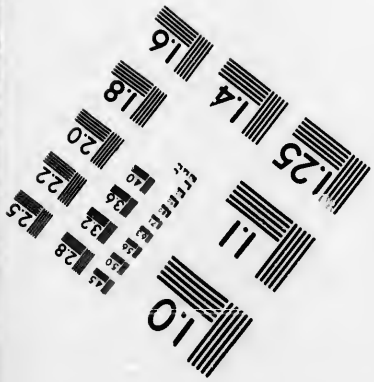


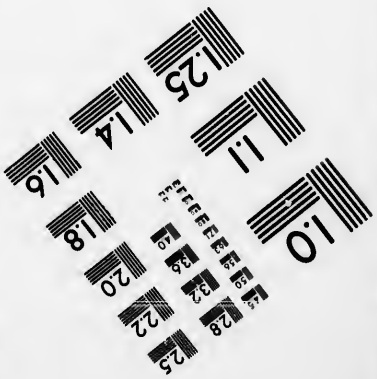


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EXERCISE 2.

Find the interest on

1. $748 for 2 years 6 months at 7½ per cent.
2. $2460 for 1 year 4 months at 6 per cent.
3. $958.60 for 2 years 2 months at 5 per cent.
4. $1346 for 3 years 1 month at 4¾ per cent.
5. $964 50 for 2 years 8 months at 5¼ per cent.
6. $2464 for 1 year 9 months at 4⅜ per cent.
7. $862.40 for 10 months at 6⅓ per cent.
8. $1248.50 for 1 year 7 months at 7 per cent.
9. $563.72 for 11 months at 8¼ per cent.
10. $654.90 for 2 years 5 months at 9 per cent.
11. $358.60 for 3 years 3 months at 4¾ per cent.
12. $1234 for 2 years 1 month at 8½ per cent.
13. $964.20 for 7 months at 6⅜ per cent.
14. $2468 for 1 year 2 months at 5½ per cent.
15. $258.20 for 2 years 11 months at 8 per cent.

---

To find the interest on a given sum for any number of days.

*Rule.*—Find the interest on the given sum, at the given rate for 1 year. Then as 365 days is to the given number of days, so is the interest for 1 year to the interest required.

EXAMPLE 4. Find the interest on $640 for 98 days at 8 per cent per annum.

By rule 1 we find the interest on $640 for 1 year at 8 per cent to be $51.20, then

days days

As 365 : 98 : : $51.20 : $13.74$\frac{5}{73}$ Ans.

EXAMPLE 5. Find the interest on $500 from 20th May to the 7th August at 6 per cent per annum.

First we find the number of days from the 20th May to 7th August which is 79 days ; and the interest on $500 for 1 year at 6 per cent which is $30, then

days days

As 365 : 79 : : $30 : $6.49$\frac{23}{73}$ Ans.

EXERCISE 3.

Find the interest on

1. $1248 for 147 days at 5 per cent.
2. $964 for 354 days at 6 per cent.
3. $2480.60 for 120 days at 7¼ per cent.
4. $796.40 for 37 days at 6½ per cent.
5. $496.20 for 56 days at 5¾ per cent.
6. $928 for 179 days at 6 per cent.
7. $324 50 for 267 days at 8 per cent.
8. $2345 for 92 days at 4½ per cent.

9. $500 for 198 days at 5⅛ per cent.
10. $624.40 for 204 days at 6¼ per cent.
11. $920 from June 3 to Dec. 26 at 6 per cent.
12. $428.60 from Aug. 21 to January 4 at 7 per cent.
13. $1234.50 from May 27 to October 21 at 5½ per cent.
14. $865 from January 14 to July 27 at 6¼ per cent.
15. $1024 from March 28 to June 4 at 7 per cent.

## COMPOUND INTEREST.

When the interest is added to the principal at the end of a year or any period, and the interest is calculated on the amount for the ensuing year or period it is called compound interest.

To find the compound interest on a given sum for a given time at a given rate per cent.

*Rule* 1.—Find the interest for the first year at the given rate per cent, add this to the principal and take the amount as principal for the second year. 2. Find the interest for the second year add it to the last principal and take the amount as principal for the third year. 3. Proceed thus until the interest has been found for the required number of years. If the given principal be subtracted from the amount for the given time the remainder will be the compound interest.

EXAMPLE.—Find the compound interest on $500 for 3 years at 5 per cent per annum.

Interest on $500 for 1 year at 5 per cent $25.
Amount at the end of first year $525.
Interest on $525 at 5 per cent $26.25.
Amount at the end of second year $551.25.
Interest on $551.25 at 5 per cent $27.5625.
Amount at the end of third year $578.8125.
The amount $578.8125—$500 the original principal = $78.8125 the compound interest on $500 for 3 years at 5 per cent.

EXERCISES.

Find the compound interest and the amount of

1. $740.60 for 3 years at 5 per cent.
2. $1240 for 2 years at 5½ per cent
3. $690.40 for 2 years at 4¾ per cent.
4. $684 for 3 years at 6 per cent.
5. $920 for 2 years at 4 per cent.
6. $2960 for 2 years at 6¼ per cent.
7. $932 for 6 years at 7 per cent.
8. $1000 for 5 years at 6½ per cent.
9. $600 for 2 years at 5 per cent.

10. $748 for 4 years at 6 per cent.
11. $890 for 3 years at 5½ per cent.
12. $2400 for 4 years at 6 per cent.

## DISCOUNT.

Discount is an allowance made for the payment of a note or debt before it becomes due.

The sum which remains after the discount has been deducted from a note or debt due some time after, is called its present worth.

Three days called days of grace are allowed to elapse after the date on which a bill is due before it becomes legally due, and in calculating the discount these three days are added to the time. Thus if a bill is drawn on the 4th January at 6 months it would not become due on the 4th but on the 7th of July following.

To find the present worth of a note or debt.

*Rule* 1. Add 3 days to the time which a note has to run before it becomes due, find the interest on the sum for this time at the given rate, consider this interest as discount, subtract it from the debt, and the remainder will be the present worth.

EXAMPLE 1.—What is the present worth of a note of $460 due 3 months hence at 6 per cent?

Here the discount for 3 months and 3 days is found by the e for simple interest to be $7.13 which subtracted from 60 leaves $452.87 the present worth.

EXAMPLE 2.—What is the present worth of a note of $780 drawn May 9 at 5 months discounted June 6 at 5 per cent?

Here by counting 5 months and 3 days from May 9, we find that the note will become due on October 12, the time from June 6 to this date is 4 months and 6 days. The interest on $780 for 4 months and 6 days at 5 per cent is $13.65 and $780—$13.65 = $766 35 the present worth.

### EXERCISE 1.

Find the present worth of.

1. A note of $490 due 3 months hence at 6 per cent.
2. A note of $940 due 5 months hence at 8 per cent.
3. A note of $624.40 due 4 months hence at 5 per cent.
4. A note of $840 due 2 months hence at 7 per cent.
5. A note of $490.20 due 36 days hence at 10 per cent
6. A bill of $1000 due 100 days hence at 8 per cent.
7. A bill of $650 due 92 days hence at 9 per cent

8. A note of $1600 drawn June 10 at 6 months, discounted July 4 at 6 per cent.

9. A bill of $864.40 drawn April 6 at 4 months, discounted June 2 at 8 per cent.

10. A bill of $450.60 drawn June 7 at 6 months, discounted September 20 at 5 per cent.

11. A note of $2400 drawn February 5 at 9 months, discounted May 28 at 6 per cent.

12. A bill of $3460.20 drawn January 7 at 10 months, discounted June 9 at 5 per cent.

13. What is the discount on $2748.20 for 92 days at 10 per cent per annum?

14. What is the discount on $948.50 for 2 months at 8 per cent per annum?

15. What is the discount on $890 for 143 days at 9 per cent per annum?

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Although the rule given above for the calculation of discount is that which is generally used in actual practice, yet it does not give the true discount, for the true discount is the interest on the present worth for the time it has to run at the given rate per cent. It is therefore evident that the discount found by rule 1 is always too large and consequently the present worth too small.

To find the true present worth of a note.

*Rule.*—As $100 together with the interest on $100 at the given rate and for the given time is to the amount of the note, so is $100 to the true present worth. The discount is found by subtracting the present worth from the amount of the note.

Example 3.—What is the true present worth of $540 due 73 days hence at $7\frac{1}{5}$ per cent?

As $100 + $1.44 = $101.44 : $540 : : $100 : $532 - 3343 Ans.

Here we add together $100 and $1.44 the interest on $100 for 73 days at $7\frac{1}{5}$ per cent. Then proceeding as in simple proportion we obtain $532 - 3343 the true present worth and the difference between this and $540 = $7-6656 the discount.

From this it is evident that the process is correct for the present worth with the interest added, for the given time at the given rate amounts to the exact sum of the debt, while by Rule 1 the discount would be $7.76 or 11 cents more than the true discount.

Exercise 2.

Find the true present worth of

1. A note of $945 due 3 months hence at 6 per cent.
2. A bill of $1000 due 4 months hence at 9 per cent.

3. A bill of $260.40 due 7 months hence at 9 per cent
4. A note of $624 due 3 months hence at 5 per cent.
5. A note of $704.80 due 9 months hence at 7 per cent.

## EQUATION OF PAYMENTS.

When a person owes another a sum of money which is to be paid at different times; the rule by which the time for the payment of the whole is determined is called Equation of payments.

There are several rules by which questions in equation of payments are worked, but the following is that which is generally employed.

*Rule* 1.—Multiply the sum of each payment by the number of months or days at the end of which it becomes due; 2 divide the sum of the products thus obtained by the sum of the amounts payable and the quotient will be the equated time for the payment of the whole.

EXAMPLE.—If a person owes a debt of $1200 payable $600 in 3 months, $400 in 5 months, and the remainder in 7 months what is the equated time for the payment of the whole?

| $ | | | | $ |
|---|---|---|---|---|
| 600 | × | 3 | = | 1800 |
| 400 | × | 5 | = | 2000 |
| 200 | × | 7 | = | 1400 |
| 1200 | | | | 5200 |

Then dividing $5200 the sum of the products by $1200 the sum of the amounts due we obtain the quotient 4 $\frac{1}{3}$ months the equated time for the payment of the whole.

The correctness of the operation is proved by adding together the interest on each of the amounts payable at any rate per cent for the given times, which will be found to correspond exactly with the interest on the sum of the amounts due for the equated time.

EXERCISES.

1. If a person owes another $200 payable in 2 months, $300 in 4 months, $250 in six months what is the equated time for the payment of the whole?
2. If a person owes a debt of $2000 payable $500 in 3 months, $450 in 5 months, $700 in 6 months, and the remainder in 8 months what is the equated time for the payment of the whole?
3. What is the equated time for the payment of $490 due at the end of six months, $370 at the end of 8 months and $600 at the end of 10 months?

4. What is the equated time for the payment of a debt of $8200, payable 700 in 6 months, 1240 in 9 months, and $6260 in 11 months ?

5. If a person owes another $650 payable at present, $750 payable in 3 months, and $360 payable in 4 months, what is the equated time for the payment of the whole ?

6. If a person buys goods to the value of $700 and agrees to pay $400 in 4 months and the balance in 6 months, what is the equated time for the payment of the whole ?

7. What is the equated time for the payment of three notes payable $820 in 7 months, $400 in 8 months, and $450 in 10 months ?

8. If a debt of $2460 is payable, one third in 6 months, one fifth in 7 months, one sixth in 9 months, and the balance in 11 months, what is the equated time for the payment of the whole ?

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## BARTER.

Barter is the exchange of goods by two parties at prices agreed upon by both.

*Rule.*—Find the value of those goods of which the price and the quantity are given ; divide this by the quantity of the other goods and the quotient will be the value ; or divide by the value and the quotient will be the quantity.

EXAMPLE 1.—If 42 lbs of tea is exchanged for 150 yards of cotton at 18 cents per yard, what does the tea cost per pound ?

150 yds. ad 18 cents = $27.00
and $27.00 ÷ 42 = $0.64,28 Ans.

EXAMPLE 2. How many pounds of tea at 60 cents per lb. ought I to receive for 240 lbs. of sugar at 10 cents per lb ?

240 lbs. at 10 cents = $24.00
and $24.00 ÷ 60 = 40 lbs Ans.

EXERCISES.

1. If 39 yards of cloth at $2.40 per yard is exchanged for 360 yards of cotton, what does the cotton cost per yard ?

2. How many pounds of coffee at 28 cents per pound, ought I to receive in exchange for 230 lbs of tea at 56 cents per lb ?

3. A grocer has 72 lbs. of tea worth 48 cents per pound ; which he barters for cheese at 27 cents per lb., what quantity of cheese should he receive ?

4. A merchant barters 236 barrels of flour at $5.90 per barrel for 148 cwt. of sugar how much did the sugar cost him per cwt ?

5. How much sugar at $9.20 per cwt. should a merchant receive in exchange for a hogshead of molasses at 31 cents per gallon?

6. A grocer owes $248 of which he pays $230 cash, and the balance in tea at 65 cents per lb., how many pounds of tea must he give?

7. A farmer sells to a merchant 140 bushels of oats at 43 cents per bushel, and receives in exchange 18 yards of cloth at $3.20 per yard and 27 yds. of cotton what does the cotton cost him per yard?

8. How many bushels of wheat at $1.23 per bushel ought I to receive in exchange for 93 bushels of oats at 46 cents per bushel?

9. A farmer exchanges 7 cows valued at $29 each for a horse valued at $117.20, and the balance in sheep at $3.90 each how many sheep should he receive?

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## PROFIT AND LOSS.

Profit and Loss treats of the gains or losses on goods in mercantile transactions.

To find the gain or loss on a given quantity of goods when the prime cost and selling price are given.

*Rule.*—Multiply the difference between the buying and selling price of a barrel, yard, lb., &c., by the number of barrels, yards, lbs., &c., and the result will be the gain or loss on the whole.

EXAMPLE 1.—If I buy 320 lbs of coffee at 24 cents per pound and sell it at 30 cents per lb. what do I gain by the transaction?

30 cents — 24 cents = 6 cents, the gain per lb.
and 6 cents × 320 = $19.20 the whole gain.

EXAMPLE 2.—If I buy 29 yds. of cotton at 18 cents per yard, and sell it for 16¾ cents per yard what do I lose on the whole?

18 cents — 16¾ cents = 1¼ cents, the loss per yard.
and 1¼ cents × 29 = 36¼ the whole loss.

EXERCISE 1.

1. If I purchase 974 bushels of oats at 37½ cents per bushel, and sell them for 43 cents per bushel, what is my gain by the transaction?

2. What is my gain on the sale of 640 barrels of flour at $6.12½ per barrel, the prime cost being $5.90 per barrel?

3. What do I lose on the sale of 3 cwt. 2 qrs. of coffee at 30 cents per lb., the prime cost being $32.60 per cwt?

4. If I buy a chest of tea containing 98 lbs. for $105 and sell it at $1.20 per lb., what is my gain on the transaction ?
5. I bought 365 lbs. of cheese at 16 cents per lb. and sold it at 12½ cents per lb., what did I lose on the whole ?
6. If I buy 213 yds of cloth at $3.40 per yard and sell it at $3 85 per yard, what is my gain on the whole ?

---

To find the gain or loss per cent when the prime cost and selling price are given.

*Rule.*—As the prime cost is to the whole gain or loss, so is $100 to the gain or loss per cent.

EXAMPLE 3. If I buy a quantity of goods for $1728 and sell them for $2018 what is my gain per cent ?

First we find the difference between $1728 the prime cost and $2018 the selling price which is $290, then

As $1728 : $290 : : $100 : 16 $\frac{160}{216}$ the gain per cent.

EXAMPLE 4. What is my loss on a quantity of goods for which I paid $792 and sold for $642 ?

As $792 : $150 : : $100 : 18 $\frac{3}{33}$ the loss per cent.

EXERCISE 2.

1. If I buy 920 bushels of wheat at $1.15 per bushel and sell the whole for $1120 what do I gain per cent ?
2. If I buy 167 barrels of pork for $2520 and sell it at $16.80 per barrel, what is my gain per cent ?
3. What is the loss per cent on a quantity of hay which was bought for $1248 and sold for $1190 ?
4. If cloth is bought at $3.10 per yard and sold at $3.25 per yard, what is the gain per cent ?
5. If tea which cost 90 cents per lb. is sold for 85 cents per lb. what is the loss per cent ?
6. Bought a farm for $2760 and sold it for $2990 what was my gain per cent on the transaction ?
7. If I buy 140 lbs. of rice for $15.40 and sell it for 10¼ cents per lb. what is my loss per cent ?
8. Bought 90 lbs. of raisins at 14 cents per lb. and sold the whole for $13.50 what was my gain per cent ?

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To find how an article must be sold to gain or lose a certain rate per cent, the prime cost being given.

*Rule*—As $100 is to $100 with the gain per cent, or diminished by the loss per cent, so is the first cost to the selling price.

EXAMPLE 5. If flour is bought at $6.15 per barrel at what rate must it be sold to gain 14 per cent?

As $100 : $114 : : $6.15 : $7.01 the selling price.

EXAMPLE 6. Bought a quantity of firewood for $560 and sold it at a loss of 7 per cent, what should I receive for it?

As $100 : $93 : : $560 : $520.80 Ans.

EXERCISE 3.

1. If I buy a quantity of flour for $2140 what must I sell it for to gain 9 per cent?
2. How much should I receive for a quantity of tea which cost $928, so as to gain 11 per cent?
3. Bought $1290 worth of sugar and sold it at a profit of 8 per cent, what did I receive for the whole?
4. If I buy 2 cwt. 3 qrs. of sugar at $9 per cwt. and sell it at a loss of 6 per cent, what should I receive for the whole?
5. If I buy a quantity of cloth for $790 and sell it at a gain of 12 per cent, what should I receive for it?
6. A grocer bought a quantity of eggs for $37 and sold them at a loss of 4 per cent, what did he receive for them?
7. Bought 200 bushels of wheat at $1.25 per bushel and sold the whole at a loss of 7 per cent, what did I receive for it?
8. Bought a quantity of firewood for $270 on which I wish to gain 9 per cent, what must I sell it for?

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To find the first cost when the gain or loss per cent and the selling price are given?

*Rule.*—As $100 with the gain per cent or diminished by the loss per cent is to $100 so is the selling price to the first cost.

EXAMPLE 7.—Sold a quantity of oats for $175 gaining 8 per cent what was the first cost?

As $108 : $100 : : $175 : $162.03$\frac{1}{27}$ the first cost.

EXAMPLE 8.—If I sell 19 sheep for $70 thereby losing 4 per cent, what was the first cost?

As $96 : $100 : : $70 : $72.91$\frac{2}{3}$ the first cost.

EXERCISE 4.

1. If I sell a hogshead of molasses at 35 cents per gallon thereby gaining 7 per cent, what was the first cost per gallon?
2. Sold a quantity of flour for $2470 gaining 10 per cent on the transaction, what was the first cost?
3. If I sell a quantity of wheat for $1748 thereby losing 5 per cent, what was the first cost?
4. If I gain 12 per cent on a horse which I sold for $190, what was the first cost?

5. What was the first cost of 36 cwt. of sugar sold for $350 the gain on the whole being 13 per cent?

6. Sold 350 lbs. of butter for $65 losing at the rate of 8 per cent what was the first cost?

7. If I gain 15 per cent on a farm which I sold for $3120 what was the first cost?

8. Sold 120 yds. of cloth for $311 gaining 7 per cent on the transaction, what was the first cost?

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## PARTNERSHIP.

Partnership or Fellowship is the method by which the profits or losses of a firm or company are divided among the respective partners.

Partnership consists of two kinds, Simple and Compound.

### SIMPLE PARTNERSHIP.

In Simple partnership, the stocks or sums contributed by the several partners, all continue in trade for the same time.

*Rule.*—As the whole stock is to each partners share of the stock, so is the whole gain or loss to each partner's share of the gain or loss.

In the same way the effects of a bankrupt may be divided among his creditors: As the sum of all the claims is to each creditor's claim, so is the value of the effects to each creditor's share or dividend.

EXAMPLE 1.—Three persons enter into partnership, A. puts into the business $750, B. $840, and C. $980; they gain $800, what is each partner's share?

