BROOKS' MENTAL ARITHMETIC

THE NORMAL MENTAL ARITHMETIC.

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THE

NORMAL MENTAL ARITHMETIC

A

THOROUGH AND COMPLETE COURSE,

BY

ANALYSIS AND INDUCTION.

BY

EDWARD BROOKS, A.M.,

PRINCIPAL AND PROFESSOR OF MATHEMATICS IN PENNSYLVANIA STATE NORMAL SCHOOL, AND AUTHOR OF "NORMAL PRIMARY ARITHMETIC," "NORMAL ELEMENTARY ARITHMETIC," "NORMAL WRITTEN ARITHMETIC," "NORMAL GEOMETRY," ETC.

Revised Edition,

WITH A

TREATISE ON MENTAL ALGEBRA

"Analysis and Induction are the golden keys which unlock the various cos ex con nations of number."

PHILADELPHIA:

SOWER, POTTS & CO

530 MARKET ST., AND 523 MINOR ST.

OFFICE OF THE CONTROLLERS OF PUBLIC SCHOOLS,
FIRST DISTRICT OF PENNSYLVANIA.
PHILADELPHIA, March 29, 1869.

At a meeting of the Controllers of Public Schools, First District of Pennsylvania, held at the Controllers' Chamber, Tuesday, March 9, 1869, the following resolution was adopted:—

Resolved, That the Normal Series of Arithmetics, comprising "Brooks's Normal Primary Arithmetic," "Brooks's Normal Elementary Arithmetic," "Brooks's Normal Mental Arithmetic," and "Brooks's Normal Written Arithmetic," by Edward Brooks, Esq., be and the same are hereby placed on the list of books to be used in the Public Schools of this District.

From the minutes:

H. W. HALLIWELL, Sec'y.

Entered, according to Act of Congress, in the year 1858, by
EDWARD BROOKS,
In the Clerk's Office of the District Court of the United States, in and for the Eastern District of Pennsylvania.

Entered, according to Act of Congress, in the year 1863, by
EDWARD BROOKS,
In the Clerk's Office of the District Court of the United States, in and for the Eastern District of Pennsylvania.

MEARS & DUSENBERY, STEREOTYPERS. SHERMAN & CO., PRINTERS.

The Board of School Trustees for the STATE OF MARYLAND, recommend Brooks's Normal Arithmetics and Fewsmith's Grammars, for use in all the Public Schools of that state.

The Board of School Commissioners for the CITY OF BALTIMORE, have adopted Brooks's Normal Series and Fewsmith's Grammars, for exclusive use in the Public Schools of that city.

TO

J. P. WICKERSHAM, A. M.

PRINCIPAL OF THE LANCASTER COUNTY NORMAL SCHOOL,

AS

A TOKEN OF HIGH PERSONAL REGARD,

AND

A TRIBUTE OF ADMIRATION FOR HIS NOBLE EFFORTS

IN THE

GREAT CAUSE OF POPULAR EDUCATION,

This Little Volume

IS MOST SINCERELY INSCRIBED BY

THE AUTHOR.

PREFACE.

THE science of Arithmetic, as taught until quite recently, has been much less beneficial as an educational agency than it should have been. Consisting mainly of dictated methods of deriving results, without presenting the reasons for the various operations, it failed to afford that high degree of mental discipline, which, when properly taught, it is so well calculated to impart. But a great change has been wrought in this respect—a new era has dawned upon the world of science—the royal road to Mathematics has been so graded and strewn with the flowers of reason and philosophy, that it is now full of interest and profit to the youthful learner;—and one of the most influential agents in this work has been the system of Mental Arithmetic.

The present is a proud period in the history of popular education. At no previous time has there been so deep and universal an interest manifested in the advancement of the cause; and this, combined with the elevation of the standard of qualification among our teachers, has created a demand for a more philosophic, systematic,

and comprehensive text book on the subject of Mental Arithmetic, than has hitherto been presented;—and, at the solicitation of his friends, the author of the present work has attempted to meet that demand; how successfully, must be determined by those whose province it is to decide.

In the prosecution of this object he has availed himself of the experience of several years of actual instruction in the science, and of the careful examination of what has been previously written, for the purpose of ascertaining wherein improvements might be made. He does not assume that every problem, or class of problems, or the principle of every solution, is original with himself; as every intelligent teacher knows that certain problems and solutions have stood the test of years, and no book would be faultless without them. The object has been not to be merely original, but to prepare a suitable and valuable text book; he feels confident, however, that it will be found to contain sufficient distinct and original features to recommend it to the favourable consideration of the friends of education.

The work, like others of the same class, is not designed for the child's first book in the science of numbers, and, therefore, the more elementary operations have not been uselessly enlarged upon; yet the arrangement is so systematic, and the transition from the easy to the complex so gradual, that even very young pupils can pursue it with ease and advantage.

A system of Mental Arithmetic should be based upon the principles of Analysis and Induction. Results should be derived by *analytic processes*, and *methods* inferred from these processes—and this is the philosophy upon

which the present treatise is founded. Analysis and Induction are the golden keys which unlock the various complex combinations of numbers—the magic wands by which the intricate and abstruse are unfolded in logical simplicity. The great element of Analysis is *comparison*, and the *equation* is the great Archimedean lever of comparison. It enters into every operation, from the simplest combination of Arithmetic, to the most complicated problem of the transcendental Analysis. In Geometry the axioms and definitions are the standards of comparison; in Algebra we compare the unknown with the known to determine its value; and in Arithmetic we compare all numbers, and the effects produced by a number of equal causes, with the unit, or effect of the single cause. And thus the science of Mathematics is evolved, comprising a vast series of dependent truths, derived from successive comparisons of the unknown with the known, the theoretic with the axiomatic, the complex with the simple

In the science of numbers, this relation of the collection to the unit is so evident, that it is intuitively apprehended, and hence the simplicity of this elementary process of Analysis. But as the pupil progresses in the science, it will be perceived that different collections bear certain relations to each other, and he should be taught to discover and apply these new relations. To develope this theory fully and completely has been the object of the author.

Attention is also called to the arrangement and treatment of Fractions. First is given the fractional *word*, treating them like denominate numbers, then the *numerical* fractional expression, and then, after extensive exercise in analytic processes, mechanical *methods* are

derived from these processes by Induction At the close of Fractions, some of these methods are stated in the form of Propositions, and their truth substantiated by demonstration. in a manner different from any which the author has met with, and which he has employed in teaching, with entire satisfaction. In nearly every section of the book will be found matter not previously introduced into works of this kind; and much that has never before been published Questions upon definitions and principles are given in various parts of the work, without answers to them, the object being to awaken original thought with the pupil, which is deemed far more valuable than the most accurate definition.

But it is impossible, as well as unnecessary, to call the attention to all the different peculiarities of the work, since intelligent teachers, upon examination, will see and judge for themselves. The whole, with its merits and demerits, is respectfully submitted to the public, with the sincere wish that it may prove a valuable auxiliary in the promotion of that noble science, which promises so much for the advancement of the great cause of popular education.

E. B.

LANCASTER COUNTY NORMAL SCHOOL.
April 7. 1858.

SUGGESTIONS TO TEACHERS.

THE attention of teachers is respectfully solicited to the following Method of Recitation. Some of them are preferable to others, but all may occasionally be used with advantage.

COMMON METHOD.— By this method the problems are read by the teacher and assigned promiscuously, the pupils not being permitted to use the book during recitation, nor retain the conditions of the problems by means of pencil and paper, as is sometimes done. The pupil selected by the teacher arises, repeats the problem, and gives the solution, at the close of which the mistakes that may have been made should be corrected by the class or teacher.

SILENT METHOD.—By this method the teacher reads a problem to the class, and then the pupils silently solve it, indicating the completion of the solution by the upraised hand. After the whole class, or nearly the whole class, have finished the solution, the teacher calls upon some member, who arises, repeats the problem, and gives the solution as in the former method.

By this method the whole class must be exercised upon every problem, thus securing more discipline than by the preceding method. It, however, requires more time than the first; hence, not so many problems can be solved at a recitation. We prefer the first method for advanced pupils, and the second, at least a portion of the time, with younger pupils.

CHANCE ASSIGNMENT.—This method differs from the first only in the assignment of the problems. The teacher marks the number of the lesson and the number of the problem, upon small pieces of paper, which the pupils may take out of a box passed around by the teacher or some member of the class. The teacher then, after reading a problem, instead of calling upon a pupil, merely gives the number of the problem, the person having the number arising, repeating, and solving it. By this method the teacher is relieved of all responsibility with reference to hard and easy problems, and it is also believed that better attention is secured with it. It is particularly adapted to reviews and public examinations.

DOUBLE ASSIGNMENT.—By this method the pupil who receives the problem from the teacher, arises, repeats it, and then assigns it to some one else to solve. It may be combined with either the first or second methods. The objects of this method are variety and interest.

METHOD BY PARTS.—By this method different parts of the same problem are solved by different pupils. The teacher reads the problem and assigns it to a pupil, and after he has given a portion of the solution, another is called upon, who takes up the solution at the point where the first stops; the second is succeeded in like manner by a third; and so on, until the solution is completed. The object of this method is to secure the attention of the whole class, which it does very effectually. It is particularly suited to a large class consisting of young pupils.

UNNAMED METHOD.—By this method the teacher reads and assigns several problems to different members of the class, before requiring any solutions, after which those who have received problems are called upon in the order of assign

ment for their solutions. The advantages of this method are, first, the pupil, having some time to think of the problem, is enabled to give the solution with more promptness and accuracy, and secondly, the necessity of retaining the numbers and their relations in the mind for several minutes, affords a good discipline to the memory.

CHOOSING SIDES.—This is a modification of the old spelling class method, and is one calculated to elicit a very great degree of interest. By it two pupils, appointed by the teacher, select the others, thus forming two parties for a trial of skill, as in a game of cricket or base ball. The problems may be assigned alternately to the sides, by the teacher, by chance, by the leaders of the sides, or in any other way that may be agreed upon by the teacher and class.

In regard to these methods, the first, second, and third are probably the best for the usual recitations, but the other methods can very profitably be employed with younger classes, or, in fact, with any class, to relieve monotony and awaken interest. With advanced pupils we prefer the first method, or the first combined with the third.

ERRORS TO BE AVOIDED.

There is a large number of errors to which pupils in every section of the country are liable, a few of which we will mention. We classify them as errors of Position and errors of Expression.

ERRORS OF POSITION.—Pupils are exceedingly liable to assume improper positions and awkward attitudes during recitation, such as leaning on the desk or against the wall, putting the foot upon a seat, jamming the hands in the pockets, particularly when the problem is hard, playing with a button, watch-chain, &c. All of these faults should be carefully guarded against, for reasons so obvious that they need not be mentioned. An erect and graceful carriage, aside from its relation to health, is of advantage to every lady and gentleman.

ERRORS OF EXPRESSION.—Under this head we include errors of Articulation, Pronunciation, Grammar, &c. There is quite a large number of words which pupils in their haste mispronounce, and also quite a large number of combinations, which by a careless enunciation make ridiculous sense, or nonsense. We will call the attention to a few of them, suggesting to the teacher to correct these and others he may notice.

"*And*" is often called "*an*;" "*for*" is called "*fur*;" "*of*" is pronounced as if the *o* was omitted; words commencing with *wh*, as when, which, where, &c., are pronounced as if spelled "*wen*," "*wich*," "*were*," &c.

"*Gave him*" is called "*gavim*;" "*did he*" is called "*diddy*;" "*had he*" is called "*haddy*;" "*give him*" is called "*givim*;" "*give her*" is called "*giver*;" "*which is*" is often changed into "*witches*;" and "*how many*" is frequently transformed into "*hominy*." "How many did each earn" is often rendered "hominy did *e churn*."

A very common error, and one exceedingly difficult to correct, is involved in the following solution: "If 2 apples cost 6 cents, one apple will cost *the* ½ of 6 cents, which *are* 3 cents." Here "*the*" is superfluous, and "*are*" is ungrammatical.

The following is a frequent error: "*If one apple cost* 3 *cents, for* 12 *cents you can buy as many apples as* 3 *is contained in* 12, *which are* 4 *times*." The objections are, first, 3 is not contained any *apples* in 12; secondly, the result obtained is *times*, when it should be *apples*, or a *number* which applies to both times and apples. The solution should be, "*You can buy as many apples for* 12 *cents as* 3 *is contained times in* 12, *which are* 4."

MENTAL ARITHMETIC.

SECTION I.

LESSON I.

1. If I have 2 cents in one hand, and 1 cent in the other, how many cents have I in both?

SOLUTION.—If I have 2 cents in one hand, and 1 cent in the other, in both hands I have 2 cents plus 1 cent, which are 3 cents. Therefore, if I have 2 cents in one hand, and 1 cent in the other, I have 3 cents in both.

2. John has 3 apples, and William has 2; how many have they both?

3. Fanny has 4 peaches, and her sister has 3; how many have they both?

4. James is 3 years old, and Sarah is 6; what is the sum of their ages?

5. Joseph bought 6 peaches, and his brother gave him 4; how many had he then?

6. I paid 10 cents for a slate, and 2 cents for a pencil; what did they both cost?

7. A cap cost 3 dollars, and a coat, 12 dollars; what did they both cost?

8. Peter had 8 cents, and found 10 more; how many had he then?

9 Martin had 6 birds, and caught 9 more; how many had he then?

10. A pig cost 5 dollars, and a sheep, 7 dollars; what did they both cost?

11. If Cyrus had 9 cows, and bought 11 more, how many would he then have?

12 A saddle cost 8 dollars, and a harness, 13 dollars; how much did they both cost?

13. Sally had 10 pins in her cushion, and put in 9 more; how many were then in the cushion?

14. If James rode 8 miles, and walked 13, how far did he travel?

15. Mustard has 10 sisters and 11 brothers; how many are there in the family?

16. Taylor had 5 horses, and his brother sold him 13, how many had he then?

17. In a garden there are 9 plum trees, and 11 peach trees; how many are there of both?

18. Required the cost of Hunter's coat, if the cloth cost 12 dollars, and the making, 5 dollars.

19. Rose gave 13 cents to her brother, and 10 to her sister; how many cents did she give away?

20. Mary's mother gave her 11 apples, and her father gave her 7; how many did they both give her?

21. If I have 12 pencils, and find 5 more, how many pencils will I then have?

22. Russell gave 3 cents for a top, 4 for a whip, and 5 for a book; what did they all cost?

23. Louisa had 5 peaches, her mother gave her 6, and her sister gave her 7; how many had she then?

24. Ruth bought 5 yards of silk for a hat, 7 for a cloak, and 9 for a dress; how many yards did she buy?

25. The head of a fish is 6 inches long, the tail 8, and the body 10; what is the length of the fish?

26 Philo caught 12 fish, Milo 9, and Nero 6; how many did they all catch?

27. Howard shot 11 robins, Howell 12, and Hoyt 13; how many did they all shoot?

28. A man bought a robin for 10 cents, a jay for 20

cents, and a blue bird for 30 cents; required the cost of all.

29. A sleigh cost 50 dollars, a horse 150 dollars, and a whip 5 dollars; what was the cost of all?

30. A lady gave 6 cents for needles, 12 cents for thread, and 10 cents for muslin; what was the cost of all?

31. Addie has 9 roses, Lizzie has 15, and Amy had 20; how many have they all?

32. A man bought some rye for 25 dollars, and some wheat for 26 dollars; what did he pay for both?

33. A merchant sold some rice for 15 dollars, some sugar for 17 dollars, and some molasses for 22 dollars; required the amount received.

34. How many are 4 and 8? 5 and 7? 3 and 9? 5 and 12? 8 and 17? 6 and 23? 7 and 15? 8 and 26? 10 and 28? 10 and 32?

35. How many are 5 and 21? 8 and 23? 9 and 31? 11 and 16? 3 and 19? 8 and 27? 10 and 27? 11 and 11? 12 and 12? 12 and 24?

36. How many are 6 and 16? 7 and 17? 8 and 18? 9 and 19? 10 and 20? 11 and 21? 12 and 22? 13 and 23? 20 and 30? 21 and 22?

37. How many are 2 and 12? 3 and 13? 4 and 14? 5 and 15? 6 and 26? 7 and 27? 8 and 28? 9 and 29? 10 and 30? 11 and 31?

38. How many are 2 and 17? 3 and 27? 4 and 36? 5 and 46? 12 and 41? 15 and 29? 24 and 37? 43 and 57? 38 and 65? 56 and 44?

A single thing is a *unit*. One or more units is a *number*. *Similar numbers* are those in which the units are the same. Addition is the process of finding the sum of two or more numbers.

The symbol, +, is the sign of addition. It is read *plus*, and when placed between two numbers denotes that they are to be added together. The symbol, —, is the sign of subtraction. It is read *minus*, and when placed between two numbers denotes that the second is to be subtracted from the first.

LESSON II.

1. If I have 4 cents, and give 2 of them away, how many will I have remaining?

SOLUTION.—If I have 4 cents, and give away 2 cents, I will have remaining the difference between 4 cents and 2 cents, which is 2 cents. Therefore, &c.

2. Hunter had 6 apples, and gave 2 of them away; how many had he remaining?

3. Morgan having 9 peaches, gave his sister 3 of them; how many had he left?

4. Ada culled 10 roses, and gave Lydia 5 of them, how many did she retain?

5. A man bought 12 lemons, and sold 7 of them; how many remained unsold?

6. Reuben finding 13 cents, spent 8 of them; how many had he remaining?

7. A watch was bought for 20 dollars, and sold for 27 dollars; what was the gain?

8. Mary has 28 pins, and Susan 15; how many more has Mary than Susan?

9. A cow was bought for 27 dollars, and sold for 19 dollars; required the loss.

10. In a school of 40 pupils, only 29 are present; how many are absent?

11. A horse cost 125 dollars, and was sold for 140 dollars; required the gain.

12. William said he found 43 marbles, and lost 13 of them; how many remained?

13. A farmer having 27 cows, sold 18 of them; how many cows had he remaining?

14. How many are 9 less 5? 11 less 7? 13 less 9? 15 less 11? 18 less 12?

15. How many are 16 less 8? 14 less 6? 12 less 4? 10 less 2? 14 less 8?

16. Required the value of 12—8? 13—7? 14—6? 15—5? 16—4?

17. Required the value of 10—5? 12—6? 14—7? 16—8? 18—9?

18. Required the value of 11—7? 14—8? 17—9? 20—10? 23—11? 26—12?

19. Required the value of 6—2? 10—4? 14—6? 8—8? 22—10? 26—12?

20. What is the value of 6+8—4? 7+5—6? 5+10—12?

What is the value

21 Of 7+6—5?	28. Of 10—6+4?
22. Of 3+8—9?	29. Of 16—7+8?
23. Of 5+6—7?	30. Of 18—6+3?
24. Of 7+8—9?	31. Of 15—8+2?
25. Of 9—6+3?	32. Of 16—7+8?
26. Of 8—5+10?	33. Of 17—9+4?
27. Of 6—3+12?	34. Of 22—12+13?

35. Silas having 3 dollars, found 6, and then lost 4; how many had he remaining?

36. A boy having 12 apples, bought 6 more, and then sold 8; how many had he left?

37. A man sold a colt for 25 dollars, which is 3 dollars more than it cost; required the cost.

38. James had 31 cents, and Harry had 27; how many had they both, and how many had James more than Harry?

39. John having 20 peaches, eat 4, and gave his sister 6; how many had he remaining?

40. Philo having 12 cents, spent 7, and then found 9; how many had he then?

41 A man having a certain number of cows, bought 6. and sold 10, and then had none left; how many had he at first?

42. Morris having a certain number of books, bought 10, and giving 30 to his sister, had none remaining; how many books had he at first?

43. Paxton had 16 peaches, he gave 6 to James, and 7 to Henry; how many had he remaining?

44. Edwin lost 4 cents, and found 6, and then had 11; how many had he at first?

45. A man sold 13 cows, then bought 10, and then had 12; how many had he at first?

46. Two boys commenced playing with 20 marbles each, at the close of the game one had 16; how many had the other?

47. A merchant bought goods to the amount of 27 dollars; how must he sell them to gain 11 dollars?

48. Thomas had 11 cents, Susan gave him 12, and Walton gave him enough to make his number 30; how many did Walton give him?

49. Mr. A gave 35 dollars for a case of goods, and paid 4 dollars for cartage; how must he sell them to gain 11 dollars?

50. How many are 4 plus 6 minus 5? 7 plus 8 minus 10? 8 plus 12 minus 9? 12 plus 13 minus 14? 16 plus 20 minus 30? 7 plus 15 minus 12?

51. How many are 7 and 20 minus 13? 9 and 13 minus 16? 13 and 15 minus 16? 18 and 19 minus 20? 16 and 17 minus 18? 20 and 30 minus 40?

52 How many are 6 plus 8 minus 10? 7 plus 9 minus 11? 8 plus 10 minus 12? 9 plus 11 minus 13? 10 plus 12 minus 14? 15 plus 17 minus 19?

53. How many are 4 plus 7 minus 10? 5 plus 8 minus 11? 6 plus 9 minus 12? 7 plus 10 minus 13? 8 plus 11 minus 14? 9 plus 12 minus 15?

54. How many are 6 plus 10 minus 14? 7 plus 11 minus 15? 8 plus 12 minus 16? 9 plus 13 minus 17? 10 plus 14 minus 18? 11 plus 15 minus 19?

55. How many are 4 plus 24 minus 14? 6 plus 26 minus 16? 7 plus 27 minus 17? 5 plus 25 minus 15? 8 plus 28 minus 18? 9 plus 29 minus 19?

56. How many are 7 plus 37 minus 27? 10 plus 30 minus 20? 11 plus 31 minus 21? 12 plus 32 minus 22? 13 plus 33 minus 23? 14 plus 34 minus 24?

57. How many are 4 and 4 minus 2 and 2? 6 and 6 minus 3 and 3? 12 and 12 minus 6 and 6? 23 and 23 minus 13 and 13? 27 and 27 minus 17 and 17?

58. How many are 2 and 20 taken from 3 and 30? 5 and 55 from 6 and 66? 4 and 44 from 5 and 55? 7 and 77 from 8 and 88? 9 and 99 from 12 and 112?

Subtraction is the taking of one number from another. The larger number is called the *minuend;* the smaller, the *subtrahend;* the result, the *difference* or *remainder.*

LESSON III.

1. What cost 4 apples, at 2 cents apiece?

SOLUTION.—If one apple cost 2 cents, 4 apples will cost 4 times 2 cents, which are 8 cents. Therefore, &c.

2. What cost 5 oranges, at 3 cents apiece?
3. At 5 cents each, what will 4 melons cost?
4. What will 8 sheep cost, at 6 dollars apiece?
5. At 3 dimes each, what will 12 turkeys cost?
6. What cost 7 cows, at 20 dollars each?
7. What cost 12 horses, at 200 dollars apiece?
8. At 30 cents apiece, what cost 11 knives?
9. What cost 12 books, at 20 cents apiece?
10. At 4 dimes each, what cost 9 ducks?
11. How far will a man travel in 9 days, at the rate of 12 miles a day?
12. A boy has 13 apples, and 5 times as many peaches; required the number of peaches.
13. Mary has 14 apples, and John has 7 times as many how many has John?
14. A has 13 dollars, and B has 9 times as many, what number have they both?
15. A farmer sold 4 horses, and then bought 6 times as many; how many did he buy?

16. How many dimes must be paid for 9 books, at the rate of 14 dimes each?

17. Amos saw 13 flocks of pigeons, with 20 pigeons in each flock; how many pigeons did he see?

18. A merchant having 10 melons, sold 6, and then ought 5 times as many as he sold; how many had he then?

19. B having 20 sheep, sold 12, and then bought 4 times as many as remained; how many did he then have?

20. A boy borrowed 6 cents from a friend, and then earned 7 times as much as he borrowed; how many cents had he then?

21. Mary found 10 pins, and then bought 8 times as many as she found; how many had she then?

22. What will 7 yards of muslin cost, at 8 cents a yard?

23. How much cost 11 yards of ribbon, at the rate of 11 cents a yard?

24. If 3 men can do a piece of work in 5 days, how long will it take 1 man to do it?

25. If 5 men can do a piece of work in 20 days, how long will it require 1 man to do it?

26. How far will a man travel in 9 hours, at the rate of 3 miles an hour?

27. In an orchard there are 11 rows of trees, and 20 trees in each row; how many trees are there in the orchard?

28. If 9 men mow a field of grass in 14 days, how long will it take 1 man to mow it?

29 Mason earned 10 dollars a week, and paid 3 dollars a week for his board; how much would he save in 5 weeks?

30 If 1 melon is worth 3 peaches, how many peaches are 7 melons worth?

31. Passmore earned 3 dollars a day, and paid 1 dollar for his board; how much could he save in a week?

32. Morton earned 30 dollars a month, he paid 3 dol-

lars a week for board, and 1 dollar for other expenses; how much could he save in a year?

33. Thomas travels 5 miles an hour, and John, 3; how much farther will Thomas travel in 12 hours than John?

34. How many are 6 times 6, plus 6? 5 times 8, plus 8? 7 times 10, plus 10? 4 times 11, plus 11? 8 times 4, plus 4? 5 times 9, plus 9?

35. How many are 3 times 4, plus 5? 6 times 7, plus 8? 8 times 9, plus 10? 9 times 10, plus 11? 10 times 11, plus 12? 11 times 12, plus 13?

36. How many are 4 times 4, minus 5? 5 times 7, minus 6? 7 times 9, minus 8? 8 times 10, minus 9? 9 times 12, minus 11? 11 times 12, minus 13?

37. How many are 7 and 7 times 8? 5 and 5 times 6? 8 and 8 times 4? 6 and 6 times 7? 9 and 9 times 11? 10 and 10 times 12?

38. How many are 4 and 5 and 4 times 5? 5 and 6 and 5 times 6? 6 and 7 and 6 times 7? 7 and 8 and 7 times 8? 8 and 9 and 8 times 9?

39. How many are 23 minus 2 times 3? 34 minus 3 times 4? 25 minus 2 times 5? 37 minus 3 times 7? 49 minus 4 times 9?

40. B and C start from the same place, and travel in opposite directions, B at the rate of 5, and C 4 miles an hour; how far are they apart in 6 hours?

41. Two men start at the same place, and travel in the same direction, the one 7, and the other 5 miles an hour; how far will they be apart in 10 hours?

Multiplication is the process of taking one number as many times as there are units in another. The number repeated is the *multiplicand;* the number of times it is repeated is the *multiplier;* the result is the *product.*

The symbol, $\times$, is the sign of multiplication; when placed between two numbers it denotes that they are to be multiplied together. The symbol, $\div$, is the sign of division; when placed between two numbers it denotes that the one before it is to be divided by the one following it.

LESSON IV.

1. How many 2's are there in 6?

SOLUTION.—In 6 there are 3 two's, because 3 times 2 are 6

2. How many 2's in 8? in 10? in 12? in 16?
3. How many 3's in 6? in 9? in 15? in 18?
4. How many 4's in 8? in 16? in 24? in 28?
5. How many 5's in 15? in 20? in 30? in 45?
6 How many 6's in 18? in 30? in 40? in 48?
7. How many 7's in 21? in 35? in 28? in 42?
8. How many 8's in 32? in 40? in 56? in 72?
9. How many 9's in 36? in 45? in 63? in 81?
10. How many 10's in 40? in 50? in 70? in 90?
11. How many 11's in 44? in 33? in 66? i 88?
12. How many 12's in 48? in 72? in 96? in 132?
13. 24 contains 3 how many times? 4? 6? 8? 12?

SOLUTION.—24 contains 3, eight times, since 8 times 3 are 24

14. 30 contains 2 how many times? 3? 5? 6? 10?
15. 36 contains 3 how many times? 4? 6? 9? 12?
16. 40 contains 4 how many times? 5? 8? 10? 20?
17. 60 contains 5 how many times? 6? 10? 12? 20?
18. 80 contains 4 how many times? 8? 10? 20? 40?
19. 90 contains 3 how many times? 6? 9? 10? 30?
20. 100 contains 4 how many times? 5? 10? 20? 25?
21. How many times 3 are 6 times 2?
22 How many times 5 are 4 times 10?
23. How many times 7 are 3 times 14?
24 How many times 8 are 5 times 6, + 2?
25 4 times 7, + 2, are how many times 6?
26 6 times 8, — 8, are how many times 10?
27. 7 times 9, — 3, are how many times 12?
28. 8 times 7, + 4, are how many times 4?
29. 10 times 9, — 6, are how many times 7?
30 9 times 8, + 8, are how many times 8?

31. 5 times 12, — 4, are how many times 1 . ?
32. 4 times 11, + 6, are how many times 5 ?
33. 5 times 6, + 10, — 8, are how many times 8 ?
34. 7 times 8, — 6, + 5, are how many times 5 ?
35. 8 times 9, + 8, — 10, are how many times 10 ?
36. 9 times 9, + 9, — 2, are how many times 8 ?
37. 8, and 4, and 2, and 3, and 5, and 6, less 12, are how many?
38. Five, and 6, and 4, and 7, and 8, and 10, less 20, are how many?
39. Four, and 7, and 6, and 5, and 3, and 2, less 17, are how many?
40. Twelve, multiplied by 2, divided by 3, multiplied by 4, divided by 8, plus 6, are how many?
41. Three times 8, increased by 6, divided by 3, diminished by 5, are how many?
42. How many times 5 times 6, increased by 10, is 6 times 10, increased by 20?

LESSON V.

1. At 3 cents each, how many melons can I buy for 12 cents?

SOLUTION.—If 1 melon cost 3 cents, for 12 cents I can buy as many melons as 3 is contained times in 12, which are 4. Therefore, &c

2 At 2 dimes apiece, how many books can I buy for 8 dimes?
3. At 4 cents a yard, how many yards of ribbon can I buy for 16 cents?
4. How many apples can I buy for 21 cents, at 3 cents apiece?
5. How many yards of ribbon, at 6 cents a yard, can be bought for 42 cents?

6. A man gave 50 dollars for sheep, at the rate of 5 dollars a head; how many did he buy?

7. If a man travel 4 miles an hour, how long will it take him to travel 48 miles?

8. A man gave 7 boys 56 cents; how much did each boy receive?

9. If 8 apples cost 24 cents, how much will one apple cost?

10. A farmer received 88 dollars for sheep, at the rate of 8 dollars each; how many did he sell?

11. How many kegs, of 9 gallons each, can be filled from a hogshead, containing 63 gallons of molasses?

12. How many days must a man work to earn 44 dollars, at the rate of 4 dollars a day?

13. How many melons, at 7 cents apiece, may be bought for 84 cents?

14. How many oranges, at 3 cents each, may be had for 5 lemons, worth 6 cents each?

15. How many yards of lace, at 6 cents a yard, may be bought for 3 yards of muslin, at 12 cents per yard?

16. If a man digs 10 yards of ditch, for 8 dimes a yard, how many bushels of rye, at 4 dimes a bushel, will pay him?

17. How many pounds of meat, at 6 cents a pound, will cost as much as 9 yards of ribbon, at 8 cents a yard?

18. How many boxes of wafers, worth 6 cents a box, may be bought for 12 sheets of paper, worth 2 cents a sheet?

19. How much wheat, at 6 dimes a bushel, may be purchased for 12 bushels of corn, worth 5 dimes a bushel?

20. How many knives, at 3 dimes each, can I buy for 2 dimes in money, and 7 boxes of raisins, at 4 dimes each?

21. If flour is worth 8 dollars per barrel, how many barrels can be bought for 3 dollars, and 7 barrels of fish, at 11 dollars per barrel?

22 A man gave 9 pencils, worth 5 cents each, for 3 packages of envelopes, worth 11 cents each; what did he lose?

23. How many lamps at 7 dimes each, can be bought for 9 dimes in money, and 6 dozen eggs, at 2 dimes per dozen?

24. How many are 12 plus 6 divided by 6? 25 plus 5 divided by 5? 32 plus 8 divided by 8? 42 plus 7 divided by 7? 45 plus 9 divided by 9?

25. How many are 16 and 4 divided by 4? 21 and 7 divided by 7? 44 and 11 divided by 11? 60 and 12 divided by 12? 96 and 8 divided by 8?

26. How many are 90 minus 9 divided by 9? 80 minus 8 divided by 8? 100 minus 4 divided by 4? 110 minus 10 divided by 10? 144 minus 12 divided by 12?

27. How many are 6 times 8 divided by 4? 7 times 9 divided by 3? 10 times 6 divided by 12? 9 times 9 divided by 3? 12 times 10 divided by 5?

28. How many are 2 times 22 divided by 11? 4 times 14 divided by ? 3 times 15 divided by 5? 6 times 16 divided by 8? 8 times 18 divided by 12?

29. How many are 48 divided by 6, plus 8? 30 divided by 5, plus 6? 8 divided by 7, plus 17? 50 divided by 5, plus 15? 35 divided by 7, plus 17? 84 divided by 12, plus 22?

30. Twice a number, + 3 times the number, — 4 times the number, + 2 times the number, equals how many times the number?

NOTE.—With young pupils this and the following problems should be read slowly, that the pupils may solve them as the teacher reads. More advanced pupils should be required to enunciate them after the teacher has read them, and then solve them.

31. Three times a number, — 2 times the number, + 4 times the number, — 5 times the number, equals how many times the number?

32. Four times Susan's age, + 3 times her age, — 5 times her age, + 2 times her age, — 3 times her age, equals 13 years; how old is Susan?

33. Three times Henry's number of marbles, + twice his number, — 3 times his number, + 4 times his number, — 5 times his number, equals 15; how many has he?

34 Eight times a number, ÷ by 4, × by 6, ÷ by 2, × by 5, ÷ by 10, equals how many times the number?

35. Five times a number, × by 4, ÷ by 10, × by 6, ÷ by 4, × by 2, equals how many times the number?

36. Think of any number, multiply it by 6, divide by 3, multiply by 2, divide by 4, add 10, subtract the number thought of, divide by 5, and the quotient is what?

37. Think of a number, multiply it by 10, divide it by 5, multiply by 3, divide by 6, add 16, subtract the number thought of, divide by 8, and the quotient is what?

38. Three times Mary's age, multiplied by 6, divided by 9, multiplied by 4, divided by 8, equals 16 years; how old is Mary?

39. Think of a number, multiply it by 5, multiply that by 4, divide the product by 10, multiply by 6, divide by 3, add 30, subtract 4 times the number, divide by 5, and name the quotient.

40. What is Division? Name and define each term employed. What kind of numbers may each term be respectively?

SECTION II.

LESSON I.

1. If I divide an apple into two equal parts, what is one of these parts called? What are 2 of these parts called?

2 How many halves of an apple in one apple?

3 What is 1 half of 6

SOLUTION.—1 half of 6 is 3, because 2 times 3 are 6.

4 What is 1 half of 4? of 8? of 10? of 12?

5 What is 1 half of 14? of 16? of 18? of 20?

6. What is 1 half of 22? of 26? of 28? of 32?

7. If 1 yard of cloth cost 16 cents, what will 1 half of a yard cost?

8 If 1 pound of sugar cost 10 cents, what will 1 half of a pound cost?

9. Paul having 20 apples, gave 1 half of them to his brother; how many did he give away?

10. Thompson bought 24 cows, and sold 1 half of them; how many did he retain?

11. Phebe had 80 peaches, and gave 1 half of them away; how many remained?

12. If I divide an apple into 3 equal parts, what is one of these parts called?

13. What are 2, and 3 of these parts called?

14. How many thirds in one apple?

15. What is 1 third of 6? of 9? of 12? of 15?

16. What is 1 third of 21? of 24? of 30? of 36?

17. James had 30 cents, and lost 1 third of them; how many did he lose?

18. Henry had 39 pears, and Thomas had 1 third as many; how many had Thomas?

19. Lucy had 21 pins, and gave Mary 1 third of them; how many did Mary receive?

20. Matthew bought 24 oranges, and gave 1 third of them to Stephen; how many remained?

21. A bought 42 cows, and sold 1 third of them to B; how many had he remaining?

22. What are 2 thirds of 9?

SOLUTION.—1 third of 9 is 3, and if 1 third of 9 is 3, 2 thirds of 9 are 2 times 3, which are 6. Therefore, &c.

23. What are 2 thirds of 6? of 12? of 15? of 18?

24. What are 2 thirds of 24? of 30? of 27? of 33?

25. John had 21 cents, and gave 2 thirds of them to Sarah; how many cents did Sarah receive?

26 Having 27 peaches, I sold 2 thirds of them; how many did I sell?

27 Henry gave his sister 2 thirds of 39 oranges; how many did he retain?

28. Hiram lost 2 thirds of 36 dollars; how much money had he remaining?

29. Chandler, having 30 pears, gave 1 third to Maria, and 1 third to Jane; how many remained?

30. If I divide an apple into 4 equal parts, what are 1. 2, and 3 of these parts?

31. How many fourths of an apple in a whole apple?

32. What is 1 fourth of 4? of 8? of 20? of 32?

33 What is 1 fourth of 12? of 24? of 16? of 48?

34. What are 2 fourths of 24? of 16? of 28? of 36?

35. What are 2 fourths of 12? of 20? of 40? of 48?

36. What are 3 fourths of 20? of 24? of 12? of 16?

37. What are 3 fourths of 16? of 28? of 40? of 52?

38. Jacob having 44 pens, sold 2 fourths of them to Joseph; how many pens did Joseph receive?

39. If a yard of cloth cost 8 dollars, what will 3 fourths of a yard cost?

40. A boy sold 2 fourths of 28 pears; how many had he remaining?

41. Samson gave his brother 1 fourth, and his sister 2 fourths of 28 oranges; how many did each receive?

42. Marion found 2 fourths of 28 cents, and then lost 3 fourths of 16 cents; how many remained?

43. A having 24 plums, gave 1 half of them to B, and 1 third to C; how many had he left?

44. Harleigh is 24 years of age, and Townsend is 3 fourths as old; how old is Townsend?

45. A farmer had 36 sheep, of which A bought half, and a dog killed 1 third; how many remained?

46. A merchant having 40 barrels of flour, sold 3 fourths of them, and then bought 1 third as many as he sold; how many had he then?

LESSON II.