The whole stock being $2570, therefore

As $2570 : $750 : : $800 : $233.46-$\frac{78}{257}$ A's profit.
As $2570 : $840 : : $800 : $261.47$\frac{321}{257}$ B's profit.
As $2570 : $980 : : $800 : $305.05$\frac{214}{257}$ C's profit.

$800.00 Whole profit.

The correctness of the operation is evident for the gain of each partner added together is found to be exactly $800 the whole gain.

EXAMPLE 2.—A grocer failing in business owes; $500 to A, $760 to B, and $1520 to C, the value of his effects is $1250, what should each creditor receive?

The sum of the debts is $2780, therefore,

As $2780 : $ 500 : : $1250 : $ 224.82$\frac{2}{139}$ A's share.
As $2780 : $ 760 : : $1250 : $ 341.72$\frac{124}{139}$ B's share.
As $2780 : $1520 : : $1250 : $ 683.45$\frac{115}{139}$ C's share.

$1250 00 Total effects.

EXERCISES.

1. Two persons enter into partnership: A, puts in $1280 and B $1860; what is each partner's share in a gain of $962?

2. Three persons enter into partnership. A puts into the business $7246, B $9640, and C $8120, at the end of a year their profits amount to $8250; what is each partner's share?

3. Four persons commence business with a capital of $12000 towards which A contributes $3150, B $2600, C $4250, and D the balance, they gain $4500, what share of this should each receive?

4. Three merchants freight a ship, the value of the cargo is $11900 of which $\frac{1}{4}$ belongs to A, $\frac{1}{5}$ to B, and the balance to C; they lose on the cargo $1700; what share of the loss does each sustain?

5. A, B, and C enter into partnership. A contributes towards the stock 740 barrels of flour at $6.20 per barrel, B 960 bushels of wheat at $1.25 per bushel, and C 270 barrels of flour at $5.80 per barrel; what share should each receive in a gain of $2600?

6. If two persons purchase a house for $12700 towards which A contributes $5300 and B the balance, what share of the gain should each receive if they afterwards sold the house for $17960?

7. A, B, and C purchase a quantity of flour for $9300, what is the loss of each if the flour is sold for $8920, A's share being $\frac{1}{3}$ of the whole, B's $\frac{1}{4}$, and C's the remainder?

8. A bankrupt, the value of whose effects is $6800, owes $1600 to A, $2400 to B, $2500 to C, and $4800 to D, what share should each receive?

9. A vessel with its cargo is valued at $18000, of which $5600 belongs to A, $6500 to B, and the balance to C, the vessel being lost at sea they receive $7900 insurance; what share of the loss does each sustain?

10. What would be the shares of three creditors of a bankrupt, the value of whose effects is $9750, the claim of the first creditor being $5500, of the second $4600, and of the third $6150?

11. A merchant failing in business owes $3500 to A, $4700 to B, $5600 to C, and $6500 to D; the value of his effects is $12500, what is the share of each creditor?

12. A and B commence business with a capital of $7500 towards which A contributes $3250 and B the balance, what

share of the profits should each receive at the end of a year the gain being $1400?

## COMPOUND PARTNERSHIP.

In Compound partnership, the stocks or sums contributed by the several partners, continue in trade for different periods.

*Rule.*—Multiply the stock of each partner by the time he continues in business. Then as the sum of the products thus obtained is to each product, so is the gain or loss to each partner's share of it.

EXAMPLE. Three persons enter into partnership. A puts into the business $1240 for 9 months, B $980 for 7 months, and C $1300 for 10 months, what is the share of each in a gain of $920?

$1240 + 9 = $11160.
$ 980 + 7 = $ 6860.
$1300 + 10 = $13000.

$31020.

As $31020 : $11160 :: $920 : $330.9864 A's share.
As $31020 : $ 6860 :: $920 : $203.4558 B's share.
As $31020 : $13000 :: $920 : $385.5577 C's share.

$920.00 whole gain.

### EXERCISES.

1. Four persons enter into partnership, A puts into the business $870 for 2 months, B $365 for 8 months. C $490 for 4 months, and D $500 for 6 months; what is the share of each in a gain of $600?

2. A, B, and C commence business with a capital of $8000, towards which A contributes $2000 for 7 months, B $2500 for 6 months, and C $3500 for 8 months, what share should each receive in a gain of $1500?

3. Three merchants enter into partnership with a capital of $20000, towards which A contributes $6000 for 6 months, B $7000 for 9 months, and C the balance for 8 months, what is the share of each in a gain of $6400?

4. Two persons in partnership having gained $2100 in trade, what share should each receive, A having contributed $4000 for 9 months and B 2400 for 11 months?

5. A, B and C gained \$780 on a capital of \$3000, towards which A contributed $\frac{1}{3}$ for 14 months, B $\frac{1}{4}$ for 16 months, and C the balance for 15 months; what share of the profits should each receive?

6. Three persons enter into partnership. A contributes \$1500 for 10 months, B \$2500 for 8 months, and C \$2600 for 11 months, they lose \$890, what share of the loss should each sustain?

7. A, B and C commence business with a capital of \$2700, towards which A contributes \$900 for 8 months, B \$700 for 11 months, and C the balance for 9 months, what is the share of each in a gain of \$300?

8. A commenced business with a capital of \$4500, three months after he entered into partnership with B who brought \$3800 into the business, 10 months after A commenced business they find that they have gained \$2700; what share of this should each receive?

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## INVOLUTION.

A power of any number is the product obtained by the continual multiplication of a number by itself.

Thus $4 \times 4$ or 16 is the second power of 4; $4 \times 4 \times 4$ or 64 is the third power of 4; $4 \times 4 \times 4 \times 4$ or 256 is the fourth power of 4, &c.

The root of a power is a number which being continually multiplied by itself produces that power.

Thus 4 is a root of 16 because $4 \times 4 = 16$; 5 is a rool of 125 because $5 \times 5 \times 5 = 125$.

When a number is taken twice as factor it is called the second power or square of that number; when taken three times as factor it is called the third power or cube; when taken four times as factor it is called the fourth power; when taken 5 times as factor it is called the fifth power, &c.

The index or exponent of a power is a small figure written after and a little above the given number, and it indicates how often the root has to be taken as factor to produce the given power.

Thus $3 \times 3 = 9$ which is the second power of 3 and is written $3^2$; $3 \times 3 \times 3 = 27$ which is the third power of 3 and is written $3^3$; $3 \times 3 \times 3 \times 3 = 81$ is the fourth power of 3 and is written $3^4$.

The method of finding the power of a number is called Involution.

To find any required power of a given number.

*Rule.*—Find the continual product of the given number, taken as factor the number of times expressed by the index.

When the given number is a vulgar fraction find the required power of the numerator and of the denominator.

When the given number is a mixed number reduce it to an improper fraction and find the required power of the numerator and of the denominator.

EXAMPLE 1. What is the fourth power of 6 ?

$6 \times 6 = 36$ the second power.
$36 \times 6 = 216$ the third power.
$216 \times 6 = 1296$ the fourth power.

EXAMPLE 2.—What is the third power of $3\frac{1}{3}$ ?

$3\frac{1}{3} = \frac{10}{3}$ then
$\frac{10}{3} \times \frac{10}{3} = \frac{100}{9}$ the second power
and $\frac{100}{9} \times \frac{10}{3} = \frac{1000}{27} = 37\frac{1}{27}$ Ans.

NOTE.—The operation of finding the 4th power of a number may be shortened by finding the square of its square ; to find the 5th power of a number find the product of its square and cube ; to find the 6th power of a number find the square of its cube ; to find the 7th power of a number take the product of its fourth power and its cube ; to find the 8th power find the square of its fourth power.

EXERCISES.

Find the value of

1. The square of 21.
2. The cube of 15.
3. $16^2$
4. $18^3$
5. The fourth power of 9.
6. The fifth power of 4.
7. The sixth power of 8.
8. $17^4$
9. $14^5$
10. $11^6$
11. The second power of 27.
12. The square of 78.
13. The third power of 13.
14. The cube of 19.
15. The sixth power of $\frac{3}{8}$.
16. The fourth power of $2\frac{1}{5}$.
17. $(3\frac{2}{5})^3$
18. $(1\frac{1}{3})^5$
19. The cube of 239.
20. The fourth power of $\frac{2}{7}$.

## EVOLUTION.

Evolution is the method of extracting any root of a given number, or

Evolution is the method of finding a number, which being multiplied by itself a given number of times, will produce a given number.

The index of a root is a small figure written above the sign $\surd$, prefixed to the number of which the root is required.

When it is required to find the square root the number 2 need not be prefixed to the sign.

Thus $\sqrt{16}$ indicates the second or square root of 16, that is a number which if multiplied by itself will produce 16; $\sqrt[3]{24}$ indicate the cube or third root of 24, that is a number whose third power is 24; $\sqrt[4]{19}$ indicates the fourth root of 19, that is a number whose fourth power is 19, &c.

## EXTRACTION OF THE SQUARE ROOT.

To extract the second or square root of a given number.

*Rule*—1. Point off the given number into periods of two figures each, commencing at the unit figure. 2. Find the highest square contained in the first period and place its root in the quotient. 3. Subtract the square of the figure in the quotient from the first period, to the remainder annex the next period, and double the part of the root already found for part of the next divisor. 4. Find how many times this part of the divisor is contained in the dividend omitting the last figure thus obtained to the part of the root in the quotient and also to the part of the divisor already found. 5. Then multiply the divisor by the last figure placed in the quotient, set down the product, and subtract it from the dividend; and annex the next period to the remainder for a new dividend. 6. Double the part of the root found for part of the next divisor and proceed as before until all the periods have been brought down. If there is a remainder annex two ciphers to find each figure of the decimal.

To extract the square root of a vulgar fraction.

*Rule.*—Find the square root of the numerator for a new numerator, and the square root of the denominator for a new denominator if both be complete squares, but if not reduce the fraction to a decimal and proceed as in the extraction of roots of whole numbers.

To find the square root of a mixed number.

*Rule.*—Reduce the fractional part to a decimal, annex it to the whole number and proceed as above.

EXAMPLE 1. What is the square root of 54756 ?

```
      5̇4̇7̇5̇6|234 Ans.
      4
  43|147
     129
 464| 1856
      1856
```

Here by placing a point over the second figure from the right, and over each alternate figure towards the left we divide the given number into three periods. The highest square in the first period is 4, the square root of which 2 we place in the quotient, then subtracting 4 from 5 and to 1 the remainder annex 47 the next period which makes the new dividend 147. To find the second figure of the root we double the first and set it down to the left of the new dividend, and finding that 4 is contained 3 times in 14 we set down 3 in the quotient and annex 3 to the part of the divisor already found which gives the complete divisor 43; this being multiplied and 129 the product subtracted from 147 we have a remainder 18 which with the next period annexed is 1856 the next dividend. Then we double 23 the part of the root found and obtain 46 part of the next divisor; finding that this is contained 4 times in 185 we place 4 in the quotient and annex 4 to the part of the divisor found, this gives the complete divisor 464 which is contained exactly 4 times in the dividend.

The correctness of the operation is proved by multiplying 234 the square root by itself, the product being exactly 54756 the given number.

EXAMPLE 2. What is the square root of $6\frac{7}{16}$ ?

$6\frac{7}{16} = 6.4375$

```
      6.4̇3̇7̇5|2.537 &c.
      4
  45|243
     225
 5.03| 1875
       1509
5.067|  36600
        35469
         1131
```

Here we reduced $\frac{7}{16}$ to a decimal and annex it to the whole number 6. Then finding that the highest square contained in 6 is 4 we place 2 its square root in the quotient and set down the decimal point after it. Then bringing down the next period we continue the process as in the first example, and finding that after all the periods are brought down there is a remainder of 366 we annex two ciphers, and thus by annexing two ciphers to each successive remainder the operation may be continued until the required number of decimal places is obtained.

EXERCISE I.

Find the square root of

1. 1156.
2. 61504.
3. 666.
4. 563918.
5. 1132·2.
6. 36372961.
7. 432.
8. $6\frac{1}{4}$.
9. 39·25.
10. 1728.
11. 123456789.
12. ·289.
13. $\frac{16}{81}$, $\frac{49}{121}$, $\frac{25}{144}$.
14. 37·84.
15. $\frac{9}{15}$.
16. $\frac{25}{8}$.
17. 30·25.
18. 562.
19. 78·5.
20. 145·491844.
21. 784.
22. 3675068.
23. 2490084.
24. 8208·36.

## EXTRACTION OF THE CUBE ROOT.

To extract the third or cube root of a given number.

*Rule* 1.—Point off the given number into periods of three figures each, commencing at the unit figure. 2. Find the highest cube contained in the first period, and place its root in the quotient. 3. Subtract the cube of the root placed in the quotient from the first period, to the remainder annex the second period, and multiply the square of the part of the root already found by 300 for part of the next divisor. 4. Find how many times the part of the divisor thus found is contained in the dividend and annex the figure thus obtained to the part of the root in the quotient. 5. Then add to the part of the divisor already found the product of the part of the root in the quotient multiplied by 30, and the square of the last figure placed in the quotient, this will give the complete divisor. 6. Multiply the divisor by the last figure placed in the root, subtract the product from the dividend, and to the remainder annex the next period for a new dividend. Continue the process until all the periods have been brought down, when if there is a remainder annex periods of three ciphers each.

To extract the cube root of a vulgar fraction :

*Rule.*—Find the cube root of the numerator for a new numerator and of the denominator for a new denominator, if both are complete cubes, but if not reduce the fraction to a decimal and proceed as in the extraction of the roots of whole numbers.

To extract the cube root of a vulgar fraction :

Reduce the fractional part to a decimal, annex it to the whole number and proceed according to the above rule.

EXAMPLE.—What is the cube root of 78402752?

78402752 | 428 Ans.
64

$4 \times 4 = 16 \times 300 = 4800$
$4 \times 2 = 8 \times 30 = 240$
$2 \times 2 = 4$

Complete divisor 5044

14402 dividend.

10088

$42^2 = 1764 \times 300 = 529200$
$42 \times 8 = 336 \times 30 = 10080$
$8^2 = 64$

Complete divisor 539344

4314752 dividend.

4314752

First pointing off the given number into periods of three figures each, we find that the highest cube contained in the first period is 64, the cube root of which 4 we place in the quotient; Then subtracting 64 from 78 and annexing the next period to he remainder we have 14402 for a new dividend. To find at divisor multipl. 16 which is the square of 4, the part of the root already found, by 300, this gives 4800, the first part of the divisor; although this is apparently contained 3 times in the dividend, yet on trial it will be found too great, we therefore take 2 and annex it to the part of the root already found; then adding together 4800 the part of the divisor already found; 240 which is the product of 4, the first part of the quotient, 2, the last figure in the quotient, and 30; together with 4, the square of the last figure placed in the quotient, we obtain the complete divisor 5044, this multiplied by 2 gives 10088, which subtracted from the dividend leaves 4314, which with the next period annexed becomes 4314752, a new dividend. Then to find the next divisor we add together 529200, the square of 42, multiplied by 300; 10088, the product of 42 and 8 multiplied by 30; and 64, the square of 8, the last figure placed in the quotient, and find that their sum is 539344, the complete divisor which is contained exactly 8 times in the dividend.

The correctness of the operation is proved by involving the root to the third power which is exactly 78402752 the given number.

EXERCISE 2.

Find the cube root of

1. 39304.
2. 14886936.
3. 175616.
4. 80621568.
5. 14455457856.
6. 1879080904.
7. 123456789.
8. 636056.
9. 5735·339
10. $\frac{27}{64}$, $\frac{125}{343}$, $\frac{216}{729}$.
11. 17779·581.
12. 48·627125.
13. 12895·213625.
14. 1092·727.
15. $40001\frac{86}{125}$.
16. 54872.

## EXTRACTION OF ROOTS IN GENERAL.

*Rule*, with example.

EXAMPLE 1. Find the cube root of 78402752.

| | | |
|---|---|---|
| 4 | 16 | 78402752 \| 428 Ans. |
| 4 | 32 | 64 |
| 8 | 4800 | 14402 |
| 4 | 244 | 10088 |
| 120 | 5044 | 4314752 |
| 2 | 248 | 4314752 |
| 122 | 529200 | |
| 2 | 10144 | |
| 124 | 539344 | |
| 2 | | |
| 1260 | | |
| 8 | | |
| 1268 | | |

First the given number is divided into periods of three figures each, commencing at the units figure. Then in the first column we place 4 the root of 64 the highest cube contained in the first period, in the second 16 the product of 4 multiplied by itself, and in the third under the first period 64 the cube of 4 which subtracted from the first period leaves a remainder 14 to which the next period is annexed which makes the dividend 14402 Then 4 the part of the root already found is added to the first column making it 8, this multiplied by 4 is 32 which is added to the second column making it 48, and another 4 is added to the first column making it 12, one cipher is then annexed to the first column making it 120 and two ciphers to the second making it 4800, this is apparently contained 3 times in the dividend, but on trial 3 is found to be too high we therefore set down 2 in the quotient and add 2 to the first column which makes it 122, this multiplied by 2 is 244, which added to the second column makes it 5044; this is multiplied by 2 and 10088 the product set down in the third column and subtracted from the dividend leaving a remainder 4314 to which 752 the next period is annexed making the dividend 4314752. To find the third figure of the root we add 2 the last figure placed in the quotient to the first column which makes it 124, multiply

124 by 2 and add 248 the product to the second column which makes it 5292, and add 2 to the first column which makes it 126, one cipher is then added to the first column making it 1260 and two ciphers to the second making it 529200, this being contained 8 times in the dividend, we set down 8 in the quotient, add 8 to the first column, multiply 1268 the sum by 8, and add 10144 the product to the second column which makes it 539344 ; this is then multiplied by 8 and 4314752 the product set down below the dividend in which it is exactly contained. We thus find the whole root to be 428.

EXAMPLE 2. Find the fifth root of 847288609443.

| | | | | |
|---|---|---|---|---|
| | | | | 847288609443 (243 Ans. |
| 2 | 4 | 8 | 16 | 32 |
| 2 | 8 | 24 | 64 | |
| 4 | 12 | 32 | 800000 | 5272886. |
| 2 | 12 | 48 | 390656 | 4762624 |
| 6 | 24 | 80000 | 1190656 | 51026209443. |
| 2 | 16 | 17664 | 468224 | 51026209443 |
| 8 | 4000 | 97664 | 16588800000 | |
| 2 | 416 | 19392 | 419936481 | |
| 100 | 4416 | 117056 | 17008736481 | |
| 4 | 432 | 21184 | | |
| 104 | 4848 | 138240000 | | |
| 4 | 448 | 1738827 | | |
| 108 | 5296 | 139978827 | | |
| 4 | 464 | | | |
| 112 | 576000 | | | |
| 4 | 3609 | | | |
| 116 | 579609. | | | |
| 4 | | | | |
| 1200 | | | | |
| 3 | | | | |
| 1203. | | | | |

In this example the fifth root is found by an extension of the principle on which the rule for the extraction of the cube root depends.

We first place the given number in the fifth column and divide it into periods of 5 figures, then place 2 which is the highest root contained in the first period in the first column, 4 the product of the first column and 2 in the second, 8 the product of the second column and 2 in the third, 16 the product of the third column and 2 in the fourth, and 32 the product of the fourth column and 2 the figure in the quotient under the first period, subtract and to the remainder add the next period which gives 5272886 for a dividend.

Now after a process exactly analogous to that employed in extracting the cube root, we find that by adding one cipher to the first column, two to the second, three to the third, and four to the fourth, the number in the first column then is 100, in the second 4000, in the third 80000, and in the fourth 800000. The next figure is found to be 4, which we add to the first column, multiply 104, the sum by 4 and add the product to the second column, multiply 4416, the sum by 4 and add the product to the third column, multiply 97664 by 4 and add the product to the fourth column, multiply 1190656 by 4, set down 4762624, the product below the dividend, and annex the next period to the remainder. To find the third figure we go through a similar process and find that 17008736481, the sum in the fourth column is contained exactly 3 times in the dividend, the whole root therefore is 243.

The correctness of the work may be proved by involving 243, the root, to its fifth power which will be found equal to the given number, of which the fifth root was required.

By an extension of the principle on which the rule used for the extraction of the root in the two preceding examples depends any root may be extracted.

NOTE.—In extracting the fourth root we may either use the preceding rule, or we may extract the second root of the given number and the second root of the result; the sixth root by extracting the cube root of the given number and the second root of the result; the eighth root by finding the second root of the given number, the second root of the result, and the second root of the second result; the tenth root by finding the fifth root of the given number and the second root of the result; the twelfth root by finding the third root of the given number, the second root of the result, and the second root of the second result; and the same way we may proceed in every case in which the index of the root to be extracted is a composite number.

EXERCISE 3.

1. Find the fourth root of 19775390625.
2. Find the fifth root of 6436343.
3. Extract the sixth root of 5289852801024.

4. Find the seventh root of 379749833583241.
5. Required the eighth root of 208827064576.
6. Extract the ninth root of 1352605460594688.
7. Find the tenth root of 11258999068426624.
8. Extract the eleventh root of 116490258898219.

## DUODECIMAL MULTIPLICATION.

This rule is chiefly used by artificers in computing the contents of work of which the dimensions are taken in feet, inches, &c.

The foot is divided into twelve parts called inches, the inches into 12 parts called lines, the lines into 12 parts called thirds, and thirds into 12 parts called fourths.

Thirds are expressed by three points written after the number and fourths by four points written after the number.

Thus 2 f. 6 in. 9 l 6 ''' 3 '''' is read 2 feet, 6 inches, 9 lines, 6 thirds, and 3 fourths.

*Rule* 1.—Set down the multiplier below the multiplicand so that feet may be under feet inches under inches, &c 2. Multiply each term of the multiplicand beginning at the lowest by the number of feet in the multiplier, carry 1 to the next higher denomination for each time that 12 is contained in the product, and set down the remainder under its corresponding denomination in the multiplicand. 3. Next multiply each term in the multiplicand by the number of inches in the multiplier, carry 1 for each time twelve is contained in the products as before, and set down each remainder one place farther to the right than when multiplying by feet. 4. In like manner multiply by the lines setting down each remainder one, place farther to the right; and the sum of these partial products will be the required product.

EXAMPLE. Multiply 6 feet 3 inches 6 lines by 5 feet 9 inches 9 lines.

| ft. | in. | l. | | | |
|---|---|---|---|---|---|
| 6 | 3 | 6 | | | |
| 5 | 9 | 9 | | | |
| 31 | 5 | 6 | | | |
| 4 | 8 | 7 | 6 | | |
| | 4 | 8 | 7 | 6 | |
| 36 | 6 | 10 | 1''' | 6'''' | Ans. |

First placing feet under feet inches under inches and lines under lines, we multiply each term in the multiplicand, commencing at 6 lines the lowest by 5 feet the highest denomination in the multiplier and obtain the partial product 31 ft. 5 in. 6 l., next we multiply by 9 inches and obtain the partial product 4 ft. 8 in. 7 l. 6''', and then we multiply by 9 lines and obtain the partial product 4 in. 8 l. 7''' 6''''. Then adding together these three partial products we obtain the answer 36 ft. 6 in. 10 l. 1''' 6''''

### Exercise 1.

1. Multiply 6 ft. 3 in. by 4 ft. 9 in.
2. Multiply 10 ft. 4 in by 3 ft. 6 in.
3. Multiply 7 ft. 11 in. by 4 ft. 10 in.
4. Multiply 11 ft. 2 in. by 9 ft. 8 in.
5. Multiply 16 ft. 4 in. 3 l. by 8 ft. 2 in.
6. Multiply 15 ft. 1 in. 7 l. by 11 ft. 4 in.
7. Multiply 9 ft. 2 in. 3 l. by 7 ft. 5 in.
8. Multiply 10 ft. 4 in. 5 l. by 9 ft. 3 in. 7 l.
9. Multiply 27 ft. 4 in. 7 l. by 3 ft. 6 in. 5 l.
10. Multiply 18 ft. 6 in. 3 l. by 9 ft. 2 in. 4 l.
11. Multiply 29 ft. 7 in. 9 l. by 18 ft. 7 in.
12. Multiply 271 ft. 3 in. 11 l. by 28 ft. 4 in. 9 l.

---

A parallelogram is a four sided figure of which the opposite sides are equal and parallel.

### Rules.

1. To find the area of a square, that is a figure whose sides are all equal and whose angles are right angles. Multiply the length of the side by itself

2. To find the area of a rectangle or oblong, that is a parallelogram whose angles are all right angles but whose length exceeds its breadth. Multiply the length by the breadth.

3. To find the area of a rhombus, that is a parallelogram of which all the sides are equal but whose angles are not right angles. Multiply the length by the perpendicular breadth.

4. To find the area of a triangle, that is a plane figure of three sides. Multiply the base by the perpendicular height and divide the product by 2.

5. To find the solid content of a body having six sides of which the opposite ones are equal and parallel. Multiply the length, breadth, and thickness together.

### Exercise 2.

1. What is the area of a square whose side is 5 ft. 9 in?
2. Required the area of a square whose side is 7 ft. 10 in.
3. Find the area of a square whose side is 11 ft. 11 in.
4. What is the superficial content of a plank which is 7 ft. 9 in. long and 2 ft. 11 in. wide?
5. What is the area of a rectangle 24 feet 3 in. in length and 7 ft. 9 in. in breadth?
6. Find the area of a table whose length is 8 ft. 5 in. and breadth 3 ft. 4 in.
7. What is the area of a rhombus whose length is 11 ft. 6 in. and perpendicular height 7 ft. 5 in?
8. Find the area of a rhombus whose length is 24 ft. 7 in. and perpendicular height 11 ft. 9 in.

9. Required the area of a rhombus the length of the side being 10 ft. 8 in. and perpendicular height 7 ft. 4 in.

10. The base of a triangle is 15 ft. 9 in and perpendicular height 9 ft. 7 in. what is its area?

11. The base of a triangle is 24 ft. 10 in. and perpendicular height 11 ft. 4 in. what is its area?

12. Required the area of a triangle whose base is 12 ft. 8 in. and perpendicular height 7 ft. 9 in.

13. What is the solid content of a log of birch whose length is 11 ft. 4 in., breadth 2 ft. 4 in., and thickness 1 ft. 10 in?

14. Required the solid content of a chest 5 ft. 8 in. in length, 4 ft. 3 in. deep, and 3 ft. 7 in. wide

15. A piece of timber is 36 ft. 4 in. long, 11 inches broad, and 11 inches thick required its solid content.

16. Find the area of a square whose side measures 7 ft. 8 in.

17. Required the superficial content of a wall whose length is 21 ft. 3 in. and height 7 ft. 4 in.

18. What is the area of a rhombus whose length is 21 ft. 11 in. and perpendicular height 9 ft. 10 in?

19. The base of a triangle measures 17 ft. 5 in. and its perpendicular height is 11 ft. 7 in. required its area.

20. What is the solid content of a cellar 16 ft. 9 in. long, 11 ft. 4 in. wide, and 7 ft. 2 in. deep?

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## MISCELLANEOUS QUESTIONS.

1. A farmer sold 67 bushels of wheat at $1.25 per bushel, 48 bushels of oats at 60 cents per bushel, and 80 bushels of potatoes at 55 cents per bushel, what should he receive for the whole?

2. A grocer bought 3 cwt. 2 qrs. of sugar at $9 per cwt., and a chest of tea containing 65 lbs. at 63 cents per lb., what did he pay for the whole?

3. If $9324.28 is equally divided among 17 persons, what share should each receive?

4. Reduce £456 : 19 : 9 to dollars and cents and divide the result by 78.

5 What amount must be taken from $3482.40 to leave a remainder of $1984.72?

6. What is the interest on $968 40 for 9 months at 7 per cent per annum?

7. If 7 cwt. 1 qr. 13 lbs. of sugar cost $57.80 what must be paid for 28 cwt. 3 qrs. at the same rate?

8. Divide the sum of 7 cwt 15 lbs., 19 cwt. 2 qrs. 13 lbs., 14 cwt. 3 qrs., and 11 cwt. 1 qr. 24 lbs. into 18 equal parts.

9. What is the compound interest on $560 for 2½ years at 6 per cent per annum?

10. Find the value of $\frac{2}{3}$ of $\frac{3}{8}$ of 20 lbs 6 oz. Avoirdupois.

11. Reduce 17 gals. 3 qts. to gills and multiply the result by 39.

12. If 24 men do a piece of work in 18 days, working 9 hours per day, in how many days might 43 men be expected to do the same work, working 8 hours per day?

13. Find the value of $(\frac{3}{5} \times \frac{5}{7}) + (1\frac{2}{3} \times 2\frac{1}{4}) \div \frac{3}{8}$.

14. Reduce $\frac{2}{5}$, $3\frac{1}{7}$, $\frac{3}{8}$, $\frac{7}{11}$ to their equivalent decimal fractions.

15. What is the square root of 85849?

16. What would be the principal on which the interest would amount to $120 in 2 years at 6 per cent per annum?

17. A. and B enter into partnership, A. puts into the business $680 for 5 months and B. $490 for 4 months, what is the share of each in a gain of $216?

18. Find the value of $2\frac{1}{3} \times (\frac{3}{7} + \frac{4}{5})$.

19. Reduce ·9, ·62, ·124, ·2345 to their equivalent vulgar fractions.

20. Divide 624 acres 3 r. 20 per. by 19 a. 2 r. 7 per.

21. If $\frac{7}{8}$ of the value of a building is $2763 what is the value of $\frac{3}{5}$ of the same building?

22. Required the cube root of 262144

23. If a grocer mixes 17 lbs. of tea at 72 cents per lb., 28 lbs. at 80 cents per lb., and 32 lbs. at 58 cents per lb., at what rate must he sell it per pound so as to gain $3.50 on the whole?

24. If I buy coffee at $18 per cwt. and sell it at $19.50 per cwt., what is my gain per cent?

25. If $\frac{2}{3}$ of 3 cwt. 1 qr. 2 lbs of sugar cost $42 what will $\frac{5}{8}$ of 17 cwt. cost at the same rate?

26. How many pounds of coffee at 27 cents per lb., must be given in exchange for $40\frac{1}{2}$ lbs. of tea at 80 cents per lb?

27. A farmer having 96 bushels of oats sold $\frac{1}{3}$ at 65 cents per bushel and the remainder at 62 cents per bushel, what did he receive for the whole?

28. What is the superficial content of the floor of a room 21 ft. 4 in long and 12 ft. 7 in. wide?

29. Three persons commence business with a capital of $32400 towards which A contributes $14600, B $8500, and C the remainder, at the end of a year their profits amount to $2600, what is the share of each?

30. What is the square root of 389376?

31. Multiply the difference between 42 days 34 seconds and 69 days by 84.

32. Find the value of $\frac{5}{7}$ of 96 yards, 3 qrs. 2 nls.

33. If 360 barrels of flour cost $2300, what will 432 barrels cost at the same rate?

34. Reduce $2964.50 to old Canadian currency.

35. If 32 horses eat 76 bushels of oats in 7 days, how many bushels will 28 horses eat in 23 days at the same rate?

36. What will be the amount of $2000 at the end of 3 years at 7 per cent per annum, compound interest?

37. Find the least common multiple of 2, 5, 7, 8, 9, 16, 28.

38. What is the cost of $\frac{2}{3}$ of $\frac{3}{14}$ of 120 yards of cloth, at $3.15 per yard?

39. Reduce 49426585 gills to hogsheads.

40. Divide $\frac{3}{4}$ of $24768.40 by 23.

41. Reduce £248 : 19 : 7$\frac{1}{2}$ to dollars and cents.

42. What is the amount of $2476 for 3 years and 4 months at 6$\frac{1}{2}$ per cent per annum, simple interest?

43. What must I pay for insuring a house and furniture valued at $3928 at a premium of 2$\frac{1}{4}$ per cent?

44. Find the square root of 529.

45. Reduce £926 : 11 : 10$\frac{1}{2}$ to dollars and cents.

46. A bankrupt the value of whose effects is $7248 owes A $3120, B $4284, and C $2864 what share of the effects should each receive?

47. If I buy 74 yards of cloth for $234 and sell it at $3.54 per yard, what do I gain on the whole?

48. Reduce 7 miles 3 fur. 28 per. 4 yds. to feet.

49. If 9 cwt. 1 qr. 11 lbs. of sugar cost $104 what must be paid for 23 cwt. 18 lbs. at the same rate?

50. Reduce $\frac{3}{8}$, $\frac{4}{5}$, $\frac{6}{11}$, $\frac{5}{9}$ to equivalent decimal fractions?

51. Reduce $\frac{99}{213}$, $\frac{144}{288}$, $\frac{1749}{3995}$ to their lowest terms?

52. What is the commission on 948.50 at 5$\frac{3}{4}$ per cent?

53. From $\frac{3}{4}$ of $\frac{7}{8}$ of $7286.70 take $1354.24?

54. What is the value of 2748 yards of cloth at $3.70 per yard?

55. Reduce 3947268 square inches to roods, &c.

56. A farmer sold 26 bushels of oats at 60$\frac{3}{8}$ cents per bushel, 39 bushels at 58$\frac{1}{2}$ cents per bushel, and 36 bushels at 63$\frac{5}{8}$ cents per bushel, what did he receive for the whole?

57. If a person owes another $250 payable in 6 months, $430 payable in 8 months, and $475 payable in 10 months; required the equated time for the payment of the whole?

58. If a man travels 140 miles in 5 days walking 10 hours each day, in how many days will he travel 560 miles walking 9 hours each day?

59. Find the compound interest on $570 for 3$\frac{1}{2}$ years at 7 per cent per annum.

60. What is the value of $\frac{2}{5}$ of $\frac{1}{8}$ of $\frac{1}{6}$ of $9562?

61. If 24$\frac{3}{4}$ yards of cloth cost $76.50, what must be paid for 62$\frac{1}{2}$ yards at the same rate?

62. If 9 men dig a trench 60 feet long, 12 feet wide, and 6 feet deep in 5 days working 10 hours each day; in how many

days will 15 men dig a trench 80 feet long, 10 feet wide, and 8 feet deep working 9 hours per day?

63. What is the cost of 764 chairs at $1.30 each?

64. From $2\frac{1}{3}$ take $\frac{2}{5}$, to the remainder add $\frac{7}{8}$, multiply the sum by $\frac{4}{9}$, and divide the product by $\frac{6}{11}$.

65. Find the square root of 550564.

66. What must be paid for flooring a room 26 ft. 8 in. long and 18 ft. 4 in. wide at 3 cents per square foot?

67. What is the price of a piece of timber 24 ft. 6 in long, 2 ft. 3 in. wide, and 1 ft. 2 in. thick at 12 cents per solid foot?

68. What is the interest on $7629 for three years and four months at 7 per cent per annum?

69. Three persons enter into partnership, A. put into the business $2850, B. $2140, and C. $1960; what is the share of each at the end of a year, the whole gain being $830?

70. How many bushels of oats at 55 cents per bushel, should be given in exchange for 37 lbs. of tea at 72 cents per pound?

71. What is the cube root of 13824?

72. Reduce £734 : 16 : 9 to dollars and cents.

73. If sugar cost $9.50 per cwt. at what rate per lb. must it be sold to gain 12 per cent on the whole?

74. Reduce $\frac{2}{5}$, $\frac{7}{8}$, $\frac{3}{10}$, $\frac{4}{5}$ to their equivalent decimal fractions.

75. What amount must I pay for one half of a farm of 79 acres 3 roods at $17.20 per acre?

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The following questions will show how they and a variety of other arithmetical problems for which there are no set rules may be solved.

1. What number is that of which $\frac{5}{12}$ is 84?

*Operation.*—As $\frac{5}{12} : \frac{1}{2} :: 84 : 16\frac{4}{5}$ or $\frac{1}{12}$ of the number, then $16\frac{4}{5} \times 12 = 201\frac{3}{5}$ the number required.

2. A farmer sold $\frac{1}{3}$ of a quantity of wheat to A., $\frac{1}{4}$ to B. and the remainder which was 36 bushels to C., how many bushels did he sell?

*Operation.*—$\frac{1}{3} + \frac{1}{4} = \frac{7}{12}$ therefore the quantity sold to C is $1 - \frac{7}{12}$ or $\frac{5}{12}$ of the whole, but the quantity sold to C. is 36 bushels, therefore As $\frac{5}{12} : \frac{7}{12} :: 36 : 50\frac{2}{5}$ bushels, the quantity sold to A. and B., then $50\frac{2}{5}$ bush. + 36 bush. = $86\frac{2}{5}$ bushels the quantity sold.

3. If A. can do a piece of work in 11 days which B. can do in 10 days and C. in 8 days, in what time can the three do it?

*Operation*—A. does $\frac{1}{11}$ of the work in 1 day, B. $\frac{1}{10}$, and C. $\frac{1}{8}$, therefore in one day the three men do $\frac{1}{11} + \frac{1}{10} + \frac{1}{8} = \frac{139}{440}$. Therefore as $\frac{139}{440}$ of the work is to 1 the whole work so is 1 day to $3\frac{23}{139}$ days, the required time.

4 A. and B. start to walk at the same time from Quebec and Lake Beauport, a distance of 12 miles, A. travels from Quebec

to Lake Beauport at the rate of 3 miles per hour, and B. from Lake Beauport to Quebec at the rate of 4 miles per hour; when and where will they meet?

*Operation.*—They approach each other at the rate of $3 + 4 = 7$ miles per hour, therefore they will meet in $12 \div 7 = 1\frac{5}{7}$ hours. Then as A. travels $1\frac{5}{7}$ hours at the rate of 3 miles per hour they will meet $1\frac{5}{7} \times 3 = 5\frac{1}{7}$ miles from Quebec, and as B. travels 4 miles per hour $1\frac{5}{7} \times 4 = 6\frac{6}{7}$ miles from Lake Beauport.

5. A and B start to walk round a circular island 30 miles in circumference from opposite sides, at the same time, and in the same direction, A travelling at the rate of 5 miles per hour and B at the rate of 4 miles per hour how many miles will A have to walk before he will overtake B?

*Operation.*—In every 5 miles walked by A he gains 1 mile on B. Therefore as 1 mile : 5 : : 15 miles half of the circumference to 75 miles the distance travelled by A.

6. A, B, and C working together can finish a piece of work in 12 days, which A alone can finish in 36 days, and B alone in 40 days, in what time can C do it working alone?

*Operation.*—A, B, and C together can do the work in 12 days, therefore in 1 day they can do $\frac{1}{12}$ of the whole, A working alone can do the work in 36 days, therefore in 1 day he can do $\frac{1}{36}$ of the work, B working alone can do the work in 40 days, therefore in 1 day he can do $\frac{1}{40}$ of the whole. Therefore A and B together can do $\frac{1}{36} + \frac{1}{40} = \frac{19}{360}$ of the work in 1 day. But A, B and C can do $\frac{1}{12}$ of the work in 1 day, therefore in one day, C can do $\frac{1}{12} - \frac{19}{360} = \frac{11}{360}$ therefore he can do the whole work in $1 \div \frac{11}{360} = 32\frac{8}{11}$ days.

7. If 5 men or six boys can do a piece of work in 45 days; in what time can 1 man and 1 boy working together do it?

*Operation.*—In 45 days 1 man will do $\frac{1}{5}$ and 1 boy $\frac{1}{6}$ of the work, therefore in 45 days 1 man and 1 boy will do $\frac{1}{5} + \frac{1}{6} = \frac{11}{30}$ of the work, hence as $\frac{11}{30}$ of the work, is to 1 the whole work, so is 45 days to $122\frac{8}{11}$ days, the time in which 1 man and 1 boy can do it.

8. If 8 bushels of wheat cost as much as 10 bushels of barley, and as much as 15 bushels of oats; and if the price of 1 bushel of wheat, 1 bushel of barley, and 1 of oats is $2 80, what is the value per bushel of the wheat, the barley, and the oats?

*Operation.*—The prices of one bushel of wheat, one of barley, and one of oats are as $\frac{1}{8}$, $\frac{1}{10}$ and $\frac{1}{15}$ hence by reducing these fractions to equivalent ones having a common denominator and using the numerators we find that the prices are 15, 12, and 8, then

As $15 + 12 + 8$ or 35 : 15 : : $2 80 : $1.20 the price of the wheat per bushel.