1. If you divide an orange into 5 equal parts, what re 1 2, 3, and 4 of these parts called?
2. How many fifths in one orange?
3. What is 1 fifth of 10? of 25? of 15? of 30?
4. What are 2 fifths of 15? of 30? of 45? of 60?
5. What are 2 fifths of 55? of 35? of 40? of 50?
6. What are 3 fifths of 10? of 30? of 25? of 55?
7. What are 4 fifths of 20? of 50? of 60? of 100?
8. Mary has 15 oranges, and Rachael 2 fifths as many; how many has Rachael?
9. Susan's age is 25 years, and her sister is 4 fifths as old; how old is her sister?
10. Rowland is 35 years of age, and his wife is 3 fifths as old; how old is his wife?
11. A horse cost 100 dollars, and a sleigh 3 fifths as much; required the cost of the sleigh.
12. A man having 40 sheep, lost 20, and found only 3 fifths of them; how many remained?
13. A man having 50 cows, sold 4 fifths of them, and then bought 4 fifths as many as he sold; how many had he then?
14. 4 fifths of 200 dollars, is 2 times what Emily's watch cost; what was the cost of the watch?
15. If you divide a melon into 6 equal parts, what are 1, 2, 3, 4, and 5 of these parts called?
16. How many sixths are there in a single thing?
17. What are 2 sixths of 24? of 18? of 36? of 60?
18. What are 3 sixths of 12? of 42? of 30? of 66?
19. What are 4 sixths of 6? of 36? of 48? of 54?
20. What are 5 sixths of 18? of 54? of 24? of 72?
21. What will 2 sixths of 12 yards of tape cost, at 3 cents a yard?
22. Raub having 48 pens, sold 3 sixths to Frescoln, and 2 sixths to Morgan; how many did he sell to both?

23. What will 5 sixths of 36 yards of cloth cost at the rate of 2 dollars a yard?

24. Warren had 12 marbles, and Oliver had 5 sixths as many, lacking 4; how many had Oliver?

25. How many yards of cloth can you buy for 20 dollars, if 1 yard cost 2 fifths of 10 dollars?

26. Dana having 60 peaches, gave 2 sixths of them to Barton, and 3 sixths to Benton; how many remained?

27. If 1 yard of linen cost 5 sixths of 36 cents, how many yards can you buy for 3 fourths of 80 cents?

28. 2 thirds of 30 dollars, increased by 2 thirds of 60 dollars, is 10 dollars less than A's money; required A's money.

29. Frazier having 40 pens, gave Brown 10, and Seal 2 sixths of the remainder; how many had he left?

30. If a melon be divided into 7 equal parts, what are 1, 2, 3, 4, 5, and 6 of these parts called?

31. How many sevenths are there in one?

32. What is 1 seventh of 21? of 28? of 42? of 56?

33. What are 2 sevenths of 28? of 49? of 63? of 70?

34. What are 3 sevenths of 14? of 35? of 49? of 28?

35. What are 4 sevenths of 70? of 77? of 63? of 84?

36. What are 5 sevenths of 77? of 91? of 42? of 140?

37. What are 6 sevenths of 35? of 42? of 49? of 28?

38. 4 sevenths of 21, are how many times 3, 4, and 6?

39. 6 sevenths of 63, are how many times 3, 6, and 9?

40. A watch was bought for 70 dollars, and sold for 6 sevenths of its cost; required the loss?

41. If 1 half of 4 yards of cloth cost 10 dollars, what will 1 fifth of 10 yards cost?

42. A gave 70 dollars for a watch, 3 sevenths as much for a chain, and sold them both for 90 dollars; required the loss.

43. 3 sevenths of 56 dollars is 6 dollars more than 1 third of a load of hay cost; what will 3 loads cost, at the same rate?

44. 4 sevenths of 42 dollars is 12 dollars less than 1 half of a building lot cost; required the cost of the lot

45. Richard had 360 dollars, 1 third of which he spent for a horse, 1 fourth for a watch, and 1 sixth for a sleigh; how much had he remaining?

46. Mr. A having 140 dollars, gave 3 sevenths of it to the poor, and lost 3 fourths of the remainder; how much then remained?

LESSON III.

1. If anything be divided into 8 equal parts, what is one of these parts called?

2. What are 2, 3, 4, 5, 6, and 7 of these parts called, and how many eighths in a unit?

3. What is 1 eighth of 24? 48? 72? 88?
4. What are 2 eighths of 32? 40? 56? 72?
5. What are 3 eighths of 16? 64? 80? 96?
6. What are 5 eighths of 8? 24? 48? 64?
7. What is 1 half of 3? 5? 7? 9? 11?
8. What is 1 third of 5? 7? 8? 10? 13?
9. What are 2 thirds of 8? 14? 16? 17? 19?
10. What are 3 fifths of 9? 21? 17? 24? 31?
11. What are 5 eighths of 7? 10? 14? 18? 20?
12. 2 eighths of 24 are how many times 3?
13. 3 eighths of 40 are how many times 5?
14. 4 eighths of 80 are how many times 8?
15. 5 eighths of 56 are how many times 7?
16. 6 eighths of 64 are how many times 12?
17. 7 eighths of 72 are how many times 3?
18. 3 eighths of 32 are how many times 1 third of 12?
19. 6 eighths of 40 are how many times 1 fourth of 24?
20. 4 eighths of 4 are how many times 2 thirds of 18?
21. 7 eighths of 96 are how many times 4 fifths of 10?
22. 3 eighths of 56 are how many times 5 sixths of 42?
23. 5 sevenths of 28 are how many times 5 sevenths of 14?
24. 2 thirds of 27 are how many times 3 fourths of 12;

25. If a single thing be divided into 9 equal parts, what are 1, 2, 3, 4, &c., of these parts called?

26. What are 2 ninths of 18? 27? 45? 36?

27. What are 3 ninths of 63? 72? 81? 27?

28. What are 4 ninths of 9? 36? 54? 81?

29. What are 5 ninths of 54? 72? 63? 27?

30. What are 6 ninths of 81? 18? 36? 90?

31 What are 7 ninths of 18? 99? 27? 108?

32. 3 times 6, and 2 thirds of 6, are how many?

33. 4 times 12, and 3 fourths of 12, are how many?

34. 5 times 10, and 3 fifths of 10, are how many?

35. 6 times 12, and 3 sixths of 12, are how many?

36. 5 times 7, and 4 sevenths of 7, are how many?

37. 9 times 8, and 5 eighths of 8, are how many?

38. 2 times 18, and 7 ninths of 18, are how many?

39. 2 ninths of 18 are how many times 2 thirds of 3?

40. 5 ninths of 27 are how many times 5 sixths of 6?

41. 6 ninths of 54 are how many times 4 fifths of 15?

42. 3 ninths of 72 are how many times 2 eighths of 16?

43. 7 eighths of 24 are how many times 7 eighths of 8?

44. 5 sixths of 48 are how many times 5 sevenths of 14?

45. 4 sevenths of 56 are how many times 8 ninths of 18?

46. A bought 15 horses, and sold 6 of them, and then lacked 4 of having 20; how many had he at first?

47. Hiram and Oliver had each 26 cents; after Hiram had given Oliver 10, and Oliver had given Hiram 6, how many had each?

48. A farmer having 48 bushels of oats, sold 4 sixths of them to one man, and 1 fourth to another; how many bushels did he sell to each?

49. A bought 60 cows, and sold 2 sixths of them to B, and 3 times 2 tenths of the remainder to C; how many then remained?

LESSON IV.

1 Harry gave 1 third of an apple to his brother, and 2 thirds to his sister; how much did he give away?

2. Matthew gave 2 fifths of a peach to Elias, and 3 fifths to Morris; how much did he give to both?

3. If I give 3 sevenths of a melon to Harry, and 1 sevenths to Harvey, how much do I give away?

4. Fanny eat 3 eighths of a quart of chestnuts yesterday, and 4 eighths to-day; how many did she eat in all?

5. Ella gave 1 fourth of a melon to Phebe, 2 fourths to Carrie, and 3 fourths to Kate; how much did she give away?

6. Philip gave 2 sixths of a dollar to Jane, 3 sixths to Sarah, and 5 sixths to Eliza; how much did he give away?

7. Willis lost 7 eighths of a dollar, and had 9 eighths emaining; how much had he at first?

8. Matthew lost 6 eighths of a dollar from one pocket, and 7 eighths from the other, and had 5 eighths remaining; how much had he at first?

9. Dora gave 3 ninths of a pound of raisins to Ella, and 7 ninths to Daisy, and then had 3 ninths remaining; how many had she at first?

10 What is the sum of 1 fourth, 3 fourths, 5 fourths, 7 fourths, and 9 fourths?

11. Jane had 7 eighths of a pound of candies, and gave Maria 5 eighths; how many eighths remained?

12. Frank had 6 sevenths of a melon, and gave Abram 4 sevenths; how much remained?

13. Louisa having 10 eighths of a dollar, gave Lizzie 7 eighths of it; how much remained?

14. What is the difference between 5 sevenths, and the sum of 4 sevenths and 6 sevenths?

15 Sallie having 24 pears, gave Buela 2 eighths,

Amanda 3 eighths, and James 1 eighth of them; how many remained?

16. Rufus having 1 third of a quart of chestnuts, bought 4 thirds of a quart, and then sold 1 quart; what part of a quart remained?

17. Peter having 5 sixths of a bushel of apples, sold sixths, and then bought 2 sixths of a bushel; how many sixths had he then?

18. What is the difference between the sum of 3 eighths and 7 eighths, and the sum of 4 eighths and 5 eighths?

19. A bought 20 sheep, and sold 2 tenths of them to B, 3 tenths to C, and 4 tenths to D; how many sheep remained?

20. A lady having 36 yards of tape, sold 5 ninths of it to one person, and 3 ninths to another; how much had she then?

21. Mariana had 3 fourths of a pint of nuts, Elva had twice as many, and Ezra 3 times as many; how many had they all?

22. A bought 4 ninths of a bushel of wheat, and B bought 3 times as much; how much did B buy?

23. If 1 yard of cloth cost 5 sixths of a dollar, what will 6 yards cost?

24 At 7 ninths of a dollar each, what will 9 turkeys cost?

25. What is the sum of 5 times 3 ninths, and 3 times 5 ninths?

26. Mary having 11 fifths of a melon, gave 2 fifths to Sarah, and twice as much to Sophia; how much remained?

27. How much greater is 7 times 2 sevenths, than 4 times 3 sevenths?

28. Cornell gave 3 times 3 sixths of an apple to Gray, and had 4 times as much remaining; how much had he at first?

29. How much is 5 times 3 fourths, minus 2 times 3 fourths, plus 6 times 3 fourths, minus 7 times 3 fourths?

30. I gave A 6 tenths of a dollar, and I gave B 3 times as much, plus 2 tenths of a dollar; how much did I give both?

31 What will 1 fifth of a yard of tape cost, at the rate of 20 fourths cents a yard? What will 3 fifths cost, at the same rate?

32. Johnston gave his brother 1 third of 6 eighths of a quart of walnuts; what part of a quart did he receive?

33. How much is 1 fourth of 8 sevenths? of 12 ninths? of 16 tenths? of 24 twelfths?

34. Stanton having 2 thirds of a dollar, found 1 half of 4 thirds of a dollar; how many thirds had he then?

35. Mr. A bought 7 tenths of a barrel of sugar, and then sold 2 thirds of 6 tenths of a barrel; how much remained?

36. What is the difference between 5 times 3 sevenths, and 1 fifth of 40 sevenths?

37. Thornton having 4 times 2 sixths of a bushel of corn, bought 3 fourths of 20 sixths of a bushel; how much had he then?

38. If 1 half of a yard of tape cost 2 tenths of a dime, how many yards may be bought for 3 fourths of 16 tenths of a dime?

39. Martin sold 2 thirds of 6 sevenths of a peck of beans, and then had 3 fourths of 8 sevenths of a peck remaining; how many had he at first?

40. Ferris lost 3 fourths of 8 ninths of a dollar, and then, having found 3 ninths of a dollar, had 3 fourths of 8 ninths remaining; how much had he at first?

LESSON V.

1 What will 4 apples cost, if 3 apples cost 9 cents?

SOLUTION.—If 3 apples cost 9 cents, 1 apple will cost one third of 9 cents, which is 3 cents; and if 1 apple cost 3 cents 4 apples will cost 4 times 3 cents, which are 12 cents. Therefore, &c.

2. What will 5 lemons cost, at the rate of 3 for 12 cents?

3. If 3 pairs of shoes cost 6 dollars, how much will 5 pairs cost?

4. What will 9 candies cost, if 4 candies cost 8 cents?

5. If 4 peaches are worth 8 cents, what are 8 peaches worth?

6. What are 10 oranges worth, if 8 oranges cost 16 cents?

7. If 7 pounds of meat cost 42 cents, what will 9 pounds cost?

8. What cost 7 sheep, at the rate of 5 for 30 dollars?

9. What cost 11 barrels of flour, at the rate of 5 barrels for 30 dollars?

10. If 12 boxes of figs cost 48 dollars, what will 7 boxes cost?

11. How much will 7 cows cost, if 3 cows are bought for 60 dollars?

12. How far will a man travel in 12 days, at the rate of 36 miles in 4 days?

13. How many tons of hay will a drover feed in 11 weeks, at the rate of 10 tons in 5 weeks?

14. How much must be paid for the keeping of 13 horses, at the rate of 80 cents for 4 horses?

15. Required the value of 5 ducks, at the rate of 120 cents for 3 ducks.

16. Mary gave 10 cents for apples, at the rate of 3 cents for 9; how many did she buy?

17. Fanny paid 8 dollars for silk, at the rate of 5 dollars for 15 yards; how many did she buy?

18. Wilkinson walked 7 hours, at the rate of 12 miles in 4 hours; how far did he travel?

19. Robert gave 12 oranges for apples, at the rate of 3 oranges for 9 apples; how many apples did he get?

20. At the rate of 3 melons for 12 oranges, how many oranges can be bought for 10 melons?

21. If 6 men can mow 12 acres of grass in a day, how much can 8 men mow in the same time?

22. If 10 men can dig 30 rods of ditch in one day, how much can 12 men do in the same time?

23. How long will it take 4 ladies to drink a box of tea, if 6 ladies can drink it in 12 days?

24. If 5 boys can do a piece of work in 16 days, how long will it take 20 boys to do it?

25. In what time will 8 girls pick a bushel of berries, if 4 girls can do it in 8 hours?

26. How many men will be required to build a boat in 6 days, if 3 men can do it in 12 days?

27. How many men can do as much work in 4 days, as 8 men can in 40 days?

28. If it require 10 men 8 days to build a wall, how many men will be required to build it in 5 days?

29. If 5 men build a boat in 20 days, how many men will be required to do it in 1 fourth of the time?

30. What cost 1 half of 12 yards of cloth, at the rate of 12 dollars for 4 yards?

31. If 7 yards of cashmere cost 21 dollars, what will 2 thirds of 15 yards cost?

32. What cost 3 fourths of 8 pounds of coffee, at the rate of 10 pounds for 60 cents?

33. If 3 fifths of 10 yards of ribbon cost 30 cents, what will 4 sixths of 12 yards cost?

34. Mary gave 7 apples for 21 chestnuts; at this rate how many chestnuts could she get for 8 apples?

35. If 8 lemons are worth 16 oranges, how many oranges can you buy for 10 lemons?

36 At the rate of 6 citrons for 18 melons, how many melons may be purchased for 11 citrons?

37 If 9 apples are worth 27 chestnuts, how many chestnuts may be had for 12 apples?

38. If 3 sevenths of 14 bunches of grapes cost 24 cents, what are 2 fifths of 15 bunches worth?

39. Peter can walk 3 fourths of 8 miles while John walks 12; how far can John go while Peter walks 7 miles?

40 If 8 quarts of molasses cost 40 cents, what will 4 sixths of 24 quarts cost?

41. What must I pay to ride 1 half of 14 miles, if it cost me 20 dimes to ride 2 thirds of 15 miles?

42. I gave 8 yards of muslin for 6 gallons of molasses; what did the molasses cost a gallon, if 4 yards of muslin cost 48 cents?

43. A gave 9 bushels of wheat for 3 barrels of flour; what was the wheat worth a bushel, if 8 barrels of flour cost 72 dollars?

44. B bought 7 yards of cloth for 21 dollars, and gave 4 yards for apples worth 2 dollars per barrel; how many barrels of apples did he receive?

45 C gave 7 grammars for 6 arithmetics; how much were the grammars worth each, if 5 arithmetics cost 35 dimes?

46. If 7 apples cost 21 cents, how many apples must be given for 9 peaches, bought at the rate of 3 for 12 cents?

47. Reuben had 9 oranges worth 4 cents apiece, and Jackson had 8 lemons worth 3 cents each, which he gave to Reuben for a part of his oranges; how many oranges had Reuben remaining?

LESSON VI.

1. What will one yard of tape cost, if 2 thirds of a yard cost 4 cents?

SOLUTION.—If 2 thirds of a yard of tape cost 4 cents, 1 third of a yard will cost 1 half of 4 cents, which is 2 cents, and 3 thirds, or one yard, will cost 3 times 2 cents, which are 6 cents. Therefore, &c.

2. What will one box of soap cost, if 3 fourths of a box cost 6 dollars?

3. If 4 fifths of a box of tea cost 8 dollars, what will one box cost?

4. If 3 fifths of a yard of cloth cost 6 dollars, what will one yard cost?

5. What will 2 pounds of starch cost, if 5 sixths of a pound cost 10 cents?

6. What cost 2 barrels of flour, at the rate of 4 dollars for 4 sixths of a barrel?

7. If 7 eighths of a keg of oysters cost 14 shillings, what will be the cost of 3 kegs of oysters?

8. What cost 3 yards of cloth, if 3 sevenths of a yard cost 6 dollars?

9. How far can A walk in 4 days, if in 5 sixths of a day he can walk 20 miles?

10. What cost 5 boxes of raisins, if 3 fifths of a box cost 6 dollars?

11. What is 5 times the distance to Lancaster, if 3 fourths of the distance is 3 miles?

12. How much will 4 bushels of apples cost, if 5 tenths of a bushel cost 50 cents?

13. What cost 8 barrels of flour, if 7 eighths of a barrel cost 7 dollars?

14. Mary bought 9 pecks of beans, at the rate of 12 cents for 6 sevenths of a peck; required the cost.

15. How much will 5 tons of hay cost, if 10 dollars will buy 5 sixths of a ton?

16. What is the cost of 10 barrels of sugar, at the rate of 20 dollars for 4 fifths of a barrel?

17. Pelton bought 4 dozen eggs at the rate of 8 cents for 2 thirds of a dozen; how much did they cost?

18. What is the value of 1 half of 6 bushels of peaches, at the rate of 2 dollars for 2 thirds of a bushel?

19. What cost 2 thirds of 9 yards of cloth, if 3 fourths of twelve yards cost 27 dollars?

20. If 4 fifths of 10 lemons cost 24 cents, what cost 3 fourths of 12 lemons?

21. If 3 fourths of a barrel of flour cost 6 dollars, what will 5 eighths of a barrel cost?

22. 3 fourths of 40 dollars is 6 times what a farmer gave for a plough; required its cost.

23. A watch cost 30 dollars, and 4 fifths of its cost is twice the cost of the chain; what was the cost of the chain?

24 B's horse cost 200 dollars, and 3 fifths of its cost lacks 80 dollars of being 4 times the cost of the sleigh; required the cost of the sleigh.

25. A merchant having 20 barrels of flour, sold 3 fourths of it to A, and 3 fifths of the remainder to B; how much remained?

26. Elmina is 25 years old, and 4 fifths of her age is 4 years less than twice Elmira's age; required Elmira's age.

27. Think of a number, multiply it by 8, divide by 4, multiply by 3, divide by 6, add 20, subtract the number thought of, divide by 4, and name the result.

28. Think of a number, multiply by 12, divide by 3, multiply by 2, divide by 8, add 12, subtract the number thought of, divide by 4, and name the result.

29. Multiply 10 by 12, divide by 6, multiply by 5, divide by 2, multiply by 4, divide by 10, and name the result.

30. How many are 24 multiplied by 6, divided by 3, multiplied by 8, divided by 4, multiplied by 2, divided by 4, divided by 8?

LESSON VII.

1. How many thirds are there in 4?

SOLUTION.—In 1 there are 3 thirds, and in 4 there are 4 times 3 thirds, which are 12 thirds. Therefore, &c.

2. How many thirds in 2? 3? 5? 7? 8?
3. How many fourths in 3? 5? 6? 4? 7?
4. How many fifths in 5? 4? 3? 2? 8?
5. How many sixths in 3? 2? 5? 6? 4?
6. How many sevenths in 2? 5? 4? 7? 9?
7 How many eighths in 3? 6? 4? 5? 7?
8 How many ninths in 8? 4? 6? 3? 10?

9. How many thirds in 3 and 2 thirds? In 4 and 1 third?

10. How many fifths in 4 and 3 fifths? In 6 and 3 fifths?

11. How many fourths in 2 and 1 fourth? In 7 and 3 fourths?

12. How many sevenths in 5 and 6 sevenths? In 3 and 4 sevenths?

13. How many ninths in 3 and 4 ninths? In 6 and 7 ninths?

14. How many sixths in 7 and 5 sixths? In 3 and 2 sixths?

15. How many eighths in 5 and 3 eighths? In 5 and 7 eighths?

16. If 5 yards of cloth cost 2 and 1 half dollars, what will 6 yards cost?

17. If 4 pears are worth 2 and 2 third cents, what are 7 pears worth?

18. What cost 10 peaches, at the rate of 4 and 1 half cents for 3?

19. If 11 ducks cost 4 and 2 fifths dollars, what will 12 ducks cost?

20. If 1 half of eight yards of cloth cost 3 and 1 fifth dollars, what cost 3 fifths of 15 yards?

21. If 2 thirds of 9 apples cost 4 and 4 fifths cents, what will 3 fourths of 12 apples cost?

22. If 4 fifths of ten pounds of sugar cost 5 and 1 third dimes, what cost 5 sevenths of 14 pounds?

23. What cost 4 fifths of 15 yards of muslin, at the rate of 7 and 1 half dimes for 3 fourths of 20 yards?

24. How many whole ones in 6 thirds?

SOLUTION.—In *one* there are *three* thirds; hence, in six thirds there are as many ones as 3 is contained times in 6, which are 2. Therefore, in 6 thirds there are 2 ones.

25. How many ones in 6 halves? 9 thirds? 12 thirds?

26. How many ones in 12 fourths? 20 fourths? 8 fourths?

27. How many ones in 10 fifths? 12 sixths? 14 sevenths?

28. How many ones in 16 eighths? 21 sevenths? 24 eighths?

29. How many ones in 18 ninths? 15 thirds? 25 fifths?

30. How many ones in 28 sevenths? 36 ninths? 24 fourths?

31. How many ones in 15 thirds? 20 tenths? 33 elevenths?

32. How many ones in 48 twelfths? 18 halves? 40 tenths?

33. How many ones in 9 halves? 7 thirds? 11 fourths?

34. How many ones in 7 fifths? 16 fifths? 19 eighths?

35. How many ones in 20 ninths? 17 sixths? 15 fourths?

36. How many ones in 13 fifths? 11 thirds? 17 fifths?

37. How many ones in 25 eighths? 23 tenths? 31 ninths?

38. If 2 apples cost 6 fifths of a cent, what cost 5 apples?

39. If 3 pens cost 9 eighths of a cent, what cost 8 pens?

40. If 5 pigs cost 10 sevenths of a dollar, what cost 7 pigs?

41. What cost 6 pairs of boots, if 4 pairs cost 12 fifths dollars?

42. What are 8 pies worth, if 3 pies are worth 15 fourths cents?

43. What cost 12 pine apples, if 3 cost 3 fourths of a dollar?

44. If 2 books cost 4 fifths of a dollar, what cost 10 books?

45. How much are 9 lamps worth, if 5 are worth 10 thirds dollars?

46. Required the cost of 8 hats, if 6 cost 12 fourths of a dollar.

47. If 3 peaches cost 9 eighths of a cent, what cost 8 peaches?

48. How much are 4 mirrors worth, if 7 are worth 14 halves dollars?

49 What cost 3 halves of a yard of linen, if 5 yards cost 10 ninths of a dollar?

50. What cost 1 half of 8 yards of cloth, if 1 half of 6 yards cost 1 third of 27 fourths dollars?

LESSON VIII.

1. 3 is 1 half of what number?

SOLUTION.—If 1 half of some number is 3, two halves, or that number, is 2 times 3, which are 6. Therefore, &c.

2. 4 is 1 third of what number?
3. 6 is 1 fourth of what number?
4. 5 is 1 sixth of what number?
5. 6 is 1 half of what number?
6. 8 is 1 seventh of what number?
7. 9 is 1 fifth of what number?
8. 7 is 1 ninth of what number?
9. 4 is 1 fifth of what number?
10. 5 is 1 seventh of what number?
11. 10 is 1 sixth of what number?
12. 9 is 1 third of what number?
13. 11 is 1 fourth of what number?
14 15 is 1 third of what number?
15. A is 10 years old, which is 1 fifth of B's age; required B's age.
16. An apple cost 3 cents, which is 1 fourth of the cost of a melon; required the cost of the melon.
17 A sheep cost 6 dollars, which is 1 fifth of the cost of a cow; what was the cost of the cow?

18. John has 20 marbles, which is 1 third of Henry's number; how many has Henry?

19. Mary's shawl cost 7 dollars, which is 1 fourth of the cost of her dress; required the cost of her dress.

20. Henry found 5 marbles, which is 1 third of hat he had; how many had he then?

21. 6 is 1 half of 3 times what number?

22. 5 is 1 fourth of 2 times what number?

23. 8 is 1 third of 4 times what number?

24. 10 is 1 fourth of 8 times what number?

25. 9 is 1 half of 6 times what number?

26. 7 is 1 sixth of 3 times what number?

27. 12 is 1 third of 9 times what number?

28. 4 is 1 ninth of 6 times what number?

29. 11 is 1 sixth of 3 times what number?

30. Flora's cloak cost 10 dollars, which is 1 third of 6 times the cost of her dress; required the cost of her dress.

31. A watch was bought for 20 dollars, which is 1 third of 4 times what the chain cost; required the cost of the chain.

32. The head of a fish is 6 inches long, which is 1 fou th of 3 times the length of the body; what is the length of the body?

33. A slate cost 20 cents, which is 1 fifth of 4 times the cost of an arithmetic; required the cost of them both.

34. A boy lost 15 cents, which is 1 fourth of 5 times the money he had remaining; how much money had he at first?

35 Mary found 12 pins, which is 1 fifth of 3 times what she then had; how many had she at first?

36. 8 is 1 third of 1 half of what number?

37. 4 is 1 fifth of 1 third of what number?

38 3 is 1 fourth of 1 fifth of what number?

39. 2 is 1 eighth of 1 fourth of what number?

40. 3 is 1 seventh of 1 sixth of what number?

41. 4 is 1 tenth of 1 fifth of what number?

42 5 is 1 half of 1 seventh of what number?

43. 6 is 1 fifth of 1 third of what number?

44 Philip's vest cost 4 dollars, which is 1 half of 1 third of the cost of his coat; what was the cost of his coat?

45. Martin is 4 years old, and his age is 1 third of 1 fourth of his father's age; how old is his father?

46. Ella's bonnet cost 3 dollars, which is 1 fifth of 1 half of the cost of her shawl; required the cost of the shawl.

47. A paid 10 dollars for a saddle, which is 1 fifth of 1 third of the cost of his horse; required the cost of the horse.

48. Mr. A walked 8 miles, which is 4 times 1 seventh of the distance he rode; how far did he travel?

49. Benton's house cost 2000 dollars, which is 1 half of 4 times the cost of his barn; required the cost of both.

50. The head of a fish is 3 inches long, and the tail 5 inches, which is 1 half of 1 third of the length of the body; required the length of the fish.

LESSON IX.

1. 6 is 2 thirds of what number?

SOLUTION.—If 2 thirds of some number is 6, 1 third of that number is 1 half of 6, which is 3, and 3 thirds, or that number, is 3 times 3, or 9. Therefore, &c.

2. 9 is 3 fourths of what number?
3. 6 is 2 thirds of what number?
4. 10 is 2 fifths of what number?
5. 12 is 4 sixths of what number?
6. 10 is 5 sevenths of what number?
7. 8 is 4 ninths of what number?
8. 9 is 3 fifths of what number?
9. 15 is 5 sixths of what number?
10. 10 is 5 eighths of what number?

11. 16 is 8 ninths of what number?

12. 14 is 7 thirds of what number?

13. Frank is 12 years old, and his age is 3 fifths of Fanny's age; how old is Fanny?

14. Augustus gave his brother 10 peaches, which is 2 thirds of all he had; how many had he?

15. Hampton lost 8 cents, which is 4 fifths of his money; how much had he remaining?

16. A lady found 12 dollars, which is 4 sixths of what money she then had; how much had she at first?

17. Lester sold a cow for 24 dollars, which is 6 fifths of the cost of the cow; required its cost.

18. A farmer sold a colt for 30 dollars, and thereby gained 1 fifth of the cost of the colt; required the cost.

19. Mr. M is 20 years of age, and 4 fifths of his age is 8 ninths of his brother's age; what is the age of his brother?

20. Frank lost 12 marbles, which is 2 fifths of what he had at first; how many remained?

21. 10 is 1 half of 4 fifths of what number?

22. 12 is 1 third of 6 sevenths of what number?

23. 9 is 1 fourth of 4 fifths of what number?

24. 16 is 2 fifths of 10 fourths of what number?

25. 4 is 2 fifths of 5 sixths of what number?

26. 6 is 3 fourths of 4 fifths of what number?

27. 15 is 5 sixths of 6 sevenths of what number?

28. 14 is 7 fourths of 4 thirds of what number?

29. 18 is 9 eighths of 4 sevenths of what number?

30. 20 is 5 fourths of 8 thirds of what number?

31. Thomas sold a book for 40 cents, which is 4 fifths of 5 sixths of the cost; required the cost.

32 Smiley sold his horse for 140 dollars, which is 7 eighths of 4 thirds of its value; required its value.

33. A's hat cost 6 dollars, which is 3 fourths of 4 fifths of the cost of his vest; required the cost of his vest.

34. 20 feet of a pole is in the water, which is 2 fifths of 5 sevenths of the length in the air; what is the length of the pole?

35 A pole is 30 feet in the air, which is 3 fifths of 2 fourths of the length of the pole; required the length in the mud and water.

36. A cow cost 24 dollars, which is 6 tenths of 2 fifths of the cost of the cow and a horse; what was the cost of the horse?

37. A man sold his watch for 60 dollars, which is 5 fourths of 4 times what the chain cost, and the watch cost 3 times as much as the chain; what was the cost of each?

38. A's horse cost 200 dollars, and 4 fifths of the cost f the horse is 8 times the cost of his harness; required the cost of the harness.

39. A man has 24 geese, and 3 fourths of the number of geese equals 2 times the number of turkeys; how many turkeys had he?

40. A man sold his horse and sleigh for 200 dollars, and 4 fifths of this is 8 times what his sleigh cost, and the horse cost 10 times as much as the sleigh; required the cost of each.

LESSON X.

1. 6 are how many times 1? 2? 3?
2. 8 are how many times 1? 2? 4?
3. 12 are how many times 2? 3? 6?
4. 20 are how many times 4? 5? 10?
5. 32 are how many times 4? 8? 16?
6. 30 are how many times 5? 6? 10?
7. 72 are how many times 6? 8? 9?
8. 80 are how many times 4? 8? 20?
9. What is the relation of 8 to 2?

REMARK —8 is 4 times 2.

10. What is the relation of 12 to 4? Of 15 to 5?
11. What is the relation of 16 to 8? Of 18 to 6?
12. What is the relation of 21 to 7? Of 24 to 8?

13 What is the relation of 32 to 4? Of 27 to 9?

14 What is the relation of 40 to 10? Of 45 to 5?

15. What is the relation of 28 to 7? Of 36 to 4?

16 If 4 yards of cloth cost 10 dollars, what will 8 yards cost?

SOLUTION.—If 4 yards of cloth cost 10 dollars, 8 yards, which are 2 times 4 yards, will cost 2 times 10 dollars, or 20 dollars. Therefore, &c.

17. If 3 bunches of grapes cost 8 cents, what will 6 bunches cost?

18. If 6 combs cost 9 cents, what will 12 combs cost at the same rate?

19. If 7 peaches cost 8 cents, what will 21 peaches cost?

20. If 5 pairs of shoes cost 9 dollars, what will 20 pairs cost?

21. If 4 pens cost 11 cents, what will 12 pens cost?

22. If 8 ducks cost 5 dollars, what will 24 ducks cost?

23. What cost 30 lamps, if 5 lamps cost 7 dollars?

24. How much will 42 primers cost, at the rate of 6 primers for 20 cents?

25. What cost 56 inkstands, if 7 inkstands cost 5 dollars?

26. If 5 pitchers cost 3 dollars, what will 45 pitchers cost?

27. How far will a man travel in 48 days, if he travel 30 miles in 4 days?

28. If 6 men can build 10 rods of wall in a certain time, how many rods can 54 men build in the same time?

29. Hiram bought 6 pigs for 11 dollars; how many could he have bought for 44 dollars?

30. 7 men earn 12 dollars in 3 days· how much could they earn in 27 days?

31. If 5 peaches are worth one pear, how many pears are 30 peaches worth?

32. If 8 dollars will buy 5 gold pens, how many will 56 dollars buy?

33. If 6 stands cost 2 thirds of 12 dollars, what will 30 stands cost?

34. 40 dollars is 2 thirds of what A gave for sheep, at the rate of 10 dollars for 3 sheep; how many did he purchase?

35. If 4 men can perform a piece of work in 18 days, how long will it require 12 men to do it?

36. If 6 men can build a boat in 10 fourths days, how long will it take 3 men to build it?

37. 15 dollars is 3 eighths of what A earns in 5 days; how much will he earn in 15 days?

38. 18 men are 3 fifths of the number required to mow a field in 8 days; how many men would be required to mow it in 24 days?

39. 20 dollars is 4 dollars more than 2 thirds of 4 times what B paid for a chain, and his watch cost 5 times as much as the chain; required the cost of each?

LESSON XI.

1. 4 is what part of 8?

SOLUTION.—4 is 1 half of 8, since 2 times 4 are 8.

2. 3 and 6 are what parts of 12?
3. 4 and 8 are what parts of 16?
4. 3 and 6 are what parts of 24?
5. 7 and 3 are what parts of 21?
6. 4 and 9 are what parts of 36?
7. What is the relation of 2 to 6? Of 4 to 8?
8. What is the relation of 3 to 9? Of 5 to 10?
9. What is the relation of 3 to 12? Of 4 to 16?
10. What is the relation of 5 to 20? Of 6 to 36?
11 What is the relation of 7 to 42? Of 8 to 40?
12 What is the relation of 6 to 54? Of 9 to 27?

13. What is the relation of 10 to 40? Of 7 to 56?

14. What is the relation of 11 to 55? Of 12 to 48?

15. If 6 apples cost 10 cents, what will 3 apples cost?

REMARK.—3 apples, the half of 6, will cost one-half of 10 cents.

16. How much will 5 books cost, if 20 books cost 16 dollars?

17. What cost 3 knives, if 18 knives cost 24 dollars?

18. If 14 pencils cost 35 cents, what will 2 pencils cost?

19. If 10 peaches are worth 12 oranges, how many oranges are 5 peaches worth?

20. How much will 4 apples cost, if 16 apples cost 24 cents?

21. How much will 9 pigs cost, if 27 pigs cost 36 dollars?

22. What cost 7 tons of hay, if 56 tons cost 96 eagles?

23. If 42 sheep are sold for 108 dollars, what are 7 sheep sold for?

24. If 100 pens cost 50 cents, what will 20 pens cost?

25. What cost 5 inkstands, if 15 inkstands cost 2 thirds of 18 dimes?

26. If 5 eighths of 32 hens cost 10 dollars, what will 2 thirds of 6 hens cost?

27. If 3 fourths of 48 oranges cost 40 cents, what will 3 fourths of 12 oranges cost?

28. If A walked 132 miles in 33 days, how far did he walk in 3 days?

29. If 8 times 6 cents is 48 cents, how much is 2 times 6 cents?

30. Mary having 27 roses gave 1 third of them to Sallie and 1 third to Annie; how many remained?

31. A worked 5 weeks for 7 dollars a week, and received in payment 12 bushels of wheat worth 1 dollar and 1 half a bushel; how much remains due A?

32 A farmer gave 2 thirds of 15 bushels of rye, worth 6 dimes a bushel, for cloth worth 3 dollars a yard; how many yards did he receive?

33. Think of a number, multiply by 10, divide by 5, multiply by 3, divide by 6, add 30, subtract the original number, divide by 10, add 7, and the result is what?

3 . What is the value of 27 multiplied by 8, divided by 4, multiplied by 6, divided by 3, multiplied by 9, divided by 12?

LESSON XII

1. What numbers multiplied together will produce 4? 8? 10? 16? 12? 18? 24?

2. What numbers multiplied together will produce 15? 21? 28? 35? 36? 39? 48?

3. What numbers multiplied together will produce 40? 42? 45? 49? 50? 51? 52?

Numbers which can be produced by multiplying together other numbers, each of which is greater than a unit, are called *composite numbers.*

Numbers which cannot be produced by multiplying together two or more numbers, each of which is greater than a unit, are called *prime numbers.*

4. Tell which of the following numbers are prime, and which composite; 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15. 16, 17, 18, 19, 20, 21, 22, 23.

5. Name the prime and composite numbers in the following list; 24, 25, 26, 27, 28, 29, 30, 31 32, 33, 34, 35, 36, 37, 38, 39, 40, 41.

The numbers, which when multiplied together will produce a composite number, are called *factors* of that number.

6 What are the factors of 12? 20? 16? 33? 30? 24? 27? 18? 25? 32?

7. What are the factors of 9? 10? 14? 34? 36? 40? 48? 50? 56? 60? 63? 72?

When these factors are prime numbers, they are called *prime factors.*

8. What are the prime factors of 4? 6? 9? 12? 15? 18?
9. What are the prime factors of 10? 20? 21? 22? 24? 25?
10. What are the prime factors of 27? 28? 30? 32? 33? 35?
11. What are the prime factors of 44? 45? 46? 48? 49? 50?
12. What are the prime factors of 52? 54? 55? 56? 57? 60?
13. What are the prime factors of 64? 68? 70? 72? 75? 80?
14. What prime factors are common to 6 and 12?
15. What prime factors are common to 9 and 12?
16. What prime factors are common to 8 and 20?
17. What prime factors are common to 10 and 20?
18. What prime factors are common to 12 and 18?
19. What prime factors are common to 16 and 24?
20. What prime factors are common to 14 and 42?
21. Is a number exactly divisible by any numbers except its prime factors, or some product of them?
22. Name the divisors of 4, 6, 8, 10, 12, 14, 16, and 20.
23. What divisors are common to 4 and 6? To 8 and 10?
24. What divisors are common to 6 and 9? To 9 and 18?
25. What divisors are common to 10 and 30? To 8 and 24?
26. What divisors are common to 9 and 27? To 10 and 20?
27. What divisors are common to 16 and 24? To 12 and 18?