As $15 + 12 + 8$ or $35 : 12 : : \$2.80 : 96$ cents the price of the barley per bushel.

As $15 + 12 + 8$ or $35 : 8 : : \$2.80 : 64$ cents the price of the oats per bushel.

9. What number is that of which $\frac{1}{3} + \frac{1}{4} + \frac{1}{5}$ is 230?

Ans. $293\frac{19}{47}$.

10. What is the value of a house of which \$840 is $\frac{3}{7}$ of its value?

Ans. \$1960.

11. Divide \$1000 between A, B, and C so that A may have \$340 more than B, and B \$260 more than C.

Ans. A's share \$1980, B's \$1640, C's \$1380.

12. A post is $\frac{1}{3}$ of its length in the mud, $\frac{1}{4}$ in the water, and 12 feet above the water: what is its length? Ans. $28\frac{4}{5}$ feet.

13. What number is that to which if 12 be added, twice the sum will equal 98?

Ans. 37.

14. If A can do a piece of work in 6 days, which B can do in 5 days, and C in 4 days; in what time can the three working together do it?

Ans. $1\frac{23}{37}$ days.

15. If A, B, and C can do a piece of work in 12 days which A alone can do in 30 days, and B alone in 35 days, in what time will C working alone do it?

Ans. $46\frac{2}{3}$ days.

16. A can build a wall in 8 days which A and B together can do in 5 days, how long will B alone take to do the work?

Ans. $13\frac{1}{3}$ days.

17. A and B together can reap a field in 12 hours, which A and C can reap in 16 hours, and A alone in 20 hours; in what time can A, B, and C together reap it?

Ans. $10\frac{10}{23}$ hours.

18. A, B, and C purchase a house A paying $\frac{2}{5}$, B $\frac{2}{7}$, and C \$2000 of the cost, what are the sums paid by A and B?

Ans. A \$903.22$\frac{18}{31}$, B \$1161.29$\frac{1}{31}$.

19. A person bought a carriage, horse, and harness for \$300. The horse cost 3 times as much as the harness, and the carriage half as much more as the horse and harness; what was the cost of each?

Ans. \$30 harness, \$90 horse, \$180 carriage.

20. A person owning $\frac{3}{10}$ of a building sold $\frac{2}{3}$ of his share for \$1000, what is the value of the building?

Ans. \$5000.

21. Divide \$256 among A, B, and C, so that A will have three times as much as B and C $\frac{1}{3}$ as much as A and B together.

Ans. A \$144, B \$48, C \$64.

22. A alone can do a piece of work in 12 days, which B alone can do in 16 days; when A and B have work together 3 days, A leaves it but B continues the work and is joined 2 days after by C, and they finish it together in 3 days, in what time would C alone do it?

Ans. 12 days.

23. A can mow $2\frac{1}{2}$ acres of grass in $6\frac{2}{3}$ hours, and B $2\frac{1}{8}$ acres in $5\frac{1}{3}$ hours; they mow together a field of 10 acres; in what time will they do it, and how many acres will each man mow?
Ans. 12 hours 48 min., A $4\frac{4}{5}$ acres, B $5\frac{1}{5}$ acres.

24. The sum of the squares of two numbers is 61 and if from the square of the first their product is taken, the remainder will be 6. What are the numbers? Ans. 6 and 5.

25. Half the trees in an orchard are apple trees, a fourth pear trees, a sixth plum trees, and there are besides, fifty cherry trees. How many trees are there altogether?
Ans. 600 trees.

26. If 3 men or 4 women can do a piece of work in 56 days, in what time will one man and one woman together perform it?
Ans. 96 days.

27. If 7 gallons of brandy cost as much as 9 gallons of rum, and 9 gallons of rum as much as 12 gallons of gin, and the price of 3 gallons of these, taking 1 of each kind was £2 : 2 : 6; what was the value of each per gallon?
Ans. Brandy 18 shillings, Rum 14 shillings, and Gin 10s. 4d.

28. Three gentlemen contribute £164 : 5 towards the building of a church at the distance of 2 miles from the first, $2\frac{7}{8}$ miles from the second, and $3\frac{1}{2}$ miles from the third, and they agree that their share shall be reciprocally proportional to their distances from the church. How much must they severally contribute?
Ans. £68 : 12 : 10, £56 : 7 : $8\frac{1}{2}$ and £39 : 4 : $5\frac{3}{4}$.

29. A merchant sells 90 pair of stockings and gloves for $50, the stockings at 60 cents, and the gloves at 50 cents per pair. Required the number of each.
Ans. 50 pair of stockings, and 40 pair of gloves.

30. If A could reap a field in 13 days, and B in 16 days, in what time would both together reap it? Ans. In $7\frac{5}{29}$ days.

31. If A, B, and C could pave a street in 18 days; B, C, and D in 20 days: C, D, and A in 24 days; and D, A, and B in 27 days; in what time will it be done by all of them together, and by each of them singly?
Ans. By all in $16\frac{56}{193}$ days; by A in $87\frac{3}{17}$ days, by B in $50\frac{5}{8}$ days; by C in $41\frac{1}{79}$ days; and by D in $170\frac{10}{13}$ days.

32. A body of 7300 troops is formed of four battalions, so that $\frac{1}{2}$ of the first, $\frac{2}{3}$ of the second, $\frac{3}{4}$ of the third, and $\frac{4}{5}$ of the fourth, are all composed of the same number of men; how many were there in each?
Ans. 2400; 1800; 1600; 1500.

33. Divide 240 into two parts, such that $\frac{1}{4}$ of one added to $\frac{1}{10}$ of the other shall equal 36. Ans. 80 and 160.

34. A father left to the elder of his two sons $\frac{13}{25}$ of his property, and $\frac{12}{25}$ of the remainder to the younger, and the residue

to his widow ; find their respective legacies, it being found that the elder son received $6760 more than the younger.

Ans. $13000 ; $6240 ; and $5760.

35. If 3 men, 5 women, or 8 children, could do a piece of work in 26½ hours, in what time will 2 men, 3 women, and 4 children complete it?

Ans. 15 hours.

36. Three soldiers, A, B, and C, divide 770 cartridges in the following manner : as often as A takes 4, B takes 3 ; and as often as A takes 6, C takes 7; how many will each have?

Ans. A, 264 ; B, 198 ; C, 308.

37. If a merchant each year increases his capital by a fifth part of itself, except an expenditure of $1600, and at the end of 15 years be worth $48000 ; what was his original capital?

Ans. $10596.21⅓.

38. A sells a quantity of tea, which cost him $986.40 to B ; and B sells it to C, who disposes of it for $1566.36⅔. Required the prices at which A and B sold it, each of the three merchants having gained at the same rate per cent?

Ans. A sold it for $1150.80, and B for $1342.60.

39. A and B set out from the same place, and in the same direction. A travels uniformly 18 miles per day, and after 9 days turns and goes back as far as B has travelled during those 9 days ; he then turns again, and pursuing his journey, overtakes B 22½ days after the time they first set out. It is required to find the rate at which B uniformly travelled?

Ans. 10 miles per day.

40. Suppose 17 gallons of spirits, at $2.10 per gallon, to be mixed with 7 gallons at a different price. What was the price of the latter per gallon, if 20 per cent be gained by selling the mixture at $2.60 per gallon?

Ans. $2.32⅔.

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## METRIC SYSTEM OF MONEY, WEIGHTS, AND MEASURES.

### METRIC TABLE OF MONEY.

The unit of money is called a franc, which is worth about 16 cents Canadian money,

10 centimes make 1 Decime marked d,
10 decimes —— 1 Franc. ——— fr.

The Copper Coins in use in France are : 1 Centime, 2 Centimes, 5 Centimes, called also a Sou, and 10 centimes called also two Sous, seldom a Decime.

Silver Coins, 20 Centimes, 50 Centimes, called also half-a-franc, 1 franc, 2 francs, and 5 francs.

Gold Coins, 5 francs, 10 francs, 20 francs, called also a Napoleon, 40 francs, 50 francs, and 100 francs.

## FRENCH OR METRIC TABLE OF LENGTH.

The unit is called a mètre and is rather more than 39 English inches.

The longer measures of length are derived by multiplying the mètre by 10; 100; 1000; and 10,000; and the measures of length so obtained are denoted by the words (derived from the Greek language) Deca, signifying 10; Hecto, 100; Kilo, 1000; Myria, 10,000; prefixed to the word Mètre; so that décamètre means 10 mètres, hectomètre 100 mètres, kilomètre 1000 mètres, myriamètre 10,000.

The shorter measures of length are derived by dividing the mètre by 10, 100, 1000, and the measures of length so obtained are denoted by the following words (derived from the Latin language) prefixed to the word mètre; Deci, signifying that the mètre is divided by 10; Centi, by 100; Milli, by 1000; so that décimètre, means that a mètre is divided by 10; centimètre, by 100; millimètre, by 1000: therefore we have the following table of length.

10 Millimètres make 1 Centimètre.
10 Centimètres —— 1 Décimètre.
10 Décimètres —— 1 Mètre, the unit.
10 Mètres —— 1 Décamètre.
10 Décamètres —— 1 Hectomètre.
10 Hectomètres —— 1 Kilomètre, 1100 Eng. yards nearly.
10 Kilomètres —— 1 Myriamètre.

The above are abreviated thus: Millim., Centim., Décim., Décam., Hectom., Kilom., Myriam.

## FRENCH OR METRIC TABLE OF WEIGHT.

The unit of weight is called a Gramme, which = 15½ English grains nearly.

10 Milligrammes make 1 Centigramme.
10 Centigrammes —— 1 Décigramme.
10 Décigrammes —— 1 Gramme, the unit.
10 Grammes —— 1 Décagramme.
10 Décagrammes —— 1 Hectogrammes.
10 Hectogrammes —— 1 Kilogramme.

The above are abbreviated thus: Millig., Centig., Décig, Gr., Deca., Hectog., Kilog.

NOTE. 1 Killogramme = 2⅕ lbs. Avoirdupois nearly.
1 Quintal = 100 kilog. = 2 English cwts. nearly.
1 Millier or Ton = 1000 kilog. = 20 English cwts. nearly.

## MICELLANEOUS EXERCISES ON THE APPLICATION OF THE METRIC TABLES OF MONEY, LENGTH AND WEIGHT TO THE ARITHMETICAL RULES.

1. Reduce 17 francs, 9 decimes, 5 centimes to centimes.
2. Reduce 1742 centimes to francs.

3. Reduce 6 kiloms, 9 hectoms, 7 metres, 6 decims, 5 centims, 4 millims to millimètres.

4. How many décamètres are there in 7248 centimètres?

5. How many myriametres are there in 64209750 millimètres?

6. Reduce 9 grammes to milligrammes.

7. Reduce 9 décag. 4 grammes, 7 decigs, 3 milligs. to milligrammes.

8. How many kilogrammes are there in 2409648 milligrammes?

9. Add together 7 francs 3d 4c; 234 fr 8d 9c; 6d 7c; 87 fr 3c; 148 fr 8d; 279 fr 4d 5c; and 93 fr 8d 7c.

10. Find the sum of 19 myriams 3 kiloms 7 decams 4 decims 8 millims; 9 decams 7 metres 5 decims 3 centims 1 millim; 6 hectoms 5 decams 4 metres 3 decims 7 centims 8 millims; and 47 myriams 8 decams 5 decims 6 centims.

11. Add together 54 kilogs 7 décags 3 grammes 4 decigs 5 centigs; 9 hectogs 4 decags 6 decigs 8 centigs 9 milligs; 5 grammes 9 centigs 8 milligs; 93 kilogs 7 grammes 6 decigs 7 milligs; and 32 kilogs 4 hectogs 7 decags 3 decigs 8 centigs 4 milligs.

12. From 38 francs 4d 8c take 21 fr 6d 3c.

13. Find the difference between 93 myriams 3 kiloms 9 decams 4 metres 6 decims 5 centims, and 13 myriams 2 kiloms 4 hectoms 3 decams 3 metres 7 decims 4 centims 7 millims.

14. From 39 kilogs 7 decags 4 centigs take 18 kilogs 4 hectogs 6 decags 8 grammes 5 decigs 3 centigs 3 milligs.

15. Multiply 247 francs 8d 9c, by 7 by 11 by 34.

16. Multiply 18 myriams 7 kiloms 9 decams 3 metres by 8 by 120.

17. Multiply 6 kilogs 5 hectogs 3 decags 7 grammes 8 centigs 5 milligs by 9 by 64.

18. Divide 832 francs 9d 8c by 6, by 2.

19. Divide 1246 myriams 5 hectoms by 3, by 9, by 45.

20. Divide 796 kilogs 4 hectogs 8 grammes 9 decigs 2 centigs by 4, by 69.

21. What cost 28 kilogs at 7 francs 9d 4c, per kilogramme?

22. What cost 96 kilogs 5 hectogs 8 decags, at 4 francs 5d 6c per kilogramme, by practice?

23. If 7 decags 4 grammes 7 centigs cost 8 decimes 9c, what will 19 kilogs 8 hectogs 3 grammes cost?

24. What must be paid for 96 kilogs 7 hectogs 5 decags if 124 kilogs 8 grammes 6 centigs cost 249 francs 3d?

25. If 9 grammes 7 centigs 8 milligs may be purchased for 13 francs 3 c, how much may be purchased for 34 francs 5d 4c?

26. If the carriage of 934 kilogs for 6 myriams cost 21 francs 5d, what must be paid for the carriage of 274 kilogs 8 hectogs for 11 myriams?

27. If the value of 18 metres of cloth ; 5 decims 5 centims wide is 216 francs 4d, what would be the value of 25 metres the width being 4 decims 5 centims ?

28. If 5 men dig a drain 9 decams long, and 4 decims deep in a day, how many days would it take 4 men to dig a drain 8 decams long, and 9 decims deep ?

29. What is the interest on 2154 francs at 6, at 7, at 9 per cent ?

30 What is the interest on 932 francs 8d at 5, at 6, at 8 per cent ?

31. Find the interest on 693 francs 4d at $4\frac{1}{2}$ per cent.

32. Find the interest on 1248 francs at $8\frac{1}{4}$ per cent.

33. What is the compound interest on 7600 francs for 3 years at $4\frac{1}{2}$ per cent per annum ?

34. What is the compound interest and the amount of 4500 francs for 2 years at 8 per cent.

## MENTAL ARITHMETIC.

### Exercise 1.

1. How many are $70 + 30 + 24$ ?
2. How many are $80 + 36 + 40 + 21$ ?
3. How many are $31 + 36 + 72 + 9 + 14$ ?
4. How many are $73 + 16 + 28 + 15 + 11 + 18$ ?
5. How many are $84 - 13$, $104 - 17$, $234 - 96$ ?
6. How many are $96 - 7$, $756 - 382$, $964 - 728$ ?
7. How many are $237 - 68 - 54$ ?
8. How many are $754 - 231 - 126 - 27$ ?
9. Find the product of $19 \times 6$, $17 \times 8$, $29 \times 9$.
10. Find the product of $92 \times 3$, $274 \times 3$, $623 \times 5$.
11. Find the product of $327 \times 10$, $246 \times 11$, $754 \times 12$.
12. Find the product of $18 \times 6 \times 8 \times 10 \times 12$.
13. Divide 928 by 4, 627 by 11, 852 by 12.
14. Divide 964 by 141, 207 by 23, 429 by 39.
15. Divide 468 by 26, 666 by 74, 696 by 87.
16. Divide 6300 by 36 and the product by 25.
17. How many are $42 + 56 - 28 \div 5$ ?
18. How many are $132 + 48 - 72 \div 9$ ?
19. How many are $942 - 324 \div 6 + 97$ ?
20. How many are $349 + 357 - 86 \div 31$ ?

### Exercise 2.

To multiply by 20, 30, 40, 50, 60, 70, 80, or 90.

*Rule.*—Annex a cipher to the multiplicand and multiply by 2 for 20 ; 3 for 30 ; 4 for 40 ; 5 for 50 ; 6 for 60 ; 7 for 70 ; 8 for 80 ; and 9 for 90.

To multiply by 200, 300, 400, 500, 600, 700, 800 or 900.

Annex two ciphers to the multiplicand and multiply by 2 for 200; 3 for 300; 4 for 400; 5 for 500; 6 for 600; 7 for 700; 8 for 800; and 9 for 900.

1. Multiply 20 by 10; by 100; by 1000.
2. Multiply 26 by 20; by 200; by 2000.
3. Multiply 37 by 30; by 300; by 3000.
4. Multiply 46 by 40; by 400; by 4000.
5. Multiply 58 by 50; by 500; by 5000.
6. Multiply 63 by 60; by 600; by 6000.
7. Multiply 74 by 70; by 700; by 7000.
8. Multiply 96 by 80; by 800; by 8000
9. Multiply 324 by 90; by 900; by 9000.

### Exercise 3.

To divide by 10, 20, 30; 100, 200, 300; 1000, 2000, 3000 &c.

*Rule.*—Cut off from the right of the dividend as many figures as there are ciphers in the divisor, and divide the remaining figures by the significant figure of the divisor.

1. Divide 17000 by 10; by 100; by 1000.
2. Divide 3724 by 20; by 200; by 2000.
3. Divide 24600 by 30; by 300; by 3000.
4. Reduce 37400 cents to dollars.
5. Reduce 4968 shillings to pounds.
6. Divide 77000 by 70; by 700; by 7000.
7. Divide 6363000 by 90; by 900; by 9000.
8. Reduce 926000 cents to dollars.
9. Reduce 472600 shillings to pounds.

### Exercise 4.

1. What is the sum of \$1.34, \$2.40, \$3.20, \$4.80, \$5.60, \$2.70 and \$4.36?
2. What is the difference between \$74.82 and \$36.40?
3. Multiply \$71.60 by 10, \$82.70 by 5, \$34.50 by 12.
4. Divide \$34.60 by 4, and \$928.37 by 6.
5. What is the value of \$4.30 + \$9.60 — \$7.20?
6. What is the value of \$3.40 + \$1.10 × 6?
7. How much is \$74 50 — \$68.30 × 2?
8. How much is \$12.50 × 2 — \$3.64?
9. What is the value of $\frac{3}{8}$ of \$42 37 + \$21.63?
10. Multiply \$71.90 by 3 and divide the product by 36.
11. How much is \$96.24 — \$86.14 + \$13.28 × 2 + \$64 — \$11.20 ÷ 3?
12. What is the value of $\frac{3}{5}$ of \$72.90 × 2 + \$73.60 — \$42.30 + \$15?

### Exercise 5.

What is the value of

1. 18 lbs. of sugar at 10 cents per lb., at 11 cents per lb.?
2. 16 lbs. of beef at 12½ cents per lb., at 11 cents per lb.?

3. 25 yards cotton at 15 cents per yard, at 12 cents per yard?
4. 16 dozen eggs at 20 cents per dozen, at 21 cents per doz?
5. 36 lbs. butter at 25 cents per pound?
6. 49 yards linen at 30 cents per yard?
7. 94 books at 70 cents each, at 80 cents each, at 90 cents each?
8. 28 yards cloth at $3.50 per yard, at $4.00 per yard?
9. 9 cows at $27.50 each, at $30 each?
10. 347 slates at 20 cents each?
11. 36 barrels flour at $5.25 per barrel?
12. 234 bushels potatoes at 70 cents per bushel?

EXERCISE 6.

1. Reduce $24.50 to pounds, shillings and pence.
2. Reduce £4 : 5 : 6 to dollars and cents.
3. Reduce 2164 gills to gallons.
4. Reduce 16 gals. 2 qts. to pints.
5. Reduce 216 inches to yards, long measure.
6. Reduce 6 yds. 2 qrs. 2 nls. to nails.
7. Reduce 12 bush. 3 pks. 1 gal. to gallons.
8. Reduce 3 cwt. 3 qrs. to pounds.
9. Reduce 275 lbs. to hundreds, qrs., &c.
10. Reduce 3 lbs. 7 oz. 10 dwts. Troy to pennyweights.
11. Reduce 1200 grains Apoth. to ounces.
12. Reduce 3 yds. 1 qr. 2 nls. to nails.

EXERCISE 7.

1. If 6 lbs. of sugar cost 54 cents, what will 10 lbs. cost at the same rate?
2. If 8 yards of cotton cost $1.28, what will 6 yards cost at the same rate?
3. What must be paid for 12 dozen eggs at the rate of 41 cents for 2 dozen?
4. If 20 lbs. of tea cost $38.40, what will 10 lbs. cost at the same rate?
5. If 3 yards of silk cost $5, what must be paid for 24 yards?
6. If 12 bushels of potatoes cost $8, how many bushels may be bought for $10?
7. If 24 dozen eggs cost $4.50, how many dozen may be purchased for $6?
8. How many pounds of coffee at 90 cents per 3 lbs. may be purchased for $4.20?
9. If $\frac{2}{3}$ of the value of a house is $1350, what is its whole value?
10. What cost 20 bushels of oats at the rate of $1.80 per bushel?
11. If 24 lbs. of sugar cost $\frac{1}{5}$ of $13.20, what will 8 lbs. cost at the same rate?

12. What must be paid for 6 yards of silk, if the value of a piece containing 30 yards is $45?

### Exercise 8.

Take aliquot parts as in practice.

Example.—Find the value of 280 articles at 25 cents each; 25 cents = ¼ of a dollar and ¼ of 280 = $70 Ans.

Find the value of

1. 272½ lbs at 25 cents per lb., at 20 cents per lb.
2. 60⅓ yds. at $1.50 per yard, at $1 per yard.
3. 245¼ doz. at 50 cents per dozen.
4. 376 doz. at 25 cents per dozen, at 12½ cents per dozen.
5. 281 lbs. at 33⅓ cents per pound, at 50 cents per lb.
6. 40⅕ yds. at $1.50 per yard, at $1. 25 per yard.
7. 328 lbs. at 75 cents per pound, at 8 cents per lb.
8. 210⅛ lbs. at $1.20 per lb., at $1.25 per lb.
9. 64⅔ yds. at $2.40 per yard, at $2.50 per yard.
10. 315½ ounces at 12½ cents per oz., at 20 cents per oz.
11. 426⅔ dozen at 60 cents per dozen, at 75 cents per doz.
12. 96½ cwt. at $10. 25 per cwt., at $10.50 per cwt.

### Exercise 9.

1. Find the commission on $300 at 5½ per cent, at 6 per cent.
2. Find the commission on $450 at 5 per cent.
3. Find the commission on $860 at 6 per cent.
4. Find the commission on $1250 at 6 per cent.
5. How much is 10 per cent of $730, of $800, of $850?
6. How much is 8 per cent of $950, of $1000?
7. How much is 12 per cent of $2150, of $1500?
8. How much is 11 per cent of $1800, of $2000?
9. What is the brokerage on $980 at 5 per cent?
10. What is the brokerage on $1240 at 8 per cent?
11. What is the brokerage on $845 at 8 per cent?
12. What is the brokerage on $960 at 11 per cent?
13. What is the premium of insurance on $1120 at 5 per cent, at 4 per cent, at 6 per cent?
14. What is the premium of insurance on $840 at 7 per cent, at 8 per cent, at 9 per cent?
15. What is the premium of insurance on $1250 at 6 per cent, at 5 per cent, at 7 per cent?
16. What is the premium of insurance on $2690 at 7 per cent, at 4 per cent, at 5 per cent?
17. Find the commission on $2170 at 3 per cent, at 4 per cent.
18. How much is 12 per cent of $1960?
19. What is the brokerage on $7560 at 11 per cent, at 10 per cent.
20. What is the premium of insurance on $2600 at 2½ per cent, at 3 per cent.

EXERCISE 10.

What is the interest on

1. $760 for 2 years at 5 per cent per annum?
2. $1000 for 5 years at 6 per cent per annum?
3. $2500 for 6 years at 5 per cent per annum?
4. $1940 for 3 years at 8 per cent per annum?
5. $2160 for 4 years at 8 per cent per annum?
6. $980 for 6 years at 7 per cent per annum?
7. $1240 for 2 years at 4 per cent per annum?
8. $1200 for 3 years at 5 per cent per annum?
9. $1020 for 2 years at 20 per cent per annum?
10. $960 for 5 years at 10 per cent per annum?
11. $2180 for 3 years at 5 per cent per annum?
12. $1650 for 4 years at 6 per cent per annum?

EXERCISE 11.

Find the interest on

1. $250 for 3 months at 6 per cent per annum.
2. $1000 for 6 months at 8 per cent per annum.
3. $500 for 4 months at 7 per cent per annum.
4. $750 for 8 months at 6 per cent per annum.
5. $960 for 9 months at 5 per cent per annum.
6. $1400 for 6 months at 9 per cent per annum.
7. $1380 for 2 months at 8 per cent per annum.
8. $2060 for 9 months at 5 per cent per annum.
9. $1800 for 4 months at 6 per cent per annum.
10. $1250 for 5 months at 6 per cent per annum.
11. $2500 for 10 months at 8 per cent per annum.
12. $920 for 6 months at 8 per cent per annum.

EXERCISE 12.

Find the interest on

1. $500 for 6 years and 4 months at 6 per cent per annum.
2. $750 for 4 years and 6 months at 8 per cent per annum.
3. $1000 for 2 years and 5 months at 7 per cent per annum.
4. $2500 for 3 years and 3 months at 7 per cent per annum.
5. $1600 for 2 years and 9 months at 6 per cent per annum.
6. $3600 for 5 years and 2 months at 5 per cent per annum.
7. $4800 for 4 years and 1 month at 5 per cent per annum.
8. $2460 for 2 years and 3 months at 8 per cent per annum.
9. $2740 for 3 years and 4 months at 5 per cent per annum.
10. $5000 for 2 years and 8 months at 6 per cent per annum.
11. $4600 for 3 years and 6 months at 8 per cent per annum.
12. $6200 for 4 years and 2 months at 7 per cent per annum.

EXERCISE 13.

1. What is the gain on a quantity of firewood bought for $317 and sold for $406?
2. What is my loss on a house bought for $3460, and sold for $2975?

3. What is my gain on 10 cwt. of sugar bought at $9.20 per cwt. and sold for $100?

4. How much do I gain on 78 bushels of oats bought for $39, and sold at 60 cents per bushel?

5. What do I lose on 96 lbs. of tea which cost 70 cents per lb and was sold at 66 cents per lb?

6. If 93 lbs. of cheese cost $18.60 and is sold at 18 cents per lb., what is the loss?

7. If 108 bushels of wheat is bought for $120 and sold at $1.05 per bushel, what is the loss on the whole?

8. Bought 120 gallons of coal oil at 25 cents per gallon and sold it at 28 cents per gallon, what do I gain on the whole?

9. How much do I lose on 70 barrels of flour which I purchase for $6.25 per barrel and sell at $6.08 per barrel?

10. What is my gain on 12 cwt. of coffee bought at $21 per cwt. and sold at $23.50 per cwt?

11. Bought 16 sheep at $3.90 each, and sold them at $4.45 each, what is my gain on the whole?

12. If 79 lbs of tea is bought at 90 cents per lb. and sold at 70 cents per lb., what is the whole loss?

# ANSWERS TO THE EXERCISES.

## NOTATION AND NUMERATION.

### Exercise 1.

1. Twenty-seven; sixty-three; ninety-four; two hundred and eight; three hundred and sixty-five; seven hundred and fifty; nine hundred and thirty-two; seven thousand six hundred and five.

2. Five thousand nine hundred; ten thousand one hundred; twenty-five thousand six hundred and two; two hundred thousand and ninety; four hundred and two thousand.

3. Nine millions three hundred thousand two hundred; twenty-seven millions and forty-two; six hundred millions seven thousand; one hundred and twenty-three millions four hundred and fifty-six thousand seven hundred and eighty-nine.

4. Five billions twelve millions three hundred thousand and eighty-six; seven hundred and two billions three hundred millions and seven.

5. Two trillions six hundred billions nine hundred and seventy millions four hundred thousand; nine hundred trillions four hundred and sixty billions seventy thousand and four.

6. Seventy quadrillions four hundred trillions six billions thirty millions two thousand; five hundred billions seven hundred and two millions three hundred thousand and one.

7. Six quadrillions nine trillions four billions three millions two thousand and five; two billions two millions two thousand and twenty.

8. Two quintillions seven hundred and fourteen quadrillions six hundred and eighty-three trillions five hundred and twenty-nine billions one hundred and twenty-three millions four hundred and fifty-six thousand seven hundred and forty-two.

## COMMON NOTATION.

4 Five thousand and twelve millions three hundred thousand and eighty-six ; seven hundred and two thousand three hundred millions and seven.

5. Two billions six hundred thousand nine hundred and seventy millions four hundred thousand ; nine hundred billions four hundred and sixty thousand millions seventy thousand and four.

6. Seventy thousand four hundred billions six thousand and thirty millions two thousand ; five hundred thousand seven hundred and two millions three hundred thousand and one.

7. Six thousand and nine billions four thousand and three millions two thousand and five ; two thousand and two millions two thousand and twenty.

8. Two trillions seven hundred and fourteen thousand six hundred and eighty-three billions five hundred and twenty-nine thousand one hundred and twenty-three millions four hundred and fifty-six thousand seven hundred and forty-two.

### EXERCISE 2.

1. 74.
2. 200.
3. 709.
4. 2067.
5. 4002.
6. 1869.
7. 3006.
8. 9060.
9. 5702.
10. 15230.
11. 39074.
12. 604009.
13. 7020908.
14. 204765792.
15. 97006000034.
16. 2000000079.
17. 400040004004.
18. 16016016016.
19. 24000007000096.
20. 365247639573694.

### EXERCISE 3.

4, 14, 20, 8, 16, 45, 81, 317, 648, 800, 407, 554, 912, 1120, 2800, 1500, 40000, 80000, 11000, 42127, 1001000, 7000, 9007, 7042, 1500368.

### EXERCISE 4.

LXXIV, XLVII, XCI, LXXXIII, CIV, DCXCII, DLXXIII, DCCCXCVI, CCCLXV, CXLIV, $\overline{\text{V}}$CCLXX, $\overline{\text{IX}}$DCL, $\overline{\text{VII}}$CDVIII, $\overline{\text{IX}}$V, MMDLX, $\overline{\text{X}}$DCCXXIV, $\overline{\text{XLIX}}$DCL, $\overline{\text{L}}$LXX, $\overline{\text{LXXV}}$MMMCMLXIV, $\overline{\text{XL}}$MMDCCLXIII, $\overline{\text{LXXX}}$MDCCXCVI, $\overline{\text{DCCC}}$MMDCCLXIV, $\overline{\text{CDL}}$MMM, $\overline{\text{DCCXC}}$MMDCCC, $\overline{\text{MDCC}}$MMD, $\overline{\text{MMMDCCXL}}$MMDLXVIII.

## SIMPLE ADDITION.

1. 21457.
2. 14087.
3. 150452.
4. 1535072.
5. 13007874.
6. 43684 pounds.
7. 4677 tons.
8. 3997 yards.
9. 34681 bushels.
10. 104275 inches.
11. 10819 days.
12. 13449 miles.
13. 135743 feet.
14. 28998 lbs.
15. 17255 lbs.
16. 544895.
17. 1697762131.
18. 12668043.
19. 17519901.
20. 25300.
21. 112980.
22. 43027.
23. 941494.
24. 48970000,
25. $519.
26. 3718 bushels.
27. 321 miles.

## SIMPLE SUBTRACTION.

1. 240413 miles.
2. 56484652 inches.
3. 6163562 tons.
4. 5610472 yards.
5. 488482 pounds.
6. 6640935 dollars.
7. 2298474 hours.
8. 30579544 feet.
9. 1239300.
10. 7128908.
11. 6650983.
12. 59499717.
13. 4153079.
14. 4803944.
15. 2879624.
16. 81877787.
17. 87106653.
18. 1330154.
19. 6504490.
20. 19521178.
21. 6760083.
22. 6999995.
23. 399206 pds.
24. 4993 days.
25. 7968793.
26. 554 dollars.
27. 2560 miles.
28. { 375,332,259,238,225, 108,104,55 years.
29. 2995041.
30. 11700000 sq. miles.
31. 554 bushels.
32. 3978 dollars.
33. 5692 feet.
34. 368 feet.
35. 3472; 3172 miles.
36. 94763000 miles.

## SIMPLE MULTIPLICATION.

### Exercise 1.

1. 153890 miles.
2. 220944 yards.
3. 3851388 pounds.
4. 4158475 inches.
5. 4761744 pounds.
6. 943992 dollars.
7. 3788656 minutes.
8. 6248457 cents.
9. 15268.
10. 18957.
11. 22428.
12. 36640.
13. 477648.
14. 175021.
15. 135312.
16. 293328.
17. 326490.
18. 861245.
19. 384852.
20. 481194.

### Exercise 2.

1. 467964.
2. 883680.
3. 282816.
4. 30660.
5. 193536.
6. 30996.
7. 1323125.
8. 2436368.
9. 4452800.
10. 4365561.
11. 36728000.
12. 20699184.

13. 1481088.
14. 18011160.
15. 650596380.
16. 189109960.
17. 14474832.
18. 378316400.
19. 1201371300.
20. 52452353748.
21. 518350564160.
22. 197515403720.
23. 104462820108.
24. 1866560000.
25. 67756662.
26. 6448458108.
27. 729668016.
28. 30267798624.
29. 8054092548.
30. 14117835000.
31. 6701431839424.
32. 10114033944.
33. 179603438052.
34. 546199612851.
35. 220133376.
36. 25106806690.
37. 5303344681 32.
38. 121323440066 40.
39. 21424 feet.
40. 20601 yards.
41. 1903874 letters.
42. 21038400 min.
43. 56940 times.
44. 9709 dollars.
45. 168 panes.

## SIMPLE DIVISION.

### Exercise 1.

1. 187532.
2. 245427.
3. 23515763/4.
4. 246913574/5.
5. 10570975/8.
6. 1989546/7.
7. 2777778/9.
8. 8021816/9.
9. 631272 5/10.
10. 10101010 1/11.
11. 4416681 9/12.
12. 2495802/5.
13. 2851791/5.
14. 9117841/7.
15. 2742236/9.
16. 123447 7/11.
17. 16072442.
18. 310489 4/12.
19. 1740842 5/8.
20. 1221162 2/6.
21. 1341038 4/7.
22. 7926963.
23. 1208159 2/8.
24. 7080538/9.

### Exercise 2.

1. 4109318/11.
2. 15628 7/47.
3. 9859332/44.
4. 9477488/99.
5. 4445 17/21.
6. 447621 6/81.
7. 50340 7/11.
8. 222051 5/12.
9. 1603337/7.
10. 11762003 2/3.
11. 39291 68/108.
12. 403003 86/132.
13. 8766053 8/13.
14. 284314 95/110.
15. 641986 21/54.
16. 997852 94/144.

### Exercise 3.

1. 26726/27.
2. 264214/36.
3. 1063436/40.
4. 1520043/48.
5. 598044/49.
6. 2368 8/65.
7. 440479/44.
8. 506370/82.
9. 641333/92.
10. 413251 1/7.
11. 15358 1/28.
12. 428510/10.
13. 7230 5/124.
14. 864 92/273.
15. 13661 62/365.
16. 15965 26/43.
17. 3017402/578.
18. 1246842 21/745.
19. 3343 76/657.
20. 134205 5/798.
21. 2706317 07/7715.
22. 781002 533/2268.
23. 1255090 619/736.
24. 4573781 891/5396.
25. 1830087 20/7742.
26. 3756623 230/248.
27. 1488824 785/1403.
28. 4085 88/623 76.
29. 1282971 4353/715.
30. 4679286 186/8382.
31. 2281830 265/32256.
32. 5125384 72/46823.
33. 9641 551 113/71053.
34. 7042253 2272/4028.
35. 1318178 278/5364.
36. 6713697 08/885.
37. 3244443 05/486.
38. 2788917 4201/704025.
39. 1348801 14/4.
40. 1545 1 1/4.
41. 3 apples.
42. 91 1/4.
43. 155 28/48.
44. 225 miles.
45. 71 200000/3800000 persons.
46. 25 24/28 days.
47. 897583428 02/84.
48. 1342842933 2362 54/7000071.

## REDUCTION.

### Exercise 1.

1. 700 cents.
2. 9400 cents.
3. 1900 cents.
4. 92424 cents.
5. 964258 cents.
6. 4296537 cents.
7. 94275 cents.
8. $704.28
9. $4950.64.
10. $286.05.

### Exercise 2.

1. $73.90.
2. $70.82$\frac{1}{2}$.
3. $303.76$\frac{2}{3}$
4. $599.29$\frac{7}{17}$.
5. $1025.93$\frac{3}{4}$.
6. $975.90$\frac{5}{6}$.
7. $3057.72$\frac{1}{7}$.
8. $1579.33$\frac{3}{4}$.
9. $307.68$\frac{1}{3}$.
10. $731.27$\frac{1}{2}$.
11. $3305.98$\frac{1}{3}$.
12. $992.96$\frac{1}{4}$.

### Exercise 3.

1. £18 : 12 : 9$\frac{1}{2}$ — $\frac{2}{3}$.
2. £185 : 14 : 6.
3. £246 : 18 : 3.
4. £436 : 11 : 2$\frac{1}{4}$ — $\frac{3}{5}$.
5. £189 : 11 : 0$\frac{1}{2}$ — $\frac{2}{3}$.
6. £2339 : 19 : 7 — $\frac{4}{5}$.
7. £1316 : 2 : 4$\frac{3}{4}$ — $\frac{1}{5}$.
8. £69 : 18 : 3.
9. £198 : 12 : 1$\frac{1}{2}$.
10. £435 : 14 : 10$\frac{1}{4}$.

### Exercise 4.

1. 4312 pence.
2. 123583 farthings.
3. 713221 farthings.
4. 1041178 far.
5. £398 : 8.
6. £1559 : 10 : 5.
7. 1510s : 1$\frac{1}{4}$d.
8. £76979 : 18 : 2$\frac{1}{2}$.

### Exercise 5.

1. 18800 quarters.
2. 45650 pounds.
3. 556739 ounces.
4. 341172 ounces.
5. 12 tons 1 cwt.
6. 706 cwt. 4 lbs.
7. 51 qrs 7 lbs 4 oz.
8. 21t 19cwt 11 lbs 10oz.

### Exercise 6

1. 5760 dwts.
2. 99916 grains.
3. 7 oz. 15 dwts. 22 grs.
4. 1 lb. 3 oz. 8 dwts. 17 grs.

### Exercise 7.

1. 3744 scruples.
2. 90057 grains.
3. 1368 lbs 11 oz 6 drs 1 scru.
4. 1269 lbs 6 oz 5 drs 1 scru 8 grs.

### Exercise 8.

1. 7140 lines.
2. 8694 inches.
3. 2437 perches.
4. 125070439 inches.
5. 11347 fur 20 per 5 yds.
6. 1534 m 30 per.
7. 21 yds 1 ft 3 in 11 lines.
8. 38 lea 2m 1 fur 11 per 1 ft 6in.

### Exercise 9.

1. 1248 nails.
2. 315 nails.
3. 214 yds 1 qr 1 nl.
4. 463 Eng ells 3 qrs 2 nls.
5. 374 Eng ells 2 qrs.
6. 410 Eng ells 2 qrs.

EXERCISE 10.

1. 9801 sq feet.
2. 206431933 sq inches.
3. 8r 22 per 17 yds 1 ft 72 in.
4. 1a 31 per 9 yds 3 ft 26 in.

EXERCISE 11.

1. 216 pints.
2. 59039 gills.
3. 790 bar 3 gals 1 qt 1 gill.
4. 27 pipes 27 gals 1 qt 1 pt.

EXERCISE 12.

1. 2928 hours.
2. 15111286 seconds.
3. 8 days 14 h 21 min 53 sec.
4. 69 wks 3d 2h 42 min 14 sec.

EXERCISE 13.