A divisor common to two or more numbers is called their *common divisor.*

28 What is a common divisor of 8 and 24? Of 9 and 15?

29. What is a common divisor of 15 and 20? Of 18 and 80?

30. What is a common divisor of 16 and 32? Of 32 and 40?

The greatest divisor common to two or more numbers is called their *greatest common divisor.*

31. What is the greatest common divisor of 4 and 8?
32. What is the greatest common divisor of 8 and 24?
33. What is the greatest common divisor of 9 and 27?
34 What is the greatest common divisor of 16 and 24?
35. What is the greatest common divisor of 24 and 32?

A multiple of a number is any number that will contain it, a whole number of times, without a remainder.

36. What is a multiple of 4? Of 3? Of 5? Of 6? Of 8?
37. What is a multiple of 7? Of 9? Of 10? Of 12? Of 20?

A multiple common to two or more numbers is called their *common multiple.*

38. What is a common multiple of 2 and 3? Of 3 and 4? Of 4 and 5? Of 5 and 6?

39. What is a common multiple of 6 and 7? Of 4 and 6? Of 5 and 10? Of 9 and 12?

The least multiple, common to two or more numbers, is called their *least common multiple.*

40. What is the least common multiple of 4 and 6? Of 6 and 8? Of 8 and 10? Of 10 and 12?

41. What is the least common multiple of 8 and 12? Of 9 and 6? Of 9 and 12? Of 12 and 20?

If a number be multiplied by itself, the result is called the *square* of the number; if the square be multiplied by the number, the result is the *cube;* if the cube be multiplied by the number, the result is the *fourth power*, &c.

42. What is the square, cube, and fourth power of 1? 2? 3? 4? 5? 6? 7? 8? 9? 10? 11? 12?

The *square root* of a number is one of the two equal factors which produce that number; the cube root. one of the three equal factors; the fourth root, one of the four equal factors.

43. What is the square root of 1? 4? 9? 16? 25? 49? 81? 36? 64?

44 What is the cube root of 1? 8? 27? 64? 125? 343? 729? 512?

45 What is the fourth root of 1? 16? 81? 256? 625?

46. Define a prime number, composite number, factors, prime factors, common divisor, least common divisor, common multiple, least common multiple, square, cube, and fourth power; square, cube, and fourth roots.

SECTION III.

LESSON I.

The number of parts into which anything is divided, instead of being expressed by a word, may be represented by a figure beneath a line, thus:—

$\frac{}{2}$ represents halves, $\frac{}{4}$ represents fourths,
$\frac{}{3}$ represents thirds, $\frac{}{5}$ represents fifths.

The number of fractional parts taken may be represented by a figure above the line, thus:—

$\frac{2}{4}$ represents 2 fourths, $\frac{5}{7}$ represents 5 sevenths,
$\frac{3}{5}$ represents 3 fifths, $\frac{7}{8}$ represents 7 eighths,
$\frac{4}{6}$ represents 4 sixths, $\frac{4}{9}$ represents 4 ninths.

These expressions are called *fractions*. A fraction is that *definite part* which a *portion* is of the *whole*. Custom, however, has sanctioned the use of the word fraction to denote both the definite *part* and the *expression* of it. The expression consists of two figures with a line between them.

The figure below the line is the *denominator;* it denotes the number of equal parts into which the unit is divided.

The figure above the line is the *numerator;* it denotes the number of equal parts taken.

A *proper* fraction is one whose value is less than a unit; as $\frac{3}{4}$, $\frac{5}{6}$.

An *improper* fraction is one whose value is equal to, or greater than a unit; as $\frac{4}{4}$, $\frac{7}{5}$.

A *mixed number* consists of a whole number and a fraction; as, $2\frac{1}{4}$, $3\frac{2}{5}$.

The *reciprocal* of a number is a unit divided by that number; thus the reciprocal of 4 is $\frac{1}{4}$; of 7 is $\frac{1}{7}$.

1. How many halves in $3\frac{1}{2}$? $2\frac{1}{2}$? $4\frac{1}{2}$? $6\frac{1}{2}$?
2. How many thirds in $3\frac{1}{3}$? $2\frac{2}{3}$? $4\frac{1}{3}$? $5\frac{2}{3}$?
3. How many fourths in $3\frac{1}{4}$? $4\frac{3}{4}$? $2\frac{2}{4}$? $7\frac{3}{4}$?
4. How many fifths in $1\frac{1}{5}$? $2\frac{2}{5}$? $3\frac{3}{5}$? $4\frac{4}{5}$?
5. How many sixths in $2\frac{1}{6}$? $3\frac{2}{6}$? $4\frac{3}{6}$? $5\frac{4}{6}$?
6. How many eighths in $2\frac{3}{8}$? $6\frac{1}{8}$? $7\frac{4}{8}$? $8\frac{5}{8}$?
7. How many thirds in $5\frac{2}{3}$? $7\frac{2}{3}$? $9\frac{1}{3}$? $10\frac{2}{3}$?
8. How many sevenths in $3\frac{2}{7}$? $5\frac{1}{7}$? $4\frac{3}{7}$? $2\frac{5}{7}$?
9. How many fifths in $5\frac{2}{5}$? $4\frac{1}{5}$? $7\frac{3}{5}$? $8\frac{4}{5}$?
10. How many ninths in $2\frac{2}{9}$? $3\frac{4}{9}$? $7\frac{5}{9}$? $6\frac{7}{9}$?
11. How many tenths in $5\frac{3}{10}$? $7\frac{5}{10}$? $3\frac{8}{10}$? $6\frac{7}{10}$?
12. If one yard of tape cost $2\frac{1}{3}$ cents, how many thirds cents will 5 yards cost?
13. How many fourths of a dollar will 7 baskets of peaches cost, at $2\frac{1}{4}$ dollars a basket?
14. What cost 3 barrels of flour, if $2\frac{1}{4}$ barrels cost 18 dollars?
15. How far can Henry walk in 7 hours, if he can walk 12 miles in $2\frac{2}{5}$ hours?
16. If $3\frac{1}{7}$ yards of muslin cost 44 cents, how much will 10 yards cost?
17. $2\frac{1}{3}$ bushels of apples cost $\frac{1}{8}$ dollars, what will $2\frac{1}{2}$ bushels cost?
18. How many ones in $\frac{7}{2}$? $\frac{5}{2}$? $\frac{12}{3}$? $\frac{8}{3}$?
19. How many ones in $\frac{6}{3}$? $\frac{5}{3}$? $\frac{10}{3}$? $\frac{12}{3}$?
20. How many ones in $\frac{8}{4}$? $\frac{14}{4}$? $\frac{10}{4}$? $\frac{16}{4}$?
21. How many ones in $\frac{7}{5}$? $\frac{11}{3}$? $\frac{18}{6}$? $\frac{21}{7}$?
22. How many ones in $\frac{5}{2}$? $\frac{18}{9}$? $\frac{14}{6}$? $\frac{28}{4}$?
23. How many ones in $\frac{15}{5}$? $\frac{16}{3}$? $\frac{17}{8}$? $\frac{21}{9}$?

24. How many ones in $\frac{16}{9}$? $\frac{15}{7}$? $\frac{11}{4}$? $\frac{10}{3}$?

25 How many ones in $\frac{18}{7}$? $\frac{25}{6}$? $\frac{24}{10}$? $\frac{27}{9}$?

26. How many ones in $\frac{11}{3}$? $\frac{22}{4}$? $\frac{25}{10}$? $\frac{16}{11}$?

27 Reduce $3\frac{1}{5}$, $7\frac{2}{4}$, $8\frac{1}{3}$, and $2\frac{1}{9}$ to improper fractions.

28. Reduce $\frac{14}{8}$, $\frac{15}{4}$, $\frac{13}{7}$, and $\frac{23}{8}$ to mixed numbers.

29. Reduce $5\frac{3}{5}$, $6\frac{5}{6}$, $7\frac{7}{8}$, and $8\frac{8}{9}$ to improper fractions.

30. Reduce $\frac{24}{7}$, $\frac{25}{8}$, $\frac{26}{9}$, and $\frac{27}{10}$ to mixed numbers.

31. Reduce $2\frac{3}{8}$, $3\frac{4}{9}$, $4\frac{5}{10}$, and $5\frac{6}{11}$ to improper fractions.

32. At $\frac{5}{6}$ of a dime a pound, what will 9 pounds of candies cost?

33. If 1 pound of sugar cost $6\frac{2}{3}$ cents, what will 8 pounds cost?

SOL.—8 pounds will cost 8 times $6\frac{2}{3}$ cents. 8 times 6 is 48. 8 times $\frac{2}{3}$ is $\frac{16}{3}$ or $5\frac{1}{3}$; 48 plus $5\frac{1}{3}$ equals $53\frac{1}{3}$.

34. At $6\frac{4}{5}$ dimes a bushel, what will 12 bushels of wheat cost?

35. What cost 8 barrels of apples, at the rate of $3\frac{2}{5}$ dollars a barrel?

36. How much will a man earn in a week, at the rate of $2\frac{3}{4}$ dollars a day?

37. At the rate of $18\frac{3}{9}$ cents a dozen, what will 3 dozen eggs cost?

38. What cost $5\frac{1}{3}$ boxes of butter, at the rate of $3\frac{1}{3}$ dollars for 10 boxes?

39. What cost 7 barrels of apples, at the rate of 9 dollars for $2\frac{1}{4}$ barrels?

40. How many chestnuts must be given for $12\frac{1}{4}$ cents, if 14 chestnuts cost $3\frac{1}{2}$ cents?

41. What cost $5\frac{3}{8}$ pounds of beef, if 2 pounds cost 32 cents?

42. How far can a man travel in $5\frac{2}{9}$ hours, if he can walk 19 miles in $2\frac{1}{9}$ hours?

43. A vessel sailed 23 miles in $4\frac{3}{5}$ hours; how far did she sail in $2\frac{2}{5}$ hours?

44. A kite arose 48 rods in $3\frac{3}{7}$ minutes; how far at this rate will it ascend in $3\frac{1}{2}$ minutes?

45. What cost 50 pounds of meat, at the rate of $4\frac{3}{5}$ pounds for $5\frac{3}{5}$ cents?

46. What cost 10 yards of ribbon, if $4\frac{1}{4}$ yards cost $6\frac{4}{5}$ cents?

47. If $\frac{6}{7}$ of a pint of almonds cost $\frac{12}{14}$ of a shilling, what cost $5\frac{3}{5}$ pints?

48. If $\frac{4}{5}$ of a ton of hay is worth $4\frac{4}{5}$ dollars, what cost $7\frac{4}{5}$ tons of hay?

49. If a man walk 3 miles in $2\frac{1}{3}$ hours, how far will he walk in $2\frac{2}{3}$ hours?

LESSON II

1. How many fourths in $\frac{1}{2}$?

SOLUTION.—In 1 there are $\frac{4}{4}$, and in $\frac{1}{2}$ there are $\frac{1}{2}$ of $\frac{4}{4}$, or $\frac{2}{4}$ Therefore, &c.

2. How many sixths in $\frac{1}{2}$? $\frac{1}{3}$? $\frac{2}{3}$? $\frac{3}{2}$?
3. How many eighths in $\frac{1}{2}$? $\frac{1}{4}$? $\frac{2}{4}$? $\frac{3}{4}$?
4. How many tenths in $\frac{1}{2}$? $\frac{1}{5}$? $\frac{3}{5}$? $\frac{4}{5}$?
5. How many twelfths in $\frac{1}{3}$? $\frac{1}{4}$? $\frac{1}{6}$? $\frac{4}{6}$?
6. How many fourteenths in $\frac{1}{2}$? $\frac{2}{7}$? $\frac{4}{7}$? $\frac{5}{7}$?
7. How many fifteenths in $\frac{2}{3}$? $\frac{3}{5}$? $\frac{4}{5}$? $\frac{5}{7}$?
8. How many sixteenths in $\frac{1}{4}$? $\frac{3}{8}$? $\frac{2}{8}$? $\frac{5}{8}$?
9. How many eighteenths in $\frac{2}{3}$? $\frac{4}{6}$? $\frac{3}{9}$? $\frac{8}{9}$?
10. How many twentieths in $\frac{4}{5}$? $\frac{3}{4}$? $\frac{7}{10}$? $\frac{3}{5}$?
11. Reduce $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{6}$ to twelfths.
12. Reduce $\frac{1}{2}$, $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{9}{10}$ to twentieths.
13. Reduce $\frac{2}{3}$, $\frac{4}{5}$, $\frac{5}{6}$, $\frac{9}{10}$, and $\frac{14}{15}$ to thirtieths.
14. Reduce $\frac{3}{4}$, $\frac{5}{8}$, $\frac{7}{10}$, $\frac{4}{5}$, and $\frac{17}{20}$ to fortieths.

When fractions have the same denominator, they are said to have a *common* denominator.

15. Reduce $\frac{2}{3}$ and $\frac{3}{4}$ to a common denominator
16. Reduce $\frac{1}{4}$ and $\frac{1}{5}$ to a common denominator.
17. Reduce $\frac{1}{3}$ and $\frac{1}{5}$ to a common denominator.
18. Reduce $\frac{1}{3}$ and $\frac{1}{6}$ to a common denominator.
19. Reduce $\frac{2}{3}$ and $\frac{3}{6}$ to a common denominator.
20. Reduce $\frac{1}{2}$ and $\frac{1}{7}$ to a common denominator.

21 Reduce $\frac{2}{3}$ and $\frac{3}{8}$ to a common denominator.
22. Reduce $\frac{2}{5}$ and $\frac{2}{6}$ to a common denominator.
23. Reduce $\frac{3}{4}$ and $\frac{5}{7}$ to a common denominator.
24. Reduce $\frac{6}{10}$ and $\frac{2}{6}$ to a common denominator.
25. Reduce $\frac{3}{4}$ and $\frac{6}{9}$ to a common denominator.
26. Reduce $\frac{2}{4}$ and $\frac{3}{10}$ to a common denominator.
27 Reduce $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ to a common denominator
28 Reduce $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{6}$ to a common denominator.
29. Reduce $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ to a common denominator.
30. Reduce $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{1}{10}$ to a common denominator.

The five following question are designed to illustrate the manner in which the pupil may be led to derive, by *induction*, an abbreviated method of obtaining the same results as those given by the analysis. Similar questions occur in several lessons, and claim particular attention.

31. Since $\frac{2}{3} = \frac{4}{6}$, by what number may you multiply both numerator and denominator of $\frac{2}{3}$ to obtain $\frac{4}{6}$?
32. Since $\frac{3}{4} = \frac{9}{12}$, by what number may you multiply both numerator and denominator of $\frac{3}{4}$ to obtain $\frac{9}{12}$?
33. Does it change the value of a fraction to multiply both numerator and denominator by the same number?
34. By what must you multiply the numerator and denominator of $\frac{3}{5}$ to reduce it to tenths?
35. By what must you multiply both numerator and denominator of $\frac{3}{4}$ to reduce it to twentieths?
36. Reduce $\frac{1}{2}$, $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{8}{10}$ to twentieths.
37. Reduce $\frac{1}{2}$, $\frac{3}{5}$, $\frac{4}{6}$, and $\frac{7}{10}$ to thirtieths.
38. Reduce $\frac{2}{3}$, $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{5}{6}$ to twelfths.
39. Reduce $\frac{1}{2}$, $\frac{2}{3}$, $\frac{5}{6}$, and $\frac{7}{9}$ to eighteenths.
40 Reduce $\frac{1}{2}$, $\frac{2}{4}$, $\frac{3}{8}$, and $\frac{5}{8}$ to sixteenths.
41 If $2\frac{1}{2}$ yards of silk cost 20 dimes, what will 4 yards cost?
42. If $2\frac{1}{6}$ yards of tape cost 13 cents, what will $3\frac{1}{2}$ yards cost?
43 What cost $3\frac{1}{5}$ pounds of sugar, if $2\frac{1}{2}$ pounds cost 25 cents?
44. Twice 18 is $\frac{2}{3}$ of a certain number; required the number

45. Mary lost 20 roses, which is $\frac{2}{3}$ as many as she then had; how many had she at first?

46. John found 60 cents, which is $\frac{5}{4}$ of $\frac{1}{2}$ of what he then had; how much had he at first?

47. If $\frac{2}{3}$ of $\frac{6}{8}$ of a yard of lace cost 8 cents, what will $\frac{3}{4}$ of 9 yards cost?

48. Henry gave his sister 20 cents, which is $\frac{4}{5}$ of what he had at first more than his sister, and $\frac{1}{2}$ of what she now has; how much had each at first?

LESSON III.

1. How many thirds are equal to $\frac{4}{6}$?

SOLUTION.—$\frac{1}{3}$ is equal to $\frac{2}{6}$, therefore $\frac{1}{2}$ of the number of sixths equals the number of thirds; $\frac{1}{2}$ of 4 is 2. Therefore, &.

2. How many halves in $\frac{2}{4}$? $\frac{6}{4}$? $\frac{8}{4}$? $\frac{10}{4}$?
3. How many thirds in $\frac{2}{6}$? $\frac{4}{6}$? $\frac{6}{9}$? $\frac{8}{12}$?
4. How many fourths in $\frac{1}{2}$? $\frac{6}{8}$? $\frac{9}{12}$? $\frac{8}{10}$?
5. How many sixths in $\frac{10}{12}$? $\frac{9}{18}$? $\frac{2}{3}$? $\frac{8}{12}$?
6. How many eighths in $\frac{4}{16}$? $\frac{12}{16}$? $\frac{8}{16}$? $\frac{12}{24}$?
7. How many fifths in $\frac{8}{10}$? $\frac{6}{15}$? $\frac{12}{20}$? $\frac{16}{20}$?
8. How many sevenths in $\frac{10}{14}$? $\frac{8}{14}$? $\frac{9}{21}$? $\frac{12}{21}$?
9. How many ninths in $\frac{12}{18}$? $\frac{16}{18}$? $\frac{15}{27}$? $\frac{18}{27}$?
10. How many tenths in $\frac{16}{20}$? $\frac{21}{30}$? $\frac{24}{40}$? $\frac{25}{50}$?

11. Since $\frac{4}{6} = \frac{2}{3}$, by what may we divide both numerator and denominator of $\frac{4}{6}$ to produce $\frac{2}{3}$?

12. Does dividing both numerator and denominator of a fraction, by the same number, change its value?

13. By what number must we divide both numerator and denominator of $\frac{4}{8}$ to reduce it to fourths?

14. By what must we divide both numerator and denominator of $\frac{5}{10}$ to reduce it to halves?

15 Reduce $\frac{6}{10}$ to fifths, and $\frac{3}{12}$ to fourths.

16 Reduce $\frac{7}{14}$ to halves, and $\frac{9}{12}$ to fourths.

17 Reduce $\frac{8}{5}$ to fourths, and $\frac{6}{9}$ to thirds.

18. Reduce $\frac{16}{20}$ to fifths, and $\frac{8}{24}$ to sixths.
19. Reduce $\frac{9}{21}$ to sevenths, and $\frac{16}{36}$ to ninths.
20. Reduce $\frac{15}{24}$ to eighths, and $\frac{24}{30}$ to tenths.
21. Reduce $\frac{28}{40}$ to tenths, and $\frac{35}{60}$ to twelfths.
22. Reduce $\frac{25}{45}$ to ninths, and $\frac{35}{55}$ to elevenths.

When a fraction cannot be reduced to an equivalent one having a less denominator, it is said to be in its *lowest terms.*

23. Reduce $\frac{4}{8}$ and $\frac{6}{12}$ to their lowest terms.
24. Reduce $\frac{10}{15}$ and $\frac{9}{15}$ to their lowest terms.
25. Reduce $\frac{12}{15}$ and $\frac{8}{12}$ to their lowest terms.
26 Reduce $\frac{16}{20}$ and $\frac{20}{36}$ to their lowest terms.
27. Reduce $\frac{15}{45}$ and $\frac{24}{36}$ to their lowest terms.
28. Reduce $\frac{21}{42}$ and $\frac{24}{48}$ to their lowest terms.
29. Reduce $\frac{25}{35}$ and $\frac{27}{36}$ to their lowest terms.

30. If 8 is $\frac{2}{3}$ of some number, what is $\frac{3}{4}$ of the same number?

31. If 6 is $\frac{2}{3}$ of some number, what is $\frac{1}{3}$ of 3 times the same number?

32. If 8 is $\frac{4}{5}$ of some number, what is $\frac{1}{5}$ of 2 times the same number?

33. Henry's horse cost 90 dollars, which is $\frac{9}{10}$ of 5 times the cost of the sleigh; required the cost of the sleigh.

34. 4 times 50 years is 10 years less than 10 times the age of James; how old is he?

35. If 4 horses eat 2 tons of hay in 8 weeks, how long will it require 5 horses to eat the same?

36 If 8 men can build a boat in 16 days, how long will it require 32 men to build it?

37. How many lemons will pay for 7 melons, if 6 lemons are worth $4\frac{4}{5}$ melons?

38. If it require $8\frac{2}{3}$ yards of cloth to make 2 coats, how much will be required to make 9 coats?

39. 42 dollars is $\frac{6}{7}$ of all the money A has, and B has 3 times as much; how much money has B?

40. What number being multiplied by 6, divided by 3, multiplied by 5, divided by 2, and 10 added, equals 30?

41. What number being multiplied by 8, divided by

4, multiplied by 3, divided by 2, and 10 subtracted, equals 14?

42. A gave B 48 cents, and $\frac{5}{6}$ of this is 4 times as many as he had remaining; how much had he at first?

43. Amanda having 50 pins, lost $\frac{4}{5}$ of them, and then found $\frac{3}{5}$ as many as remained; how many had she then?

44. A watch cost $90, which is $\frac{3}{9}$ of 10 times what the chain cost; required the cost of both.

45. Mary gave Lilly 24 pins, which is $\frac{3}{5}$ of what Lilly already had, and $\frac{3}{5}$ of what Mary had remaining; how many had each at first?

LESSON IV.

1. What is the sum of $\frac{1}{3}$ and $\frac{2}{3}$?
2. What is the sum of $\frac{2}{4}$ and $\frac{3}{4}$?
3. What is the sum of $\frac{4}{6}$ and $\frac{3}{6}$?
4. What is the sum of $\frac{2}{5}$ and $\frac{4}{5}$?
5. What is the difference between $\frac{6}{7}$ and $\frac{3}{7}$?
6. What is the difference between $\frac{7}{8}$ and $\frac{3}{8}$?
7. What is the difference between $\frac{8}{9}$ and $\frac{5}{9}$?
8. What is the difference between $2\frac{1}{4}$ and $1\frac{2}{4}$?
9. What is the difference between $3\frac{1}{3}$ and $2\frac{2}{3}$?
10. How many fourths in $\frac{1}{2}$ and $\frac{3}{4}$?
11. How many eighths in $\frac{3}{4}$ and $\frac{3}{8}$?
12. How many tenths in $\frac{1}{2}$ and $\frac{1}{5}$?
13. How many twelfths in $\frac{1}{4}$ and $\frac{1}{6}$?
14. How many fifteenths in $\frac{2}{3}$ and $\frac{3}{5}$?
15. How many sixteenths in $\frac{3}{4}$ and $\frac{5}{8}$?
16. How many eighteenths in $\frac{2}{3}$ and $\frac{5}{6}$?

What is the sum

17. Of $\frac{1}{2}$ and $\frac{1}{3}$?
18. Of $\frac{1}{3}$ and $\frac{1}{4}$?
19. Of $\frac{1}{4}$ and $\frac{1}{5}$?
20. Of $\frac{2}{4}$ and $\frac{3}{4}$?
21. Of $\frac{2}{3}$ and $\frac{2}{5}$?
22. Of $\frac{2}{5}$ and $\frac{3}{4}$?
23. Of $\frac{3}{4}$ and $\frac{3}{8}$?
24. Of $\frac{2}{4}$ and $\frac{2}{7}$?

25 Of $\frac{5}{6}$ and $\frac{4}{5}$?
26 Of $\frac{1}{4}$ and $\frac{1}{9}$?
27. Of $\frac{2}{5}$ and $\frac{3}{7}$?
28. Of $\frac{2}{3}$ and $\frac{3}{5}$?
29. Of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{3}{4}$?
30. Of $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$?
31. Of $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$?
32. Of $\frac{2}{7}$ and $\frac{3}{4}$?
33. Of $\frac{3}{4}$ and $\frac{3}{10}$?
34. Of $\frac{5}{6}$ and $\frac{4}{7}$?
35. Of $\frac{3}{7}$ and $\frac{3}{8}$?
36. Of $2\frac{1}{2}$ and $3\frac{1}{3}$?
37. Of $3\frac{1}{3}$ and $4\frac{1}{4}$?
38. Of $2\frac{2}{3}$ and $1\frac{3}{4}$?
39. Of $3\frac{1}{4}$ and $2\frac{3}{5}$?
40. Of $6\frac{2}{5}$ and $5\frac{3}{6}$?
41. Of $4\frac{1}{6}$ and $5\frac{1}{7}$?
42. Of $6\frac{1}{5}$ and $5\frac{1}{8}$?
43. Of $7\frac{2}{3}$ and $8\frac{2}{7}$?
44. Of $1\frac{1}{2}$, $2\frac{2}{3}$, and $3\frac{3}{4}$?
45. Of $2\frac{1}{3}$, $3\frac{1}{4}$, and $4\frac{1}{6}$?
46. Of $3\frac{1}{2}$, $2\frac{1}{4}$, and $4\frac{3}{5}$?

47. Thomas having $\frac{1}{3}$ of a dollar, found $\frac{2}{5}$ of a dollar; how much had he then?

48. A man having $\frac{2}{5}$ of a barrel of flour, bought $\frac{3}{4}$ of a barrel; how much had he then?

49. Mary having $\frac{1}{2}$ of a dozen of pins, found $\frac{5}{6}$ of a dozen; how many pins had she then?

50. Peter having $\frac{3}{8}$ of a certain sum of money, found $\frac{1}{2}$ of the same sum, and then had $21; how much was the sum?

51. $\frac{2}{3}$ of a certain number, increased by $\frac{3}{4}$ of the same number, equals 34; required the number.

52. Fanny's number of roses, increased by $\frac{1}{2}$ and $\frac{1}{3}$ of her number, equals 55; how many roses has she?

53. $\frac{2}{5}$ of A's money increased by its $\frac{3}{4}$, equals 69 doll lars; how much money has A?

54. B gave $24 for a watch, and $\frac{1}{2} + \frac{2}{3}$ of this is 4 times what he paid for a chain; required the cost of the chain.

55. If $\frac{3}{4}$ of James's age, increased by $\frac{1}{3}$ and $\frac{1}{8}$ of his age, equals 57 years, what is James's age?

Subtract

56 $\frac{1}{3}$ from $\frac{1}{2}$.
57. $\frac{1}{6}$ from $\frac{1}{4}$.
58. $\frac{2}{3}$ from $\frac{3}{4}$.
59. $\frac{1}{6}$ from $\frac{1}{4}$
60. $\frac{2}{5}$ from $\frac{3}{4}$
61. $\frac{2}{3}$ from $\frac{4}{5}$.
62. $\frac{2}{5}$ from $\frac{3}{8}$
63. $\frac{3}{5}$ from $\frac{3}{4}$.
64. $\frac{3}{4}$ from $\frac{8}{9}$.
65. $\frac{1}{6}$ from $\frac{1}{5}$.

66 $\frac{1}{7}$ from $\frac{1}{6}$.
67 $\frac{1}{3}$ from $\frac{2}{3}$.
68 $\frac{2}{5}$ from $\frac{3}{5}$.
69 $\frac{1}{2}$ from $\frac{5}{7}$.
70. $\frac{1}{8}$ from $\frac{1}{7}$.
71. $\frac{1}{9}$ from $\frac{1}{2}$.
72. $\frac{2}{7}$ from $\frac{2}{3}$.
73. $\frac{3}{7}$ from $\frac{6}{8}$.
74. $2\frac{1}{3}$ from $3\frac{1}{4}$.
75. $3\frac{1}{5}$ from $4\frac{1}{4}$.
76. $2\frac{1}{4}$ from $3\frac{1}{6}$
77. $3\frac{1}{5}$ from $5\frac{1}{6}$

78 What number is that, which being diminished by its $\frac{2}{5}$ equals 36?

79. Joshua's age, diminished by its $\frac{3}{7}$, equals 20 years; how old is Joshua?

80. A certain sum of money, diminished by its $\frac{1}{2}$ and $\frac{1}{3}$, equals 15 dollars; required the sum.

81. What number is that, which being increased by its $\frac{1}{3}$ and diminished by its $\frac{1}{4}$, equals 130?

82. A boy having 36 marbles, lost $\frac{3}{4}$ of them, and then found $\frac{5}{6}$ as many as he had at first; how many had he remaining?

83. $40 is 4 times what A paid for a chain, and the cost of the chain, increased by its 11 tenths, is $\frac{1}{4}$ of the cost of his watch; required the cost of the watch.

84. Janson's age, diminished by its $\frac{1}{4}$ and $\frac{1}{5}$, is 22 years, which is $\frac{2}{5}$ of his uncle's age; required the age of each.

85. $\frac{4}{5}$ of B's money, increased by the difference between $\frac{3}{5}$ and $\frac{3}{4}$ of his money, equals 190 dollars; required his money.

What is the value

86 Of $\frac{1}{2}+\frac{1}{3}-\frac{1}{4}$?
87. Of $\frac{1}{2}+\frac{3}{4}-\frac{1}{3}$?
88. Of $\frac{1}{4}+\frac{2}{5}-\frac{1}{2}$?
89 Of $\frac{1}{2}+\frac{1}{6}-\frac{1}{4}$?
90 Of $\frac{1}{3}+\frac{1}{6}-\frac{1}{2}$?
91 Of $\frac{1}{3}-\frac{3}{10}+\frac{1}{4}$?
92. Of $\frac{3}{8}-\frac{3}{12}+\frac{3}{4}$?
93. Of $2\frac{1}{2}+4\frac{1}{5}-4\frac{1}{4}$?
94. Of $1\frac{1}{3}+1\frac{1}{4}-2\frac{1}{5}$?
95. Of $3\frac{2}{3}+2\frac{3}{4}-5\frac{1}{3}$?
96. Of $2\frac{1}{6}-1\frac{1}{4}+3\frac{1}{3}$?
97. Of $4\frac{2}{5}-4\frac{1}{4}+6\frac{1}{3}$?
98. Of $6\frac{1}{2}-2\frac{1}{3}+3\frac{1}{4}$?
99. Of $2\frac{1}{6}+2\frac{1}{5}-2\frac{1}{10}$?

100. $60 is $\frac{3}{5}$ of what B gave for a horse, and the cost of the horse, increased by its 3 fifths, is 5 times what he paid for a sleigh; required the cost of the sleigh.

LESSON V.

1. A man spent $\frac{3}{5}$ of his money for a horse, and then had $60 remaining; how much money had he at first?

SOLUTION.—After spending $\frac{3}{5}$ of his money, there remained $\frac{5}{5} - \frac{3}{5} = \frac{2}{5}$ of his money, which equals $60. If $\frac{2}{5}$ of his money equals $60, $\frac{1}{5}$ equals $\frac{1}{2}$ of $60, which is $30, &c.

2. A lady, after giving away $\frac{1}{3}$ of her money, had only 40 cents remaining; how much money had she at first?

3. A farmer sold $\frac{3}{8}$ of his cows, and then had 25 remaining; how many had he at first?

4. A boy lost 4 marbles and found 10, and then had $\frac{3}{2}$ as many as at first; how many had he at first?

5. Mary gave $\frac{1}{2}$ of her money for silk, and $\frac{1}{3}$ for satin, and had 10 dollars remaining; how much had she at first?

6. Philo lost $16 and found $6, and then had $\frac{3}{4}$ as much as he had at first; how much had he before his loss?

7. $\frac{1}{3}$ of the length of a pole is in the air, $\frac{1}{4}$ in the water, and 10 feet in the ground; required the length of the pole.

8. Henry's money, diminished by its $\frac{1}{5}$ and $\frac{1}{6}$, equals 57 dollars; how much money has he?

9. Milo lost 24 cents, and then found $\frac{1}{3}$ as many as he lost, and then had only $\frac{2}{3}$ of what he had at first; how many had he before his loss?

10. Mr. A's money, increased by its $\frac{1}{2}$ and $\frac{1}{5}$, equals 34 dollars; how much money has he?

11. Says B to C, $\frac{3}{5}$ of my age diminished by $\frac{2}{5}$ of my age, equals 12 years; how old was he?

12. Peter gave 10 cents for a pie, which is $\frac{2}{3}$ of $\frac{1}{2}$ of the cost of his supper; required the cost of his supper.

13. A lady being asked her age, replied that her daughter's age is 8 years, which is $\frac{4}{5}$ of $\frac{1}{4}$ of her age; required her age.

14. Frank, after spending $\frac{2}{5}$ of his money, found that $16 was $\frac{2}{3}$ of what he had remaining; how much money had he at first?

15. $\frac{2}{5}$ of an army was killed, $\frac{2}{6}$ taken prisoners, and 800 escaped; of how many men did the army consist?

16. When E was married he was 27 years old, and $\frac{3}{4}$ of his age was 4 years more than $\frac{2}{3}$ of his wife's age; required the age of his wife.

17. A boy, after spending $\frac{1}{4}$ of his money for candies, and $\frac{1}{6}$ for peaches, found that 20 cents was $\frac{2}{7}$ of what remained; how much money had he?

18. What number is that, which being increased by its $\frac{1}{2}$, and that sum diminished by $\frac{2}{3}$ of the number, the remainder is 50?

19. Mr. K's hat cost $6, which was $3 less than $\frac{3}{8}$ of the cost of his coat; required the cost of the coat.

20. What number is that which being doubled, and then diminished by its $\frac{3}{4}$, equals 60?

21. $\frac{5}{6}$ of 30 cents is 5 cents less than $\frac{5}{6}$ of what a bushel of potatoes cost; what will be the cost of 5 bushels at the same rate?

22. What number is that, which being tripled and diminished by its $\frac{2}{3}$, the remainder will equal 70?

23. A merchant sold $\frac{1}{3}$ of $\frac{3}{5}$ of his stock in a month; how many thirds of $\frac{3}{5}$ of his stock remained?

24. Alsop having $\frac{6}{7}$ of an apple, gave $\frac{1}{6}$ of what he had to Jane; what part of $\frac{6}{7}$ of an apple remained?

25. A farmer having $\frac{9}{10}$ of a ton of hay, sold $\frac{2}{9}$ of it; how much of it then remained?

26. A boy having $\frac{5}{7}$ of a bushel of berries, sold $\frac{1}{8}$ of them; what part of a bushel had he remaining?

27. A fishing rod is 15 feet long, and $\frac{3}{5}$ of its length lacks 3 feet of being $\frac{6}{7}$ of the length of the line; required the length of the line.

28. A tree is 60 feet high, which is $\frac{5}{8}$ of $\frac{6}{7}$ of the length of its shadow, diminished by 20 feet, required the length of the shadow.

29. 10 dollars is $\frac{2}{5}$ of what M paid for a cow, and the

cost of the cow is $\frac{5}{12}$ of the cost of an ox; required the value of the ox.

30. A pen cost 16 cents, which is $\frac{2}{5}$ of $\frac{2}{3}$ of what the pen and holder both cost; required the cost of the holder

LESSON VI

1 How many are 4 times $\frac{3}{8}$?

SOLUTION.—4 times $\frac{3}{8}$ are $\frac{12}{8}$, which equals $\frac{3}{2}$ or $1\frac{1}{2}$. Therefore, &c.

2. How many are 3 times $\frac{3}{6}$? 3 times $\frac{2}{9}$?
3. How many are 4 times $\frac{6}{8}$? 5 times $\frac{4}{10}$?
4. How many are 7 times $\frac{3}{14}$? 3 times $\frac{2}{6}$?
5. How many are 4 times $\frac{6}{12}$? 6 times $\frac{7}{12}$?

How many are

6. 3 times $\frac{6}{9}$?
7. 8 times $\frac{2}{4}$?
8. 5 times $\frac{3}{6}$?
9. 3 times $\frac{6}{9}$?
10. 5 times $\frac{4}{8}$?
11 6 times $\frac{5}{8}$?
12. 10 times $\frac{3}{5}$?
13. 8 times $\frac{3}{16}$?
14. 4 times $\frac{2}{6}$?
15. 8 times $\frac{3}{6}$?
16. 5 times $\frac{7}{8}$?
17. 4 times $2\frac{1}{2}$?
18. 6 times $3\frac{1}{4}$?
19. 8 times $5\frac{3}{4}$?
20. 9 times $2\frac{2}{3}$?
21. 10 times $4\frac{3}{5}$?

22. If you give to 8 boys, each $2\frac{3}{4}$ apples, how many apples will it require?

23. How many dollars does that man give away, who gives to each of 10 beggars $\frac{4}{5}$ of a dollar?

24. Mary gave to each of 12 poor children, $\frac{5}{6}$ of a pie, and had 3 pies remaining; how many pies had she?

25. How many quarts of nuts will it require, to give $\frac{4}{5}$ of a quart to each of 18 boys, and have 2 quarts remaining?

26. What will be the cost of 25 pounds of sugar, at the rate of $\frac{4}{5}$ of a dime a pound?

27. How much will $4\frac{2}{3}$ yards of muslin cost, at the rate of 6 cents a yard?

28. What will 15 books cost, at the rate of $\frac{2}{3}$ of a dollar apiece?

29. How much will 9 inkstands cost, at the rate of 2 for $\frac{4}{6}$ of a dollar?

30. If 4 apples cost $\frac{3}{4}$ of a dime what will 16 apples cost?

31. What will 7 quarts of beans cost, if 4 quarts cost $\frac{4}{5}$ of a dollar?

32. If a man walk $3\frac{1}{5}$ miles in 2 hours, how far will he walk in 1 day of 10 hours?

33. William lost $2\frac{1}{4}$ dollars, and then having found 4 times as much as he lost, had 12 dollars; how much had he at first?