1. 720427 cents.
2. $7642.85.
3. $2899.91¼.
4. £991 : 8 : 11½ — ⅗.
5. 379037 farthings.
6. £829 : 12 : 2¾.
7. 3967451 drams.
8. 2170 t. 2 cwt. 3 qrs 2 lbs. 12 oz. 7 drs.
9. 5629 grains.
10. 6 lbs. 5 oz. 5 dwts 16 grs.
11. 2255 scruples.
12. 256 lbs. 9 oz. 6 drs.
13. 121968 feet.
14. 5412 lea 1 m 3 fur 32 per 4 yds 1 ft 3 in 1 l.
15. 255171871 sq inches.
16. 15 a 2 r 1 per 16 yds 4 ft 101 in.
17. 1150 nails.
18. 36 Eng ells 3 qrs 3 nls.
19. 39644 gills.
20. 2287 gals 1 qt.
21. 277740 minutes.
22. 203 weeks 3 days 3 h 20 min 7 sec.
23. 290.
24. 710.
25. 36 English ells.
26. 120 yards.
27. 56⅔ Flemish ells.
28. 745.
29. 102 two pences.
30. 361 five pences.
31. 54 four pences.
32. 32 packages.

## COMPOUND ADDITION.

1. $27833.89.
2. £13108 : 19 : 2½.
3. 815 cwt 3 qrs 12 lbs 13 oz.
4. $16858.56.
5. 104 miles 3 fur 20 per 4½ yds 2 ft.
6. $38409.96.
7. £19140 : 5 : 11½
8. $28375.96¼.
9. 107 tons 2 qrs 24 lbs 6 oz 9 drs.
10. 154 wks 2 d 23 h 7 min 12 sec.
11. 121 acres 1 r 8 per 24½ yds.
12. 292 lbs 7 oz 4 grs.
13. $38121.82.
14. 251 yds 1 qr 2 nls.
15. £3619 : 1 : 4.
16. $9388.82½.
17. 185 gals. 1 pint.
18. 91 lbs 4 oz 14 dwts 1 gr.
19. 3751 cwt 3 qrs 4 lbs.
20. 339 miles 6 fur 38 per 1½ yds.
21. 409 acres 3 r 25 per.
22. $42174.44.
23. 539 yds 1 ft 6 in 9 lines.
24. 656 days 15 h 40 min 25 sec.
25. 328 gals 1 qt 1 pt 3 gills.
26. 172 tons 18 cwt 1 qr 17 lbs.

## COMPOUND SUBTRACTION.

1. $6635.76.
2. £679 : 8 : 9¾.
3. 31 cwt 2 qrs 20 lbs.
4. $98765.56.
5. 7 tons 6 cwt 3 qrs 5 lbs.
6. 44 weeks 6 d 5 min 36 sec.
7. 8 yds 3 qrs 3 nls.
8. $18094.63.
9. £167 : 2 : 11¾.
10. $8888.89.
11. 56 gals 3 qts 1 gill.
12. 437 miles 4 far 39 per 5 yds 1 ft.
13. 25 acres 26 per 4 ft 127 in.
14. 125 tons 15 cwt 3 qrs 3 lbs.
15. 6 lbs 9 oz 6 grs.
16. $87654.78.
17. 47 yds 2 ft 11 in 11 lines.
18. 210 tons 12 cwt 1 qr 4 lbs 6 oz 9 drs.
19. 888 acres 10 per 12 yds 2 ft 16 in.
20. 4 hh lds 10 gals 1 pint.
21. 11 min 10 sec.
22. 1° 17′ 30″

## COMPOUND MULTIPLICATION.

### Exercise 1.

1. 33 cwt 3 qrs 9 lbs 10 oz.
2. £884 : 13 : 5¼.
3. $318593.56.
4. 137 miles 2 fur 17 per 1½ yds.
5. 341 gals. 1 qt.
6. 277 acres 1 r 8 per 2½ yds.
7. $6636544.72.
8. 177 tons 12 cwt 2 qrs 7 lbs.
9. £7949 : 6 : 3.
10. $4059941.93.
11. 286 weeks 6 d 12 h 5 min 24 sec.
12. 1703 cwt 3 qrs 24 lbs 11 oz.
13. 82 lbs 7 oz 2 drs 2 scru 9 grs.
14. $771424605.52.
15. 475 acres 3 r 29 per 13¾ yds 6 ft.
16. 1285 yds 3 qrs 2 nls.
17. 109 tons 8 cwt 3 qrs 17 lbs.
18. 1373 gals 2 qts 3 gills.
19. $35894634.16.
20. 27 cwt 2 lbs 12 oz 10 drs.

### Exercise 2.

1. $10349899.84.
2. £13450 : 19 : 8¼.
3. $6305055.52.
4. 1348 cwt 14 lbs 6 oz.
5. 1134 acres 1 r 37 per 25¾ yds.
6. 774 yds 1 qr 2 nls.
7. 613 weeks 5 d 18 h 57 min 32 sec.
8. 299 lbs 11 oz 4 drs.
9. 198 lea 2 m 1 fur 33 per 1 yd.
10. $80156133.36.
11. £11108 : 14 : 2.
12. 264 tons 19 cwt 1 lb 13 oz 6 drs.
13. 1567 gallons.
14. $247396923.84.
15. 1531 wks. 20 h 40 min. 48 s.
16. 1124 yds 1 ft 5 in 3 lines.
17. 1820 acres 3 r 27 per 21¼ yds.
18. $44014061.28.
19. 398 lbs 3 oz 1 dr 1 scr 19 grs.
20. 1763 cwt 2 qrs 12 lbs 14 oz.
21. 5615 acres 38 per 3½ yds.
22. $1162491454.80.

23. 12152 gallons.
24. 1173 bushels 2 pks 1 gal 2 qts 1 pt.
25. 27663 weeks 2 d 9 h 52 min.
26. 1911 yds 1 qr.
27. 1733 acres 1 r 15 per 17¼ yds 1 ft.
28. $878595.48.
29. 23578 bush 1 gal.
30. 9923 cwt 9 lbs 1 oz.

EXERCISE 3.

1. $58939941.06.
2. £23484 : 6 : 4½.
3. $835454.70.
4. 5984 cwt 1 qr 10 lbs 7 oz.
5. 982 lea 2 m 6 fur 22 per 2½ yds.
6. 3261 yds 1 qr 2 nls.
7. 1353 lbs 3 oz 6 drs 2 scr.
8. 10828 acres 3 r 29 per 14¼ yds.
9. $1887652.86.
10. 10834 lbs 6 oz 1 dwt 7 grs.
11. 1898 tons 10 cwt 10 lbs.
12. 2970 weeks 4 d 4 h 36 min.
13. £232442 : 15: 3.
14. 26541 gals 1 qt 1 gill.
15. 2897 bush 1 gal 2 qts.
16. 6610 per 2 yds 6 in 4 lines.
17. 470 cwt 3 qrs 11 lbs 13 oz.
18. $580906.92.
19. 2732 acres 1 r 8 per 2⅜ yds.
20. 5180 days 8 h 56 min 3 sec.
21. 424 miles 5 fur 10 per 4 yds 2 ft.
22. £84264 : 10 : 6.
23. 6894 yds 3 nls.
24. 13019 lbs 9 oz 8 dwts.
25. $465206.68.
26. 9377 cwt 3 qrs 8 lbs.
27. 7373 gals 2 qts 1 pt.
28. 3468 bushels.
29. 3797 wks 1 day 23 h 46 min 49 sec.
30. 657 cwt 1 qr 8 lbs 2 oz 12 drs.

## COMPOUND DIVISION.

EXERCISE 1.

1. $3698437.26½.
2. £321 : 2 : 5¼.
3. 1 ton 18 cwt 10 lbs 10 oz
4. 13 gals 3 qts 1⅔ gills.
5. 15 acres 1 r 4 per 29 yds. 6 ft 30 in.
6. 113 yds. 1 qr 2¼ nls.
7. 1 lea 2 m 1 fur 39 per 3 yds 1 ft 3 in 9 lines.
8. $105208.25.
9. 73 cwt 1 qr 21 lbs 7 oz 12 drs.
10. 3 per 1 yd 2 ft 10 in 1 1/11 line
11. 61 gals 1 pt 3 2/3 gills.
12. 33 bush 1 pk 1 gal 3 qts 1 pt 2 gills.
13. £536 : 0 : 11¾ — 5.
14. 67 yds 2 qrs 2⅜ nls.
15. 13 acres 2 r 10 per 10 yds 6 ft 143 29/36 in.
16. 2 lbs 5 oz 2 drs 1 scr. 18 1/12 qrs.
17. 3 cwt 3 qrs 20 lbs 4 oz.
18. 2 lbs 4 oz 8 dwts 2 113/180 grs.
19. $496744.84.
20. 2 wks 3 d 18 h 47 min 28 8/12 sec.
21. 6 gals 1 qt 1 116/147 gills.
22. £4 : 10 : 3½ — 120.
23. 4 bush 3 pks 3 qts 1 96/98 pt.
24. 25 cwt 3 qrs 4 lbs 12 oz 14 drs.
25. 1 mile 1 fur 32 per 1 35/88 ft.
26. 2 Eng ells 2 qrs 3 nls.
27. $14506.23.
28. 3 acres 1 r 32 per 21 yds.
29. 6 days 8 h 14 min 57 sec — 432 rem.
30. 1 qr 5 lbs 14 oz 12 35/88 drs.

### Exercise 2.

1. $56896.05.
2. £25 : 4 : 8 $\frac{2}{17}$.
3. 49 cwt 2 qrs 9 lbs 7 oz.
4. 11 gals 3 qts 1 pt 1 $\frac{20}{23}$ gills.
5. 8 miles 3 fur 2 per 5 yds.
6. 15 yds 2 qrs 0 $\frac{6}{47}$ nls.
7. $15194.45.
8. 5 weeks 5 d 6 h 10 min 24 sec.
9. 10 lbs 4 oz 1 scr 3 $\frac{35}{74}$ grs.
10. 12 cwt 2 qrs 20 lbs 8 oz 2 $\frac{235}{313}$ drs.
11. 2 miles 3 fur 36 per 2 yds 2 ft 3 $\frac{663}{1927}$ in.
12. £34 : 3 : 8 $\frac{53}{293}$.
13. 3 gals 2 qts 1 $\frac{98}{176}$ gills.
14. 3 acres 3 r 26 per 4 yds 3 ft 71 in.
15. 10 tons 7 cwt 2 qrs 9 oz. 8 drs.
16. 11 cents.
17. $856.42 $\frac{8}{33}$.
18. 61 $\frac{22}{38}$ cents.
19. $2.64.
20. 21 $\frac{46}{127}$ cents.

### Exercise 3.

1. 7 $\frac{308}{1092}$.
2. 30 suits.
3. 40 dozen.
4. 5068 $\frac{1}{2}$ times.
5. 13 persons.
6. 13 $\frac{56}{88}$ spoons.
7. 21 $\frac{9}{16}$ lbs.
8. 5 stoves.
9. 29 parcels.
10. 976 ducats.
11. 67 $\frac{283}{324}$ cwt.
12. 37 ounces.
13. 8 boards.
14. 15840 steps.
15. 11 $\frac{78}{154}$ cwt.
16. 14 $\frac{308}{378}$ yds.

### Exercise 4.

1. £268 : 2 : 5 $\frac{3}{4}$ — $\frac{3}{4}$.
2. £79 : 7 : 1.
3. £18 : 11 : 3.
4. £60 : 13 10 — $\frac{3}{4}$.
5. £10 : 7 : 7 $\frac{1}{4}$ — $\frac{15}{25}$.
6. £17 : 16 : 10 $\frac{1}{2}$ — $\frac{86}{96}$.
7. £9 : 8 : 0 $\frac{1}{2}$ — $\frac{185}{217}$.
8. £0 : 6 : 7.

## MISCELLANEOUS QUESTIONS.

1. 7396842 cents.
2. $816007.03.
3. $7982.98.
4. 625.35.
5. $345392.20.
6. $390.56 $\frac{2}{11}$.
7. $45.35 $\frac{772}{884}$.
8. 35939 lbs.
9. 140 tons 2 qrs 1 lb 14 oz 4 drs.
10. 88 lbs 6 oz 4 drs 5 grs.
11. 270 cwt 1 qr 19 lbs 9 oz 15 drs.
12. £9167 : 12 : 9.
13. 9021 yds 3 qrs.
14. 84 miles 7 fur 20 per 4 yds.
15. 13 cwt 4 lbs 11 oz 7 $\frac{40}{74}$ drs.
16. 2 lbs 4 oz 9 dwts 18 grs.
17. $2971.90.
18. £1836 : 11 : 3.

## SIMPLE PROPORTION.

### Exercise 1.

1. 5.
2. 39.
3. 10.
4. 9.
5. 15.
6. 10 $\frac{2}{3}$.
7. 38.
8. 70 $\frac{1}{2}$.
9. 17.
10. 56.
11. 6.
12. 360.

## Exercise 2.

1. $21.50.
2. $154.81$\frac{73}{167}$.
3. $36.
4. 21$\frac{56}{59}$.
5. 243 gals 2 qts 1 pt.
6. 421.74$\frac{912}{937}$.
7. 693 miles 2 fur 10 per.
8. $278.33$\frac{13}{37}$.
9. 277 cwt 1 qr 13 lbs 10 oz.
10. 91 men.
11. $283.92$\frac{3}{16}$.
12. $988.93.
13. $14.06.
14. £21 : 2 : 9.
15. $468.09$\frac{13}{43}$.
16. $58.33$\frac{1}{3}$.
17. $50.37.
18. 284$\frac{8}{13}$ miles.
19. $71.38$\frac{3}{8}$.
20. 180 gals 2 qts.
21. $383.76.
22. $892.18$\frac{9}{25}$.
23. $1.02.
24. 196 feet 9 in.
25. 66 men.
26. $7032.54$\frac{1}{50}$.
27. 21 weeks 3 days, nearly.
28. 36$\frac{1}{7}$ days.
29. 11 weeks 3$\frac{2}{11}$ days.
30. $140.56$\frac{7}{9}$.
31. £72 : 16 : 0$\frac{1}{2}$.
32. $216 39.
33. 124.86$\frac{7}{25}$.
34. 2$\frac{87}{221}$ days.
35. 60 cents.
36. 147 barrels.
37. $7.03$\frac{10}{11}$.
38. £25 : 11 : 9$\frac{1}{2}$.
39. £31 : 3 : 6.
40. 55 yds 2 qrs 3 nls.
41. 61 cwt 2 qrs 15 lbs.
42. $509.91$\frac{73}{117}$.
43. 27 gals 1 pt 1 gill.
44. $116.73.
45. $125.55.
46. 204 bushels.
47. $51.58$\frac{10}{17}$.
48. 82$\frac{1}{2}$ cents.
49. 19$\frac{38}{73}$ cents.
50. £90 : 12 1$\frac{1}{4}$.
51. 103 feet 5 in 10 lines.
52. $6.30.
53. 499$\frac{1}{2}$ miles.
54. 264$\frac{32}{37}$ miles.
55. $12.15$\frac{15}{79}$.
56. $40.72.
57. $1.10.
58. $2.02$\frac{37}{84}$.
59. 11 days 9$\frac{51}{253}$ hours.
60. $193.60.
61. $33.58.
62. $744.92$\frac{22}{25}$.
63. 33$\frac{53}{847}$ cents.
64. 286.58.
65. 10$\frac{45}{259}$ days.
66. $443.48$\frac{1}{4}$.
67. $83.32.
68. $443.58.
69. $1.76.
70. 321 men.
71. 34 days.
72. 70 cwt 2 qrs 15$\frac{5}{8}$ lbs.
73. 28$\frac{1}{9}$ days.
74. $92.91$\frac{2}{3}$.
75. $14.94$\frac{2}{3}$.

## Compound Proportion.

1. 120 acres.
2. $24.40.
3. 466$\frac{2}{3}$ bushels.
4. $76.85.
5. 144 feet 3 $\frac{11}{15}$ inches.
6. $30.16.
7. 33 days.
8. $1098.50.
9. 85 men.
10. 359 miles 7$\frac{9}{11}$ fur.

11. $192.88$\frac{8}{9}$.
12. 104 cwt 17$\frac{2}{19}$ lbs.
13. $1640.33$\frac{1}{3}$.
14. 50$\frac{10}{51}$ days.
15. 16$\frac{8}{425}$ days.
16. 22$\frac{66}{133}$ days.
17. $1904.
18. 10 men.
19. 72 acres 3 r 13$\frac{1}{3}$ per.
20. 3$\frac{13}{17}$ days.
21. $413.69.
22. $129.81.
23. 11$\frac{1}{15}$ days.
24. 33 men.
25. $18.37.

## GREATEST COMMON MEASURE.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | 5. | 4. | 4. | 7. | 2. | 10. | 5. |
| 2. | 3. | 5. | 5. | 8. | 2. | 11. | 2. |
| 3. | 4. | 6. | 9. | 9. | 93. | 12. | 12. |

## LEAST COMMON MULTIPLE.

| | | | |
|---|---|---|---|
| 1. 315. | 5. 15120. | 9. 240. | 13. 69240864. |
| 2. 120. | 6. 7956. | 10. 4788. | 14. 128707425. |
| 3. 10098. | 7. 2520. | 11. 11592. | 15. 536130. |
| 4. 720. | 8. 120. | 12. 2520. | 16. 10228140. |

## VULGAR FRACTIONS.

### Exercise 1.

| | | | |
|---|---|---|---|
| 1. $\frac{3}{5}$. | 4. $\frac{623}{4486}$. | 7. $\frac{5}{11}$. | 10. $\frac{1}{7}$. |
| 2. $\frac{7}{11}$. | 5. $\frac{155}{919}$. | 8 $\frac{1}{5}$. | 11. $\frac{2484}{7387}$. |
| 3. $\frac{23}{30}$. | 6. $\frac{37}{39}$. | 9. $\frac{1}{12}$. | 12. $\frac{9321}{11468}$. |

### Exercise 2.

| | | | |
|---|---|---|---|
| 1. 138$\frac{2}{7}$. | 4. 105$\frac{31}{123}$. | 7. 1$\frac{1079}{8136}$ | 10. 6944$\frac{7}{16}$. |
| 2. 1. | 5. 1$\frac{3772}{5873}$. | 8. 10$\frac{734}{1103}$. | 11. 8610$\frac{25}{92}$. |
| 3. 86. | 6. 1$\frac{6104}{6241}$. | 9. 408$\frac{66}{97}$. | 12. 6734. |

### Exercise 3.

| | | | |
|---|---|---|---|
| 1. $\frac{119}{12}$. | 4. $\frac{4024}{84}$. | 7. $\frac{5235}{56}$. | 10. $\frac{1004021}{2748}$. |
| 2. $\frac{11135}{1001}$. | 5. $\frac{274241}{2468}$. | 8. $\frac{123927}{697}$. | 11. $\frac{915}{32}$. |
| 3. $\frac{225894}{300}$. | 6. $\frac{7691}{28}$. | 9. $\frac{9678}{19}$. | 12. $\frac{6870}{71}$. |

### Exercise 4.

| | | | |
|---|---|---|---|
| 1. $\frac{1}{5}$. | 4. $\frac{648}{2695}$. | 7. $\frac{8}{315}$. | 10. $\frac{189}{5440}$. |
| 2. $\frac{42}{275}$. | 5. $\frac{7}{64}$. | 8. $\frac{896}{4845}$. | 11. 14$\frac{7}{15}$. |
| 3. $\frac{16}{945}$. | 6. $\frac{3}{22}$. | 9. 2$\frac{6}{35}$. | 12. $\frac{3}{8}$. |

EXERCISE 5.

1. $\frac{30}{60}, \frac{40}{60}, \frac{45}{60}, \frac{48}{60}$.
2. $\frac{2100}{2520}, \frac{2160}{2520}, \frac{2205}{2520}, \frac{2240}{2520}, \frac{2268}{2520}$.
3. $\frac{10920}{12012}, \frac{11011}{12012}, \frac{11088}{12012}, \frac{11154}{12012}$.
4. $\frac{4752}{7920}, \frac{4455}{7920}, \frac{5040}{7920}, \frac{3564}{7920}, \frac{7480}{7920}$.
5. $\frac{288}{504}, \frac{180}{504}, \frac{224}{504}, \frac{432}{504}, \frac{336}{504}$.
6. $\frac{48195}{58905}, \frac{13860}{58905}, \frac{16830}{58905}, \frac{15708}{58905}, \frac{32725}{58905}$.
7. $\frac{237405}{271320}, \frac{57120}{271320}, \frac{140226}{271320}, \frac{255360}{271320}, \frac{245480}{271320}$.
8. $\frac{1728}{5616}, \frac{3159}{5616}, \frac{2184}{5616}, \frac{832}{5616}$.
9. $\frac{426972}{705432}, \frac{633080}{705432}, \frac{188955}{705432}, \frac{428298}{705432}, \frac{394212}{705432}$.
10. $\frac{101680}{343170}, \frac{44280}{343170}, \frac{125829}{343170}, \frac{100440}{343170}$.
11. $\frac{2717}{9152}, \frac{704}{9152}, \frac{6688}{9152}, \frac{5824}{9152}, \frac{2816}{9152}$.
12. $\frac{29376}{53244}, \frac{18734}{53244}, \frac{42891}{53244}, \frac{32538}{53244}, \frac{43848}{53244}$.