34. Mary found $4\frac{2}{3}$ shillings, and then losing $\frac{1}{2}$ as much as she found, had $6\frac{1}{3}$ shillings remaining; how many had she at first?

35. Since 2 times $\frac{3}{4} = \frac{6}{4}$, or $\frac{3}{2}$, how may the last result be obtained by omitting the analysis?

36. Since 3 times $\frac{5}{6} = \frac{15}{6}$, or $\frac{5}{2}$, how may the last result be obtained without the analysis?

37. How then may a fraction be multiplied by a number which will divide the denominator?

38. What is the effect of dividing the denominator of a fraction by any number?

How many are

39. 4 times $\frac{5}{8}$?
40. 6 times $\frac{5}{6}$?
41. 7 times $\frac{3}{14}$?
42. 5 times $\frac{9}{10}$?
43. 8 times $\frac{10}{16}$?
44. 3 times $\frac{3}{9}$?
45. 9 times $\frac{15}{27}$?
46. 7 times $\frac{18}{21}$?
47. 6 times $\frac{8}{12}$?
48. 4 times $\frac{9}{12}$?
49. 10 times $\frac{6}{20}$?
50. 8 times $\frac{24}{32}$?
51. 6 times $\frac{18}{36}$?
52. 4 times $\frac{15}{16}$?
53. 3 times $2\frac{6}{8}$?
54. 5 times $2\frac{2}{5}$?
55. 7 times $3\frac{1}{7}$?
56. 12 times $\frac{9}{24}$?
57. 10 times $3\frac{15}{30}$?
58. 11 times $2\frac{10}{22}$?

59. 3 times $2\frac{2}{3}$ miles is twice the distance from the Normal School to Lancaster; required the distance.

60. 5 times $4\frac{4}{5}$ miles is 3 times the distance from Paoli to Oakland; required the distance.

61 A is $6\frac{7}{8}$ years old, and 8 times A's age is 5 times B's age; required the age of B.

62. Six times $2\frac{2}{6}$ miles is $\frac{7}{10}$ of the distance from Oakland to Christiana; what is the distance?

63. $6\frac{2}{3}$ dollars is $\frac{1}{3}$ of 4 times $3\frac{3}{4}$ times B's money; how much money has B?

64. 7 times $3\frac{1}{7}$ miles is $5\frac{1}{2}$ times the distance from Columbia to Marietta; what is the distance?

65. James lost $\$5\frac{1}{3}$, and then had 5 times $\$6\frac{7}{10}$ remaining; how much money had he at first?

66. Peter gave $\frac{1}{5}$ of his marbles to Samuel, and 2 times $\frac{1}{4}$ of them to Anson, and had 15 remaining; how many had he at first?

67. A having lost $\frac{1}{7}$ of his hens, sold 3 times $\frac{2}{3}$ of the remainder, and then had 20; how many had he at first?

68. $4\frac{1}{4}$ miles, the distance from M to B, being multiplied by 8, lacks 2 miles of being 2 times the distance from M to W; required the distance.

LESSON VII.

1. What is $\frac{1}{3}$ of 4?

SOLUTION.—$\frac{1}{3}$ of 1 is $\frac{1}{3}$, and $\frac{1}{3}$ of 4 is 4 times $\frac{1}{3}$, which are $\frac{4}{3}$. Therefore $\frac{1}{3}$ of 4 is $\frac{4}{3}$ of one.

2 What is $\frac{1}{3}$ of 5? $\frac{1}{4}$ of 6?
3. What is $\frac{1}{5}$ of 7? $\frac{1}{6}$ of 9?
4. What is $\frac{1}{2}$ of 5? $\frac{1}{4}$ of 10?
5. What is $\frac{1}{7}$ of 12? $\frac{1}{8}$ of 20?
6. What is $\frac{1}{10}$ of 24? $\frac{1}{12}$ of 32?
7. What is $\frac{2}{4}$ of 6? $\frac{3}{4}$ of 10?

8. What is $\frac{3}{5}$ of 3? $\frac{5}{6}$ of 14?
9. What is $\frac{2}{7}$ of 4? $\frac{3}{9}$ of 15?
10 What is $\frac{3}{5}$ of 2? $\frac{3}{8}$ of 12?
11. What is $\frac{5}{6}$ of 9? $\frac{3}{9}$ of 16?
12. What is $\frac{5}{8}$ of 6? $\frac{6}{8}$ of 20?
13. What is $\frac{7}{10}$ of 5? $\frac{9}{12}$ of 18?
14. B has 5 dollars, and $\frac{2}{7}$ of B's money equals $\frac{5}{7}$ of A's; how much money has A?
15. James is 7 years old, and $\frac{4}{9}$ of his age equals $\frac{7}{9}$ of Mary's age; how old is Mary?
16. One part of a pole is 9 feet long, which lacks 3 feet of being $\frac{4}{11}$ of the length of the other part; required the length of the pole.
17. The distance from A to B is 11 miles, and $\frac{5}{6}$ of this is $\frac{11}{12}$ of the distance from A to C; required the distance to C.
18. A watch cost $21, and $\frac{4}{5}$ of its cost is $\frac{7}{10}$ of the cost of the chain; required the cost of both.
19. A cask contains 5 gallons, and $\frac{6}{7}$ of its contents is $\frac{10}{14}$ of the contents of another cask; required the contents of the second cask
20. Charles has 9 apples, and $\frac{5}{8}$ of his, $+\frac{3}{5}$ of an apple, equals $\frac{6}{8}$ of Chester's; how many has Chester?
21. What is $\frac{2}{3}$ of $\frac{6}{8}$?

SOLUTION.—$\frac{1}{3}$ of $\frac{6}{8}$ is $\frac{2}{8}$, and if $\frac{1}{3}$ of $\frac{6}{8}$ is $\frac{2}{8}$, $\frac{2}{3}$ of $\frac{6}{8}$ are 2 times $\frac{2}{8}$, which are $\frac{4}{8}$, or $\frac{1}{2}$ Therefore, &c.

What is

22 $\frac{3}{5}$ of $\frac{10}{12}$?
23. $\frac{2}{7}$ of $\frac{7}{8}$?
24. $\frac{3}{6}$ of $\frac{6}{9}$?
25. $\frac{4}{5}$ of $\frac{18}{20}$?
26. $\frac{3}{5}$ of $\frac{15}{18}$?
27 $\frac{2}{7}$ of $\frac{14}{16}$?
28 $\frac{2}{3}$ of $\frac{9}{12}$?
29. $\frac{3}{5}$ of $2\frac{1}{5}$?
30 $\frac{5}{6}$ of $2\frac{2}{5}$?
31 $\frac{3}{4}$ of $3\frac{1}{5}$?
32. $\frac{2}{5}$ of $3\frac{3}{4}$?
33. $\frac{3}{5}$ of $1\frac{1}{3}$?
34. $2\frac{1}{3}$ times $1\frac{2}{7}$?
35. $2\frac{1}{4}$ times $3\frac{1}{5}$?
36. $3\frac{2}{5}$ times $3\frac{5}{10}$?
37. $2\frac{1}{4}$ times $2\frac{2}{3}$?
38. $\frac{3}{5}$ of $\$5\frac{2}{6}$ is $\frac{2}{7}$ of what A gave for a bureau; what was the cost of the bureau?

39. $\frac{5}{7}$ of $\$\frac{14}{25}$ is $\frac{2}{20}$ of the cost of a watch; how much did the watch cost?

40. B has 27 marbles, and $\frac{3}{8}$ of $\frac{6}{9}$ of B's number equals $\frac{2}{5}$ of C's; how many has C?

41. Henry's hat cost $\frac{4}{5}$ of an eagle, which is $\frac{2}{3}$ of $\frac{3}{5}$ of the cost of his coat; required the cost of the coat.

42. Peter had $\frac{8}{9}$ of a barrel of flour, and after selling $\frac{3}{4}$ of it, the remainder is $\frac{2}{18}$ of what Paxton had; how much had Paxton?

43. If there are 48 chestnuts in a pint, how many does each of two boys receive, if A receives $\frac{6}{8}$ of a pint, and B $\frac{2}{3}$ as many as A?

44. Mary bought $\frac{4}{6}$ of a paper of needles, which is $\frac{8}{9}$ of what Sarah bought; how many did each purchase, provided there are 24 needles in a paper?

45. Frank has 18 apples, Francis $\frac{8}{9}$ as many, and Fanny $\frac{3}{4}$ as many as Francis; how many has each?

46. A has 40 fruit trees, $\frac{4}{10}$ of which bear apples, $\frac{1}{2}$ of the remainder, pears, and the rest, peaches; how many trees of each kind has he?

LESSON VIII.

1. What is $\frac{1}{3}$ of $\frac{1}{4}$?

SOLUTION.—$\frac{1}{3}$ of $\frac{1}{4}$ is *one* of the *three* equal parts into which $\frac{1}{4}$ may be divided; if each fourth is divided into three equal parts, 4 fourths or the unit will be divided into 4 times 3, or 12 equal parts; hence, each part is $\frac{1}{12}$ of a unit. Therefore $\frac{1}{3}$ of $\frac{1}{4}$ is $\frac{1}{12}$.

2. What is $\frac{1}{5}$ of $\frac{1}{4}$? $\frac{1}{4}$ of $\frac{1}{4}$? $\frac{1}{5}$ of $\frac{1}{4}$?
3 What is $\frac{1}{3}$ of $\frac{1}{5}$? $\frac{1}{2}$ of $\frac{1}{3}$? $\frac{1}{3}$ of $\frac{1}{6}$?
4. What is $\frac{1}{4}$ of $\frac{1}{6}$? $\frac{1}{5}$ of $\frac{1}{6}$? $\frac{1}{6}$ of $\frac{1}{7}$?
5. What is $\frac{1}{5}$ of $\frac{1}{3}$? $\frac{1}{2}$ of $\frac{1}{7}$? $\frac{1}{3}$ of $\frac{1}{7}$?
6. What is $\frac{1}{4}$ of $\frac{1}{8}$? $\frac{1}{6}$ of $\frac{1}{8}$? $\frac{1}{7}$ of $\frac{1}{9}$?
7 What is $\frac{1}{6}$ of $\frac{1}{12}$? $\frac{1}{8}$ of $\frac{1}{9}$? $\frac{1}{7}$ of $\frac{1}{10}$?
8 What is $\frac{1}{9}$ of $\frac{1}{11}$? $\frac{1}{10}$ of $\frac{1}{11}$? $\frac{1}{11}$ of $\frac{1}{12}$?

9. What is $\frac{1}{4}$ of $\frac{1}{7}$? $\frac{1}{3}$ of $\frac{1}{11}$? $\frac{1}{4}$ of $\frac{1}{10}$?

10. Mary having $\frac{1}{5}$ of a pie, gave $\frac{1}{3}$ of it to Hannah; what part of a pie did Hannah receive?

11 Philo having $\frac{1}{4}$ of an orange, gave $\frac{1}{2}$ of it to Peter; what part of an orange did Peter receive?

12 A had $\frac{1}{3}$ of a dollar, and gave $\frac{1}{5}$ of it to B; what part of a dollar did B receive?

13. Since $\frac{1}{3}$ of $\frac{1}{4}$ equals $\frac{1}{12}$, how may the same result be obtained without the analysis?

14. Since $\frac{1}{4}$ of $\frac{1}{5}$ equals $\frac{1}{20}$, how may we obtain the same result without the analysis?

15. What is $\frac{1}{2}$ of $\frac{1}{3}$? $\frac{1}{3}$ of $\frac{1}{5}$? $\frac{1}{5}$ of $\frac{1}{6}$? $\frac{1}{5}$ of $\frac{1}{7}$?

16 What is $\frac{1}{3}$ of $\frac{1}{6}$? $\frac{1}{5}$ of $\frac{1}{8}$? $\frac{1}{7}$ of $\frac{1}{3}$? $\frac{1}{8}$ of $\frac{1}{9}$?

17. What is $\frac{1}{6}$ of $\frac{1}{4}$? $\frac{1}{7}$ of $\frac{1}{7}$? $\frac{1}{9}$ of $\frac{1}{5}$? $\frac{1}{10}$ of $\frac{1}{11}$?

NOTE.—Problem 1st may also be solved thus: $\frac{1}{4}$ equals $\frac{3}{12}$, and $\frac{1}{3}$ of $\frac{3}{12}$ is $\frac{1}{12}$, hence $\frac{1}{3}$ of $\frac{1}{4}$ is $\frac{1}{12}$. This is simpler than the solution given, but since it does not show *the reason why* $\frac{1}{3}$ of $\frac{1}{4} = \frac{1}{12}$, we prefer the other solution.

18. What is the difference between $\frac{1}{2}$ of $\frac{1}{3}$, and $\frac{1}{3}$ of $\frac{1}{4}$?

19. What is the value of $\frac{1}{4}$ of $\frac{1}{5}$, subtracted from $\frac{1}{2}$ of $\frac{1}{4}$?

20. How much greater is $\frac{1}{3}$ of $\frac{1}{4}$, than $\frac{1}{2}$ of $\frac{1}{8}$?

21. A man owning $\frac{1}{8}$ of a farm, sold $\frac{1}{6}$ of it to his neighbour; what part of it did his neighbour receive?

22. Susan bought $\frac{1}{6}$ of a cake, and gave Eliza $\frac{1}{3}$ of it; how much did Susan retain?

23. A man, having $\frac{1}{7}$ of a share of bank stock, sold $\frac{1}{4}$ of it; how much of a share did he retain?

24. Carlo, finding $\frac{1}{5}$ of a pound of meat, let Towser eat $\frac{1}{4}$ of it; what part of a pound did Carlo eat?

25. What is A's age, supposing that $\frac{1}{3}$ of 10 years is $\frac{1}{2}$ of $\frac{1}{3}$ of his age?

26. How much money has Jacob, if $\frac{1}{4}$ of 13 dollars is $\frac{1}{2}$ of $\frac{1}{8}$ of his money?

27. A cow cost 17 dollars, and $\frac{1}{3}$ of the cost of the cow is $\frac{1}{2}$ of $\frac{1}{3}$ of the cost of an ox; required the cost of the ox

28. A pen cost 20 cents, and $\frac{2}{3}$ of its cost is $\frac{1}{3}$ of $\frac{2}{3}$ of the cost of the holder; required the cost of the holder.

29. What is $\frac{1}{3}$ of $\frac{4}{5}$?

SOLUTION.—$\frac{1}{3}$ of $\frac{1}{5}$ is $\frac{1}{15}$, and if $\frac{1}{3}$ of $\frac{1}{5}$ is $\frac{1}{15}$, $\frac{1}{3}$ of $\frac{4}{5}$ is 4 times $\frac{1}{15}$, which are $\frac{4}{15}$. Therefore $\frac{1}{3}$ of $\frac{4}{5} = \frac{4}{15}$.

30. What is $\frac{1}{3}$ of $\frac{2}{3}$? $\frac{1}{4}$ of $\frac{3}{5}$? $\frac{1}{5}$ of $\frac{4}{7}$?
31. What is $\frac{1}{4}$ of $\frac{5}{7}$? $\frac{1}{6}$ of $\frac{5}{8}$? $\frac{1}{7}$ of $\frac{5}{6}$?
32. What is $\frac{1}{5}$ of $\frac{6}{7}$? $\frac{1}{8}$ of $\frac{7}{9}$? $\frac{1}{6}$ of $\frac{4}{12}$?
33. What is $\frac{2}{3}$ of $\frac{4}{5}$? $\frac{3}{4}$ of $\frac{5}{6}$? $\frac{4}{5}$ of $\frac{6}{8}$?
34. What is $\frac{3}{5}$ of $\frac{4}{6}$? $\frac{5}{6}$ of $\frac{5}{7}$? $\frac{3}{4}$ of $\frac{3}{8}$?
35. What is $\frac{2}{5}$ of $\frac{4}{7}$? $\frac{7}{10}$ of $\frac{5}{8}$? $\frac{5}{9}$ of $\frac{7}{10}$?
36. What is $\frac{8}{10}$ of $\frac{9}{11}$? $\frac{7}{6}$ of $\frac{6}{12}$? $\frac{9}{5}$ of $\frac{10}{18}$?
37. Since $\frac{2}{3}$ of $\frac{4}{5} = \frac{8}{15}$, in what manner may we obtain the same result by omitting the analysis?
38. What is $\frac{3}{8}$ of $\frac{3}{9}$? $\frac{2}{5}$ of $\frac{2}{7}$? $\frac{3}{4}$ of $\frac{3}{5}$? $\frac{4}{5}$ of $\frac{4}{6}$?
39. What is $\frac{5}{7}$ of $\frac{2}{3}$? $\frac{6}{8}$ of $\frac{3}{4}$? $\frac{7}{6}$ of $\frac{3}{7}$? $\frac{5}{4}$ of $\frac{2}{10}$?
40. What is $\frac{3}{4}$ of $\frac{8}{6}$? $\frac{4}{5}$ of $\frac{10}{8}$? $\frac{3}{7}$ of $\frac{14}{9}$? $\frac{7}{3}$ of $\frac{6}{14}$?
41. What is $\frac{2}{7}$ of $\frac{14}{4}$? $\frac{3}{8}$ of $\frac{8}{9}$? $\frac{8}{5}$ of $\frac{15}{16}$? $\frac{10}{11}$ of $\frac{22}{20}$?
42. Johnston, having $\frac{2}{3}$ of a melon, gave $\frac{2}{3}$ of it to Martin; how much of it remained?
43. Having $\frac{3}{4}$ of a bushel of apples, I gave $\frac{3}{4}$ of them to Westlake; what part of a bushel remained?
44. What is the difference between $\frac{2}{3}$ of $\frac{3}{4}$ of a lemon, and $\frac{3}{4}$ of $\frac{8}{9}$ of a lemon?
45. How much money has Sarah, if $\frac{2}{3}$ of 11 dollars is $\frac{2}{5}$ of her money?
46. A can build a boat in $2\frac{2}{3}$ weeks, which is $\frac{2}{3}$ of $\frac{6}{8}$ of the time in which B can build it; how long will it take B to build it?
47. A hat cost \$5, and $\frac{4}{5}$ of its cost is $\frac{2}{3}$ of $\frac{15}{20}$ of the cost of a coat; required the cost of the coat.
48. A man lost $\frac{8}{9}$ of his money, and then found as much as $\frac{1}{6}$ of the remainder; what part of his money did he then have?
49. A squirrel fell $\frac{5}{6}$ of the distance from the top of a tree to the ground, and then ascended $\frac{1}{4}$ of the distance he was from the ground; what part of the whole distance was he from the ground?
50. Annie, having $\frac{2}{5}$ of a pound of candies, shared

them equally with 5 of her schoolmates; what part of a pound did each receive?

51. Richard, having $\frac{3}{2}$ of $\frac{2}{7}$ of a quart of chestnuts, shared them equally with 4 of his playfellows; what part of a quart did each receive?

52. Matthew lost $\frac{6}{8}$ of his property, then selling $\frac{1}{2}$ of the remainder, bought as much as 1 third of what then remained; what part of his property did he then have?

53. A, having $\frac{2}{5}$ of a dollar, gave $\frac{1}{2}$ of it to B, and B gave $\frac{1}{3}$ of his to C; what part of a dollar did each then have?

54. A kite in the air fell $\frac{1}{2}$ of the distance to the ground, then arose $\frac{1}{3}$ of the distance it was from the ground, and then fell $\frac{1}{4}$ of the distance it arose; what part of the whole distance was it from the ground?

LESSON IX.

1. How many times is $\frac{2}{3}$ contained in 4?

SOLUTION.—1 is contained in 4, 4 times; and if 1 is contained in 4, 4 times, $\frac{1}{3}$ is contained in 4, 3 times 4 times, which are 12 times, and 2 thirds is contained in $4\frac{1}{2}$ of 12 times, or 6 times, Therefore, &c.

2. How many times is $\frac{3}{4}$ contained in 2? In 3?
3. How many times is $\frac{2}{5}$ contained in 3? In 5?
4. How many times is $\frac{3}{7}$ contained in 2? In 4?
5. How many times is $\frac{2}{3}$ contained in 5? In 7?
6. How many times is $\frac{5}{6}$ contained in 4? In 5?
7. How many times is $\frac{6}{8}$ contained in 2? In 4?
8. How many times is $\frac{5}{9}$ contained in 5? In 8?
9. How many times is $\frac{9}{10}$ contained in 7? In 9?
10. How many times is $\frac{8}{11}$ contained in 2? In 4?
11. How many times is $\frac{4}{6}$ contained in 4? In 12?
12. By what method may we derive the results obtained above, without the analysis?

13 If a yard of cloth cost $\frac{3}{5}$ of a dollar, how many yards can you buy for 12 dollars?

14. If 2 quarts of nuts cost $\frac{3}{4}$ of a dime, how many quarts can be bought for 1 dollar?

15. How many yards of tape can be bought for 11 cents, if 3 yards cost $2\frac{1}{2}$ cents?

16. What cost 7 peaches, at the rate of 5 peaches for $6\frac{1}{2}$ cents?

17. If 5 pints of milk cost 12 cents, how many pints can you purchase for 25 cents?

18. If $2\frac{1}{2}$ barrels of apples cost 15 dollars, how many barrels can be bought for $8\frac{2}{3}$ dollars?

19. If $\frac{3}{4}$ of an apple cost $\frac{3}{5}$ of a cent, what will $\frac{1}{2}$ of $\frac{2}{3}$ of an apple cost?

20. What cost $2\frac{1}{5}$ oranges, at the rate of 4 oranges for $5\frac{1}{3}$ cents?

21. If $3\frac{1}{3}$ boxes of butter cost $\$5\frac{1}{4}$, what will 10 boxes cost, at the same rate?

22. $7\frac{1}{2}$ dollars is $\frac{1}{2}$ of 5 times what a watch-key cost, and the chain cost 8 times as much; required the cost of the chain.

23. What cost 16 lemons, if $5\frac{1}{3}$ lemons cost $12\frac{2}{3}$ cents?

24. What cost 17 yards of lace, if $4\frac{1}{4}$ yards cost $7\frac{1}{2}$ dimes?

25. If 3 men can do a piece of work in $6\frac{2}{3}$ days, how long will it take 12 men to do the same?

26. If it require 9 men to do a piece of work in $4\frac{1}{3}$ days, how many men will be required to do it in 13 days?

27. What cost 26 gallons of molasses, if $4\frac{3}{5}$ gallons cost $2\frac{1}{6}$ dollars?

28. How many times is $\frac{2}{3}$ contained in $\frac{3}{4}$?

REMARK.—Solution similar to that at the beginning of the lesson.

29. How many times is $\frac{2}{3}$ contained in $\frac{3}{5}$? In $\frac{3}{8}$?

30 How many times is $\frac{3}{4}$ contained in $\frac{2}{7}$? In $\frac{5}{6}$?
31. How many times is $\frac{5}{6}$ contained in $\frac{3}{4}$? In $\frac{4}{5}$?
32. How many times is $\frac{2}{3}$ contained in $\frac{5}{8}$? In $\frac{7}{9}$?
33. How many times is $\frac{4}{7}$ contained in $\frac{5}{6}$? In $\frac{6}{8}$?
34. How many times is $\frac{4}{5}$ contained in $\frac{8}{9}$? In $\frac{7}{10}$?
35. How many times is $\frac{3}{8}$ contained in $\frac{3}{7}$? In $\frac{1}{6}$?
36. How many times is $\frac{5}{6}$ contained in $\frac{10}{12}$? In $\frac{15}{18}$?
37. How many times is $\frac{4}{7}$ contained in $\frac{8}{21}$? In $\frac{12}{14}$?
38. How many times is $\frac{7}{8}$ contained in $\frac{7}{16}$? In $\frac{14}{32}$?
39. How many times is $\frac{2}{4}$ contained in $\frac{3}{5}$??

ANOTHER SOLUTION.—$\frac{2}{4}$ is equal to $\frac{10}{20}$, and $\frac{3}{5}$ is equal to $\frac{12}{20}$; $\frac{10}{20}$ is contained as many times in $\frac{12}{20}$ as 10 is contained in 12, which is $\frac{12}{10}$ or $\frac{6}{5}$ times. Therefore, &c.

40. How many times is $\frac{2}{3}$ contained in $\frac{2}{4}$? In $\frac{3}{7}$?
41. How many times is $\frac{3}{4}$ contained in $\frac{2}{5}$? In $\frac{4}{7}$?
42. How many times is $\frac{2}{5}$ contained in $\frac{3}{4}$? In $\frac{2}{3}$?
43. How many times is $\frac{5}{8}$ contained in $\frac{2}{4}$? In $\frac{3}{7}$?
44. How many times $\frac{3}{4}$ is $\frac{3}{2}$? $\frac{5}{6}$? $\frac{3}{6}$?
45. How many times $\frac{3}{5}$ is $\frac{2}{7}$? $\frac{3}{8}$? $\frac{9}{10}$?
46. How many times $\frac{2}{7}$ is $\frac{2}{3}$? $\frac{3}{4}$? $\frac{4}{5}$?
47. How many times $\frac{4}{9}$ is $\frac{1}{2}$? $\frac{2}{3}$? $\frac{3}{4}$?
48. How many times $\frac{3}{8}$ is $\frac{2}{4}$? $\frac{5}{6}$? $\frac{6}{10}$?
49. From the results in either of the above solutions, what method may be derived to divide fractions by omitting the analysis?
50. If a yard of muslin cost $\frac{3}{5}$ of a dime, how many yards can you purchase for $\frac{7}{8}$ of a dime?
51. If a quart of vinegar cost $\frac{3}{10}$ of a dollar, how many quarts can you buy for $2\frac{1}{2}$ dollars?
52. How many pens, at $\frac{1}{3}$ of a dime each, can be bought for 10 sheets of paper, worth $\frac{4}{6}$ of a cent each?
53. A divided 14 apples equally among his companions, giving to each $\frac{7}{2}$ of an apple; required the number of companions.
54 A lady distributed 29 dimes equally among some poor children, giving to each $5\frac{4}{5}$ dimes; how many children were there?

55. How many bushels of grain, at $\$\frac{4}{5}$ a bushel, can be bought for 12 bushels of apples, worth $\$\frac{1}{5}$ a bushel?

56. If 1 pound of butter cost $\$\frac{3}{8}$, how many pounds can be had for $\frac{3}{4}$ of a barrel of flour, worth $6 per barrel?

57. B bought 6 yards of ribbon, worth $5\frac{2}{3}$ cents a yard; how many apples, worth $1\frac{1}{3}$ cents each, will be required to pay for it?

58. Harvey bought 8 bushels of potatoes, worth $\$\frac{5}{6}$ a bushel, and paid for them with eggs, worth $\$\frac{2}{5}$ a dozen; how many eggs did it take?

LESSON X.

1. What part of 2 is $\frac{3}{4}$?

SOLUTION.—1 is $\frac{1}{2}$ of 2, and $\frac{1}{4}$ is $\frac{1}{4}$ of $\frac{1}{2}$ of 2, which is $\frac{1}{8}$ of 2, and $\frac{3}{4}$ is 3 times $\frac{1}{8}$, or $\frac{3}{8}$ of 2. Therefore $\frac{3}{4}$ is $\frac{3}{8}$ of 2.

2. What part of 3 is $\frac{2}{3}$? Of 2 is $\frac{3}{4}$?
3. What part of 4 is $\frac{2}{5}$? Of 5 is $\frac{3}{8}$?
4. What part of 4 is $\frac{4}{6}$? Of 7 is $\frac{5}{8}$?
5. What part of 9 is $\frac{3}{7}$? Of 5 is $\frac{1}{2}$ of $\frac{3}{4}$?
6. What part of 6 is $\frac{2}{3}$ of $\frac{2}{4}$? Of 7 is $\frac{2}{5}$ of $\frac{3}{2}$?
7. What part of 2 is $\frac{3}{5}$ of $\frac{2}{6}$? Of 5 is $\frac{4}{5}$ of $\frac{10}{12}$?
8. What part of 6 is $\frac{3}{4}$ of $\frac{2}{6}$? Of 8 is $\frac{2}{5}$ of $\frac{1}{4}$?

9. If a pole 10 feet long cast a shadow $3\frac{1}{3}$ feet, what is the length of the shadow of a pole 8 feet long, at the same time of day?

10. If 7 apples are worth $5\frac{3}{5}$ peaches, how many apples are 12 peaches worth?

11. If at a certain time of day, a pole 9 feet long cast a shadow $4\frac{1}{2}$ feet, what must be the length of a pole to cast a shadow $5\frac{1}{2}$ feet long, at the same time of day?

12. If 8 pipes fill a vessel in $2\frac{1}{5}$ hours, how many pipes will be required to fill it in $\frac{1}{10}$ of an hour?

13. Required the length of the shadow of a pole, 16

feet long, at the same time that a pole $3\frac{1}{3}$ feet long casts a shadow $7\frac{2}{4}$ feet in ength?

14. Mr. B, having lost \$10, found that only $\frac{6}{8}$ of his money remained; how much money had he?

15. A merchant sold goods for $\frac{10}{13}$ of what they cost, and thereby lost \$24; what was the cost of his goods?

16. What part of $\frac{2}{3}$ is $\frac{4}{5}$?

SOLUTION.—$\frac{1}{3}$ is $\frac{1}{2}$ of $\frac{2}{3}$, and $\frac{3}{3}$ or *one* is 3 times $\frac{1}{2}$, or $\frac{3}{2}$ of $\frac{2}{3}$. Since *one* is $\frac{3}{2}$ of $\frac{2}{3}$, $\frac{1}{5}$ is $\frac{1}{5}$ of $\frac{3}{2}$, which is $\frac{3}{10}$ of $\frac{2}{3}$, and $\frac{4}{5}$ is 4 times $\frac{3}{10}$, which are $\frac{12}{10}$ or $\frac{6}{5}$ of $\frac{2}{3}$. Therefore, $\frac{4}{5}$ is $\frac{6}{5}$ of $\frac{2}{3}$.

What part

17. Of $\frac{3}{4}$ is $\frac{2}{5}$?
18. Of $\frac{3}{6}$ is $\frac{2}{3}$?
19. Of $\frac{4}{5}$ is $\frac{5}{6}$?
20. Of $\frac{6}{7}$ is $\frac{3}{8}$?
21. Of $\frac{2}{5}$ is $\frac{3}{4}$?
22. Of $\frac{3}{5}$ is $\frac{3}{4}$?
23. Of $\frac{5}{7}$ is $\frac{3}{5}$?
24. Of $\frac{3}{4}$ is $\frac{5}{6}$?
25. Of $\frac{5}{6}$ is $\frac{3}{4}$?
26. Of $\frac{5}{7}$ is $2\frac{1}{2}$?
27. Of $\frac{6}{7}$ is $\frac{2}{3}$ of $\frac{6}{7}$?
28. Of $\frac{7}{8}$ is $\frac{3}{4}$ of $\frac{5}{6}$?
29. Of $\frac{9}{10}$ is $\frac{4}{5}$ of $\frac{7}{8}$?
30. Of $\frac{11}{12}$ is $\frac{5}{8}$ of $2\frac{2}{5}$?

31. 16 is $\frac{4}{5}$ of how many times 5?
32. 18 is $\frac{3}{4}$ of how many times 8?
33. 25 is $\frac{5}{8}$ of how many times 10?
34. 14 is $\frac{7}{10}$ of how many times 4?
35. 27 is $\frac{3}{4}$ of how many times 9?
36. 15 is $\frac{5}{9}$ of how many times 3?
37. 28 is $\frac{2}{3}$ of how many times 7?
38. 10 is $\frac{5}{12}$ of how many times 12?
39. 20 is $\frac{4}{5}$ of how many times $\frac{1}{3}$ of 10?
40. 24 is $\frac{3}{4}$ of how many times $\frac{2}{3}$ of 12?
41. 28 is $\frac{4}{7}$ of how many times $\frac{1}{3}$ of 21?
42. 30 is $\frac{5}{6}$ of how many times $\frac{3}{4}$ of 12?
43. 18 is $\frac{6}{8}$ of how many times $\frac{6}{7}$ of 14?
44. 40 is $\frac{4}{5}$ of how many times $\frac{5}{6}$ of 30?
45. 36 is $\frac{4}{6}$ of how many times $\frac{3}{5}$ of 15?
46. 60 is $\frac{6}{5}$ of how many times $\frac{5}{7}$ of 14?
47. 48 is $\frac{8}{9}$ of how many times $\frac{3}{8}$ of 16?
48. 35 is $\frac{7}{8}$ of how many times $\frac{4}{9}$ of 18?
49. 60 is $\frac{6}{9}$ of how many times $\frac{3}{4}$ of 20?
50. 80 is $\frac{4}{5}$ of how many times $\frac{2}{8}$ of 30?

51. $\frac{1}{2}$ of 16 is how many times $\frac{1}{3}$ of 12?
52. $\frac{2}{3}$ of 30 is how many times $\frac{2}{5}$ of 10?
53. $\frac{3}{4}$ of 40 is how many times $\frac{5}{7}$ of 21?
54. $\frac{4}{5}$ of 45 is how many times $\frac{3}{5}$ of 15?
55. $\frac{6}{7}$ of 42 is how many times $\frac{6}{7}$ of 14?
56 $\frac{7}{8}$ of 48 is how many times $\frac{3}{8}$ of 16?
57. $\frac{3}{7}$ of 56 is how many times $\frac{6}{11}$ of 22?
58. $\frac{5}{8}$ of 80 is how many times $\frac{2}{5}$ of 25?
59. $\frac{5}{6}$ of 72 is how many times $\frac{5}{4}$ of 16?
60. $\frac{4}{3}$ of 27 is how many times $\frac{2}{5}$ of 12?

61. A's horse cost $200, and $\frac{4}{5}$ of this is twice the cost of his sleigh, and the sleigh cost 4 times as much as his harness; required the cost of each.

62. B's wedding-coat cost $40, and $\frac{3}{4}$ of this is twice the cost of his vest, and three times the cost of his hat; what was the cost of each and of all?

63. Hannah's wedding-dress cost $50, and $\frac{4}{5}$ of this is 4 times the cost of her bonnet, and $\frac{2}{3}$ of the cost of her cloak; required the cost of the bonnet and cloak, respectively.

LESSON XI.

1 Myron, having $\frac{2}{3}$ of a certain sum of money, found $\frac{1}{2}$ of the same sum, and then had $28; required the sum.

2. If $\frac{2}{3}$ of John's age, increased by $\frac{1}{2}$ and $\frac{1}{4}$ of his age, equals 34 years, what is his age?

3. What number is that, which being increased by its $\frac{1}{2}$, and diminished by its $\frac{1}{3}$, equals 35?

4. Henry's age, diminished by its $\frac{1}{3}$ and $\frac{1}{4}$, equals 15 years, and his age is $\frac{3}{4}$ of his brother's age; required the age of each.

5. Francis, after losing $\frac{2}{3}$ of his money, found that $12 was $\frac{3}{4}$ of what remained; how much money had he?

6. What is the sum of the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$?

7. How many apples does that man give away, who gives to 5 girls each $\frac{5}{6}$ of an apple?

8. What is the cost of 7 pens, at the rate of $\frac{2}{3}$ of a cent apiece?

9. B is $9\frac{3}{4}$ years old, and 4 times B's age is $\frac{3}{5}$ of C's age; what is the age of C?

10. Peter gave $\frac{1}{5}$ of his money to James, and 3 times $\frac{2}{9}$ of it to John, and then had $20 remaining; how much money had Peter at first?

11. A chain cost $15, and $\frac{1}{2}$ of its cost is $\frac{3}{4}$ of the cost of a watch; required the cost of the watch.

12. Required the value of $\frac{1}{3}$ of $\frac{1}{4}$, $\frac{1}{4}$ of $\frac{1}{5}$, $\frac{1}{3}$ of $\frac{1}{7}$, and $\frac{3}{4}$ of $\frac{4}{6}$?

13. A cow cost $14, and $\frac{1}{3}$ of the cost of the cow is $\frac{2}{9}$ of the cost of a horse; required the cost of the horse.

14. A, having $\$\frac{1}{2}$, gave $\frac{1}{3}$ of it to B, and B gave $\frac{1}{4}$ of his part to C; what part did each then have?

15. If a yard of cloth cost $\frac{3}{4}$ of a dollar, how many yards can be bought for 9 dollars?

16. How many yards of muslin can be bought for $6, if 2 yards cost $\frac{3}{4}$ of a dollar?

17. How many times $\frac{2}{3}$ is $\frac{4}{5}$? How many times $\frac{4}{5}$ is $\frac{6}{7}$?

18. If $\frac{1}{2}$ of an apple cost $\frac{1}{3}$ of a cent, what will $\frac{1}{5}$ of an apple cost?

19. What cost 30 yards of lace, if $3\frac{1}{3}$ yards cost $\frac{2}{3}$ of a dollar?

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

21. If 7 men can do a piece of work in $2\frac{1}{3}$ days, how long will it require 6 men to do it?

22. If a yard of muslin cost $\frac{2}{3}$ of a dime, how much can you buy for $\frac{5}{6}$ of a dime?

23. What part of $\frac{3}{8}$ is $\frac{2}{3}$? What part of $1\frac{1}{2}$ is $2\frac{1}{3}$?

24. A shared 8 apples with his companions, giving to each $\frac{4}{5}$ of an apple; required the number of companions.

25. How many bushels of corn, worth $5\frac{2}{3}$ shillings a bushel, can be bought for 34 shillings?

26 How many apples will pay for 10 peaches, if 5 apples are worth $8\frac{1}{3}$ peaches?

27. Mary shared 21 dimes with her schoolmates, giving to each $2\frac{1}{3}$ dimes; how many schoolmates had she?

28. B bought 4 yards of silk, worth $\$1\frac{2}{3}$ a yard, and paid for it with cloth, worth $\$1\frac{1}{3}$ a yard; how many yards of cloth did it take?

29. The distance from Paoli to Christiana is 24 miles, and $\frac{2}{3}$ of this distance is $\frac{4}{5}$ of the distance from Christiana to Lancaster; what is the distance to Lancaster?

30. The distance from Columbia to Rockville is 30 miles, and $\frac{2}{3}$ of this distance is $\frac{2}{5}$ of the distance from Columbia to Newport; required the distance to Newport.

31. The distance from Conewago to Duncannon is 3 miles, and $\frac{2}{3}$ of this distance is $\frac{1}{3}$ of the distance from Conewago to Mexico; what is the distance to Mexico?

LESSON XII.

1. Cyrus, after spending $\frac{3}{4}$ of his fortune, found that $40 was $\frac{2}{3}$ of what remained; what was his fortune?

2. What is the length of a pole, the shadow of which is 10 feet, at the same time that a pole 10 feet long casts a shadow $2\frac{1}{2}$ feet in length?

3. Martha is 35 years old, and $\frac{3}{7}$ of her age is $\frac{3}{4}$ of twice her son's age; how old is her son?

4. Rachael had $\frac{2}{3}$ of a peck of walnuts, which she shared with 5 of her schoolmates; what part of a peck did each receive?

5. Henry, having $\frac{3}{4}$ of a barrel of cider, sold his neighbour $\frac{1}{5}$ of it; what part of a barrel remained?

6. A farmer, having sold $\frac{1}{2}$ of his sheep, and 10 cows, found 15 sheep and $\frac{1}{3}$ of his cows remained; how many of each did he own?

7. Take any number, multiply it by 4, divide by 2, multiply by 6, divide by 3, then divide by twice the number, and name the result.

8. A's money, being increased by its $\frac{1}{3}$, and then diminished by its $\frac{1}{2}$, is $40; required his money.

9. $\frac{2}{4}$ of B's money, increased by the difference between $\frac{2}{3}$ and $\frac{3}{4}$ of his money, is $55; what is his money?

10. When B was married he was 25 years old, and $\frac{3}{5}$ of his age was 3 years more than $\frac{2}{3}$ of his wife's age; required the age of his wife.

11. What number is that, which being diminished by its $\frac{1}{3}$, and the remainder increased by its $\frac{2}{3}$, equals 40?

12. Stephen lost 12 cents, then found $\frac{1}{2}$ as much as he lost, and then had $\frac{3}{4}$ as much as he had at first; how much had he at first?

13. A fishing-rod is 16 feet long, and $\frac{3}{4}$ of its length lacks 2 feet of being $\frac{2}{3}$ of the length of the line; required the length of the line.

14. A watch cost $40, which is $\frac{2}{3}$ of $\frac{3}{4}$ of the cost of the watch and chain; required the cost of the chain.

15. Susan has 7 peaches, and $\frac{4}{5}$ of Susan's number, minus $\frac{3}{5}$ of a peach, is $\frac{5}{8}$ of Elizabeth's number; how many has Elizabeth?

16. If there are 50 chestnuts in a pint, how many do A and B receive respectively, if A has $\frac{4}{5}$ of a pint, and B $\frac{3}{4}$ as many as A?

17. A has 60 fruit trees, $\frac{2}{5}$ of which bear peaches, $\frac{2}{3}$ of the remainder, pears, and the remainder, apples; how many are there of each?

18. A farmer had 40 sheep in one field, which was $\frac{4}{5}$ of the number in another field; then $\frac{1}{2}$ of the sheep in each field jumped into the other; how many then in each field?

19. Maria gave away some money, and then found 10 cents, which is $\frac{1}{2}$ of what she then had, and $\frac{1}{5}$ of what she at first had; how much did she give away?

20 A man lost $\frac{4}{5}$ of all his money, and then won $\frac{3}{4}$ as

much as he lost, and then had $20 how much had he at first?

21. If to $\frac{1}{2}$ of the cost of B's horse you add $80, the sum will equal $\frac{2}{3}$ of the cost; required the cost of his horse.

22. A paid $80 for flour, and $\frac{3}{8}$ of the number of dollars, is 3 times the number of barrels purchased; what was the price of the flour a barrel?

23. Philo found 10 cents, and then lost $\frac{2}{5}$ of what he found, and then had $\frac{3}{2}$ as much as he had at first; how much had he at first?

24. The distance from Medway to Columbia is 42 miles, and $\frac{4}{7}$ of this distance is $\frac{1}{3}$ of the distance from Medway to Rockville; required the distance.

25. A has 8 marbles, and B has 7, and 6 times what they both have, is equal to the number that C has, increased by 10; how many has C?

26. Mary has 5 roses, Jane, 3 times as many, lacking 5, and Susan has twice as many as both, increased by 5; how many has each, and how many have they all?

27. Frescoln had 20 apples, and Lucy gave him 10 more, he then gave his father 7, and his mother a certain number, and had 13 remaining; how many did he give his mother?

28. A and B had each 30 apples; A gave B 10 of his, and B gave A 6 of his, and then lost a certain number, so that A had 12 more than B; how many did B lose?

29 A and B had each 40 cents, A gave B 10 of his, and B gave A twice as many of his, and then losing a certain number, had twice as many as A gave him; how many did he lose?

30. The distance from Oakland to Parkesburg is 16 miles, and $\frac{3}{4}$ of this distance is $\frac{1}{3}$ of the distance from Parkesburg to Marietta, lacking 1 mile; what is the distance?

31. The distance from Mount Joy to Harrisburg is 25 miles, and $\frac{4}{5}$ of this distance is $\frac{5}{8}$ of $\frac{4}{9}$ of the distance from Harrisburg to McVeytown; what is the distance to McVeytown?

32. From Philadelphia to Lancaster the distance is 68 miles, and $\frac{1}{4}$ of this, increased by 2 miles, equals $\frac{4}{7}$ of the distance from Lancaster to Harrisburg, minus 1 mile; required the distance to Harrisburg.

We have derived the principles of the following propositions by *induction* from analytical processes; we will now proceed to establish their truth by rigid demonstration.

PROP. 1.—*Multiplying the numerator of a fraction by any number multiplies the value of the fraction by that number.*

PROP. 2.—*Dividing the numerator of a fraction by any number divides the value of the fraction by that number.*

PROP. 3.—*Multiplying the denominator of a fraction by any number divides the value of the fraction by that number.*

PROP. 4.—*Dividing the denominator of a fraction by any number multiplies the value of the fraction by that number.*

PROP. 5.—*Multiplying both numerator and denominator of a fraction by any number does not change the value of the fraction.*

PROP. 6.—*Dividing both numerator and denominator of a fraction by any number does not change the value of the fraction.*

DEMONSTRATION OF THE FIRST.—If we multiply the numerator of a fraction by any number, as 5, the resulting fraction will express 5 times as many parts each of the same size as before; hence the value of the fraction is 5 times as great.

DEMONSTRATION OF THE THIRD.—Since the denominator shows the number of equal parts into which the unit is divided, if we multiply the denominator by any number, as 4, the unit will be divided into 4 times as many parts, hence each part will be $\frac{1}{4}$ as large as before, and the same number of parts being taken the value of the fraction will be $\frac{1}{4}$ as great.

DEMONSTRTAION OF THE FIFTH.—Since multiplying the numerator multiplies the value, and multiplying the denominator divides the value of the fraction, multiplying both numerator and denominator by the same number, multiplies and divides the value by the same number, and hence does not change its value. Therefore, &c.

NOTE.—The 2d is demonstrated very much like the 1st, the 4th like the 3d, the 6th like the 5th.

SECTION IV.

LESSON I.

FEDERAL MONEY.

10 mills (*m.*) . .	equal 1 cent,	. . .	*ct.*
10 cents . . .	" 1 dime,	. . .	*d.*
10 dimes . . .	" 1 dollar,	. . .	$
10 dollars . . .	" 1 eagle,	. . .	*E.*

Federal money is the currency of the United States. The coins are of three kinds, gold, silver, and copper. The new cent coin consists of 88 parts copper and 12 parts nickle. The gold and silver coins contain $\frac{1}{10}$ alloy, excepting the 3 cent piece, which is $\frac{1}{4}$ alloy. The alloy of the silver coin consists of copper, and of the gold coin, of equal parts of copper and silver.

Dollars and cents, written together, are separated by a point (.), thus $5.60 is read 5 dollars and 60 cents.

1. How many mills in 4 cents? In 7 cents? In 8 dimes?

2. How many cents in 5 dimes? In 6 dollars? In 3 eagles?

3. How many dollars in 9 eagles? In 40 dimes? In 500 cents?

4. How many eagles in 50 dollars? In 300 dimes? In 7000 cents?

5. If 5 apples cost 20 cents, how many apples can you buy for $2?

6. How many sheep can you buy for 18 eagles, at the rate of 3 sheep for 15 dollars?

7. What part of 2 dollars is 5 cents, and what part of 3 dimes is 6 cents?

8. What part of 4 eagles is 8 dimes, and what part of 5 cents is $\frac{3}{5}$ of a dime?

ENGLISH OR STERLING MONEY

4 farthings (*qr.*) . .	equal	1 penny,	*d.*
12 pence	"	1 shilling, .	*s.*
20 shillings	"	1 pound, . .	£
21 shillings	"	1 guinea.	

1 £ = $4.84. 1 *s.* = $0.24. 1 *d.* = $0.02.

The symbols £, *s.*, *d.*, and *qr.* are the initials of the Latin words *libra*, *solidus*, *denarius*, and *quadrans;* signifying, respectively pound, shilling, penny, and quarter.

1. How many farthings in 2 pence? In 3? In 5? In 6? In 8? In 10?
2. How many pence in 8 farthings? In 2? In 20? In 28? In 30?
3. How many pence in 2 shillings? In 4? In 5? In 6? In 10?
4. How many shillings in 24 pence? In 48? In 72? In 96? In 150?
5. How many shillings in 3 pounds? In 5? In 6? In 8? In 12?
6. How many pence in 3*s.* and 6*d.*? In 1£, 2*s.* and 4*d.*?
7. What part of 2 pence is 3 farthings, and what part of 3 shillings is 5 pence?
8. What part of 8 pence is $\frac{2}{3}$ of a penny, and what part of a guinea is $\frac{3}{5}$ of a pound?

LESSON 11

TROY WEIGHT.

24 grains (*gr.*) . .	equal	1 pennyweight,	*pwt.*
20 pennyweights . .	"	1 ounce, . .	*oz.*
12 ounces	"	1 pound, . .	*lb*

The term *Troy* is said to be derived from *Troyes*, the name of a town in France, where the weight was first used in Europe. The symbol (*oz.*) is from the Spanish word *onza*, for ounce, and (*lb.*) from *libra*, a pound.

1. How many grains in 2 pwts.? In 3. In 4? In 5? In 6? In 7?

2. How many pwts. in 48 grs.? In 72? In 96? In 120? In 240?

3. How many pwts. in 3 oz.? In 4? In 5? In 6? In 7? In 10?

4. How many ounces in 5 pounds? In 7? In 10? In 8? In 4? In 12?

5. If 10 pwts. of silver are worth 3 shillings, what is the value of 5 lbs. of silver?

6. What is the value of 3 ounces of gold, if 3 grains are worth 3 dollars?

APOTHECARIES' WEIGHT.

20 grains (*gr.*) . .	equal	1 scruple, . .	℈
3 scruples . . .	"	1 dram, . . .	ʒ
8 drams	"	1 ounce, . . .	℥
12 ounces	"	1 pound, . . .	℔

This weight is used for mixing and retailing medicines. The pound is the same as the pound Troy.

1. How many grs. in 3 ℈s? In 5 ʒs? In 2 ℥s? In 1 ℔?

2. How many scruples in 4 ʒs? In 40 grs.? In 2 ℥s and 3 ʒs?

3. How many ounces in 3 ℔s? In 16 ʒs? In 4 ℔s and 5 ℥s?

4. How many drams in 120 grs.? In 36 ℈s? In 3 pounds?

5. Which is the heavier, an ounce of opium or an ounce of silver?

6. If 5 grs. of medicine cost 10 cents, what will 3 oz and 4 ʒs cost?

7. Two-thirds of 9 scruples of a certain drug cost 18 cents, what will 3 fourths of 8 pounds cost?

AVOIRDUPOIS WEIGHT.

16 drams (*dr.*) .	equal	1 ounce, .	*oz.*
16 ounces	"	1 pound, . .	*lb.*
25 pounds	"	1 quarter, . .	*qr.*
4 quarters . . .	"	1 hundred weight,	*cwt.*
20 hundred weight .	"	1 ton, . . .	*T.*

The term *Avoirdupois* is derived from the French *avoir du poids*, signifying *to have weight.* The pound consists of 7000 Troy grains. This weight is used for weighing almost all articles except gold, silver, platina, and precious stones, which are weighed by Troy Weight.

1. How many drams in 2 ounces? In 3? In 5? In 10?

2. How many ounces in 3 pounds? In 5? In 48 drams?

3. How many quarters in 75 pounds? In 3200 oz.? In 5 cwt.?

4. How many hundredweight in 36 quarters? In 300 lbs.? In 6 tons?

5. How many tons in 5 hundredweight? In 240 qrs.? In 600 lbs.?

6. What will 12 pounds of starch cost, if 5 ounces cost 20 cents?

7. What will 2 cwt. of coffee cost, at the rate of 4 pounds for 60 cents?

8. I gave 3 cwt. 2 qrs. of hay, worth $20 a ton, for butter worth 25 cents a pound; how many pounds of butter did I receive?

9 Which is the heavier, a pound of gold or a pound of lead? An ounce of silver or an ounce of feathers?

METRIC SYSTEM.—In the Metric System of weights and measures the *unit of weight* is the *Gram.* The *gram* = 15.44 Troy grs.; it is used for light weights. The *Kilogram* (1000 grams), abbreviated into *kilo*, will be the ordinary weight of commerce. The *kilogram* = $2\frac{1}{2}$ lbs. Avoirdupois, very nearly.

LESSON III.

LONG MEASURE.

12 inches (*in*) . .	equal	1 foot, . .	*ft.*
3 feet	"	1 yard, . .	*yd.*
5½ yards	"	1 rod, . . .	*rd.*
40 rods	"	1 furlong, . .	*fur.*
8 furlongs . . .	"	1 mile, . . .	*m.*

The yard is the standard unit of length. It is formed by dividing a pendulum, which vibrates seconds in a vacuum, at the level of the sea, in the latitude of London, into 391393 equal parts and taking 360000 of these parts. From this unit all other measures and weights are derived.

1. How many inches in 3 feet? In 5? In 7? In 2 yds.? In 2 rods and 2 feet?

2. How many feet in 60 inches? In 96? In 108? In 6 rds.? In 4 rds. 7 yds.?

3. How many yards in 45 feet? In 66? In 72 in.? In 4 rds.? In 1 fur. 4 rods?

4. How many furlongs in 320 rods? In 440? In 660 feet? In 9 miles?

5. How many miles in 104 furlongs? In 640? In 800? In 1760 yards?

6. Mary ran 60 rods, and 4 fifths of this distance equals $\frac{3}{10}$ of the distance Henry ran; how many furlongs did Henry run?

7. Three fourths of the length of a pole is 6 feet, which is 2 sixths of the length of another pole; how many yards long is each pole?

8. What part of 1 yard is 2 feet, and what part of 2 furlongs is 4 yards?

METRIC SYSTEM.—In the Metric System the *unit of length* is the *Meter*. It equals 39.37 inches, or very nearly 3 ft. 3 in. and ⅜ of an inch. Long distances will be measured by the *Kilometer* (1000 meters), which equals ⅝ of a mile, very nearly.

CLOTH MEASURE.

2¼ inches . . .	equal	1 nail, . .	*na.*
4 nails	"	1 quarter, .	*qr.*
4 quarters . . .	"	1 yard, . . .	*yd.*
2 quarters .	"	1 Ell Flemish, .	*E. Fl.*
5 quarters . . .	"	1 Ell English, .	*E. E.*
6 quarters . . .	"	1 Ell French, .	*E. Fr*

Cloth Measure is used in measuring cloth, lace, muslin, &c.

1. How many inches in 4 nails? In 5 quarters? In 3 ells Flemish? In 2 ells English?

2. How many nails in 18 inches? In 54 inches? In 4 E. E. and 3 qrs.? In 5 E. Fr. and 2 qrs.?

3. How many quarters in 24 nails? In 63 inches? In 3 E. E., 4 E. Fl., and 2 qrs.? In 52 yards?

4. How many yards in 144 inches, 48 nails, and 32 qrs.? In 7 E. Fr. and 2 qrs.?

5. What is the difference between 8 E. Fr. and 4 E. E.? Between 5 E. Fl. and 32 nails?

6. How many coats can be made from 9 E. E. and 3 qrs., if one coat require 3 yards?

7. Four fifths of the number of yards in Mary's dress equals 8, which is 4 times $\frac{2}{3}$ as many yards as her cloak contains; how many yards more in the dress than cloak;

LESSON IV.

ALE OR BEER MEASURE.

2 pints (*pt.*) . .	equal	1 quart, . . .	*qt.*
4 quarts . . .	"	1 gallon, . .	*gal.*
36 gallons . . .	"	1 barrel, . .	*bar.*
54 gallons . . .	"	1 hogshead, .	*hhd.*

Ale or Beer Measure is used in measuring ale, beer, &c. The gallon consists of 282 cubic inches.

1. How many pints in 5 quarts? In 10 gallons? In 5 barrels? In $\frac{2}{3}$ of a hogshead?

2. How many quarts in 46 pints? In 7 gallons? In 3 bar. 10 gals.? In 2 hhd. 2 gals. 3 qts.?

3. How many gallons in 64 pints and 20 quarts? In $\frac{2}{3}$ of a hhd. and $\frac{3}{4}$ of a barrel?

4. What part of a hhd. is $\frac{1}{4}$ of a barrel? What is the difference between 2 hhd. and 3 barrels?

5. What part of 2 barrels is 9 gallons? What cost a gal. of ale, at 5 cents a pint?

LIQUID OR WINE MEASURE.

4 gills (*gi.*) . . .	equal	1 pint, . .	*pt.*
2 pints	"	1 quart, . .	*qt.*
4 quarts	"	1 gallon, . .	*gal.*
31½ gallons . . .	"	1 barrel, . .	*bar.*
42 gallons . . .	"	1 tierce, . .	*tier.*
63 gallons . . .	"	1 hogshead, .	*hhd.*
2 hogsheads . . .	"	1 pipe, . .	*pi.*
2 pipes	"	1 tun, . .	*tun.*

Wine Measure is used in measuring wine, and liquids generally. The gallon consists of 231 cubic inches.

1. How many gills in 6 pints? In 5 quarts? In 3 gallons? In 2 barrels?

2. How many pints in 24 gills? In 8 quarts? In 2 tierces? In 1 hhd. and 7 gals.?

3. How many quarts in 40 gills? In 26 pints? In 2 tuns and 3 hogsheads?

4. What part of $\frac{2}{7}$ of a hogshead is $\frac{1}{7}$ of a tierce? What part of $\frac{1}{9}$ of a hhd. is 7 quarts?

5. What part of $\frac{4}{7}$ of a gal., wine measure, is $\frac{1}{3}$ of a gal., beer measure?

6 Which is the greater, a gallon of wine or a gallon of beer? A hogshead of ale or molasses?

METRIC SYSTEM.—The *unit of capacity* is the *Liter*, equal to $1\frac{1}{18}$ liquid quarts, very nearly. The *Hectoliter* (100 liters), equal to about $2\frac{5}{6}$ bus., will be used for measuring grain, etc.

DRY MEASURE.

2 pints (*pt.*) . . .	equal	1 quart,	. *qt.*
8 quarts	"	1 peck,	. *pk.*
4 pecks	"	1 bushel,	*bu.*
36 bushels	"	1 chaldron,	. *ch.*

Dry Measure is used for measuring grain, fruit, coal, &c.

1. How many pints in 3 quarts? In 2 pecks? In $2\frac{1}{2}$ bushels? In one chaldron?

2. How many quarts in $6\frac{1}{2}$ pecks? In 10 bushels? In $\frac{3}{8}$ of a chaldron? In 24 pints?

3. How many pecks in $5\frac{1}{2}$ bushels and 3 pecks? In 96 pints? In 56 quarts?

4. How many bushels in 2 ch. 8 bu.? In 192 quarts? In 128 pints? In 78 pecks?

5. Which cost the more, and how much, 5 bu. 3 qts. of salt, at 4 cents a quart, or 10 bu. 3 pks. of apples, at 50 cents per bushel?

6. At ten cents a peck, how many bushels of pears can be bought for 8 dollars?

7. A grocer bought 7 bushels and 2 pecks of cherries at the rate of 3 cts. a pint, and sold them for 2 cwt. 2 qrs. of sugar at 6 cts. per lb.; how much did he gain?

LESSON V.

TIME.

60 seconds (*sec.*) . .	equal	1 minute, . .	*m.*
60 minutes . . .	"	1 hour, . . .	*hr.*
24 hours	"	1 day, . .	*da*
7 days	"	1 week, . . .	*wk.*
4 weeks	"	1 month, . .	*mo.*
52 weeks	"	1 year, . . .	*yr.*
12 calendar months .	"	1 year, . . .	*yr.*

1. How many seconds in 2 minutes? In 3? In 6? In 8? In 10?

2. How many minutes in 3 hours? In 4? In 5? In 120 seconds?

3. How many hours in 4 days? In 5? In 10? In 240 minutes?

4. How many days in 3 weeks? In 9? In 12? In 96 hours?

5. How many weeks in 7 months? In 11? In 28 days? In 168 hours?

6. How many months in 10 years? In 24 weeks? In 56 days? In 112 days?

7. How many years in 24 months? In 104 weeks? In 364 days?

8. Mary is 4 years and 6 months old, and her brother is 6 years and 4 months old; how much younger is Mary than her brother?

9. How many days, of 10 hours each, will be required to make 40 hats, if 4 hats can be made in 7 hours?

CHANGE OF CURRENCIES.

In New England, Virginia, Kentucky, and Tennessee, ...	6*s.*	= $1
In New York, Ohio, and North Carolina, . .	8*s.*	= $1
In New Jersey, Pennsylvania, Delaware, and Maryland, ...	7*s.* 6*d.*	= $1.
In South Carolina and Georgia, ...	4*s.* 8*d.*	= $1.
In Canada and Nova Scotia, ...	5*s.*	= $1.

1. Ten dollars, in New York, equal how many pounds?

SOLUTION.—In $1 there are 8 shillings, and in £1 there are 20 shilling One shilling is $\frac{1}{20}$ of a pound, and 8 shillings, or $1, are 8 times $\frac{1}{20}$, which are $\frac{8}{20}$, or £$\frac{2}{5}$, and $10 are 10 times $\frac{2}{5}$, wh ch are £4. Therefore, $10, in New York, equals £4.

2. How many pounds in $20 in Ohio? In $60 in North Carolina?

3. How many pounds in $30 of New England? In $90, Kentucky? In $100, Virginia?

4. How many pounds in $48, New Jersey? In $64, Pennsylvania? In $72, Maryland?

5. How many pounds in $120, South Carolina? In $240, Georgia? In $56, Canada?

6. How many dollars in £24, New York? In £26, Ohio? In £30, North Carolina?

7. How many dollars in £27, Maine? In £54, Vermont? In £60, Massachusetts?

8. How many dollars in £21, South Carolina? In £63, Georgia currency?

9. What is the value of a shilling, in cents, in each of the states mentioned in the table?

REMARK.—The class should now review, unless they are entirely familiar with the preceding sections.

SECTION V.

LESSON I.

Special attention is called to the adaptation of the remainder of the book to elementary and advanced classes. Each lesson commences simply enough for the most elementary pupils, and near the close becomes sufficiently difficult for the most advanced. The more difficult problems are separated from the easier by a line; these are to be omitted by young pupils until review, while the older or more advanced pupils take the whole lesson.

1. If $\frac{2}{3}$ of a yard of cloth cost $\frac{4}{5}$ of a dollar, what will $\frac{3}{4}$ of a yard cost?

2. If 8 horses eat a quantity of hay in 16 weeks, how long would it last 32 horses?

3. If 5 men earn 30 dollars in a certain time, how much will 8 men earn in $\frac{1}{2}$ the time?

4. If 6 persons spend $36 in 3 days, how much will 10 persons spend in 5 days?

5. How long will 5 tons of hay last 8 horses, if 6 horses eat it in 12 weeks?

6. How long will 3 barrels of flour last 10 persons, if 4 persons eat 4 barrels in 40 weeks?

7. If 7 men can earn $28 in 4 days, how many dollars can 9 men earn in 6 days?

8. How long will 6 men require to build 6 boats, if 7 men build 3 boats in 12 weeks?

9. If 10 oxen eat 4 acres of grass in 6 days, in how many days will 30 oxen eat 8 acres?

10. If it require 4 men 7 days to perform a certain piece of work, how many men can perform a piece, 3 times as large, in 6 days?

11. If it require 5 men 8 days to build 20 rods of wall, how many men can, in 2 days, build $\frac{1}{2}$ as much wall?

12. How many men, in 10 days of 6 hours each, can earn as much as 6 men in 20 days of 8 hours each?

13. How many oxen will eat 5 tons of hay in 5 weeks, if 12 oxen eat 4 tons in 4 weeks?

14. If 3 horses, in $\frac{1}{4}$ of a month, eat $\frac{3}{4}$ of a ton of hay, how long will $\frac{5}{6}$ of a ton last 5 horses?

15. If 4 men can do a piece of work in 6 days, in what time will it be completed if they receive the assistance of 5 men, when the work is half done?

16. How many cents are 10 melons worth, if 4 melons are worth 8 oranges, and 3 oranges are worth 9 cents?

17. How many cents will 5 oranges cost, if 3 oranges are worth 9 apples, and 4 apples are worth 8 cents?

18. How many dollars will 10 sheep cost, if 5 sheep are worth 2 cows, and 4 cows are worth $80?

19. How many pigs can a man get for 2 cows, if 12 pigs are worth 3 sheep, and 12 sheep are worth 3 cows?

20. How many oranges can you buy for 20 cents, of 4 oranges are worth 8 apples, and 4 apples are worth 8 cents?

21 How many hens can you purchase for $12, if 4 hens are worth 8 turkeys, and 3 turkeys are worth $6?

22. If 6 sheep are worth 2 cows, and 10 cows are worth 5 horses, how many sheep can you buy for 3 horses?

23. If a measure of flour make 5 four cent loaves, how many 2 cent loaves will it make? How many 5 cent loaves will it make?

24. If a certain sum of money buy 9 four cent oranges, how many 6 cent oranges can you buy with the same sum?

25. If a 5 cent loaf weigh 7 ounces, when flour is worth 6 dollars a barrel, how much should it weigh when flour is worth 7 dollars per barrel?

26. If a 3 cent loaf weigh 9 ounces, when flour is 6 dollars a barrel, how much ought a 4 cent loaf to weigh when flour is $8 a barrel?

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27. A can do as much work in 2 days as B can in 4, or C in 6 days; in how many days can B do as much as C can in 18 days?

28. A can do as much in 6 days as B can in 2 days, and B can do as much in 5 days as C can in 15 days; in how many days can A do as much as C can in 4 days?

29. A can do 3 times as much in a day as B, and B can do twice as much as C; in how many days can A do as much as C can in 4 days?

30. If 5 horses can eat a lot of grain in 12 days, in what time will it be consumed, if 7 horses are added when the grain is $\frac{1}{3}$ eaten?

31. If 8 boys can weed a garden in 5 hours, in what time will the job be completed, provided 3 boys leave when the work is half done?

32. If 9 men build 10 rods of wall in 8 days, in what time can 20 rods be built, if $\frac{2}{3}$ of their number leave when the work is $\frac{1}{4}$ part completed?

LESSON II.

1. A gentleman gave 4 cents each to some poor children; had he given them 7 cents each it would have taken 36 cents more; how many children were there?

SOLUTION.—By the second condition of the question he gave each child 7 — 4, which is 3 cents more than by the first, and to them all, 36 cents more; hence there were as many children as 3 is contained times in 36, which are 12. Therefore, &c.

2. A teacher gave his pupils 2 questions each, and had 26 questions remaining; if he had given them 4 apiece there would have been none remaining; required the number of pupils and questions.

3. A father gave his sons 5 dollars each, and had 30 dollars remaining; had he given them 8 dollars each it would have taken all his money; required the number of sons and amount of money.

4. Mary gave some beggars 6 cents each, and had 25 cents remaining; had she given them 8 cents each she would have had 3 cents remaining; how many beggars were there?

5. Edward bought a certain number of melons, at the rate of 5 cents each; if he had paid 3 cents each they would have cost 14 cents less; how many melons did he buy?

6. A lady, wishing to buy some ribbon, found if she bought that at 10 cents a yard she would want 9 cents to pay for it, but if she bought that at 7 cents a yard she would have 9 cents remaining; how much money had she?

7. Morris and Robert have each a certain number of peaches; if Morris had 10 more he would have twice as many as Robert, but if he had 30 more he would have 4 times as many as Robert; how many has each?

8. A drover bought a number of sheep at $3\frac{1}{2}$ a head, and found he lacked $6 of having money enough to pay

for them; if he had paid $2 a head he would have had $9 remaining; how much money had he?

9. Sallie wishes to buy a silk dress; if she pays $5 a yard she will lack $10 of having money enough to pay for it, but if she pays $2.50 a yard she will have $5 remaining; required her money, and the number of yards in the dress?

10. A certain number of oranges, at the rate of 3 for 12 cents, will cost 18 cents more than the same number of apples, at the rate of 4 for 8 cents; required the number.

11. A certain number of peaches, at 3 for 10 cents, will cost 20 cents more than the same number of pears, at the rate of 3 for 5 cents; required the number.

12. James and Henry have a certain number of marbles; if James had 8 more he would have 6 times as many as Henry, but if 12 less he would have only twice as many; how many has each?

13. A gentleman divided 28 apples between an equal number of boys and girls, giving to each girl 3, and to each boy 4 apples; required the number of boys and girls.

14. A man bought an equal number of pigs and sheep for $81, giving $4 each for the pigs, and $5 each for the sheep; how many of each did he buy?

15. A boy expended 36 cents for an equal number of melons and lemons, giving 4 cents each for the melons, and 2 cents each for the lemons; how many of each did he purchase?

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16. A lady gave 60 cents to some poor children: to each boy she gave 2 cents, and to each girl 4 cents; how many were there of each, provided there were 3 times as many boys as girls?

17. Two boys had an equal sum of money; one bought a certain number of oranges, at 4 cents each, and had 12 cents remaining: the other bought twice as many apples,

for 3 cents each, and had 2 cents remaining; how much money had each?

18. A, B, and C, dig a ditch for $60; A receives 1\frac{1}{2}$ B $2, and C 2\frac{1}{2}$ a day; how many days were they employed, and what did each receive?

19. A and B agree to perform a piece of work, A receiving $2, and B $3 a day; A works twice as many days as B, and they together receive $70; how many days did each labour?

LESSON III.

1. If to Harry's age its $\frac{1}{2}$ be added, the sum will be 24 years; what is his age?

SOLUTION.—By the condition of the problem, $\frac{2}{2}$ of Harry's age, plus $\frac{1}{2}$ of his age, which is $\frac{3}{2}$ of his age, equals 24 years. If $\frac{3}{2}$ of Harry's age equals 24 years, $\frac{1}{2}$ of his age equals $\frac{1}{3}$ of 24 years, which is 8 years, and $\frac{2}{2}$, or his age, equals 2 times 8, or 16 years. Therefore, &c.

2. What number is that to which, if its $\frac{1}{3}$ be added, the sum will be 36?

3. Required the number, which being increased by its $\frac{2}{3}$ equals 40.

4. What number is that, which being increased by its $\frac{3}{4}$ the sum will be 80?

5. What number is that, which being diminished by its $\frac{3}{5}$ the remainder will be 30?

6. Three times a certain number, increased by $\frac{2}{3}$ of itself, equals 22; required the number.

7. Reuben's age, being doubled and diminished by $\frac{3}{4}$ of his age, equals 50 years; how old is he?

8. Three and $\frac{1}{2}$ times a number, minus $\frac{2}{3}$ of the number, equals 34; what is the number?

9. Two-fifths of a number being subtracted from $\frac{1}{2}$ of the number equals 7; required the number.

10 A boy being asked his age, replied, that his age, increased by its $\frac{1}{2}$ and $\frac{2}{3}$, equalled 39 years; what was his age?

11. What number is that, which being increased by the difference between its $\frac{1}{4}$ and $\frac{1}{5}$, equals 42?

12. If the height of a tree be increased by its $\frac{2}{3}$ and 10 feet more, the sum will be twice the height; what is the height of the tree?

13. If twice the length of a pole be increased by its $\frac{3}{5}$ and 2 feet more, the sum will equal 3 times the length of the pole; required its length.

14. If 3 times Henry's age be increased by its $\frac{1}{2}$, $\frac{1}{3}$ and 2 years more, the sum will equal 4 times his age; what is his age?

15. If the height of a steeple be increased by its $\frac{1}{2}$, and that sum diminished by the difference between $\frac{1}{4}$ and $\frac{1}{5}$ of the sum, it will equal $\frac{7}{4}$ of its height, minus 13 feet; required its height.

16. Two times a number, plus 6, equals 3 times the same number, plus 2; what is the number?

17. Three times a certain number, plus 8, equals 4 times the same number, plus 3; required the number.

18. $\frac{1}{2}$ of a certain number, increased by 10, equals $\frac{2}{3}$ of the same number, plus 8; what is the number?

19. Four times A's age, diminished by 10 years, equals 3 times his age, increased by 10 years; what is his age?

20. Two-thirds of Morton's apples, increased by 2, equals $\frac{3}{4}$ of his number, diminished by one; how many apples has he?

21. Benton lost $\frac{4}{5}$ of all his money, and then found $\frac{3}{4}$ as much as he lost, and then had $120; how much money had he at first?

22. Mary gave $\frac{3}{4}$ of her money to the poor, and then found $\frac{2}{3}$ as much as she gave away, and then had $30; how much had she at first?

23. William borrowed $\frac{2}{3}$ of Emily's money, and after spending $\frac{3}{4}$ of it, returned the remainder, which was $20; how much money had Emily?

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24. A thief stole $\frac{3}{5}$ of Harry's money, and before he was caught spent $\frac{2}{3}$ of it; the remainder, which was $20 less than he stole, was given back; how much money had Harry?

25. Two times a certain number, + 10, equals 3 times the sum obtained by increasing the number by 2; what is the number?

26. Baldwin had stolen from him $\frac{5}{7}$ of his money, and the thief was not caught until he had spent $\frac{4}{5}$ of it; the remainder, which was $30 less than Baldwin had remaining, was given back; how much money had Baldwin?

LESSON IV.

1. William and Henry have 15 marbles; how many has each, provided William has twice as many as Henry?

SOLUTION.—By a condition of the problem, twice Henry's number equals William's, which, added to Henry's number, equals three times Henry's, which is what they both have, or 15 marbles. If 3 times Henry's number equals 15, once his number equals $\frac{1}{3}$ of 15, which is 5, and twice his number, or William's, equals twice 5, or 10 marbles. Therefore, &c.

2. Robert has 3 times as many cents as Elias, and they together have 24; how many has each?

3. William has 4 times as many nuts as Oliver, and they together have 20 pints; how many pints has each?

4. Emma has 35 flowers, and 4 times the number of roses equals the number of pinks; how many has she of each kind?

5. Divide the number 25 into two such parts, that 4 times one part shall equal the other.

6. A father and son earned in one week $12; how much did each earn, if the father earned twice as much as the son?

7. A pole, 36 feet in length, was broken into two

unequal pieces, such that $\frac{1}{3}$ of the longer piece equals the shorter; required the length of each piece.

8. In a certain school, consisting of 35 scholars, there were $\frac{1}{4}$ as many girls as boys; how many boys and how many girls in the school?

9. The sum of two numbers equals 40, and $\frac{1}{3}$ of the greater equals the less; required the numbers.

10. A man bought a horse and cow for $100, and the how cost $\frac{2}{3}$ as much as the horse; required the cost of each.

11. Twice the sum of two numbers is 30, and 3 times the smaller equals twice the greater; what are the numbers?

12. Two thirds of the number of dollars that A and B have equals 40; how many has each, if 5 times A's number equals 7 times B's number?

13. Three fourths of 40 is $\frac{3}{5}$ of the number of apples and pears that Reuben has; how many has he of each, if 3 times the number of apples equals 7 times the number of pears?

14. Divide 36 apples among three boys, so that the second may have twice as many as the first, and the third 3 times as many as the first.

15. Divide 66 plums among Ella, Emma, and Ettie, so that Ella shall have twice, and Emma three times as many as Ettie.

16. A watch and chain cost 42 dollars; what was the cost of each, provided $\frac{2}{5}$ of the cost of the watch equals the cost of the chain?

17. A, B, and C, together, earned $70; A earned twice as much as B, and B twice as much as C; how much did each earn?

18. The sum of three numbers is 50; the second is 3 times the first, and the third is twice the second; what are the numbers?

19. Harry and Thomas lost a purse of money containing $24, of which Harry owned $\frac{5}{7}$ as much as Thomas; how much did each lose?

20. A turkey, duck, and hen, cost 66 dimes, the duck cost twice as much as the hen, and the turkey 4 times as much as the duck; required the cost of each.

21. The difference between two numbers is 27, and the greater is 4 times the smaller; what are the numbers?

22. Marie has 40 cherries more than Jane, and 5 times Jane's number equals Marie's; how many has each?

23. Two thirds of 30 is $\frac{5}{2}$ of the difference between two numbers, and the less is $\frac{3}{5}$ of the greater; what are the numbers?

24. A man bought a horse, cow, and sheep for $105; how much did he pay for each, provided the cow cost 4 times as much as the sheep, and the horse 4 times as much as the cow?

25. A farmer has 102 animals, consisting of hogs, sheep, and cows; there are $\frac{3}{4}$ as many sheep as hogs, and $\frac{4}{5}$ as many cows as hogs; required the number of each.

26. Of a certain pole, whose parts are in the mud, air, and water, $\frac{2}{3}$ of the length in the air equals the length in the water, and $\frac{3}{4}$ of the length in the water equals the length in the mud; required the length of each part, supposing the part in the water to be 10 feet longer than the part in the mud.

LESSON V

1. A and B have 25 oranges; how many has each, if B has 5 more than A?

SOLUTION.—By a condition of the problem, A's number + 5 oranges equals B's number, which, added to A's, is twice A's number + 5, which equals 25 oranges. If twice A's + 5 = 25, twice A's = 25 — 5, or 20; if twice A's = 20, once A's equals $\frac{1}{2}$ of 20, which is 10; and since B had 5 more than A, 10 + 5, or 15, equals B's number. Therefore, &c.