EXERCISE 6.

1. $\frac{3}{28}$.
2. $22\frac{1}{2}$.
3. $\frac{8}{21}$.
4. $11\frac{1}{4}$.
5. $\frac{27}{405}$.
6. $\frac{95}{111}$.
7. $\frac{34}{99}$.
8. $\frac{35}{48}$.
9. $\frac{31}{54}$.
10. $1\frac{6}{71}$.
11. $1\frac{21}{44}$.
12. $\frac{566}{627}$.

EXERCISE 7.

1. $\frac{400}{717}$ of a pound.
2. $\frac{1}{480}$ of a quarter.
3. $\frac{7}{1540}$ of a day.
4. $196\frac{4}{11}$ perches.
5. $\frac{28}{29}$ of an hour.
6. $82\frac{2}{7}$ lines.
7. $\frac{7}{2301}$ of an acre.
8. $14\frac{47}{88}$ Eng ells.
9. $11\frac{3}{43}$ gills.
10. $\frac{117}{3325000}$ of a ton.

EXERCISE 8.

1. $\frac{77}{2376}$.
2. $\frac{7}{660}$.
3. $\frac{7}{425}$.
4. $\frac{107}{2016}$.
5. $\frac{48}{2883}$.
6. $\frac{4}{47}$.
7. $\frac{310}{6317}$.
8. $\frac{1388}{44103}$.
9. $\frac{21}{5115}$.
10. $\frac{201}{14350}$.

EXERCISE 9.

1. 2 qrs 12 lbs 8 oz.
2. 1 peck 1 gal 1 qt 1 $\frac{3}{7}$ pt.
3. 2 roods.
4. 2s : $4\frac{3}{4}$d $- \frac{1}{5}$.
5. 1 fur $16\frac{8}{77}$ per.
6. 1 ft 8 in $7\frac{9}{55}$ lines.

7. 8 oz 3 drs 12 grs.
8. 9 bushels.
9. 1 bush 3 pks $3\frac{1}{2}\frac{1}{4}$ qts
10. 34 gals 1 qt 1 pt $3\frac{7}{6}\frac{7}{0}$ gills.
11. 10 miles 1 fur $14\frac{2}{1}\frac{2}{r}$ per.
12. 2 acres 1r $30\frac{1}{5}\frac{3}{6}\frac{2}{0}$ per.
13. 3 qrs 18 lbs.
14. 6 hours 59 min 56 sec.

### Exercise 10.

1. $1\frac{1}{2}\frac{8}{4}\frac{6}{8}\frac{5}{5}$.
2. $2\frac{4}{8}\frac{3}{0}$.
3. $4\frac{8}{2}\frac{9}{5}\frac{2}{2}\frac{3}{0}$.
4. $2\frac{1}{8}\frac{0}{8}\frac{9}{6}\frac{1}{4}$.
5. $1\frac{1}{4}\frac{7}{2}\frac{7}{0}$.
6. $2\frac{4}{3}\frac{1}{0}\frac{1}{2}\frac{5}{4}$.
7. $\frac{5}{9}\frac{9}{0}\frac{0}{4}\frac{2}{4}$.
8. $2\frac{2}{2}\frac{5}{8}\frac{3}{9}\frac{2}{8}\frac{3}{0}$.
9. $2\frac{4}{6}\frac{3}{0}$.
10. $10\frac{2}{7}\frac{2}{2}\frac{1}{0}$.
11. $46\frac{8}{1}\frac{7}{6}\frac{7}{7}\frac{4}{4}$.
12. $242\frac{3}{8}\frac{7}{4}\frac{6}{2}\frac{3}{0}$.
13. $309\frac{5}{1}\frac{7}{0}\frac{4}{2}\frac{9}{6}\frac{2}{0}$.
14. $6\frac{1}{4}\frac{8}{6}$.
15. $8\frac{2}{4}\frac{3}{9}\frac{9}{5}$.
16. $17\frac{3}{7}\frac{2}{9}$.
17. $1\frac{2}{2}\frac{8}{8}\frac{3}{8}$.
18. $4\frac{8}{4}\frac{5}{5}\frac{0}{4}\frac{7}{5}\frac{2}{5}$.
19. $\frac{1}{1}\frac{7}{8}\frac{6}{4}\frac{5}{8}$.
20. $\frac{9}{1}\frac{2}{3}\frac{2}{0}\frac{4}{8}\frac{4}{0}\frac{7}{1}\frac{8}{2}\frac{3}{3}\frac{0}{0}$.

### Exercise 11.

1. $\frac{2}{7}\frac{3}{5}$.
2. $\frac{7}{1}\frac{3}{1}\frac{6}{4}\frac{5}{0}$.
3. $1\frac{4}{1}\frac{1}{0}\frac{1}{5}\frac{5}{5}$.
4. $1\frac{3}{1}\frac{5}{0}\frac{8}{7}\frac{8}{5}\frac{7}{9}$.
5. $1\frac{2}{2}\frac{3}{4}$.
6. $11\frac{8}{2}\frac{7}{2}$.
7. $26\frac{7}{2}\frac{1}{0}\frac{1}{9}$.
8. $1\frac{5}{2}\frac{3}{4}\frac{1}{4}\frac{1}{8}$.
9. $12\frac{7}{5}\frac{4}{6}\frac{9}{6}$.
10. $3\frac{2}{1}\frac{7}{4}\frac{3}{9}\frac{6}{6}$.
11. $\frac{8}{1}\frac{3}{2}\frac{3}{1}\frac{6}{6}$.
12. $5\frac{1}{8}\frac{2}{7}\frac{0}{8}\frac{1}{5}\frac{5}{2}$.

### Exercise 12.

1. $\frac{5}{9}\frac{6}{5}$.
2. $\frac{3}{1}\frac{0}{0}$.
3. $1\frac{1}{1}\frac{4}{7}$.
4. $71\frac{5}{1}\frac{9}{0}\frac{2}{5}$.
5. $38\frac{4}{8}\frac{2}{0}$.
6. $79\frac{1}{7}\frac{7}{7}$.
7. $\frac{1}{4}$.
8. $\frac{6}{4}\frac{6}{8}$.
9. $\frac{1}{4}\frac{1}{7}$.
10. $\frac{2}{2}\frac{9}{2}$.
11. $\frac{4}{7}\frac{8}{1}\frac{8}{5}$.
12. $1\frac{3}{8}\frac{0}{8}\frac{7}{4}$.
13. $\frac{3}{1}\frac{7}{4}\frac{7}{0}$.
14. $\frac{7}{1}\frac{7}{2}\frac{7}{0}$.
15. $98\frac{4}{3}\frac{4}{1}\frac{4}{5}$.
16. $\frac{2}{1}\frac{9}{4}\frac{9}{1}\frac{2}{1}$.
17. $5\frac{1}{5}\frac{5}{2}\frac{1}{9}\frac{7}{2}$.
18. $5\frac{6}{1}\frac{1}{7}$.
19. $\frac{4}{1}\frac{5}{2}\frac{5}{9}\frac{6}{6}$.
20. $17\frac{1}{2}\frac{2}{0}\frac{2}{0}$.

### Exercise 13.

1. $1\frac{1}{8}$.
2. $1\frac{6}{1}\frac{1}{2}\frac{1}{4}$.
3. $\frac{1}{1}\frac{1}{7}\frac{9}{4}$.
4. $\frac{6}{8}\frac{0}{1}\frac{7}{9}$.
5. $2\frac{7}{8}\frac{6}{1}$.
6. $\frac{1}{2}\frac{7}{0}\frac{1}{8}$.
7. $\frac{2}{8}\frac{1}{5}$.
8. $17\frac{5}{2}\frac{5}{7}$.
9. $1\frac{6}{1}\frac{3}{2}\frac{9}{4}\frac{5}{5}$.
10. $7\frac{1}{3}\frac{1}{0}$.
11. $\frac{1}{2}\frac{9}{5}\frac{5}{9}$.
12. $\frac{8}{8}\frac{3}{9}\frac{0}{1}$.
13. $\frac{1}{2}\frac{1}{3}\frac{7}{2}$.
14. $5\frac{5}{1}\frac{5}{7}$.
15. $3\frac{3}{3}\frac{8}{8}\frac{1}{5}$.
16. $\frac{1}{3}\frac{1}{7}$.
17. $2\frac{6}{1}\frac{7}{6}\frac{3}{2}\frac{3}{0}$.
18. $1\frac{1}{2}\frac{2}{9}\frac{7}{1}\frac{8}{2}$.
19. $2\frac{3}{8}\frac{2}{5}\frac{6}{7}$.
20. $1\frac{9}{2}\frac{4}{6}\frac{9}{9}\frac{0}{1}$.

## DECIMAL FRACTIONS.

### Exercise 1.

1. Thirty-six, hundredths.
2. Sixty-four, thousandths.
3. Two hundred and seven, thousandths.
4. Six hundred and fifty-two, thousandths.
5. Seventy-two, hundred thousandths.
6. Thirty-four, and five hundred and six, thousandths.

7. Three hundred and nine, and sixty-four hundredths.
8. Sixty-three millionths.
9. Seventy-one thousand and forty-two, and five hundred and sixty thousandths.
10. Ninety-two, and six thousand five hundred and seven millionths.
11. Seven hundred and twenty-four, hundred billionths.
12. Six hundred and seventy-one, and four hundred and eight thousand two hundred and sixty-three, millionths.

EXERCISE 2.

1. ·046.
2. ·0980.
3. ·000640.
4. ·84000·000700.
5. ·000000003506.
6. ·000408.
7. ·000000107600.
8. ·0000096000.
9. ·00000020064.
10. ·00702.

EXERCISE 3.

1. 36·9272.
2. 161·13839.
3. 113·5451.
4. 46·06516.
5. 487.7719.
6. 106.6120199.
7. 284·954336.
8. 835·75511.

EXERCISE 4.

1. 1·267.
2. 18·80146.
3. ·40366.
4. 4·6855.
5. 155·307.
6. 5·0673.
7. 10·94814.
8. ·928$\frac{42}{}$.
9. ·6·268858.
10. 2·18076.

EXERCISE 5.

1. ·1101.
2. ·18468.
3. ·477862.
4. 6·3583.
5. 46·0842.
6. 186·3648.
7. ·4896.
8. ·02548.
9. ·6426.
10. ·3933.
11. ·262632.
12. 3·02778.

EXERCISE 6.

1. 18·7.
2. 9·765625.
3. 364·285.
4. 5·6058345 +
5. 1.24.
6. 792·6.
7. 7·608524 +
8. 97·5.
9. 359·2.
10. 23·226.
11. 994·34396 +
12. 3·567.
13. 234·5.
14. 2·2119032 +
15. 2·1896482 +
16. 132·10759.

EXERCISE 7.

1. ·375.
2. ·046875.
3. ·183.
4. ·2.
5. ·69583.
6. ·009765625.
7. ·9.
8. ·0227.
9. 6·2617058.
10. 35·688311.

11. $\cdot\dot{7}\dot{2}$.
12. $\cdot 5625$.
13. $\cdot\dot{1}92307\dot{6}$.
14. $\cdot 612244897959$.
15. $134\cdot226337448$.
16. $\cdot 0030230507620607$.

### Exercise 8.

1. $\frac{3}{5}$.
2. $\frac{37}{80}$.
3. $\frac{21}{1000}$.
4. $\frac{64}{125}$.
5. $6\frac{9}{1000}$.
6. $\frac{1}{8}$.
7. $\frac{64}{99}$.
8. $\frac{333}{999}$.
9. $\frac{13714}{111111}$.
10. $\frac{7643}{9999}$.
11. $10\frac{114}{333}$.
12. $9\frac{7}{11}$.
13. $\frac{2068}{7875}$.
14. $\frac{352}{990}$.
15. $\frac{301}{825}$.
16. $\frac{1231}{9900}$.
17. $\frac{31111}{99000}$.
18. $\frac{883}{900}$.
19. $6\frac{24}{75}$.
20. $21\frac{2488}{9990}$.

### Exercise 9.

1. $\cdot 58$.
2. $\cdot 32979452054\dot{}$.
3. $\cdot 634375$.
4. $\cdot 5$.
5. $\cdot 847916\dot{}$.
6. $\cdot 21875$.
7. $\cdot 0703125$.
8. $\cdot 0246527\dot{}$.
9. $\cdot 2225$.
10. $\cdot 6875$.
11. $\cdot 594948\ldots$
12. $\cdot 7808984375$.
13. $\cdot 031521739$.
14. $\cdot 0365\dot{}$.
15. $\cdot 361445783$.

### Exercise 10.

1. 1 qr 18 lbs 2 oz 6 4 drams.
2. 39 minutes 27·36 sec.
3. 25 per 1 yd 1 ft 11 in 2·8992 lines.
4. 3 lbs 6 oz 6 dwts 17·28 grs.
5. 14s $7\frac{1}{2}$ d.
6. 7 sq perches.
7. 1·1136 quarts.
8. 2 yds 3 qrs 2 nls.
9. 2 roods 18 per 2 yds 3 ft 112.32 in.
10. 4 lbs. 8 oz 1·6128 drs.
11. 1·8176 gills.
12. 5 fur 39 per 3 yds 2 ft 2·64 in.
13. 1 qr 1 lb 12 oz 12·8 drs.
14. 8 sq ft 35·5248 sq inches.
15. 3·1 quarts.
16. 7 cwt 3 qrs 15 lbs 3 oz.

## PROPORTION OF FRACTIONS.

1. $1\frac{29}{35}$ days.
2. $\$16.33\frac{13}{99}$.
3. $7\frac{271}{455}$.
4. $\$20.19\frac{3}{7}$.
5. $£\frac{288}{583}$.
6. $\$10\frac{59}{55}$.
7. $35{\cdot}790\dot{1}\dot{8}$ gallons.
8. $\$147{\cdot}5622807$.
9. $48{\cdot}176516$ lbs.
10. $\$2{\cdot}569896907$.
11. $\$34.375$.
12. $\$105{\cdot}2350877$.

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## MISCELLANEOUS.

1. 2.
2. $\$118.67\frac{1}{2}$.
3. $1\frac{179}{180}$.
4. $\$387.70\frac{1}{3}$.
5. $18\frac{31}{350}$.
6. 1008.
7. $\frac{37485}{229820}$, $\frac{121030}{229320}$, $\frac{25740}{229320}$, $\frac{214032}{229320}$.
8. 12736 ounces.
9. 185748 inches.
10. 2 roods 29 sq per 4 sq yds 3 sq ft 134 sq in.
11. 2 lbs 7 oz 1 dr 1 scr 4 grs.
12. 143 19 ounces.
13. $138\frac{4}{117}$.
14. $11{\cdot}432389937$.
15. $\$167.83$.
16. $100{\cdot}27754$.
17. $5{\cdot}1187$.
18. $\cdot704352$.
19. $\$321.56\frac{31}{34}$.
20. 6 fur $8\frac{5}{11}$ per.
21. $\$3784.75\frac{29}{840}$.
22. $\$434.04\frac{45}{56}$.
23. $\$3635.75\frac{43}{56}$.
24. $\$2424.35\frac{3119}{3465}$.
25. $\$4024.31\frac{7}{10}$.
26. $\$76640.58\frac{9}{40}$.

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## PRACTICE.

### Exercise 1.

1. $652.75.
2. $356 25.
3. $1801.64.
4. $\$10059.52\frac{1}{2}$.
5. $795.08.
6. $4350.24.
7. $8673.
8. $775396.24.
9. $671422.07.
10. $\$41391\ 52\frac{1}{2}$.
11. $\$937105.16\frac{2}{3}$.
12. $\$61305.79\frac{1}{5}$.
13. $\$211967.76\frac{6}{11}$.
14. $\$75625.11\frac{1}{2}$.
15. £1278 : 15.
16. £3061 : 6.
17. £3211 : 7.
18. £26744 : 16 : $11\frac{1}{4}$.
19. £22583 : 17 : $1\frac{1}{4}$.
20. £3129 : 2 : $10\frac{1}{4}$.
21. $4419.90.
22. £73 : 3 : 8.
23. $\$1162661\ 79\frac{5}{9}$.
24. £11945 : 9 : $7\frac{3}{4}$.
25. $1631.12.
26. $4357.08.
27. $\$3903.23\frac{1}{13}$.
28. £733 : 12.
29. £561 : 1 : 3.
30. $48347.51\frac{1}{8}$.

## EXERCISE 2.

1. $433·23$\frac{2}{5}$.
2. $8558·72.
3. $449·355725.
4. $27·2681.
5. $17985·86$\frac{37}{64}$.
6. $327·73$\frac{5}{7}$.
7. $16·11$\frac{1}{7}$.
8. $7710·4375.
9. $159·53$\frac{5}{8}$.
10. $126·51$\frac{3}{16}$.
11. £41 : 19 : 2$\frac{1}{4}$.
12. £470 : 16 : 6$\frac{3}{4}$.
13. £64 : 11 : 10.
14. £32 : 19 : 2.
15. $1266·09$\frac{3}{8}$.
16. £858 : 18 : 3$\frac{1}{2}$.
17. $491·7234375.
18. £1136 : 17 : 1$\frac{3}{4}$.
19. $678·1028125.
20. $187.40$\frac{5}{8}$.
21. $2858·89$\frac{13}{25}$.
22. £71 : 2 : 8$\frac{1}{4}$.
23. $1307·17$\frac{2}{25}$.
24. $148·93$\frac{1}{8}$.
25. $9·82$\frac{5}{6}$.
26. $67·60.
27. $34·20$\frac{1}{5}$.
28. $1293·76$\frac{4}{5}$.
29. $623·36$\frac{1}{4}$.
30. $2722·19$\frac{13}{25}$.

## TARE AND TRET.

1. 22 cwt 2 qrs 13 lbs.
2. 1246 pounds.
3. 87 cwt 1 qr 16 lbs.
4. 26 cwt.
5. 107 cwt 2 qrs 14 lbs.
6. 51 cwt 12 lbs.
7. 34 cwt 20 lbs.
8. 108 cwt 3 qrs 1 lb.
9. 42 cwt 1 qr 2 lbs.
10. 18 cwt 6 lbs.
11. 4 cwt 1 qr 18 lbs.
12. 14 cwt 2 qrs 23 lbs.
13. 79 cwt 3 qrs 5 lbs.
14. 152 cwt 1 qr 23 lbs.
15. 82 cwt 1 qr 6 lbs.

## COMMISSION, INSURANCE, BROKERAGE.

1. $68.78.
2. $58.58.
3. $408·5544.
4. $28·0404.
5. $130·8853.
6. $928.55.
7. $2221.33$\frac{1}{3}$.
8. $215.32.
9. $1008.47$\frac{1}{4}$.
10. $56.52.
11. $129·409.
12. $443·3756.
13. $597.36.
14. $36·102.
15. $521·5512.
16. $63.22.
17. $129.07$\frac{1}{2}$.
18. $725.
19. $54.80.
20. $167.85.
21. $15.89$\frac{1}{2}$.
22. $176.93$\frac{3}{4}$.
23. $190.64$\frac{1}{2}$.
24. $206·7731.
25. $910.
26. $153·2131.
27. $235.06.
28. $2540.89$\frac{1}{2}$.
29. $98.35.
30. $280·91$\frac{1}{4}$.

## STOCK.

1. $2616.
2. $734.88$\frac{16}{13}$.
3. $2466.
4. $11457.60.
5. $830·5084.
6. $7732.80.
7. $4684.68$\frac{52}{111}$.
8. $1092.
9. $8741.25.
10. $8602.15$\frac{5}{13}$.
11. $6388.08.
12. $4097.