2. Mary has 7 oranges more than William, and they together have 27; how many has each?

3. Stephen has 10 cents more than Martha, and they together have 40; how many has each?

4. The sum of two numbers is 31, and their difference 5; what are the numbers?

5. Thomas and Reuben earned the same sum of money, when Reuben found $9, and they then together had $45; how much did each earn?

6. Ella and Kate had each the same number of candies; Ella eat 5 of hers, and they then together had 21; how many had each at first?

7. Divide the number 28 into two such parts, that one part may be 6 less than the other.

8. Two boys found an equal number of cents; one lost 6, and the other 4, and they then together had 22; how many did each find?

9. A and B had equal sums of money; A lost $5, and B earned $7, and they then together had $36; how much had each at first?

10. Daniel and Edwin had each the same number of peaches; Daniel lost 6, and Edwin gave him 4, and they then together had 14; how many had each then?

11. Three times Harry's age, increased by 5 years, equals Harvey's age, and the sum of their ages is 45 years; how old is each?

12. Divide the number 48 into two such parts, that twice the first part, diminished by 6, shall equal the second part?

13. The sum of two numbers is 55, and the greater equals 3 times the less, diminished by 5; required the numbers.

14. A pole whose length was 48 feet, was broken into two unequal pieces, $\frac{3}{5}$ of the longer part equalling the shorter; required the length of each piece?

15. A tree whose length was 45 feet was broken into two unequal parts, and $\frac{3}{5}$ of the longer piece, plus 5 feet, equals the shorter required the length of each piece.

16. A watch and chain cost $85, and $\frac{3}{10}$ of the cost of the watch, plus $7, equals the cost of the chain; required the cost of each.

17. Francis has 9 cents more than $\frac{1}{2}$ as many as Fannie, and they together have 42; how many cents has each?

18. A cow and horse cost $132; required the cost of each, if the cow cost $\frac{2}{5}$ as much as the horse, minus 8 dollars.

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19. A man walked 110 miles in three days; he walked 5 miles further the second day than the first, and 10 miles further the third than the second; how far did he walk each day?

20. A man bought a sleigh, horse, and harness, for $152; for the sleigh he gave twice as much as for the harness, plus $6, and for the horse 4 times as much as for the harness, plus $6; what did he pay for each?

21. A lady bought a hat, cloak, and shawl for $78; what did she pay for each, supposing the cloak cost twice as much as the hat, plus $4, and the shawl twice as much as the cloak, lacking 4 dollars?

22. One half of Mary's oranges equals Annie's, and $\frac{1}{2}$ of Annie's equals Emma's, and they together have 28; how many has each?

23. A earned $\frac{2}{3}$ as much as B, and B earned $\frac{3}{4}$ as much as C, and they together earned $108; required the amount earned by each.

24. In a certain field there are 42 animals, consisting of horses, sheep, and cows; required the number of each, provided $\frac{1}{2}$ of the number of sheep, + 10, equals the number of cows, and $\frac{1}{3}$ of the number of sheep, + 10, equals the number of horses.

SECTION VI.

LESSON I.

Per cent., from the Latin *per*, by, and *centum*, the hundred, means by or on the hundred. Thus, 5 per cent. of a number of apples is 5 apples of a hundred, 10 per cent. of a number of dollars is 10 dollars on a hundred, and so on, whatever be the denomination.

1. At a gain of 10 per cent., what part of the value equals the gain?

SOLUTION.—A gain of 10 per cent. is a gain of 10 on 100. If on 100 the gain is 10, on 1 it is $\frac{1}{100}$ of 10, which is $\frac{10}{100}$, or $\frac{1}{10}$. Therefore, at a gain of 10 per cent., $\frac{1}{10}$ of the value equals the gain.

2. At 2, 4, 5, or 8 per cent., what part of the cost equals the gain?

3. At a loss of 12, 14, 16, or 20 per cent., what part of the value equals the loss?

4. If I gain 25, 30, or 35 per cent. on an investment, what part of the money invested equals the gain?

5. A gains 50 per cent. on his capital; what part of the capital equalled the gain?

6. B gained at one time 60, at another time 70, and at another time 80 per cent.; what part of the capital each time equalled the gain?

7 What part of the cost equals the gain at $8\frac{1}{3}$, $12\frac{1}{2}$, $16\frac{2}{3}$, or $33\frac{1}{3}$ per cent ?

8. A man paid $150 for a horse, and sold it at a gain of 10 per cent.; what was the gain?

SOLUTION.—At a gain of 10 per cent. $\frac{10}{100}$, or $\frac{1}{10}$, of the cost equals the gain $\frac{1}{10}$ of $150 is $15. Therefore, &c

9. A lady bought a shawl for $8, and sold it at a gain of 25 per cent.; required the gain.

10. A merchant sold 20 per cent. of 50 barrels of flour; how many barrels did he sell, and how many remained?

11. Henry sold a cow worth $40, at a loss of 5 per cent.; what did he receive for the cow?

12. Samuel spent 20 per cent. of $50 for a watch, and 20 per cent. of the remainder for a chain; how much had he remaining?

13. How much is 5 times 4 per cent. of 400 barrels of flour, and 6 times 5 per cent. of 300 barrels?

14. Which is the greater, and how much; 20 per cent. of 50 apples, or 6 times 4 per cent. of 25 apples?

15. Thomas having a horse which cost $120, sold it at a gain of 25 per cent., and the buyer sold it at a loss of 20 per cent.; what did the latter receive for it?

16. A lady bought 6 yards of calico for 180 cents, and sold it at a gain of 10 per cent.; what was the gain on each yard?

17. 10 per cent. of $300 dollars is $\frac{3}{5}$ of what Mary paid for a shawl; required the cost of the shawl.

18. A merchant purchased 10 barrels of flour for $50, and sold them at a loss of 20 per cent.; what did he receive for each barrel?

19. A man owning $\frac{8}{15}$ of a house, sold 25 per cent. of it; how much had he remaining?

20. 8 per cent. of $200 is $\frac{2}{5}$ of what A gave for a watch; he sold it so as to gain 20 per cent.; for what did he sell it?

21. A and B together have $1600, of which A owns $\frac{3}{5}$ as much as B; A then obtains 20 per cent. of B's part; how much does each now possess?

22. A owned 50 acres of land, and B owned three times as much; A sold B 20 per cent. of his land, and then bought 25 per cent. of B's; how much had each after this operation?

LESSON II.

1. A man bought a watch for 20 dollars, and sold it for $25; what was the gain per cent.?

SOLUTION.—If he bought it for $20, and sold it for $25, he gained the difference between $25 and $20, which is $5. If on $20 he gained $5, on $1 he gained $\frac{1}{20}$ of 5, which is $\frac{5}{20}$, or $\frac{1}{4}$, and on $100 he would gain 100 times $\frac{1}{4}$, which are $\frac{100}{4}$, or $25; hence the gain is 25 per cent.

2. A boy gave 25 cents for a knife, and sold it for 30 cents; what did he gain per cent.?

3. A lady bought a shawl for $5, and sold it for $8; what was the gain per cent.?

4. Thompson bought a boat for $20, and sold it for $16; what was the loss per cent.?

5. Rose bought a dress for $4, and sold it for $6; what was the gain per cent.?

6. Edwin bought a horse for $150, and sold it for $\frac{2}{3}$ of the cost; required the loss per cent.

7. Robert sold his horse for $150, which was $\frac{3}{4}$ of what he paid for it; what per cent. did he lose?

8. Elihu bought 10 cows for $200, and sold 8 of them for what they all cost; what was the gain per cent.?

9. What per cent. of $25 is $5? Of 40 cows is 8 cows? Of 60 apples is 6 apples?

10. What per cent. of 16 is 4? Of 30 is 5? Of 200 is 8? Of 80 is 4? Of 96 is 12?

11. James having 50 marbles, sold 20 per cent. of them; what per cent. of the whole remained?

12. A man bought 25 barrels of flour; he lost 20 per cent. of it, and sold 25 per cent. of the remainder; what per cent. of the whole remained?

13. What per cent. of $\frac{1}{4}$ is $\frac{1}{8}$? Of $\frac{1}{2}$ is $\frac{1}{10}$? Of $\frac{1}{3}$ is $\frac{1}{6}$? Of $\frac{3}{4}$ is $\frac{3}{16}$? Of $\frac{4}{5}$ is $\frac{1}{10}$? Of $\frac{2}{3}$ is $\frac{3}{5}$?

14. If a miller takes 8 quarts of every bushel he grinds for toll, what per cent. does he take for toll?

15. $\frac{2}{3}$ of \$6 is twice what per cent. of $\frac{1}{5}$ of 50 dollars?

16. $\frac{4}{5}$ of \$10 is $\frac{1}{2}$ of what per cent. of $\frac{4}{5}$ of 50 dollars?

17. Two-thirds of 90 dimes is $\frac{6}{8}$ of what Samuel paid for 10 books; he sold them for 3 dimes apiece; required the loss per cent.

18. A merchant bought 30 barrels of flour for \$5 each, and sold $\frac{2}{3}$ of them at the rate of 3 barrels for \$24, and the rest for cost; required the gain per cent.

19. $\frac{1}{2}$ of 10 per cent. is what per cent. of 20 per cent.?

20. $\frac{3}{4}$ of 8 per cent. is what per cent. of 30 per cent.?

21. $\frac{3}{5}$ of 15 per cent. is what per cent. of $4\frac{1}{2}$ times 16 per cent.?

22. Mary sold some silk for \$12, and thereby cleared $\frac{1}{3}$ of this money; what would she have lost per cent. if she had sold it for 6 dollars?

23. A man sold a cow for \$25, and thereby cleared $\frac{1}{5}$ of this money; how much would he have gained per cent. if he had sold it for \$30?

24. Willis sold some books for \$12, and thereby cleared $\frac{1}{5}$ of the cost; what would he have lost per cent. by selling them for \$8?

LESSON III.

1. Thomas sold his watch for \$25, and thereby gained 25 per cent.; what was the cost of the watch?

SOLUTION.—If he gained 25 per cent., then $\frac{25}{100}$, or $\frac{1}{4}$, of the cost equals the gain, which added to $\frac{4}{4}$, the cost, is $\frac{5}{4}$ of the cost, which equals \$25. If $\frac{5}{4}$ of the cost equals \$25, $\frac{1}{4}$ of the cost equals $\frac{1}{5}$ of \$25, which is \$5, and $\frac{4}{4}$, or the cost, equals 4 times \$5, which are \$20. Therefore, &c.

2. Mary sold her shawl for \$14, which was at a gain of 40 per cent.; required the cost of the shawl.

3. A farmer sold a cow for \$23, and thereby gained 15 per cent.; required the value of the cow.

4. A student sold his library for $140, and thereby lost 30 per cent.; what was its value?

5. By selling a hat for $8, Mary lost 20 per cent.; what was the value of the hat?

6. A dog was bought for $15, and sold at a gain of 20 per cent; for what was it sold?

7. Mason gained 20 per cent. by selling cloth at $6 per yard; how should he have sold it to gain 25 per cent.?

8. If a merchant sells muslin at 39 cents a yard, and thereby gains 30 per cent., how ought he to sell it to lose 40 per cent.?

9. If by selling land at $75 an acre I gain 25 per cent., how must I sell it to lose 40 per cent.?

10. A boat was sold for $91, which was at a loss of 35 per cent.; how ought it to have been sold to gain 40 per cent.?

11. Taylor lost 60 per cent. on a watch, by selling it for $40; what ought he to have received to gain 60 per cent.?

12. Hinkston sold his horse and carriage for $240, and thereby lost 4 per cent.; what would he have gained per cent. by selling it for $300?

13. A wagon was sold for $90, which was 10 per cent. less than its value; what would have been the gain per cent. if it had been sold for $120?

14. Mr. Bowman sold 2 books for $15 each; on one he gained 25 per cent., and on the other he lost 25 per cent.; how much did he lose by the transaction?

15. A tailor sold 2 coats for $12 each; on one he gained 20 per cent., and on the other he lost 20 per cent.; did he gain or lose by the sale, and how much?

16. B bought a watch for $42, which was 40 per cent less than its value; he sold it for 30 per cent. more then its value; what was the gain?

17. A man sold 2 watches for $80 each; on one he lost 20 per cent., and on the other he gained 25 per cent.; how much was gained or lost by the transaction?

18. A merchant sold a stove for $30, and thereby lost 25 per cent; he then bought another for $30, and upon

:t gained 25 per cent.; what was gained or lost by the transaction?

19. Martha sold a painting, so that $\frac{2}{3}$ of what she received for it equalled $\frac{4}{5}$ of the cost; did she gain or lose, and how much per cent.?

20. Terrel sold his watch and chain for $120, receiving 5 times as much for the watch as for the chain; on the watch he gained 25 per cent., and on the chain he lost 20 per cent.; what was the gain?

LESSON IV.

1. A man gained 25 per cent. by selling his watch for $20 more than it cost; required its cost.

2. A farmer gained 30 per cent. by selling a cow for $9 more than she cost; what did the cow cost?

3. A, by selling his dog for $6 less than it cost, lost 15 per cent. on the sale; required the cost of the dog.

4. A hat was sold for 20 cents less than cost, which was at a loss of 40 per cent.; required the value of the hat.

5. Four is 10 per cent., 5 is 20 per cent., and 6 is 25 per cent., of what number?

6. Eight is 40 per cent., 9 is 30 per cent., and 12 is 12 per cent., of what number?

7. Thirty is 25 per cent. less, and 25 per cent. more, than what numbers?

8. A man gained $20 by selling a boat for 20 per cent more than its value; what would he have gained by selling it for 10 per cent. above its value?

9. A piano was sold for $60 less than its value, which was at a loss of 30 per cent.; what would have been the gain per cent. if it had been sold for $250?

10. $24 is 4 per cent. of the sum of A's and B's fortune; how much money has each, provided A has twice as much as B?

11. An agent receives $120 to purchase goods, after deducting his commission, which is 20 per cent. on the amount expended; required his commission.

REMARK.—$\frac{1}{5}$, his commission, $+ \frac{5}{5}$ what he expended. $= \frac{6}{5}$ of what he expended, which is $120.

12 A man receives 25 per cent. for purchasing goods, how many dollars worth can he purchase with $200, retaining his commission?

13. A receives $216 to buy goods, and is to retain 8 per cent. on the money expended; required the amount of money expended.

14. Frick received $2800 to invest in land, after deducting his commission, which is 12 per cent. on the amount invested; required his commission.

15. How much grain must a farmer take to mill that he may bring away the flour of 2 bushels, after the miller has taken 20 per cent. of all he took there?

16. A's money is 25 per cent. more than B's, then B's money is how many per cent. less than A's?

17. Morgan sold two horses for $180 each; on one he gained 25 per cent., and on the other he lost 10 per cent.; did he gain or lose, and how much?

18. A's shop is valued at $900; for what sum must he have it insured, at 10 per cent., so that in case of loss he may receive both the value of the shop and premium?

19. At 5 per cent., what must be insured on a house worth $1900, to include the premium in case of loss?

20. At 8 per cent., what must $2300 worth of property be insured for, so that the premium may be included in case of loss?

21. How many yards of cloth, at $4 a yard, must a merchant buy, that by selling it at a profit of 20 per cent., he may gain $8?

22. A man receives $530 to purchase sheep and cows; what sum will he expend for each, after deducting his commission, which is 6 per cent. of the money expended, provided he expends 4 times as much for cows as sheep?

LESSON V

INTEREST.

Interest is money charged for the use of money or property it is estimated at a certain rate per cent., per annum.

The *Principal* is the sum on which interest is computed.

The *Amount* is the sum of the principal and interest.

The *Rate per cent.* is the interest of 100 for one year.

In computing interest we shall consider 30 days to the month, and 12 months to the year.

1. Reduce 2 years and 6 months to the fraction of a year.

SOLUTION.—In 1 yr. there are 12 months, hence 1 month is $\frac{1}{12}$ of a year, and 6 months are 6 times $\frac{1}{12}$, which are $\frac{6}{12}$, or $\frac{1}{2}$ of a year, which, added to 2 years, equals $2\frac{1}{2}$, or $\frac{5}{2}$ years.

2. Reduce each of the following to the fraction of a year: 2 yr. 8 mo., 3 yr. 4 mo., 4 yr. 3 mo., 5 yr. 6 mo.

3. How many years in 3 yr. 9 mo.? 7 yr. 2 mo.? 4 yr. 10 mo.? 6 yr. 5 mo.? 6 yr. 8 mo.?

4. Reduce 3 years, 7 months, 15 days, to the fraction of a year.

SOLUTION.—There are 30 days in a month, hence 1 day is $\frac{1}{30}$, and 15 days are $\frac{15}{30}$, or $\frac{1}{2}$ of a month, which, added to 7 mo., equals $7\frac{1}{2}$, or $\frac{15}{2}$ months, &c.

5. How many years in 2 yr. 6 mo.? 2 yr. 8 mo.? 3 yr. 4 mo.? 4 yr. 3 mo.? 5 yr. 6 mo.?

6 How many years in 3 yr. 9 mo.? 7 yr. 2 mo.? 4 yr. 10 mo.? 6 yr. 5 mo.? 5 yr. 8 mo.?

7. How many years in 2 yr. 2 mo 2 da ? 3 yr. 3 mo 9 da ? 2 yr. 4 mo. 5 da.?

8. How many years in 4 yr. 7 mo. 6 da.? 5 yr. 5 mo 10 da.? 6 yr. 2 mo. 12 da.?

9. How many years in 7 yr. 3 mo. 18 da.? 8 yr. 6 mo. 20 da.? 2 yr 1 mo. 6 da.?

10. At 5 per cent. for 4 years, what part of the principal equals the interest?

SOLUTION.—At 5 per cent. $\frac{5}{100}$ of the principal equals the interest for 1 year, and for 4 yrs., 4 times $\frac{5}{100}$, which are $\frac{5}{25}$ or $\frac{1}{5}$ of the principal equals the interest.

11. At 10 per cent. for 5 years, or 20 per cent. for 2 years, what part of the principal equals the interest?

12. At 8 per cent. for 5 years, or 9 per cent. for 10 years, what part of the principal equals the interest?

13. At 7 per cent. for 5 years, and 6 per cent. for 15 years, what part of the principal equals the interest?

14. At 6 per cent. for 2 yr. and 4 mo., what part of the principal equals the interest?

15. At 8 per cent. for 3 yr. and 3 mo., what part of the principal equals the interest?

16. At 6 per cent. for 5 yr. and 8 mo., what part of the principal equals the interest?

17. At 7 per cent. for 12 yr. and 6 mo., what part of the principal equals the interest?

18. At 8 per cent. for 1 yr. 4 mo. 15 da., what part of the principal equals the interest?

19. At 9 per cent. for 2 yr. 5 mo. 10 da., what part of the principal equals the interest?

20. At 5 per cent. for 3 yr. 7 mo. 6 da., what part of the principal equals the interest?

21. What is the interest of $60 for 6 years, at 5 per cent.?

22. What is the interest of $40 for 4 years, at 5 per cent.?

23. What is the interest of $30 for 5 years, at 1 per cent.?

24. What is the interest of $80 for 7 years, at 5 per cent.?

25. What is the interest of $75 for 8 years, at 6 per cent.?

26. What is the interest of $50 for 9 years, at 8 per cent?

27. What is the interest of $250 for 6 years, at 4 per cent.?

28. What is the interest of $28 for 10 years, at 5 per cent.?

29. What is the interest of $400 for 11 years, at 5 per cent.?

30. What is the interest of $200 for $6\frac{1}{2}$ years, at 6 per cent.?

31. What is the interest of $300 for $5\frac{2}{3}$ years, at 9 per cent.?

32. What is the interest of $240 for $7\frac{1}{2}$ years, at 9 per cent.?

What is the interest

33. Of $600 for 2 years, 3 months, at 8 per cent.?
34. Of $300 for 4 years, 6 months, at 6 per cent.?
35. Of $240 for 3 years, 9 months, at 8 per cent.?
36. Of $225 for 6 years, 8 months, at 6 per cent.?
37. Of $500 for 5 years, 4 months, at 9 per cent.?
38. Of $330 for 7 years, 6 months, at 4 per cent.?
39. Of $222 for 8 years, 4 months, at 6 per cent.?
40. Of $666 for 6 years, 3 months, at 8 per cent.?
41. Of $288 for 4 years, 2 months, at 12 per cent.?
42. Of $440 for 2 years, 1 month, at 12 per cent.?
43. Of $120 for 5 years, 10 months, at 12 per cent.?
44. Of $540 for 3 years, 7 months, 6 days, at 5 per cent.?
45. Of $300 for 5 years, 3 months, 18 days, at 10 per cent.?
46. Of $400 for 2 years, 3 months, 9 days, at 40 per cent.?
47. Of $500 for 2 years, 2 months, 12 days, at 5 per cent.?
48. Of $600 for 1 year, 6 months, 12 days, at 15 per cent.?
49. Of $200 for 1 year, 6 months, 20 days, at 9 per cent.?
50. Of $500 for 3 years, 8 months, 12 days, at 10 per cent.?

LESSON VI.

1. What is the amount of $50 for 5 years, at 8 per cent.?

REMARK.—$\frac{2}{5}$ of the principal equals the interest, which added to $\frac{5}{5}$, the principal, equals $\frac{7}{5}$ of the principal, which equals the amount. $\frac{7}{5}$ of $50 = $70.

2. What is the amount of $250 for 4 years, at 5 per cent.?

3. What is the amount of $120 for 7 years, at 10 per cent.?

4. What is the amount of $400 for 5 years, at 7 per cent.?

5. What is the amount of $240 for 5 years, at 5 per cent.?

6. What is the amount of $200 for 2 years, 3 mo., at 8 per cent.?

7. What is the amount of $600 for 7 years, 6 mo., at 6 per cent.?

8. What is the amount of $300 for 3 years, 9 mo., at 8 per cent.?

9. What is the amount of $320 for 8 years, 10 mo., at 3 per cent.?

10. What is the amount of $400 for 7 years, 6 mo., at 6 per cent.?

11. What is the amount of $360 for 8 years, 4 mo., at 9 per cent.?

12. What is the amount of $100 for 2 years, 6 months, 20 days, at 9 per cent.?

13. A and B wish to divide the amount of $500 for 8 years, at 5 per cent., so that A's part shall be 6 times B's; required the share of each?

14. The amount of $250 for 6 years, at 10 per cent., is to be divided between C and D, so that C shall have 3 times as much as D; what does each receive?

15. James and Henry have $1500 on interest for 4 years, at 10 per cent.; what amount of interest will each receive, provided James has twice as much as Henry?

16. A's fortune is $200, which is $\frac{1}{4}$ of B's; what interest will each receive on his money in 4 years, at 5 per cent.?

17. C's money is $300, which is $\frac{3}{4}$ of D's; what is the amount of each for 5 years, at 6 per cent.?

18. A's money is $400, which is $\frac{2}{3}$ of B's; how much more interest will B receive than A, in 8 years, at 5 per cent.?

19. A, B, and C, together, have $1200, of which A has twice, and B 3 times as much as C; what is the interest of each for 5 years, at 6 per cent.?

20. If the interest of $2500 for 4 years, at 10 per cent., be divided into two parts, which are as 2 to 3, it will respectively give $\frac{1}{3}$ of B's, and $\frac{1}{2}$ of A's money; how much has each?

LESSON VII.

1. What principal will, in 6 years, at 5 per cent., give $60 interest?

REMARK.—We find $\frac{3}{10}$ of the principal equals the interest, which is $60. If $\frac{3}{10}$ of the principal equals $60, $\frac{1}{10}$ equals $\frac{1}{3}$ of $60, which is $20, and $\frac{10}{10}$, or the principal, equals 10 times $20, which are $200.

2. What principal will, in 7 years, at 5 per cent., give $21 interest?

3 What principal will, in 8 years, at 6 per cent., give $12 interest?

4. What principal will, in 3 years, at 8 per cent., give $60 interest?

5. What principal will, in 7 years, at 4 per cent., give $70 interest?

6. What principal will, in 8 years, at 5 per cent., give $60 interest?

7. What principal will, in 3 years and 4 months, at 6 per cent., give $80 interest?

8. What principal will, in 7 years and 6 months, at 4 per cent., give $90 interest?

9 What principal will, in 6 years and 3 months, at 8 per cent., give $85 interest?

10. A man pays $360 interest, at 6 per cent., annually, on money borrowed; what is the sum borrowed?

11. How much money must a person borrow, that he must pay an annual interest of $150, at 5 per cent.?

12. How much money has Howard on interest, supposing he receives $320 for 5 years, 4 months, at 6 per cent.?

13. The interest of $\frac{2}{3}$ of A's money for 6 years and 3 months, at 4 per cent., is $250; what is his money?

14. The interest of $\frac{2}{3}$ of A's, and $\frac{3}{4}$ of B's fortune, for 5 years, at 6 per cent., is $00, and $90, respectively, required the fortune of each.

15. The interest of the sum of A's and B's fortune, for 5 years, at 7 per cent., is $210; what is the fortune of each, provided B. is worth twice as much as A?

16. Howard's money is 3 times Howell's, and in 5 years, at 8 per cent., Howard receives $600 interest; how much money has each?

17. The interest on $\frac{1}{2}$ of A's and $\frac{1}{3}$ of B's fortune for 5 years, at 6 per cent., is $240; what is the fortune of each, provided $\frac{1}{2}$ of A's equals $\frac{1}{3}$ of B's?

18. The interest for 4 years, at 5 per cent., on the money Martin owes, is $40; and the interest for the same time and rate per cent., on the money due him. $70; how much more has he due than he owes?

19 A's money is 4 times B's, and the sum of the interest received by both for 3 years, at 8 per cent, is $600; how much money has each?

20. The interest on the money A paid for a farm, house, and store for 8 years, at 5 per cent., is equal to

$18 000: what was the cost of each, provided the farm cost 3 times as much as the house, and the house twice as much as the store?

LESSON VIII.

The *present worth* of a debt, payable at some future time, without interest, is such a sum as would, at a given rate per cent., *amount* to the debt at the time it becomes due. The *present worth* may therefore be found in the same manner as the principal, when we have given the amount, time, and rate per cent. The *Discount* is the allowance made for the payment of money before it is due. It equals the debt minus the present worth.

1. What principal will, in 8 years, at 5 per cent., amount to $140?

SOLUTION.—At 5 per cent., $\frac{5}{100}$ of the principal equals the interest for 1 year, and for 8 years, 8 times $\frac{5}{100}$, which are $\frac{40}{100}$ or $\frac{2}{5}$, of the principal equals the interest, which added to $\frac{5}{5}$, the principal, equals $\frac{7}{5}$ of the principal, which equals the amount, or $140, &c.

2. What principal will, in 7 years, at 6 per cent., amount to $710?

3. What principal will, in 4 years, at 10 per cent., amount to $420?

4. What principal will, in 6 years and 8 months, at 9 per cent., amount to $320?

5 What principal will, in 8 years and 9 months, at 8 per cent., amount to $510?

6. What principal will, in 5 years and 10 months, at 6 er cent., amount to $540?

7. What is the present worth of $60, due 4 years hence, at 5 per cent.?

8 What is the present worth of $52, due 5 years hence, at 6 per cent.?

9. The amount of $\frac{2}{3}$ of B's fortune, for 3 years and 4 months, at 6 per cent., is $600; what is his fortune?

10. The amount due on a note which had been on interest for 3 years and 4 months, at 9 per cent., is $520; required the face of the note.

11. What is the present worth of $270, due 7 years hence, at 5 per cent.?

12. What is the present worth of $370, due 8 years hence, at 6 per cent.?

13. What is the discount of $580, due 9 years hence, at 5 per cent.?

14. What are the present worth and discount of $340, due 10 years hence, at 7 per cent.?

15. Required the discount of $700, due 5 years hence, at 8 per cent.

16. Required the discount of $149, due 7 years hence. at 7 per cent.

17. The sum of A's and B's money, being on interest for 3 years and 9 months, at 8 per cent., amounts to $2600; what is the money of each if A's is 3 times B's?

18. A's money added to B's, being on interest for 5 years and 4 months, at 6 per cent., amounts to $660; what sum has each if A's is 4 times B's?

19. A man wishes to place such a sum of money on interest, at 6 per cent., that it will give an annual interest of $360 for a poor sister; required the amount invested.

20. Four times A's money, added to 3 times B's, being on interest for 4 years, at 10 per cent., amounts to $4200; how much has each, if 3 times B's equals A's?

21. Two thirds of A's fortune, plus $\frac{3}{4}$ of B's, being on interest for 6 years, at 5 per cent., amounts to $7800, what is the fortune of each, supposing $\frac{2}{3}$ of A's equals $\frac{3}{4}$ of B's?

22. $\frac{1}{2}$ of the cost of Bowman's house, plus $\frac{2}{3}$ of the cost of his farm, being on interest for 5 years, at 8 per cent., amounts to $2100; what is the cost of each, provided the house cost $\frac{1}{3}$ as much as the farm?

23 Two times the value of a horse, plus 3 times the

value of a cow, which is $\frac{1}{2}$ of the value of the horse, in 8 years, at 5 per cent., gives $84 interest; required the value of each.

24. The money Henry paid for a horse, carriage, and harness, in 10 years, at 5 per cent., would give such an interest, that it on interest for the same time, and rate, would amount to $270; how much did he pay for each, if the horse cost twice as much as the carriage, and the carriage 3 times as much as the harness?

LESSON IX.

1. The interest of $200, for a certain time, at 5 per cent., is $60; required the time.

SOLUTION.—At 5 per cent. for *one* year, $\frac{5}{100}$, or $\frac{1}{20}$, of the principal equals the interest. $\frac{1}{20}$ of $200 is $10. If it require one year for $200 to gain $10, to gain $1 it will require $\frac{1}{10}$ of a year, and to gain $60 it will require 60 times $\frac{1}{10}$ of a year, which are $\frac{60}{10}$ or 6 years.*

2. In what time will $100, at 6 per cent., give $21 interest?

3. In what time will $100, at 7 per cent., give $14 interest?

4. In what time will $200, at 5 per cent., give $40 interest?

5. In what time will $150, at 6 per cent., give $45 interest?

6. In what time will $100, at 8 per cent, give $32 interest?

7. In what time will $300, at 10 per cent., give $120 interest?

8. In what time will $200, at 8 per cent., give $48 interest?

* The latter part of this may be given thus: it will require as many years as $10 is contained times in $60, which are 6.

9. In what time will $60, at 5 per cent., give $21 interest?

10. In what time will $25, at 6 per cent., give $9 interest?

11. In what time will $50, at 9 per cent, give $36 interest?

12. In what time will $50, at 4 per cent., amount to $62?

13. In what time will $150, at 5 per cent., amount to $210?

14. In what time will $300, at 7 per cent., amount to $510?

15. In what time will a principal gain twice itself, at 40 per cent.?

REMARK.—$\frac{2}{5}$ of the principal = the interest in 1 year, and twice the principal is $\frac{10}{5}$; hence it will require as many years as $\frac{2}{5}$ is contained times in $\frac{10}{5}$.

16. In what time will a principal gain 3, 4, and 5 times itself, at 10 per cent?

17. In what time will a principal double itself, at 5 per cent.? At 6? 7? 8? 9? 10?

18. In what time will a principal double itself, at 10 per cent.? At $12\frac{1}{2}$? 15? 20? 25? 50?

19. In what time will a principal treble itself, at 5 per cent.? At 10? 20? 25? 40? 50?

20. In what time will a principal quadruple itself, at 5 per cent.? At 15? 30? 50? 60? 100?

21. The amount of a certain principal, for a certain time, at 5 per cent., is $250, and the amount for the same time at 8 per cent. is $280; required the principal and time.

22. A certain sum of money, on interest, amounts, in a certain time, at 6 per cent., to $310, and, at 10 per cent., for the same time, to $350; required the time and principal.

LESSON X.

1 At what per cent. will $60, in 5 years, give $21 interest?

SOLUTION.—For 5 years, at *one* per cent., $\frac{5}{100}$, or $\frac{1}{20}$ of the principal equals the interest. $\frac{1}{20}$ of $60 is $3. If $60 in 5 years, at 1 per cent., gains $3, to gain $1, it will require $\frac{1}{3}$ of 1 per cent., and to gain $21 it will require 21 times $\frac{1}{3}$, which are $\frac{21}{3}$, or 7 per cent.*

2 At what per cent. will $40, in 5 years, give $20 interest?

3. At what per cent. will $200, in 3 years, give $36 interest?

4. At what per cent. will $300, in 4 years, give $60 interest?

5. At what per cent. will $80, in 5 years, give $32 interest?

6. At what per cent. will $50, in 6 years, give $15 interest?

7. At what per cent. will $60, in 7 years, give $21 interest?

8 At what per cent. will $50, in 8 years, give $22 interest?

9. At what per cent. will $100, in 4 years, amount to $120?

10. At what per cent. will $90, in 5 years, amount to $117?

11. At what per cent. will $20, in 7 yr. 6 mo., amount to $26?

12. At what per cent will $6, in 3 yr. 4 mo., amount to $7?

* The latter part of this may be given thus:—It will require as many times 1 per cent. as $3 is coutained times in $21, which are 7.

13. At what per cent. will a given principal gain 3 times itself in 10 years?

REMARK.—$\frac{1}{10}$ of the principal equals the interest at 1 per cent.; hence it will require as many times 1 per cent. as $\frac{1}{10}$ is contained times in $\frac{30}{10}$.

14. At what per cent. will a principal gain 2, 4, 5, and 6 times itself in 30 years?

15. At what per cent. will a principal double itself in 4 years? In 10? 12? 20?

16. At what per cent. will a principal double itself in 8 years? In 25? $33\frac{1}{3}$? 50?

17. At what per cent. will a principal treble itself in 10 years? In 20? 25? 40? 80? 100?

18. At what per cent. will a principal quadruple itself in 10 years? In 15? 30? 60? 100? 150?

19. At what per cent. will a principal quintuple itself in 4 years? In 20? 40? 80? 100? 200?

20. A gained $20 by selling an article for 20 per cent. more than cost; required the cost and amount received for it.

21. B lost 25 per cent. by selling a boat for 20 per cent. of $150; required the value of the boat and the amount received for it.

22. A man sold 2 cows for $50, gaining 25 per cent. on the first, and losing 25 per cent. on the second; what was the value of each, if he received $\frac{2}{3}$ as much for the second as for the first?

23. The amount of a certain principal for 7 years, at a certain per cent., is $540, and for 10 years, $600; required the principal and rate per cent.

24. The amount of a certain principal for 4 years, at a certain per cent., is $420, and for 9 years, at the same rate, $570; required the rate per cent. and principal.

SECTION VII.

LESSON I.

1. A and B hired a pasture for $36. A pastured 4 cows and B 5 cows; how much should each pay?

SOLUTION.—If A pastured 4 cows and B 5, they both pastured 4 + 5, which are 9 cows. If the pasturage of 9 cows cost $36, the pasturage of 1 cow will cost $\frac{1}{9}$ of $36, which is $4, and the pasturage of 4 cows, A's number, will cost 4 times $4, or $16, and the pasturage of 5 cows, B's number will cost 5 times $4, or $20.

2. Two boys bought 60 apples for 12 cents; one paid 5 cents, and the other 7 cents; how many apples should each receive?

3. Rufus and William paid 20 cents for 40 peaches, of which Rufus paid 9, and William, 11 cents; how many peaches belong to each?

4. Three men hired a horse for 20 days, at the rate of $1 per day; the first used it 5, the second, 6, and the third, 9 days; how much should each pay?

5. A and B hired a pasture for $44; A puts in 12 oxen, and B 100 sheep; how much should each pay, supposing an ox to eat as much as 10 sheep?

6. Two farmers hire a pasture for $56; one turns in 10 cows, and the other 36 horses; how much should each pay, provided a cow eats twice as much as a horse?

7. Three men, A, B, and C, bought 144 bushels of peaches for $72, of which A paid $\frac{1}{6}$, B, $\frac{2}{6}$, and C, the remainder; how many bushels did each receive?

8. A and B engage to do a piece of work for $72; A sends 6 men, and B, 15 boys; how much should each receive, supposing 2 men to do as much as 3 boys?

9 A and B agree to mow a field of grass for $54; A

sends 3 men 5 days, and B sends 4 men 3 days; how much should A and B receive respectively?

10. Two men hire a lot of pasture for $10; one turns in 6 horses for 7 days, and the other, 7 horses for 4 days; how much should each pay?

11. A and B built a boat for $140; A sent 6 men 5 days, and B, 4 men 10 days; how much should A and B receive respectively?

12. Two men gain in trade $440; A put in $25 for 4 months, and B, $15 for 8 months; what is each man's share of the gain?

13. C and D build a wall for $120; C with 4 assistants laboured 4 days, and D with 3 assistants laboured 5 days; how much do C and D receive respectively?

14. A, B, and C build a boat for $80; A sent 3 men 4 days, B 5 men 2 days, C 3 men 6 days; how much do A, B, and C receive respectively?

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15. A and B plough a field for $76; A employed 12 horses, and B 18 oxen; they completed it in 4 days; what was the value of the daily labour of each horse and ox, supposing 3 horses do as much as 5 oxen?

16. E and F engaged to reap a field of wheat for $54; E sent 3 men 5 days, and F, 6 boys 4 days; how much should each receive, if 1 man does as much as 2 boys?

17. In a field of grass, which cost $24, M turned 16 horses for 3 weeks, and N, 25 cows for 4 weeks; how much should each pay, if 4 horses eat as much as 5 cows?

18. R, S, and T hire a pasture for $63; R puts in 6 horses, S puts in 18 cows, and T, 48 sheep; how much should each pay, if a horse eat twice as much as a cow, and a cow 4 times as much as a sheep?

LESSON II.

1. Divide 30 cents between A and B, so that their shares will be to each other as 4 to 6.

SOLUTION.—Since the shares are to be to each other as 4 to 6, if we divide 30 cents into 4 + 6, which are 10 equal parts, 4 of these parts, or $\frac{4}{10}$, will be A's, and 6 of these parts, or $\frac{6}{10}$, will be B's number, &c.

2. Divide 45 apples between Thomas and Harry, so that their shares may be to each other as 3 to 2.

3. Divide the number 50 into two parts, that shall be to each other as 7 to 3.

4. In a school consisting of 45 pupils, there are 5 girls for every 4 boys; how many of each sex in the school?

5. The sum of two numbers is 40, and the larger is to the smaller as 5 to 3; required the numbers.

6. Divide 45 plums among three boys, so that their shares may be in the proportion of 2, 3, and 4.

7. Two men bought a barrel of flour for $8, the first paying $3, and the second $5; how much of the flour belongs to each?

8. Three men bought 75 horses, and as often as the first paid $4, the second paid $5, and the third, $6; how many horses should each receive?

9. Divide $44 between A and B, so that B shall have $3\frac{1}{2}$ as often as A $2.

10. The sum of 2 numbers is 50, and the first is to the second as $\frac{1}{2}$ to $\frac{1}{3}$; what are the numbers?

11. Divide the number 49 into two parts which are to each other as $\frac{1}{3}$ to $\frac{1}{4}$.

12. The sum of three numbers is 46; what is each of the numbers, if they are to each other as $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{3}{4}$?

13. Divide the number 50 into 3 parts which shall be to each other as $\frac{2}{3}$, $1\frac{1}{2}$, and 2.

14. A, B, and C found a purse containing $100, which

they agree to divide in the proportion of $\frac{3}{4}$, $\frac{7}{8}$, and $1\frac{1}{2}$; how much does each receive?

15. A and B agree to pay $25 toward building a church, which is to be situated 2 miles from A, and 3 miles from B; how much does each contribute, if they pay in proportion to the reciprocals of their distances?

16. If $420 be divided into two parts, which are to each other as $\frac{1}{2}$ to $\frac{2}{3}$, it will respectively give $\frac{3}{4}$ of A's, and $\frac{4}{5}$ of B's fortune; required the fortune of each.

17. If the interest of $500 for 4 years, at 5 per cent., be divided into two parts, to each other as 2 to 3, it will respectively give $\frac{2}{3}$ of A's, and $\frac{3}{4}$ of B's fortune; required the fortune of each.

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18. A's fortune added to $\frac{1}{2}$ of B's, being on interest for 5 years at 6 per cent., equals $2600; what is the fortune of each, provided A's is to B's as 3 to 4?

19. $\frac{1}{3}$ of A's fortune, plus $\frac{1}{4}$ of B's fortune, being on interest for 6 years at 10 per cent., amounts to $800; what is the fortune of each, if A's fortune is to B's as 9 to 8?

20. M's fortune, + $\frac{3}{4}$ of N's, which is equal to $\frac{1}{2}$ of M's, is $900, and if the sum of M's and N's be divided in the proportion of $\frac{1}{2}$ to $\frac{3}{4}$, it will respectively give $\frac{1}{2}$ of R's and $\frac{3}{4}$ of T's fortune; required the fortunes of each.

LESSON III.

1. A can do a piece of work in 4 days; what part of it can he do in one day?

2. B can cut a cord of wood in $\frac{1}{8}$ of a day; how much can he cut in one day?

3. A man can build $\frac{3}{8}$ of a boat in a week; how long will it require for him to build the whole boat?

4. A mason can build a wall in $2\frac{1}{3}$ days; what part of it can he build in one day?

5. If A and B can mow $\frac{4}{9}$ of a field of grass in one day how long will it require to mow the whole field?

6. A can do a piece of work in 3 days, and B in 6 days; what part can each do in one day?

7. If B can do a piece of work in 3 days, and C in 6 days, how much can they together do in one day?

8. If B and C can do $\frac{3}{8}$ of a piece of work in one day, how long will it require to do the whole work?

9. Fuller can eat a bushel of apples in 4 days, and Brodhead in 6 days; how many days would it last them both?

10. A can dig a ditch in 5 days, and B in 6 days; in what time will they do it working together?

11. C can make a chest in 4 days, and D in 7 days; in what time can they make it working together?

12. E can reap a field in 6 days, and F in 8 days; how long will it take them both to reap it?

13. A can do a piece of work in 3 days, B in 4 days, and C in 6 days; in what time can they together do it?

14. A cistern has two pipes, by the first of which it may be filled in 12 hours, and by the second, in $\frac{2}{3}$ of the time; how long will both be in filling it?

15. A can make a book-case in 6 days, and A and B can make it in 4 days; in what time can B make it alone?

16. A, B, and C can dig a ditch in 3 days. A can dig it in 6 days, and B in 8 days; in what time can C alone dig it?

17. A pound of tea lasted a man and wife 3 months, and the wife alone, 4 months; how long would it last the man alone?

18. A, B, and C can mow a field in 4 days, A and B in 6 days, and B and C in 9 days; how long will it take each to mow it?

19. A, B, and C can dig a ditch in 6 days, A and B

in 8 days, and B in 12 days; how long will it take each to do it?

20. If 3 men, or 4 boys, can do a piece of work in 12 days, in what time can 3 men and 4 boys do it?

21. If A can do a piece of work in $\frac{1}{3}$ of a day, and B in $\frac{1}{4}$ of a day, how long will it take both to do it?

22. C can cut a cord of wood in $\frac{3}{4}$ of a day, and D in $\frac{4}{5}$ of a day; in what time can they together cut a cord?

23. D can make a fence in 9 days, and D and E in 6 days; how long will it take E to make what remains after D has built $\frac{2}{3}$ of it?

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24. Two men, or 3 boys, can plough an acre in $\frac{1}{6}$ of a day; how long will it require 3 men and 2 boys to do it?

25. A can plough a field in $\frac{3}{2}$ of a day, B in $\frac{2}{3}$ of a day, and C in $\frac{3}{4}$ of a day; how long will it take them together to plough the field?

26. A, B, and C can mow a field in 6 days, and A and B in 9 days; after the three had worked 2 days, C left; how long did it require A and B to finish it?

27. Marie can make a dress in 6 days, Sallie in $\frac{1}{2}$ of the time, and Ewretta in $\frac{2}{3}$ of the time; in what time can Marie and Sallie finish it, after the three have worked $\frac{2}{3}$ of a day?

28. A can build a boat in $\frac{3}{4}$ of a month, and B in $\frac{5}{6}$ of a month; after A had wrought $\frac{1}{4}$ of a month B joined him; how long was the boat building?

29. Amos can plough 25 per cent. of a field in a month, and Anson, 45 per cent.; after they both had worked 2 weeks, how long would it require Amos to finish it?

30. A, B, and C can build a vessel in $\frac{1}{4}$ of a year, A and C in $\frac{1}{2}$ of a year, and C in $\frac{2}{3}$ of a year; after they had all laboured 1 month, A left; in what time could B and C finish it?

LESSON IV.

1. A and B together have 34 apples, and $\frac{2}{3}$ of A's number equals $\frac{3}{4}$ of B's number; how many has each?

SOLUTION.—If $\frac{2}{3}$ of A's number equals $\frac{3}{4}$ of B's, $\frac{1}{3}$ of A's equals $\frac{1}{2}$ of $\frac{3}{4}$, which is $\frac{3}{8}$ of B's, and $\frac{3}{3}$ of A's equals 3 times $\frac{3}{8}$, which are $\frac{9}{8}$ of B's; that is, $\frac{9}{8}$ of B's equals A's, which, added to $\frac{8}{8}$ of B's, equals $\frac{17}{8}$ of B's, which equals 34 apples, &c.

2. Thomas and Walton together have $55, and $\frac{2}{3}$ of Thomas's money equals $\frac{4}{5}$ of Walton's; how much has each?

3. The sum of two numbers is 28, and $\frac{1}{3}$ of the smaller equals $\frac{1}{4}$ of the greater; what are the numbers?

4 Divide 46 oranges between Chester and Henry, so that $\frac{3}{4}$ of Chester's may equal $\frac{2}{5}$ of Henry's number.

5. $\frac{3}{8}$ of the number of apple-trees in an orchard equals $\frac{3}{7}$ of the number of peach-trees, and in all there are 60 trees; required the number of each.

6. A pole, whose length was 63 feet, was broken into two parts, such that $\frac{3}{4}$ of the first part equals $\frac{3}{5}$ of the second; required the length of each piece.

7. The sum of two numbers is 69; what is each of the numbers, provided they are to each other as $\frac{2}{5}$ to $\frac{3}{4}$?

8. Walter bought a hat and coat for $26, and $2\frac{1}{2}$ times the cost of the hat equals $\frac{3}{4}$ of the cost of the coat; required the cost of each.

9. Says B to C, $\frac{2}{3}$ of my age, + 6 years equals $\frac{3}{4}$ of yours, and the sum of our ages is 42 years; required the age of each.

10. The difference between two numbers is 6, and $\frac{2}{5}$ of the first equals $\frac{4}{7}$ of the second; what are the numbers?

11. Fanny has 14 plums more than Sallie, and $\frac{2}{5}$ of Fanny's equals $\frac{3}{4}$ of Sallie's number; how many has each?

12. $\frac{1}{2}$ of the difference between two numbers is 6, and $\frac{1}{3}$ of the first number equals $\frac{1}{4}$ of the second; required the numbers.

13. $\frac{2}{3}$ of A's money equals $32, and $\frac{2}{3}$ of B's money equals $\frac{3}{4}$ of A's; how much has each?

14. Five sixths of the difference between A's and B's fortune is $500, and $\frac{2}{5}$ of A's equals $\frac{4}{7}$ of B's fortune; what is the fortune of each?

15. A and B can build $\frac{1}{6}$ of a boat in a day, and twice what A builds equals what B builds; how much can each build in one day?

16. Two boys can do a piece of work in 6 days, and twice what A does equals what B does; how long will it take each to do it?

17. Two pipes fill a cistern in 15 hours, and $\frac{2}{3}$ of what one pours in equals $\frac{2}{5}$ of what the other pours in; how long will it take each to fill it?

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18. John and Henry can mow 60 acres of grass in 6 weeks, and $\frac{1}{2}$ of what John can mow in a day equals what Henry can mow in a day; how long will it take each to mow it?

19. Three men can build a boat in 6 days, and the parts they each build are to each other as 1, 2, and 3; in what time could each build it alone?

20. A horse and cow eat a quantity of hay in 3 weeks; how long will it last each, provided the horse eat only $\frac{2}{3}$ as much as the cow?

21. Three men, A, B, and C, can build a boat in 12 days, and their rates of working are as $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$; how long would it take each alone to build it?

22. B can drink a keg of mead in 4 days; $\frac{2}{3}$ of what B drinks equals $\frac{1}{2}$ of what A drinks, and $\frac{1}{3}$ of what C drinks. After the three had been drinking $\frac{6}{13}$ of a day, A and C drink the remainder; how long did it take them?

LESSON V.

1. A man receives $3 a day for his labour, and forfeits $1 each day he is idle, and at the expiration of 30 days receives $50; how many days was he idle?

SOLUTION.—Had he laboured 30 days, he would have received 30 times $3, or $90; he therefore lost $90 — $50, which is $40, by his idleness. Every day he was idle he lost $3, his wages, plus $1, his forfeit, which are $4. If in one day he lose $4, to lose $1 it will require $\frac{1}{4}$ of a day, and to lose $40, 40 times $\frac{1}{4}$, which are 10 days, the number of days he was idle.

2. Warner receives $2.50 a day for his labour, and pays 50 cents for his board, and at the expiration of 40 days he saves $50; how many days was he idle?

3. A labourer agreed to work, on the condition, that for every day he worked he should receive $2, and for every day he was idle he should forfeit 50 cents; how many days did he labour, if at the end of 25 days he received $30?

4. A boy agreed to carry 32 glasses to a certain store for 5 cents apiece, on condition that for each one he broke he should forfeit 10 cents; he received $1. How many did he break?

5. James engaged to labour on condition that for every day he worked he should receive 1\frac{1}{2}$, and for every day he played he should pay $$\frac{1}{2}$$ for his board; at the expiration of 30 days he received $35. How many days did he work?

6. Robert agreed to carry 50 oranges to market for $\frac{1}{2}$ a cent each, on condition that he should forfeit $2\frac{1}{2}$ cents for each one he eat; he received 16 cents. How many did he eat?

7. The head of a fish is 10 inches long, the tail is as long as the head, plus $\frac{1}{2}$ of the body, and the body is as

long as the head and tail both; required the length of the fish

SOLUTION.—Since the tail is as long as the head, $+ \frac{1}{2}$ of the body $\frac{1}{2}$ of the length of the body, $+$ 10 inches, equals the length of the tail, which, added to the length of the head, equals $\frac{1}{2}$ of the length of the body, $+$ 20 inches, which, by the condition of the problem, equals $\frac{2}{2}$ of the length of the body. If $\frac{2}{2}$ of the length of the body equals $\frac{1}{2}$ of the length of the body, $+$ 20, $\frac{2}{2} - \frac{1}{2}$, or $\frac{1}{2}$ of the length of the body, must equal 20 inches, &c.

8. The head of a fish is 8 inches long, the tail is as long as the head, plus $\frac{1}{2}$ of the body, and the body is as long as the head and tail both; required the length of the fish.

9. The head of a perch is 4 inches long, the tail is as long as the head, plus $\frac{1}{2}$ of the body, and the body is as long as the head and tail both; what is the length of the perch?

10. A has 6 cents, B has as many as A, plus $\frac{1}{3}$ as many as C, and C has as many as A and B both; required the number of cents possessed by each and all.

11. The tail of a pike weighs 3 ounces, the head weighs as much as the tail, plus $\frac{1}{4}$ of the weight of the body, and the body, twice as much as the head and tail; required the weight of the fish.

12. A tree by falling was broken into 3 pieces; the bottom piece was 5 feet long, the top as long as the bottom, plus $\frac{1}{4}$ of the middle, and the middle 3 times as long as the other two pieces; what was the length of each piece, and the tree?

13. A agreed to labour a certain time for $60, on condition, however, that for each day he was idle he should forfeit $2; at the expiration of the time he received $30: how many days did he labour, supposing he receives $2 a day for his labour?

14. The head of a trout weighs 2 pounds, the tail weighs 2 pounds more than the head, plus $\frac{1}{2}$ of the body,

and the body weighs as much as the head and tail together; required the weight of the fish.

15. A man left $26,000 to his wife, son, and daughter, on condition that if the daughter died before becoming of age the widow should have $\frac{1}{4}$ of the fortune, but if the son died the widow should have $\frac{3}{4}$ of it; required the share of each if they all live.

REMARK.—It will be readily seen that the widow has three times as much as the daughter, and the son three times as much as the widow, which is 9 times as much as the daughter.

16. A man wishing to erect some buildings, concluded that if he built a store and house, the store should cost $\frac{1}{3}$ of his money, but if he built a house and barn, the barn should cost $\frac{1}{3}$ of his money; what was the cost of each, supposing he built all three, and his fortune was $77,000?

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17. A gentleman receives $4 per day for his labour, and pays $8 per week for his board; at the expiration of 10 weeks he has saved $144; required the number of idle and working days.

18. A man having a daughter in France, and a son in Spain, willed, if the daughter returned, and not the son, the wife should have $\frac{2}{3}$ of the fortune, but if the son returned, and not the daughter, he should have $\frac{2}{3}$ of the fortune; they both returned, and it was found that the son received $3000 more than the daughter; required the fortune and share of each.

19. A, B, and C, contemplating the purchase of a farm, agreed if A and B bought it, A should pay $\frac{2}{5}$ of the price, but if B and C bought it, B should pay $\frac{2}{5}$ of the price, at length the three agreed to buy it together, when it was found that C paid $500 more than A; what did the farm cost, and what did each pay?

LESSON VI.

1. Henry is 35 years old, and Mary is 5, in how many years will Henry be only 6 times as old as Mary?

SOLUTION.—At the required time, 6 times Mary's age will equal Henry's age; then 6 times Mary's age, which is Henry's age, minus Mary's age, equals 5 times Mary's age, which equals the difference between their ages, which is 35 — 5, or 30 years. If 5 times Mary's equals 30 years, once her age equals $\frac{1}{5}$ of 30 years, which is 6 years. Hence when Mary is 6 years old Henry will be 6 times as old as she, but Mary is now 5, therefore in 6 — 5, or 1 year, Henry will be 6 times as old as Mary.

2. James is 28 years old, and Ellen is 8; in how many years will James be 3 times as old as Ellen?

3. A is 30 years, and B is 6 years old; in how many years will A be only 4 times as old as B?

4. Eva is 6 years old, and her mother, 7 times as old; in how many years will the mother be 5 times as old?

5. Morton is 10 years old, and Moses 30; how long since Moses was 5 times as old as Morton?

6. Jacob is twice as old as his son, who is 20 years of age; how long since Jacob was 5 times as old as his son?

7. Mary is $\frac{1}{4}$ as old as her aunt, who is 40 years of age; how long since Mary was only $\frac{1}{7}$ as old as her aunt?

8. Samuel is 15 years of age, which is $\frac{5}{3}$ of Sarah's age; how long since Sarah was $\frac{1}{3}$ as old as Samuel?

9. Jason is 5 times as old as John, and the difference of their ages is 20 years; in how many years will Jason be 3 times as old as John?

10. Henry is 4 times as old as William, and the sum of their ages is 25 years; in how many years will Henry be but 3 times as old as William?

11. $\frac{2}{3}$ of A's age equals $\frac{4}{5}$ of B's, and the difference between their ages is 10 years; how long since A was 3 times as old as B?

12. A lady bought some ribbon at 5 cents a yard, and as much more at the rate of 7 cents a yard, and sold it all at 8 cents a yard; how much was the gain on 20 yards?

13. Albert bought some oranges at 2 cents each, and as many more at 4 cents each, and sold them at the rate of 2 for 8 cents, and gained 12 cents; required the number bought.

14. Witmer bought some tea at 4 shillings a pound, and as much more at 8 shillings, and sold it all for 7 shillings a pound, and gained 40 shillings; required the number of pounds of each kind.

15. Bowman mixed some sugar worth 5 cents a pound, with an equal quantity worth 9 cents a pound, and sold the mixture for 10 cents a pound, and gained $6; required the quantity of each kind.

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16. Sophia bought a number of yards of silk at the rate of 3 yards for $1, and as much more at the rate of 4 yards for $1, and sold it all at the rate of 8 yards for $3, and thereby gained $5; how many yards did she buy?

17. A boy bought some apples at the rate of 4 for 1 cent, and as many more at the rate of 5 for 1 cent, and sold them all at the rate of 10 for 2 cents, and thereby lost 5 cents; how many of each kind did he buy?

18. $\frac{1}{2}$ of M's age equals $\frac{1}{3}$ of N's, and 8 years is $\frac{4}{5}$ of the difference of their ages; in how many years will $\frac{1}{3}$ of M's age equal $\frac{1}{4}$ of N's age?

19. Two tenths of B's age equals $\frac{4}{5}$ of C's, and the sum of their ages is 30 years; in how many years will B be 3 times as old as C?

20. $\frac{3}{4}$ of A's age added to $\frac{2}{3}$ of B's, which equals $\frac{1}{2}$ of A's, is 100 years; how long since A was 5 times as old as B?

21. $\frac{2}{3}$ of Daniel's age equals $\frac{3}{4}$ of David's, and the sum

of their ages is 68 years; how long since $\frac{2}{3}$ of Daniel's age equalled $\frac{4}{5}$ of David's age?

22. A boy bought some apples at 2 cents apiece, and twice as many oranges at 4 cents apiece, and sold them all at 3 cents each, and thereby lost $1; how many of each kind did he buy?

LESSON VII.

1. A's age equals 3 times B's, but in 10 years A's age will be only twice B's; how old is each?

SOLUTION.—By the first condition of the problem, 3 times B's age equals A's age, and, in 10 years, 3 times B's age, now, + 10 years, will equal A's, and once B's, now, + 10 years, will equal B's; but A's age at that time is twice B's; hence 2 times (B's, now, + 10) which is twice B's + 20 = 3 times B's + 10, therefore 3 B's, now, — 2 B's, now, which is B's, at present time, equals 20 — 10, or 10 years, and A's is 3 times 10, or 30 years. Therefore, &c.

2. John is 5 times as old as Oliver, but in 8 years he will be only 3 times as old; what is the age of each?

3. Mary is $\frac{1}{4}$ as old as her aunt, but in 20 years she will be $\frac{1}{2}$ as old; what is the age of each?

4. Henry is $\frac{1}{5}$ as old as his father, but in 25 years he will be $\frac{3}{5}$ as old; required the age of each.

5. Ten years ago, when I first met Mr. Morgan, I was $\frac{1}{4}$ as old as he, but now I am $\frac{1}{2}$ as old as he is; required each of our ages.

6. Sixteen years ago, when Agnew married, he was 3 times as old as his wife, but now he is only twice as old: what is the age of each?

7. A hare is 30 rods before a hound, and runs 3 rods while the hound runs 6; how many rods must the hound run to catch the hare?

8. Stephen is 40 steps before James, and takes 5 steps to James's 7; how many steps must James take to catch Stephen, supposing their steps to be equal?

9. A hare takes 2 leaps while a hound takes 1, but 1 of the hound's leaps equals 4 of the hare's; how much does the hound gain on the hare in taking one leap?

10. A hare is 30 leaps before a hound, and takes 4 leaps while the hound takes 2, but 2 of the hound's equal 8 of the hare's; how many leaps must the hound take to catch the hare?

11. A fox is 40 leaps before a hound, and takes 3 leaps while the hound takes 2, but 2 of the hound's equal 4 of the fox's; in how many leaps will the hound catch the fox?

12. A thief is 20 steps before an officer, and takes 6 steps while the officer takes 5, but 5 of the officer's equal 8 of the thief's; how far will the thief run before he is overtaken?

13. A rabbit is 60 leaps before a hound, and takes 9 leaps while the hound takes 3, but 2 of the hound's equal 7 of the rabbit's; how many leaps will the rabbit take before being caught?

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14. Twenty-five years ago, Willard was $\frac{1}{7}$ as old as his uncle, but 5 years ago he was $\frac{1}{3}$ as old; how old is each at present?

15. Four years ago B's house was four times as old as his barn, but 2 years hence it will be only twice as old; how long has each been built?

16. Three years ago Emma's doll was only $\frac{1}{5}$ of the age of herself, but 7 years hence it will be $\frac{3}{5}$ of her age; required the age of each.

17. A is 10 steps before B, and takes 2 steps while B takes 4, and 4 of A's steps equal 6 of B's; how many steps will each take before they are together?

18. B takes 30 steps to overtake C; how far was C ahead of B when they started, provided B takes 2 steps while C takes 3, and 2 of B's equal 5 of C's steps?

19. E takes 60 steps before he is overtaken by D; how many steps does D take to catch E, provided E takes 4

steps while D takes 3, and 5 of D's equal 8 of E's, and how far ahead was E when they started?

21. M and N are 60 rods apart and approach each other; how far will each travel before they meet, provided M takes 3 steps while N takes 6, and 2 of M's equal 6 of N's steps?

22. A and B are 150 of B's steps apart, and approach each other; how many steps will each take before they are together, if 4 of A's steps equal 8 of B's, and B takes 9 steps while A takes 3?

LESSON VIII.

1. What is the time of day, provided $\frac{1}{2}$ of the time past midnight equals the time to noon?

SOLUTION.—By the condition of the problem, $\frac{1}{2}$ of the time past midnight equals the time to noon, which, added to $\frac{2}{2}$ of the time past midnight, equals $\frac{3}{2}$ of the time past midnight, which equals the time from midnight to noon, or 12 hours. If $\frac{3}{2}$ of the time past midnight equals 12 hours, $\frac{1}{2} = \frac{1}{3}$ of 12 hours, which is 4, and $\frac{2}{2} = 2$ times 4, or 8 hours, the time past midnight. Hence, it is 8 o'clock in the morning.

2. What is the time of day, supposing $\frac{2}{3}$ of the time past midnight equals the time to noon?

3. What is the time of day, if $\frac{1}{3}$ of the time past midnight equals the time past noon?

4. What is the time of day, if $\frac{1}{5}$ of the time past midnight equals the time past noon?

5 What is the hour of day, supposing $\frac{1}{7}$ of the time past midnight equals the time to midnight again?

6. What is the hour of day, provided $\frac{3}{5}$ of the time past midnight equals the time to midnight again?

7. What is the hour of day, if $\frac{1}{3}$ of the time to noon equals the time past midnight?

8. What is the time of day, if $\frac{1}{5}$ of the time to noon equals the time to midnight?

9. A person being asked the time of day, said, $\frac{1}{5}$ of the time past noon equals the time to midnight; what was the hour?

10. William recited his lesson when $\frac{3}{7}$ of the time past noon equalled the time past midnight; at what hour did he recite?

11. A person being asked the time of day, said, $\frac{3}{5}$ of the time to midnight equals the time past midnight; what was the time?

12. A lady being asked the time of day, replied, that $\frac{1}{6}$ of the time to midnight equalled $\frac{1}{2}$ of the time past noon; what was the time?

13. Required the hour of day, provided $\frac{2}{7}$ of the time to midnight equals $\frac{2}{3}$ of the time to noon.

14. What time, after 12 o'clock, are the hour and minute hands of a watch exactly together?

REMARK.—It will be seen that the minute hand gains on the hour hand 11 spaces in going 12; hence, to gain 1 space, the distance they are apart at 1 o'clock, it must go $\frac{1}{11}$ of 12 spaces, which is $\frac{12}{11}$ spaces, equal to $5\frac{5}{11}$ minutes.

15. What time, after 2 o'clock, are the hour and minute hands of a clock together?

16. A man being asked the hour of the day, replied, that it was between 4 and 5 o'clock, and that the hour and minute hands were together; what was the time?

17. $\frac{1}{2}$ of the time past 9 o'clock, A. M., equals $\frac{1}{3}$ of the time to midnight; what is the time?

18. A man being asked the hour of day, replied, that $\frac{1}{4}$ of the time past 3 o'clock, equalled $\frac{1}{2}$ of the time to midnight; what was the hour?

19. A has $20 in gold and silver, and for every $6 of

gold he has $4 of silver; how much gold must be added that there may be $9 of gold for $3 of silver?

REMARK.—Since the gold is to the silver as 6 to 4, and there are $20 in all, we find there are $12 of gold and $8 of silver. After the addition, since 3 times the silver equals the gold, 3 times $8, or $24, is the gold, and $24 — $12, or $12, equals the amount added.

20. A man has 40 pieces of money, consisting of copper and silver, and for every 7 of copper there are 3 of silver; how many pieces of silver must be added, that for every 4 of copper there may be two of silver?

21. A drover has 100 animals, consisting of sheep and cows, and he has 2 sheep for every 3 cows; how many sheep must he sell that he may have 2 sheep to 6 cows?

22. There are 50 pupils in a certain school, consisting of girls and boys, and there are 8 boys to 2 girls; how many boys must leave the school that there may be 6 boys to 2 girls?

23. A man expends 60 cents for an equal number of apples and pears, giving 3 cents each for his apples, and 2 cents each for his pears; how many pears must he sell, that the remainder may be to his apples as 2 to 3?

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24. A man, being asked the hour of day, replied, that $\frac{1}{8}$ of the time past 2 o'clock equalled $\frac{1}{2}$ of the time to midnight; what was the hour?

25. What time, between 7 and 8 o'clock, are the hour and minute hands of a watch exactly together?

26. In how many minutes, after 4 o'clock, will the hour and minute hands be 5 minutes apart?

27. A lady, being asked the hour of day, replied, that $\frac{2}{3}$ of the time past noon equalled $\frac{4}{5}$ of the time to midnight, minus $\frac{4}{5}$ of an hour; what was the time?

28. A tree 90 feet in length, by falling, was broken into two parts, such that $\frac{1}{4}$ of the shorter equalled $\frac{1}{5}$ of the longer; how much must be cut from the longer, so that $\frac{1}{4}$ of it may equal $\frac{1}{5}$ of the other part?

29. A boy bought 24 oranges and lemons, and $\frac{2}{3}$ of the number of oranges equals $\frac{2}{5}$ of the number of lemons; how many more oranges must be purchased, that $\frac{2}{3}$ of the number of oranges may equal $\frac{2}{3}$ of the number of lemons?

LESSON IX

1. How far may a person ride in a coach, which goes at the rate of 10 miles an hour, so that he may be gone but 8 hours, provided he walks home at the rate of 6 miles an hour?

SOLUTION.—If he walks 6 miles in 1 hour, to walk 1 mile it will require $\frac{1}{6}$ of an hour, and to walk 10 miles, the distance he rides in an hour, it will require 10 times $\frac{1}{6} = \frac{10}{6}$, or $\frac{5}{3}$, of an hour, hence $\frac{5}{3}$ of the time he rides equals the time he walks, which added to $\frac{3}{3}$, the time he rides, equals $\frac{8}{3}$ of the time he rides, which is 8 hours, &c.

2. How far may a person ride in a carriage, going at the rate of 9 miles an hour, provided he is gone only 10 hours, and walks back at the rate of 6 miles an hour?

3. How many miles may I sail in a steamboat, going at the rate of 15 miles an hour, provided I am gone only 9 hours, and return at the rate of 12 miles an hour?

4. A steamboat whose rate of sailing in still water is 12 miles an hour, descends a river whose current is 4 miles an hour, and is gone 6 hours; how far did it go?

5. A boat whose rate of sailing is 10 miles an hour, moves down a river whose current is 2 miles an hour; how far may it go that it may be gone but 5 hours?

6. Eight men hire a coach to ride to Lancaster, but by taking in 4 more persons, the expense of each is diminished by $\$\frac{3}{4}$; what do they pay for the coach?

7. Ten men hire a coach for a certain sum of money,

but taking in 5 more persons, the expense of each is diminished $\$\frac{1}{6}$; what did the coach cost them?

8 Twenty persons engage a pleasure boat for sailing, but before they start, 12 of the company decline going, by which the expense of each is increased $3; what did they pay for the boat?

9. A boy being asked his age, replied, 3 times the square of my age equals 75 years; how old was he?

10. Albert being asked how many marbles he had, answered, $\frac{1}{2}$ of the square of the number equals 18; how many marbles had he?

11. Three fourths of the square of the number of letters in a sentence equals 27; how many letters are there in the sentence?

12. The square of twice a number equals 256; what is that number, and what is the square of $\frac{1}{2}$ of the number?

13. If $\frac{2}{5}$ of the number of trees in an orchard be squared, the result will be 100; how many trees are there in the orchard?

14. The square of twice a number is 18 more than twice the square of the number; what is the number?

15. Twice the square of a number is 8 more than 6 times the square of half the number; what is the number?

16. $\frac{3}{4}$ of the square of a number is 36 more than $\frac{3}{4}$ of the square of half the number; required the number.

17. 15 is 3 more than $\frac{3}{2}$ of the cube of some number: what is that number?

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18. $\frac{2}{3}$ of the cube of a number is 10 more than the cube of $\frac{2}{3}$ of the number; what is the number?

19. $\frac{2}{3}$ of the square of twice a number is equal to $\frac{1}{3}$ of the square of $\frac{3}{2}$ of the number, diminished by 3; what is the number?

20. A lady being asked how many music pupils she had, replied, $\frac{2}{3}$ of the number multiplied by $\frac{3}{4}$ of the number is 9 more than the square of $\frac{1}{2}$ the number; how many had she?

21. A company of 15 persons engage a dinner at a hotel, but before paying the bill 5 of the company withdraw, by which each person's bill was augmented $\$\frac{1}{2}$; what was the bill?

LESSON X.

1. In what proportion must I mix tea worth 6 shillings a pound, with that worth 11 shillings a pound, so that the mixture may be worth 9 shillings a pound?

SOLUTION.—If I take 1 lb. at 6*s.*, and sell it for 9*s.*, I will gain 9—6, or 3*s.*, and to gain 1*s.* I must take $\frac{1}{3}$ of a pound; if I take 1 lb. at 11*s.*, and sell it for 9*s.*, I lose 11—9, or 2*s.*, and to lose 1*s.* what I gained on the first, I must take $\frac{1}{2}$ of a pound; hence I must take $\frac{1}{3}$ of a pound at 6*s.* as often as $\frac{1}{2}$ a pound at 11*s.*, or, in whole numbers, 6 times $\frac{1}{3}$, which are 2 lbs. at 6*s.*, as often as 6 times $\frac{1}{2}$, which are 3 lbs. at 11*s.*

2. In what proportion must I mix rice worth 7 cents a pound, with that worth 12 cents, so that the mixture may be worth 9 cents a pound?

3. In what manner shall I mix sugar worth 5 cents a pound, with that worth 12 cents a pound, so that the mixture may be worth 8 cents a pound?

4. Having two kinds of wine worth $2 and $9, respectively, a gallon, how shall I mix them that the mixture may be worth $4 a gallon?

5. How many pounds of sugar worth 6 cents a pound must I mix with 4 pounds at 11 cents a pound, so that the mixture may be sold for 8 cents a pound?

6. How many pounds of coffee worth 8 cents a pound can I mix with 12 pounds worth 13 cents a pound, so that a pound of the mixture may be worth 11 cents?

7. How many gallons of wine worth $2 a gallon must be mixed with 9 gallons at $9 a gallon, so that the mixture may be sold for $5 a gallon?

8. How many pounds of tea worth 3 shillings a pound must be mixed with 10 pounds worth 9 shillings a pound, so that the mixture may be worth 5 shillings a pound?

9. A grocer mixed 4 pounds of sugar worth 5 cents a pound, with 6 pounds worth 10 cents a pound; what is the value of one pound of the mixture?

10. In what proportion must I mix sugars worth 6, 7, and 11 cents a pound, so that the mixture may be worth 9 cents a pound?

11. A merchant mixed 5 gallons of wine worth 60 cents per gallon, with 5 gallons worth 80 cents a gallon; required the value of a gallon of the mixture.

12. In what proportion must I mix rice at 5, 6, and 12 cents a pound, so that one pound of the mixture may be worth 8 cents?

13. How shall teas worth 3, 4, 8, and 9 shillings per pound be mixed, that the mixture may be sold for 6 shillings a pound?

14. If a man travels 2 miles one day, 4 the next, 6 the next, and so on, how many miles will he travel the sixth day?

SOLUTION.—Since the distance increases 2 miles each day after the first, on the sixth day, or 5 days after the first, it will increase 5 times 2, which are 10 miles, which, added to 2 miles, the distance he travels the first day, equals 12 miles, the distance he travels the sixth day.

15. If a man travels 2 miles the first day, and each day travels 3 more than on the preceding day, how far will he travel the tenth day?

16. If a lady pays 4 cents for one yard of muslin, and 4 cents more for each yard than the preceding one, how much will the eighth yard cost?

17. If a person travels 3 miles the first day, and 13 the sixth day, how much more did he travel each day than on the preceding one?

18. How many days did a person travel, supposing he went 4 miles the first day, 14 the last day, and went 2 miles more each day than on the preceding one?

19. If a person paid 5 cents for one yard of cloth, and 2 cents more for each succeeding one, how many yards must be bought that the last yard may cost 25 cents?

20. If a lady pays 4 cents for the first yard of muslin and 31 cents for the tenth yard, how much more did she pay for each yard than for the preceding one?

21. If Elmira bought 12 yards of muslin, paying 3 cents more for each yard than for the preceding, and 40 cents for the last yard; how much did she pay for the first yard?

22. A merchant having sugar worth 4, 5, 10, and 11 cents a pound, wishes to make a mixture of 60 lbs. worth 7 cents a pound; how many pounds of each kind must he take?

LESSON XI.

1. A lady bought two watches and a chain. The chain and gold watch cost 4 times as much as the silver watch, and the chain and silver watch cost twice as much as the gold watch. What is the value of each, if the silver watch is worth $30?

SOLUTION.—By the first condition of the problem 4 times $30, or $120, equals the cost of the gold watch and chain, which added to $30, the cost of the silver watch, is $150, the cost of the two watches and chain. By the second condition, twice the cost of the gold watch equals the cost of the silver watch and chain, which, added to the cost of the gold watch, equals 3 times the cost of the gold watch, which equals the cost of all, or $150. If 3 times the cost of the gold watch equals $150, &c

2. A farmer bought a horse, colt, and saddle. If the horse be saddled it will be worth 5 times as much as the colt, but if the colt be saddled it will be worth $\frac{1}{2}$ as much as the horse. What is the value of the horse and the saddle, supposing the colt to be worth $50?

3. The head of a fish is 10 inches long; 7 times the

length of the head equals the length of the body and tail, and 3 times the length of the tail equals the length of the head and body. Required the length of the tail and body respectively.

4. A person has two silver cups and only one cover for both. The first cup weighs 12 ounces. If the first cup be covered it will weigh twice as much as the second, but if the second cup be covered it will weigh 3 times as much as the first. Required the weight of the second cup and cover.

5. A farmer bought a cow for $30, which was $\frac{1}{3}$ of what he paid for a horse and sheep, and $\frac{1}{5}$ of what he paid for the horse and cow equals what the sheep cost; required the cost of the horse and sheep.

6. A has $20, which is $\frac{1}{3}$ of what B and C have, and C has $\frac{1}{7}$ as much as A and B together; how much have B and C respectively?

7. A went to a store and borrowed as much money as he had, and spent 4 cents; he then went to another store and did the same, and then had 4 cents remaining; how much money had he at first?

8. A boy went to a store, borrowed as much money as he had, and spent 8 cents; he then went to a second store, borrowed as much as he had, and spent 12 cents, and had no money remaining; how much money had he at first?

9. Rolland went to a store, borrowed as much money as he had, and spent 8 cents; he then went to a second and third store and did the same, and had no money remaining; how much had he at first?

10. A gentleman has two silver cups and only one cover for both. The first cup weighs 10 ounces, and if the first cup be covered it will weigh 3 times as much as the second, but if the second cup be covered it will weigh 5 times as much as the first; required the weight of the second cup and cover.

11. A expended 10 cents for apples, which was $\frac{1}{5}$ of what he expended for peaches and oranges, and twice

what he spent for oranges equals what he spent for apples and peaches; how many did he buy of each if the apples cost 2, the peaches 3, and the oranges 4 cents each?

12. Reynolds went to a hotel, borrowed as much money as he had, and spent 2 cents; he then went to a second and third hotel, did the same, and had 6 cents remaining; how much money had he at first?

13. William went to a store, borrowed 10 cents, and then spent 8 cents, doing the same at a second and third store, he found he had doubled his money; how much money had he?

14. A has $20, which is $\frac{1}{4}$ of what B and C have, and twice B's money is equal to $\frac{1}{2}$ of the sum of A's and C's money; how much money have B and C respectively?

15. James went to a store, borrowed 10 cents, and then spent 12 cents; he did this at a second and third store, and then had no money left; how much money had he at first?

16. A man expended $5 for ducks, which was $\frac{1}{5}$ of what he paid for geese and turkeys, and twice what he paid for geese equals what he paid for ducks and turkeys; how many of each kind did he buy, provided the ducks cost $\$\frac{1}{2}$, the geese $1, and the turkeys $3 each?