## SIMPLE INTEREST.

### Exercise 1.

1. $24.92.
2. $127.
3. $106.04.
4. $438·5475.
5. $886.15.
6. $54·52725.
7. $1901.25.
8. $312.
9. $134.9831.
10. $375.63¾.
11. $674.88.
12. $50.29⅞.
13. $16·095.
14. $139.20.
15. $65·736.
16. $142.72½.
17. $155·682.
18. $55.82½.
19. $59.40.
20. $186.82½.

### Exercise 2.

1. $140.25.
2. $196.80.
3. $103.84⅝.
4. $197·1329.
5. $135.03.
6. $188.65.
7. $45·5155.
8. $138·3754.
9. $42·6313.
10. $142.44.
11. $55·3588.
12. $210·8083.
13. $37.49¾.
14. $147·5658.
15. $60·2466.

### Exercise 3.

1. $25.13$\frac{7}{13}$.
2. $56·0968.
3. $59.1266.
4. $5·2475.
5. $4·3774.
6. $27·306.
7. $18·9899.
8. $26.59$\frac{2}{13}$.
9. $13.90.
10. $21.81$\frac{2}{13}$.
11. $31.15$\frac{2}{13}$.
12. $11·1788.
13. $27·345.
14. $28·7345.
15. $13.35$\frac{14}{36}$.

## COMPOUND INTEREST.

| Amount. | Interest. |
|---|---|
| 1. $857·337. | $116·737. |
| 2. $1380.151. | $140·151. |
| 3. $757·5457. | $67·1457. |
| 4. $814.6549. | $130.6549. |
| 5. $995.072. | $75.072. |
| 6. $3341.56¼. | $381.56¼. |
| 7. $1398.68. | $466 68. |
| 8. $1370.0866. | $370.0866. |
| 9. $661.50. | $61.50. |
| 10. $944·3327. | $196.3327. |
| 11. $1045·0748. | $155·0748. |
| 12. $3029·9447. | $629.9447. |

## DISCOUNT.

### Exercise 1.

1. $482.40½.
2. $908.04.
3. $613.73.
4. $829.71.
5. $484·9622.
6. $977.4246.
7. $634.77.
8. $1557.40.
9. $851.52.
10. $445.60.
11. $2335 30.
12. $3387.01.
13. $71·5284.
14. $13.2789.
15. $32.04.

### EXERCISE 2.

1. \$931·0344.
2. \$970·8737.
3. \$247.41.
4. \$616·2962.
5. \$669.6437.

## EQUATION OF PAYMENTS.

1. $4\frac{2}{15}$ months.
2. $5\frac{3}{8}$ months.
3. $8\frac{11}{78}$ months.
4. $10\frac{111}{410}$ months.
5. $2\frac{21}{74}$ months.
6. $4\frac{9}{7}$ months.
7. $8\frac{8}{167}$ months.
8. $8\frac{1}{8}$ months.

## BARTER.

1. 26 cents.
2. 460 pounds.
3. 128 pounds.
4. \$9.40$\frac{39}{7}$.
5. 2 cwt $12\frac{13}{16}$ lbs.
6. $27\frac{9}{13}$ lbs.
7. [illegible] cents.
8. [illegible] bush $3\frac{5}{4}$ pks.
9. 22 sheep.

## PROFIT AND LOSS.

### EXERCISE 1.

1. \$53.57.
2. \$144.
3. \$9.10.
4. \$12.60.
5. \$12.77½.
6. \$95.85.

### EXERCISE 2.

1. $5\frac{455}{570}$ per cent.
2. $11\frac{1}{9}$ per cent.
3. $4\frac{191}{156}$ per cent.
4. $4\frac{228}{51}$ per cent.
5. $5\frac{5}{9}$ per cent.
6. $8\frac{1}{5}$ per cent.
7. $6\frac{9}{11}$ per cent.
8. $7\frac{1}{7}$ per cent.

### EXERCISE 3.

1. \$2332.60.
2. \$1030.08.
3. \$1393.20.
4. \$23·265.
5. \$884.80.
6. \$35.52.
7. \$232.50.
8. \$294.30.

### EXERCISE 4.

1. $32\frac{76}{107}$ cents.
2. \$2245·45$\frac{5}{11}$.
3. \$1840.
4. \$169·642$\frac{2}{7}$.
5. \$309.73$\frac{51}{113}$.
6. \$70·65$\frac{3}{23}$.
7. \$2713·04$\frac{5}{23}$.
8. \$290·65$\frac{15}{107}$.

## SIMPLE PARTNERSHIP.

1. A's share $392·15 $\frac{45}{167}$.
   B's —— $569·84 $\frac{112}{167}$.
2. A's share $2390·60 $\frac{7820}{12503}$.
   B's —— $3180·43 $\frac{8371}{12503}$.
   C's —— $2678·95 $\frac{8816}{12503}$.
3. A's gain $1181·25.
   B's —— $975.
   C's —— $1593·75.
   D's —— $750.
4. A's loss $425.
   B's —— $340.
   C's —— $935.
5. A's share $1622·08 $\frac{1184}{3677}$.
   B's —— $424·25 $\frac{3276}{3677}$.
   C's —— $553·65 $\frac{2825}{3677}$.
6. A's gain $2195·11 $\frac{103}{127}$.
   B's —— $3064·88 $\frac{24}{127}$.
7. A's loss $126·66 $\frac{2}{3}$.
   B's —— $95.
   C's —— $158·33 $\frac{1}{3}$.
8. A's share $962·83 $\frac{21}{113}$.
   B's —— $1444·24 $\frac{88}{113}$.
   C's —— $1504·42 $\frac{54}{113}$.
   D's —— $2888·49 $\frac{63}{113}$.
9. A's loss $3142·22 $\frac{2}{9}$.
   B's —— $3647·22 $\frac{2}{9}$.
   C's —— $3310·55 $\frac{5}{9}$.
10. A's share $3300.
    B's —— $2760.
    C's —— $3690.
11. A's share $2155·17 $\frac{49}{203}$.
    B's —— $2894·08 $\frac{170}{203}$.
    C's —— $3448·27 $\frac{116}{203}$.
    D's —— $4002·46 $\frac{62}{203}$.
12. A's gain $606·66 $\frac{2}{3}$.
    B's —— $793·33 $\frac{1}{3}$.

## COMPOUND PARTNERSHIP.

1. A's share $108.52 $\frac{188}{481}$.
   B's —— $182.12 $\frac{28}{481}$.
   C's —— $122.24 $\frac{250}{481}$.
   D's —— $187.11 $\frac{2}{1}$.
2. A's share $368.42 $\frac{2}{19}$.
   B's —— $394.73 $\frac{13}{19}$.
   C's —— $736.84 $\frac{4}{19}$.
3. A's gain $1486.45 $\frac{5}{31}$.
   B's —— $2601.29 $\frac{1}{31}$.
   C's —— $2312.25 $\frac{25}{31}$.
4. A's gain $1211.53 $\frac{11}{13}$.
   B's —— $888.46 $\frac{2}{13}$.
5. A's share $244.02 $\frac{42}{179}$.
   B's —— $209.16 $\frac{36}{179}$.
   C's —— $326.81 $\frac{101}{179}$.
6. A's loss $209.90 $\frac{30}{53}$.
   B's —— $279.87 $\frac{67}{179}$.
   C's —— $400.22 $\frac{2}{179}$.
7. A's gain $87.09 $\frac{21}{31}$.
   B's —— $93.14 $\frac{16}{31}$.
   C's —— $119.75 $\frac{25}{31}$.
8. A's share $1696 92 $\frac{122}{179}$.
   B's —— $1003.07 $\frac{47}{179}$.

## INVOLUTION.

1. 441.
2. 3375.
3. 256.
4. 5832.
5. 6561.
6. 1024.
7. 262144.
8. 83521.
9. 537824.
10. 1771561.
11. 729.
12. 6084.
13. 2197.
14. 6859.
15. $\frac{729}{15625}$.
16. $\frac{14641}{625}$.
17. $\frac{4913}{125}$.
18. $\frac{161051}{371293}$.
19. 13651919.
20. $\frac{16}{2401}$.

## EVOLUTION.

### Exercise 1.

1. 34.
2. 248.
3. 25·8069758.
4. 750·964712.
5. 33·6181.
6. 6031.
7. 20.784.
8. 2·47847879.
9. 6·26498.
10. 41·569219.
11. 11111·11106.
12. ·17.
13. $\frac{4}{5}$, $\frac{7}{11}$, $\frac{5}{12}$.
14. 6·15142259.
15. ·244948974.
16. 1·62018517.
17. 5·5.
18. 23.7065391.
19. 8·86602257.
20. 12.062.
21. 28.
22. 1917.04668.
23. 1578.
24. 90.6.

### Exercise 2.

1. 34.
2. 246.
3. 56.
4. 432.
5. 2436.
6. 1234.
7. 497.933859.
8. 86.
9. 179.
10. $\frac{3}{4}$, $\frac{5}{7}$, $\frac{6}{9}$.
11. 26·1.
12. 3.65.
13. 23·45.
14. 10·3.
15. 34·2.
16. 38.

### Exercise 3.

1. 375.
2. 23.
3. 132.
4. 121.
5. 26.
6. 48.
7. 32.
8. 19.

## DUODECIMAL MULTIPLICATION.

### Exercise 1.

1. 29 ft 8 in 3 lines.
2. 36 ft 2 in.
3. 38 ft 3 in 2 l.
4. 107 ft 11 in 4 l.
5. 133 ft 6 in 8 l 6$^{m}$
6. 171 ft 5 in 11 l 4$^{m}$
7. 68 ft 1 in 8 l 3$^{m}$
8. 96 ft 4 in 10 lines 9$^{m}$ 11$^{mm}$
9. 96 ft 9 in 5 l 4$^{m}$ 11$^{mm}$
10. 170 ft 3 in 5 l 7$^{m}$
11. 550 ft 11 in 0 l 3$^{m}$
12. 7704 ft 6 in 5 l 7$^{m}$ 3$^{mm}$

### Exercise 2.

1. 33 ft 0 in 9 l.
2. 61 ft 4 in 4 l.
3. 142 ft 0 in 1 l.
4. 22 ft 7 in 3 l.
5. 187 ft 11 in 3 l.
6. 28 ft 0 in 8 l.
7. 85 ft 3 in 6 l.
8. 288 ft 10 in 3 l.
9. 78 ft 2 in 8 l.
10. 75 ft 5 in 7 l 6$^{m}$
11. 140 ft 8 in 8 l.
12. 49 ft 1 in.
13. 48 ft 5 in 9 l 4$^{m}$
14. 86 ft 3 in 7 l.
15. 30 ft 6 in 4 l 4$^{m}$
16. 58 ft 9 in 4 l.
17. 155 ft 10 in.
18. 215 ft 6 in 2 l.
19. 100 ft 10 in 5 l 6$^{m}$
20. 1360 ft 5 in 8 l.

## MISCELLANEOUS.

1. $156.55.
2. $72.45
3. $548.48$\frac{12}{17}$.
4. $23.43$\frac{1}{8}$.
5. $1497.68.
6. $50.841.
7. $225.16.
8. 2 cwt 3 qrs 19$\frac{5}{8}$ lbs.
9. $88.09.
10. 8 lbs 2$\frac{2}{3}$ oz.
11. 22152.
12. 11$\frac{13}{43}$ days.
13. 1$\frac{79}{616}$.
14. ·2,3·571428, ·25, ·75.
15. 293.
16. $1000.
17. A's share $137.01$\frac{33}{67}$.
    B's —— $78.98$\frac{34}{67}$.
18. 2$\frac{1}{17}$.
19. $\frac{2}{10}$, $\frac{31}{50}$, $\frac{31}{250}$, $\frac{468}{2000}$.
20. 31$\frac{304}{3127}$.
21. $789.42$\frac{6}{7}$.
22. 64.
23. 73$\frac{7}{11}$ cents.
24. 8$\frac{1}{3}$ per cent.
25. $204.70.
26. 120 pounds.
27. $60.48.
28. 268 feet 5 in 4 l.
29. A's share $1261.72$\frac{88}{81}$.
    B's —— $734.56$\frac{64}{81}$.
    C's —— $803.70$\frac{10}{27}$.
30. 624.
31. 2267 days 23 h 12 min 24 sec.
32. 69 yds 3$\frac{1}{7}$ nails.
33. $2760.
34. £741 : 2 : 6.
35. 218$\frac{1}{4}$ bushels.
36. $2450.08.
37. 5040.
38. $41.23$\frac{7}{11}$.
39. 24517 hhdds 9 gals 3 qts 1 gill.
40. $807.66$\frac{12}{25}$.
41. $995.92$\frac{1}{2}$.
42. $536.46$\frac{3}{5}$.
43. $88.38.
44. 23.
45. $3706.37$\frac{1}{2}$.
46. A's share $2202.35$\frac{755}{2567}$.
    B's —— $3024.
    C's —— $2021.64$\frac{1812}{2567}$.
47. $27.96.
48. 39414 feet.
49. $257.55$\frac{65}{117}$.
50. .375, ·571428, ·54, ·5.
51. $\frac{33}{71}$, $\frac{1}{2}$, $\frac{348}{709}$.
52. $54·53871$\frac{1}{2}$.
53. $2896.33$\frac{1}{2}$.
54. $10167.60.
55. 2 roods 20 sq per 20 sq yds 6 sq feet 84 sq inches.
56. $61.41$\frac{3}{4}$.
57. 8$\frac{39}{77}$ months.
58. 22$\frac{2}{7}$ days.
59. $152.71.
60. $79.68$\frac{1}{3}$.
61. $196.15$\frac{5}{13}$.
62. 4$\frac{4}{9}$ days.
63. $993.20.
64. 2$\frac{203}{620}$.
65. 742.
66. $14.66$\frac{2}{3}$.
67. $7.71$\frac{3}{4}$.
68. $1780.10.
69. A's share $340.35$\frac{35}{139}$.
    B's —— $255.56$\frac{116}{139}$.
    C's —— $234.07$\frac{27}{139}$.
70. 48$\frac{24}{55}$ bushels.
71. 24.
72. $2939.35.
73. 10$\frac{1}{2}$ cents.
74. ·4, ·875, ·3, ·8.
75. $685.85.

## ANSWERS TO EXERCISES ON METRIC SYSTEM.

1. 1795 centimes.
2. 17 francs 4 decimes 2 c.
3. 6907654 millimètres.
4. 7 décams 2 mètres 4 décims 8 centims.
5. 6 myriams 4 kiloms 2 hectoms 9 mètres 7 décims 4 centims.
6. 9000 milligrammes.
7. 94703 milligrammes.
8. 2 kilogs 4 hectogs 9 grams 6 décigs 4 centigs 8 milligs.
9. 852 francs 5 centimes.
10. 66 myriams 3 kiloms 9 hectoms 2 metres 8 décims 7 centims 7 millims.
11. 180 kilogs 4 hectogs 9 décags 7 grammes 2 décigs 2 centigs 8 milligs
12. 16 francs 8 d 5 c.
13. 85 myriams 6 hectoms 6 décams 9 décims 3 millims.
14. 20 kilogs 6 hectogs 1 gram 5 decigs 7 milligs.
15. 1735 fr 2 d 3 c ; 2726 fr 7 d 9 c ; 8428 fr 2 d 6 c.
16. 149 myriams 6 kiloms 7 hectoms 4 décams 4 mètres.
    2245 myriams 1 kilom 1 hectom 6 décams.
17. 58 kilogs 8 hectogs 3 décags 3 grammes 7 décigs 6 centigs 5 milligs.
    418 kilogs 3 hectogs 7 décags 3 grammes 4 decigs 4 centigs.
18. 138 francs 8 d 3 c.
    416 francs 4 d 9 c.
19. 415 myriams 3 kiloms 5 hectoms.
    138 myriams 4 kiloms 5 hectoms.
    27 myriams 6 kiloms 9 hectoms.
20. 199 kilogs 1 hectog 2 grams 2 decigs 3 centigs.
    11 kilogs 5 hectogs 4 décags 2 grammes 1 décig 5 centigs 8 milligs.
21. 222 francs 3 d 2 c.
22. 440 francs 4 d.
23. 225 francs 9 d 3 c.
24. 194 francs 5 d.
25. 2 décags 4 grammes 6 centigs 4 milligs.
26. 15 francs 5 d 9 c.
27. 245 frs 9 d.
28. $2\frac{1}{2}$ days.
29. 129 frs 2 d 4 c.
    150 frs 7 d 8 c.
    193 frs 8 d 6 c.
30. 46 frs 6 d 4 c.
    55 frs 9 d 6 c.
    74 frs 6 d 2 c.
31. 31 frs 2 d.
32. 102 frs 9 d 6 c.
33. 1072 frs 8 d 6 c.
34. Amount 5248 frs 8 d.
    Interest 748 frs 8 d.

THE END.

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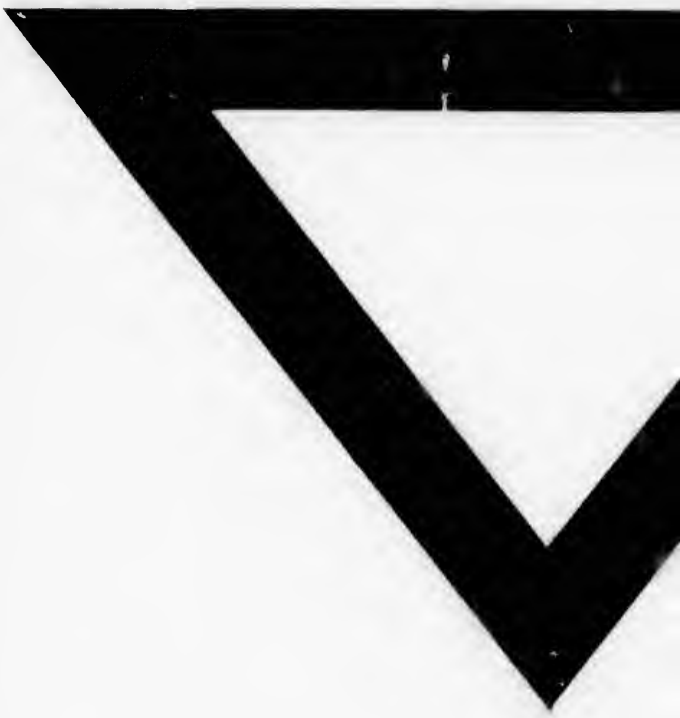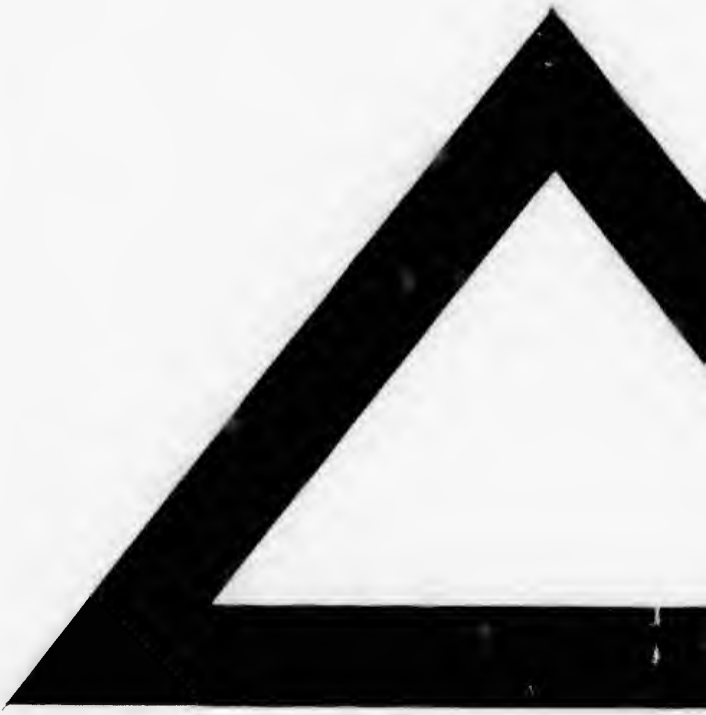
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