LESSON XII

1. Two men, A and B, in partnership gain $300. A owns $\frac{2}{3}$ of the stock, lacking $40, and gains $180; required the whole stock, and share of each.

SOLUTION.—If A had owned $\frac{2}{3}$ of the stock, his gain would have been $\frac{2}{3}$ of $300, or $200; but he gained only $180, therefore the $40 must gain the difference between $200 and $180, which is $20. If $40 gain $20, to gain $1 it will require $\frac{1}{20}$ of $40, which is $2, and to gain $300 it will require 300 times $2 which are $600

2. A and B enter into partnership and gain $240. A owns $\frac{3}{4}$ of the stock, lacking $10, and his share of the gain is $175· required the whole stock, and share of each.

3. Two men in partnership gain $200. The first owns $\frac{1}{4}$ of the stock + $40, and his gain is $60; what is the entire stock and share of each?

4. A and B bought a lottery ticket with which they drew a prize of $600. A paid $\frac{2}{3}$ of the price of the ticket, lacking $12, and his share of the prize was $340; what did each pay for the ticket?

5. A man and his son agree to mow a certain field for $72. The son mowed $\frac{1}{4}$ of the whole + 10 acres, and received $38; how many acres did each mow?

6. Two men pay $120 for the pasturage of some cattle. The first turns in $\frac{1}{4}$ of the whole number, + 20, and pays $40; how many cattle does each turn in?

7. A and B agree to mow a field of grass for $60; A mows twice as much as B, lacking 8 acres, and receives $24; how many acres does each mow?

8. Two men engage to build a boat for $84. The first labours $\frac{1}{3}$ as many days as the second, + 6 days, and receives $48; how many days does each labour?

9. Two men receive the same sum for labour; but had one received $10 more, and the other $6 less, one would have received 5 times as much as the other; how much does each receive?

10. A and B invested the same sum in speculation. A lost $200, and B gained $1000, when it was found that B had 4 times as much money as A; what was the sum invested?

11. Said James to Isaac, our purses contain the same sum of money, but if you give me $20, and I give you $10, I shall have 3 times as much as you; how much money had each?

12. A person being asked the hour of the day, replied that 2 hours ago the time past noon was $\frac{1}{3}$ of the time to midnight 2 hours hence; required the time

13. Said E to F my age is 5 years more than yours, but 4 years ago my age was $\frac{1}{2}$ of what yours will be 4 years hence; what was the age of each?

14. A pole whose length was 44 feet, was broken into two unequal parts; if the shorter be increased by 3 feet, and the longer be diminished by 5 feet, the first will be $\frac{1}{2}$ of the length of the second; required the length of each part.

15 A staff, whose length is 33 feet, is in the air and water; and the length in the air, — 2 feet, equals 4 times the length in the water, + 6 feet; required the length in the air.

16. A person being asked the time of day, replied, that $\frac{2}{3}$ of the time past midnight, 2 hours ago, equalled $\frac{2}{5}$ of the time to midnight, 3 hours and 20 minutes hence; required the time.

17. A man having an equal number of cows in two fields, sold $\frac{1}{3}$ of the number from each, then 7 having jumped from the first into the second, there were 3 times as many in the second as in the first; required the number in each field.

18. A had twice as many oranges as B, and then each losing $\frac{1}{3}$ and A giving B 8, they each have the same number; how many had each at first?

19. C's fortune is twice D's, but after each had spent $\frac{1}{6}$ of his fortune, and C had given D $10, D had twice as much money as C; required the fortune of each.

20. Two men, A and B, agree to dig a ditch for $50; and $\frac{4}{5}$ of what A digs, increased by 4 rods, equals $\frac{2}{3}$ of what B digs, and B receives $30; how many rods did each dig?

LESSON XIII.

1 A lost 15 cents, and then found $\frac{1}{3}$ as much as he had remaining, and then had $\frac{1}{2}$ as much as he had at first, how much had he at first?

SOLUTION.—After finding $\frac{1}{3}$ as much as he had remaining, he had $\frac{3}{3} + \frac{1}{3}$, which is $\frac{4}{3}$ of what remained after losing 15 cents; which, by the last condition of the problem, equals $\frac{1}{2}$ of what he had at first. If $\frac{1}{2}$ of what he had at first equals $\frac{4}{3}$ of what remained, $\frac{2}{2}$, or what he had at first, equals 2 times $\frac{4}{3}$, or $\frac{8}{3}$ of what remained: then $\frac{8}{3}$ of what remained, which is what he had at first, minus $\frac{3}{3}$ of what remained, which is $\frac{5}{3}$ of what remained, equals what he lost, or 15 cents, &c.

2. B lost $22, and then found $\frac{1}{4}$ as much as he had remaining, and then had $\frac{1}{3}$ as much as he had at first; how much had he at first?

3. A, having a certain sum of money, found $20, and then lost $\frac{1}{3}$ of what he then had, and then had twice as much as he had at first; how much had he at first?

4. A man having some money, borrowed 30 cents, and then losing $\frac{1}{4}$ of what he then had, found there remained 3 times as much as at first; how much had he at first?

5. A boy lost 44 cents, and then earning $\frac{2}{3}$ as much as remained, found he had $\frac{3}{4}$ as much as at first; how much had he at first?

6. A man went to a store and spent 21 cents, and then borrowing $\frac{1}{5}$ of what he had remaining, had $\frac{1}{2}$ as much as he had at first; how much money had he at first?

7. A, at a game of chess, won $18, and then lost $\frac{3}{4}$ of what he then had, when, counting his money, he found he had $2\frac{1}{2}$ times as much as at first; how much did he make by playing?

8. A and B lost 12 apples, and then bought $\frac{3}{4}$ as many as they lost, and then had $\frac{4}{5}$ as many as they had at first; how many had they remaining?

9. A, in a game of chance, lost $\frac{1}{3}$ of his money and then won $10, after which he had $\frac{5}{6}$ as much as he had at first; how much did he lose at play?

10. A and B lost 32 peaches, and then bought $\frac{2}{3}$ as many as remained, and then had $\frac{3}{5}$ as many as at first; how many had each at first, supposing their shares to be as 2 to 3?

11. A boy being asked his age, replied, that if 11 years ago his age had been increased by its $\frac{1}{4}$, it would then have been $\frac{1}{3}$ of what it now is; required his age.

12. A lady being asked her age, said, that if her age were increased by its $\frac{1}{5}$, the sum would equal 3 times her age 12 years ago; what was her age?

13. A, B, and C, dine together; A furnishing 2 loaves, B 3 loaves, and C contributing 25 cents to be divided between A and B; required the share of each.

14. A boy being asked his age, replied, that if my age in 3 years be diminished by its $\frac{2}{5}$, the remainder will be $\frac{3}{4}$ of my age now; what was his age?

15. A furnished 2 loaves for supper, and B 4, while C contributed 20 cents to be divided between A and B; how much of it should each receive?

16. Two partners, A and B, lost $210, and the next year gained $\frac{1}{3}$ of what remained, which was $\frac{1}{6}$ of the original stock; what was the stock of each, if $\frac{2}{3}$ of A's equals $\frac{2}{5}$ of B's stock?

17. A furnished 6 eggs for a repast, and B 10 eggs, while C contributed 16 cents to be divided between A and B; how much shall each receive, provided A and B eat the same number, and C, 4 more than each?

18. A person being asked his age, said, that if my age in 4 years be diminished by its $\frac{2}{3}$, the remainder will equal $\frac{1}{2}$ of my age 4 years ago; what was his age?

19. A, B, and C eat 14 peaches, of which A owned 5, and B 9, and C contributed 24 cents; how much of the money ought A and B each to receive, if B eats twice as many as A, and C eats twice as many as B?

20 Two merchants having a certain number of yards

of cloth, bought 30 yards more, then sold $\frac{1}{4}$ as many as they had, and then had 3 times as many as at first; how many yards had each, if $\frac{1}{2}$ of A's number equals $\frac{1}{3}$ of B's?

LESSON XIV.

1. A man bought a certain number of sheep for $100, when a dog having killed 8 of them, he sold $\frac{1}{3}$ of the remainder for cost, and received $20; how many did he buy?

SOLUTION.—If $\frac{1}{3}$ of the remainder cost $20, $\frac{3}{3}$ of the remainder cost 3 times $20, or $60; then, since they all cost $100, the 8 must have cost $100—$60, or $40, &c.

2. A farmer bought a number of pigs for $80, when 5 of them having died, he sold $\frac{2}{3}$ of the remainder for cost, and received $40; how many did he buy?

3. A lady purchased a number of yards of muslin for $1.50, and after using 6 yards she sold $\frac{2}{3}$ of the remainder for cost, and received 90 cents less than it all cost; how many yards did she purchase?

4. A bought a number of turkeys for $10, when, having killed 10, he sold $\frac{2}{5}$ of the remainder for cost, receiving $8 less than the cost of all; required the number purchased.

5. A bought a number of sheep for a certain sum, and having lost 6 he sold $\frac{3}{4}$ of the remainder for cost and received $15, which was $35 less than they all cost; how many did he buy?

6. A farmer bought a number of hens for a certain sum, and having killed 10, he sold $\frac{4}{5}$ of the remainder for cost, and received 48 dimes, which was 72 dimes less than they all cost; how many did he retain?

7. A bought a number of ducks for $16, and having

killed 12, he sold $\frac{4}{5}$ of the remainder, lacking 8, for cost, and received $4; how many did he buy?

8. B bought a number of sheep for $30, and losing 2, he sold $\frac{3}{4}$ of the remainder, lacking 3, for cost, and received $21 less than all cost; required the number bought.

9. Henry bought a number of pigs for $48, and losing , he sold $\frac{2}{3}$ of the remainder, minus 2, for cost, receiving $32 less than all cost; required the number purchased.

10. A bought some calves for $80, and having lost 10, he sold 4 more than $\frac{2}{3}$ of the remainder for cost, and received $32 less than all cost; required the number purchased.

11. A dog killed $\frac{1}{4}$ of A's sheep; now if he sells the remainder for cost he will receive $60, but reserving 8 and selling $\frac{1}{2}$ of the remainder for cost he will receive $22; how many had he at first?

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12. A lost $\frac{2}{5}$ of his hens, and found if he sold $\frac{2}{3}$ of the remainder for cost he would receive 40 dimes, but if he kept 15 and sold $\frac{2}{3}$ of the remainder he would receive 20 dimes; how many did he have?

13. B lost $\frac{2}{3}$ of his turkeys, and then finds by selling $\frac{2}{3}$ of the remainder for cost, he would receive $20, but finding 6, and selling $\frac{2}{3}$ of the number he then had, he received $24; how many did he retain?

14. A lost $\frac{3}{4}$ of his hens; now if he finds 10 and sells $\frac{3}{4}$ of his number then for cost price he will receive 60 dimes, but if he loses 10 and sells $\frac{3}{4}$ of the remainder for cost he will receive 30 dimes; how many had he at first?

15. If 60 lbs. of sea water contain 2 lbs. of salt, how much fresh water must be added to these 60 lbs., so that 10 lbs. of the new mixture may contain $\frac{1}{5}$ of a pound of salt?

16. Suppose that for every 4 cows a farmer has, he should plough an acre of land, and allow one acre of pasture for every 3 cows, how many cows could he keep on 140 acres?

17. B lost $\frac{3}{5}$ of his sheep; now if he finds 5, and sell

$\frac{3}{5}$ of what he then has for cost price, he will receive $18; but if he loses 5, and sells $\frac{3}{5}$ of the remainder for cost price, he will receive $6; how many had he at first?

LESSON XV

1. A father divided $4400 between his two children, A and B, whose ages were 11 and 16 years respectively, in such a manner that the parts, at 5 per cent., simple interest, would amount to equal sums when they became of age; what were the parts?

SOLUTION.—A's money was on interest 10 years and B's 5 years. For 10 years at 5 per cent., $\frac{3}{2}$ of the principal equals the amount, hence $\frac{3}{2}$ of A's *share* equals A's *amount;* and in the same way we see that $\frac{5}{4}$ of B's *share* equals B's *amount.* Now the amounts are to be equal, hence $\frac{3}{2}$ of A's share $= \frac{5}{4}$ of B's share, from which we find A's share $= \frac{5}{6}$ of B's share; then $\frac{6}{6}$ of B's $+ \frac{5}{6}$ of B's, or $\frac{11}{6}$ of B's share $=$ $4400, $\frac{1}{6}$ of B's $=$ $400, $\frac{6}{6}$ of B's $=$ $2400, and $\frac{5}{6}$ of B's, or A's $=$ $2000.

2. A divided $5600 between his two sons, whose ages were 11 and 15 years, in such a manner that the two parts on interest, at five per cent., would amount to equal sums when they became 21 years of age; required the parts.

3. A gentleman dying divided $5100 among his three sons, whose ages were 9, 11, and 17 respectively so that the different shares, being on interest at 5 per cent., would amount to equal sums when they became of age; what were the shares?

4. A widow divided $3700 among her sons, whose ages were respectively 14, 16, and 18 years, in such a manner that the shares, being put on interest at 20 per

cent., would amount to equal sums when they became of age; required the share of each.

5. A boy spends $\frac{1}{2}$ of his money, + $\$\frac{1}{2}$, then $\frac{1}{2}$ of the remainder, + $\$\frac{1}{2}$, and then had \$3; how much money had he at first?

6. C and D together have 20 sheep, and $\frac{1}{3}$ of C's number, + $\frac{1}{4}$ of D's, equals $\frac{1}{2}$ of C's; how many sheep does each own?

7. A man spent $\frac{1}{2}$ of his money and \$2 more, and then spent \$2 more than $\frac{1}{2}$ of the remainder, and then had \$2 remaining; required his money at first.

8. Sarah gave away $\frac{1}{3}$ of her peaches, lacking $\frac{1}{3}$ of a peach, and then gave away $\frac{1}{3}$ of the remainder, lacking $\frac{1}{3}$ of a peach, and then had $5\frac{4}{9}$ peaches remaining; how many peaches had she at first?

9. A fish caught in the Conowingo, weighs 8 pounds, and $\frac{2}{5}$ of the body, + $\frac{2}{3}$ of the head and tail, weigh as much as $\frac{4}{5}$ of the body; required the weight of each part, if the tail is $\frac{1}{3}$ as heavy as the head.

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10. A father left \$5500 to his son and daughter, whose ages are respectively 19 and 15 years, so that, being on interest at 10 per cent., the son should receive twice as much as the daughter, when they were 21 years of age; what was the share of each?

11. Harry gave $\frac{1}{4}$ of his money, lacking 3 cents, to James, $\frac{1}{3}$ of the remainder, lacking 2 cents, to Willie, and $\frac{1}{2}$ of the remainder, lacking 1 cent, to Charles, and then had 8 cents remaining; what was Harry's money before his gifts?

12. Divide \$290 between A and B, whose ages are respectively 15 and 19 years, in such a manner that the parts, being placed on interest, at 10 per cent., shall amount to such sums, at the time they are 21, that $\frac{2}{3}$ of A's shall be equal to $\frac{2}{5}$ of B's money.

13. A lady, having two watches, bought a chain for \$20 If the chain be put on the silver watch their value

will be $\frac{1}{3}$ as much as the gold watch, but if it be put on the gold watch they will be worth 7 times as much as the silver watch; what was the value of each watch?

14. Jordan gave $\frac{1}{5}$ of his money, plus 4 cents, to John, $\frac{1}{4}$ of the remainder, plus 3 cents, to George, and $\frac{1}{3}$ of what now remained, plus 2 cents, to Jackson, and found he had $\frac{1}{5}$ as much as at first; how much money had he at first?

15. A person has two cups and a cover which weighs 30 ounces. If the first cup be covered it will weigh twice as much as the second, but if the second cup be covered, it will weigh 3 times as much as the first; what is the weight of each cup?

LESSON XVI.

1. A farmer bought a certain number of sheep for $60; had he bought 5 more at $1 less each, they would have cost him $75; how many sheep did he buy?

SOLUTION.—By the conditions of the problem the 5 more, at $1 less each, cost $75—$60, or $15, and one, at this rate, cost $\frac{1}{5}$ of $15, which is $3, which, increased by $1, equals $4, the price of those purchased: hence, there were as many purchased as $4 is contained times in $60, which are 15. Therefore, &c.

2. A farmer bought a certain number of cows for $200; had he bought 2 more, at $2 less each, they would have cost $216; how many did he buy?

3. A man bought a certain number of sheep for $80; and afterwards bought twice as many more, at $2 less each, and paid for all $180; how many did he buy?

4. Mr. A bought a certain number of turkeys for $5; had he bought 3 times as many, + 4, for the same price, they would have cost him $12 more; how many did he purchase?

5. A teacher bought a number of books for $8; had he bought 4 times this number, diminished by 5, they would have cost $4 more; how many did he buy?

6. Willis sold 2 books for 60 cents each; on one he gained 20 per cent., and on the other he lost 40 per cent.: did he gain or lose by the sale, and how much?

7. What part of 20 per cent. of 6 is 25 per cent. of 3?

8. I gave 20 per cent. of my money to A, 25 per cent. of the remainder to B, and had $30 remaining; how much money had I at first?

9. If A pays $\frac{1}{4}$ of his salary for board, what per cent. does he have left for other purposes?

10. If I sell $\frac{1}{5}$ of a quantity of grain, and $\frac{1}{2}$ of the remainder is spoiled, what per cent. remains?

11. Janson sold 20 per cent. of his apples to A, 25 per cent. of the remainder to B, and $33\frac{1}{3}$ per cent. of this last remainder to C, and had 20 barrels remaining; how many had he at first?

12. A sold B a gun and gained 25 per cent., and B sold it to C for $24 and gained 20 per cent.; what did A pay for it?

13. Bought apples at 6 cents for 4, and sold them at the rate of 6 for 4 cents; what was the loss per cent.?

14. B bought melons for 20 per cent. more than 10 cents each, and sold them for 20 per cent. less than 10 cents each; required the loss per cent.?

15. If a book is bought for $\frac{3}{4}$ of its value, and sold for 20 per cent. more than its value, what is the gain per cent.?

16. If William has 25 per cent. more money than Henry, how many per cent. has Henry less than William?

17. If a principal gain $\frac{1}{4}$ of itself in a year, how long will it require to double itself?

18. At 25 per cent., in what time will a principal gain $\frac{1}{4}$ of itself? $\frac{3}{2}$ of itself? 3 times itself?

19. A's and B's money on interest for 10 years at 5

per cent. amounts to $900; how much has each, if A's money equals 3 times B's money?

20. Henry received $224 to invest in property, after retaining 12 per cent. on the amount invested; how much did he invest?

21. If I gain $20 by selling an article for 20 per cent. more than cost, required the cost and amount received

22. A lost $60 by selling a horse for 30 per cent. less than cost; required the cost and amount received.

23. B bought goods 20 per cent. below par, and sold them 20 per cent. above par; supposing he gained $90, what amount of goods did he buy?

24. A man bought goods 25 per cent. below par, and sold them 20 per cent. above par; how much did he invest if he gained $270?

25. A merchant asked for cloth 20 per cent. more than cost, but sold it for $\frac{1}{3}$ of his asking price; what was the loss per cent.?

26. B asked for flour 25 per cent. more than cost, but sold it for 80 per cent. of the price asked; what did he lose per cent.?

27. A grocer asked for sugar 20 per cent. more than cost, and sold it for $33\frac{1}{3}$ per cent. less than he asked for it; what was the loss per cent.?

28. A man asked 10 per cent. less for an article than cost, but sold it for $33\frac{1}{3}$ per cent. more than he asked for it; required the gain per cent.?

29. What must I ask for hay, worth $10 a ton, that after falling 20 per cent., I may gain 20 per cent. on the value?

30 What must I charge for flour, worth $5 a barrel, that after falling 25 per cent. on my price, I may gain 20 per cent. on the cost?

31. What must I ask for cloth, worth $40, that after falling 20 per cent. on my price, I may gain 30 per cent. on the cost?

32 If my retail gain is 25 per cent., and my whole

sale gain is 20 per cent. of my retail less, what per cent do I gain at wholesale?

33. If I retail at a gain of 50 per cent., and sell at wholesale for 25 per cent. less than at retail, what do I gain per cent. at wholesale?

34. If my gain at retail is 60 per cent., and my gain at wholesale is 25 per cent. of my retail gain less, what is my gain per cent. at wholesale?

35. If A's gain at wholesale is 20 per cent., and his gain at retail is 25 per cent. of his wholesale more, what does he gain per cent. at retail?

36. If B's loss at wholesale was 10 per cent., and his retail price was $33\frac{1}{3}$ per cent. more; what was the gain per cent. by retail?

37. A lost 40 per cent. of his flour, and sold the remainder at a gain of 50 per cent.; did he gain or lose, and how much per cent.?

38. A barrel of molasses lost 20 per cent. by leakage, and the remainder was sold at a gain of 40 per cent.; required the gain per cent.

39. An article lost 25 per cent. by wastage, and the remainder was sold for 20 per cent. above cost; what per cent. was gained or lost?

40. A drover lost $33\frac{1}{3}$ per cent. of his cattle, and sold the remainder at a gain of 50 per cent.; required the gain or loss per cent.

41. The amount of B's fortune for 4 years, at 10 per cent., is $200 more than its amount for 6 years at 5 per cent.; required the fortune.

42. The amount of C's fortune for 2 years, at 10 per cent., is $400 less than its amount for 6 years at 5 per cent.; what is the fortune?

43. The amount of M's money for 5 years, at 8 per cent., is $40 more than its amount for 4 years at 6 per cent.; required his money.

44. The amount of D's money for 2 years, at 5 per cent., is $60 more than its interest for 9 years at 10 per cent.; what is his money?

45. The amount of B's fortune for 5 years, at 10 per cent., is $330 more than the amount of C's for the same time and rate per cent.; what is the fortune of each, provided B's is twice C's?

LESSON XVII.

1. A has 3 times as many plums as B, and B has twice as many as C; how many has each, if A has 12 more than B and C together?

2. A, B, and C can mow a field in 20 days, A and B in 30 days, and B and C in 40 days; after the three had worked 5 days, A and C finished it; in what time was it completed?

3. A lady bought 10 yards of silk at the rate of $4 a yard, but finding some of it damaged, for it she only paid $1 a yard, and thus paid $28; how many yards were damaged?

4. A having his fortune on interest at 5 per cent., in one year spends $\frac{1}{2}$ of his income in travelling, $\frac{1}{3}$ for educational purposes, and saves $100; what is his fortune?

5. A can do a piece of work in 20 days, B and C in 12 days, and if all work 6 days, C can complete it in 3 days; in what time could B and C each have done it?

6. A bought 12 cows for $360, and sold $\frac{2}{3}$ of them for what all cost; what was the gain per cent.?

7. B gained 50 per cent. in each of 3 years on what he had at the beginning of the year, and then had gained $190; what was his first capital?

8. A and B can do a piece of work in 15 days, and after working 9 days they called in C, with whose assistance they finished the work in 4 days, in what time could C alone have done it?

9. Edward and Ella have $900, and 20 per cent. of

Edward's money equals 25 per cent. of Ella's money; how much money has each?

10. A can do 15 per cent. of a piece of work in a day, B 20 per cent., and C 25 per cent.; after B had wrought 3 days, and A 2 days, C joined them; in what time was the work completed?

11. A man left $5000 to his wife, son, and daughter, and if the daughter died before becoming of age, the widow should have $\frac{1}{3}$ of the fortune, but if the son died, she should have $\frac{2}{3}$ of it; required the shares of the son and daughter if the widow dies?

12. A boy bought some peaches at 4 cents each, and 3 times as many pears at 2 cents each, and sold them all at 6 cents each, and thus gained 28 cents; how many of each did he buy?

13. Three fifths of A's age was his wife's age when married, but in 40 years, $\frac{4}{5}$ of his age equals hers; what was the age of each when married?

14. C and D ran from the same point in the same direction, and when D had run 40 rods, $\frac{1}{9}$ of the distance C had run equalled the distance he was ahead of D; how much did C, in running 40 rods, gain on D?

15. What is the hour of day if $\frac{2}{3}$ of the time past 9 A. M. equals $\frac{2}{4}$ of the time to 11 o'clock P. M.?

16. A boat whose rate of sailing is 5 miles an hour, moves down a river whose current is 3 miles an hour; how far may it go that it may be back in 10 hours?

17. A and B, in partnership, gain $40; A owned $\frac{1}{8}$ of the stock, lacking $12, and B's share of the gain was $10; required the whole stock and share of each.

18. A man went to a store and spent 20 cents, and then losing $\frac{3}{4}$ as much as remained, had $\frac{1}{3}$ as much as he had at first, minus $1; how much had he at first?

19. A lost 20 per cent. of his peaches, and sold the remainder for 20 per cent. more than they all cost; what did he gain per cent. on those sold?

20. A drover lost 30 per cent. of his cattle, and sold

the remainder for 10 per cent. more than they all cost, what did he gain per cent. on those sold?

21. A digs $\frac{2}{5}$ of a ditch in 8 days, and then calling in B, they together finish it in 9 days; in what time could B have done it alone?

22. Bought hay for $8 a ton, but in getting it I lost 20 per cent. of it; what did it really cost me a ton?

23. I bought 8 apples for 16 cents, and lost $\frac{3}{4}$ of them; what per cent. must I gain on the remainder, that I may neither gain nor lose by the transaction?

24. A bought 9 melons for 36 cents, but losing $33\frac{1}{3}$ per cent. of them, how must the remainder be sold to gain $33\frac{1}{3}$ per cent. by the transaction?

25. The amount of A's fortune for 3 years, at 10 per cent., is $520 more than the amount of B's for 5 years, at 6 per cent.; required the fortune of each, supposing A's to equal 3 times B's.

26. If $\frac{2}{3}$ of a barrel of flour is sold for what $\frac{4}{5}$ of it cost, what is the gain per cent.?

27. B lost 20 per cent. of his marbles; what must he gain per cent. on the remainder, that he may gain 20 per cent. on the whole?

28. A barrel of molasses leaked away 20 per cent.; what per cent. must I gain on the remainder, that I may gain 40 per cent. by the transaction?

29. A sum of money at interest amounts, in 2 years, to $240, and in 6 years to $320; required the sum and rate per cent.

30. A man sold 2 horses for $250; on one he gained 25 per cent., on the other he lost 20 per cent.; did he gain or lose, and how much, if he received for the second $\frac{2}{3}$ as much as for the first?

31. The amount of a sum of money for 3 years is $230, and the amount for 4 times as long, at $\frac{1}{2}$ the same rate, is $260; what are the sum and rates per cent.?

32. A man sold 2 horses for $210; on one he gained 25 per cent. and on the other he lost 25 per cent.; how

much did he gain, supposing the second horse cost him $\frac{3}{8}$ as much as the first horse?

33. A man sold a horse and carriage for $230; on the horse he lost 20 per cent., and on the carriage he gained 25 per cent.; did he gain or lose, and how much, if $\frac{4}{5}$ of what he paid for the horse equalled $\frac{2}{3}$ of the cost of the carriage?

NOTE.—For additional problems, see "METHODS OF TEACHING MENTAL ARITHMETIC, &c.," by the Author of this work; where may be found a large collection, of an amusing and interesting character, under the head of *Social Arithmetic.*

MENTAL ALGEBRA.

The transition from Arithmetic to Algebra being so easy and natural, and a knowledge of the abbreviated and general language of Algebra being so important, the author is induced to present the following short treatise upon the subject of *Mental Algebra.*

METHOD OF TREATMENT.—The peculiarity of this treatment is that Mental Arithmetic and Algebra are taught in combination,—like twin sisters going hand in hand,—one text-book answering for both subjects. A solution is given to the first problem of a lesson, or class of problems, which the pupils should be required to apply to the other problems of that class.

METHOD OF SOLUTION.—In Algebra we let some symbol, as x, represent the number we wish to find, and use this as we would the answer in proving a problem. This will give an expression or *equation* from which we may find the unknown number represented by the symbol.

The following problem and solution will indicate the method and spirit of the Algebraic treatment. The pupil will observe how much shorter and simpler it is than the method of Arithmetic.

PROBLEM.—Henry's number of apples increased by 3 times his number equals 24; how many apples has he?

ARITHMETICAL SOLUTION.
Once Henry's number plus 3 times his number equals 24.
Hence, 4 times Henry's number equals 24,
And once his number equals $\frac{1}{4}$ of 24, which is 6.

Now if we represent the expression "*Henry's number*" by some symbol as x, and use the sign, $=$, for the word "*equals*," etc., the solution will be much shorter; thus:

ALGEBRAIC SOLUTION.

$$x + 3x = 24,$$
Hence, $$4x = 24,$$
And $$x = 6, \text{ Ans.}$$

NOTE.—In Algebra $2x$, $3x$, &c., mean 2 times x, 3 times x, etc.,—$\frac{1}{2}$ of x, $\frac{1}{3}$ of x, $\frac{2}{3}$ of x are represented thus, $\frac{1}{2}x$, $\frac{1}{3}x$, $\frac{2}{3}x$, etc., or $\frac{x}{2}$, $\frac{x}{3}$, $\frac{2x}{3}$, etc.

From this explanation the pupil will be prepared to understand the solutions which follow. The solution given to the first problem of each class is to be applied to the others of the same class. The class is indicated by referring to the page and problem of the Mental Arithmetic.

PAGE 37, PROB. 1.

SOLUTION.—Let x represent the number;—then $\frac{1}{2}$ of x equals 3, and x equals 2 times 3, or 6. Therefore the number is 6.

Let $x =$ the number.
then, $\frac{x}{2} = 3$.
and $x = 6$, Ans.

PAGE 58, PROB. 1.

SOL.—Let x equal his money;—then x minus $\frac{3}{5}$ of x, or $\frac{2}{5}$ of x equals 60, and $\frac{1}{5}$ of x equals $\frac{1}{2}$ of 60, or 30, and x equals 5 times 30, or 150. Therefore, etc

Let $x =$ his money.
then, $\frac{2x}{5} = 60$,
and $\frac{x}{5} = 30$,
$x = 150$ Ans.

Page 67, Prob. 1.

Sol.—Let x equal the number of times;—then, since the product of the divisor and quotient equals the dividend, we have $\frac{2}{3} \times x = 4$, hence $\frac{1}{3} \times x = \frac{1}{2}$ of 4, or 2, and $x = 3$ times 2, or 6.

Let $x =$ the No.
then $\frac{2}{3} \times x = 4$,
and $\frac{1}{3} \times x = 2$,
$x = 6$. Ans.

Page 68, Prob. 28.

Sol.—Let $x =$ the number, then, since the product of the divisor and quotient equals the dividend, we have $\frac{2}{3} \times x = \frac{3}{4}$, hence $\frac{1}{3} \times x = \frac{3}{8}$, and $x = \frac{9}{8}$. Therefore, etc.

Page 70, Prob. 1.

Sol.—Let x equal the part of 2 which equals $\frac{3}{4}$; then 2 multiplied by x equals $\frac{3}{4}$, and x equals $\frac{1}{2}$ of $\frac{3}{4}$, which is $\frac{3}{8}$.

Let $x =$ the part.
$2 \times x = \frac{3}{4}$.
$x = \frac{3}{8}$. Ans.

Page 71, Prob. 16.

Sol.—Let x equal the part, then $\frac{2}{3}$ times x equals $\frac{4}{5}$, hence $\frac{1}{3}$ of x equals $\frac{2}{5}$ and x equals $\frac{6}{5}$. Therefore, etc.

Page 90, Prob. 1.

Sol.—Let x equal the number of children; then $4x$ equals what they received by the first condition, and $7x$, what they received by the second condition; hence $7x - 4x$, or $3x$, equals 36, and $x = \frac{1}{3}$ of 36, or 12. Therefore, etc

Let $x =$ No. of children,
then, $4x =$ first sum,
and $7x =$ second sum.
hence, $3x = 36$,
$x = 12$. Ans.

Page 94, Prob. 1.

Sol.—Let $x =$ Henry's number;—then $2x$ will equal William's number, and $2x$ plus x, or $3x$, equals what both have, or 15. If $3x = 15$, $x = \frac{1}{3}$ of 15, which is 5, and $2x = 2$ times 5, or 10. Therefore, &c.

Let $x =$ Henry's number.
then, $2x =$ William's number
and $3x = 15$
hence, $x = 5$, Henry's.
and $2x = 10$, William's.

PAGE 96, PROB. 1.

SOL.—Let $x =$ A's number;—then will $x + 5$ equal B's number, and, adding, $2x + 5$ will equal what both have, which is 25. If $2x + 5 = 25$, $2x$ must equal 25 minus 5, which is 20, &c.

Let $x =$ A's number
then $x + 5 =$ B's number,
and $2x + 5 = 25$.
hence, $2x = 20$,
$x = 10$ A's.
$x + 5 = 15$ B's.

DEFINITIONS AND PRINCIPLES.

Having applied the above solutions to the different lessons, the pupils will now be able to understand the following definitions and principles:—

An *equation* is an expression of the equality or two equal quantities; thus $2x + 4 = 10$.

The quantity on the left of the sign of equality is called the *first member*, the quantity on the right is called the *second member* of the equation.

To *transpose* a quantity is to change it from one member of an equation to the other.

We now present four simple principles, which will enable the pupil to understand the following solutions.

PRIN. 1. *If the same number be added to or subtracted from both members of an equation, the resulting members will be equal.*

PRIN. 2. *If both members of an equation be multiplied or divided by the same number, the resulting members will be equal.*

PRIN. 3. *In transposing a number from one member of the equation to the other, we change the sign preceding it.*

PROOF. Take the equation $3x + 4 = 16$. If $3x$ increased by 4 equals 16, it is evident that $3x = 16 - 4$, hence in changing 4 from the first member to the second we change its sign. Again,

From the equation $4x = 22 - 6$, it is evident that 22 is 6 more than $4x$, hence $4x + 6 = 22$, therefore the 6 may be taken from the second member to the first by changing the sign.

PRIN. 4. *An equation may be cleared of fractions by multiplying both members by any number which is divisible by all the denominators.*

PROOF. Take the equation $\frac{x}{2}+\frac{x}{3}=\frac{10}{4}$. If we multiply this by 12 we have $6x+4x=30$, which is an equation without fractions. Therefore, &c.

NOTE.—The symbol ( ) is called a *parenthesis*, and denotes that the quantities enclosed in it are to be treated as a single quantity; thus $(30-x)\times 3$ denotes that $30-x$ is to be multiplied by 3, and $=90-3x$, while $30-x\times 3=30-3x$.

EXAMPLES FOR PRACTICE.

Given, $5x=24+2x$, to find x.
Transposing, $5x-2x=24$.
Subtracting, $3x=24$.
Hence, $x=8$. Ans.

Given, $\frac{2x}{3}-\frac{5}{2}=4$, to find x.
Multiplying by 6, $4x-15=24$.
Transposing, $4x=24+15=39$.
Hence, $x=9\frac{3}{4}$.

3. Find x in $3x-7=8$; In $4x=18-2x$; In $7x=35-2x$ In $\frac{x}{2}-\frac{x}{4}=6$; In $\frac{2x}{3}=\frac{8}{4}-\frac{x}{4}$; In $4x-\frac{3}{2}=5\frac{1}{2}$; In $3x=\frac{4}{5}-\frac{2x}{3}$ In $6x-4=8+4x$; In $(3x-4)\times 5=25$.

PAGE 101, PROB. 1.

SOL.—Let $x=$ the gain per cent.

Then, $\frac{x}{100}\times 20=25-20=5$.

Hence, $\frac{x}{5}=5$.
$x=25$, Ans.

PAGE 102, PROB. 1.

SOL.—Let $x=$ the cost.
Then, $x+\frac{1}{4}x=25$
Or, $\frac{5}{4}x=25$
And $x=20$ Ans.

PAGE 104, PROB. 1.

SOL.—Let $x=$ the cost.
Then, $\frac{1}{4}x=20$.
And $x=80$. Ans

PAGE 118, PROB. 1.

SOL.—Let $x =$ what they pay for one cow

Then, $4x =$ what A pays.

And $5x =$ what B pays.

Then, $4x + 5x = 36$.

Or, $9x = 36$.

$x = 4$.

$4x = 16$, A's part.

$5x = 20$, B's part.

PAGE 120, PROB. 1.

SOL.—Let $4x =$ A's share.

And $6x =$ B's share.

Then, $4x + 6x = 30$,

Or, $10x = 30$.

$x = 3$.

$4x = 12$, A's share.

$6x = 18$, B's share.

PAGE 122, PROB. 9.

SOL.—Let $x =$ the time in which both can eat it

Then, $\frac{1}{x} =$ what both can eat in one day.

$\frac{1}{4} =$ what Fuller can eat in a day.

$\frac{1}{6} =$ what Brodhead can eat in a day

Then, $\frac{1}{4} + \frac{1}{6} = \frac{1}{x}$.

Or, $\frac{5}{12} = \frac{1}{x}$.

$5x = 12$.

$x = 2\frac{2}{5}$. Ans.

PAGE 126, PROB. 1.

SOL.—Let $x =$ number of idle days.

Then $30 - x =$ number of working days

$(30 - x) \times 3 =$ what he earned.

$x =$ what he forfeited.

Hence, $50 + x = (30 - x) \times 3$.

Or $50 + x = 90 - 3x$.

$4x = 40$.

$x = 10$, Ans.

PAGE 127, PROB. 8.

SOL.—Let $x =$ length of body.

Then, $\frac{x}{2} + 8 =$ length of tail.

And $8 =$ length of head.

Hence, $2x = 16 + \frac{3x}{2}$.

And $\frac{x}{2} = 16$.

$x = 32$, the body.

Then, $\frac{x}{2} + 8 = 24$, the tail.

$32 + 24 + 8 = 64$, Ans.

PAGE 129, PROB. 1.

SOL.—Let $x =$ the time.

Then, $35 + x =$ H's age at that time.

And $5 + x =$ M's age at that time.

Hence, $(5 + x) \times 6 = 35 + x$.

Or, $30 + 6x = 35 + x$.

Hence, $5x = 5$.

$x = 1$, Ans.

PAGE 130, PROB. 16.

SOL.—Let $x =$ the number of each kind.

Then, $2x =$ cost of first kind,

And $4x =$ cost of second kind.

And $6x =$ cost of both kinds.

Since there were $2x$ in all and they were sold at the rate of 4 cts. each,

$8x =$ what they were sold for.

Then $8x - 6x = 12$.

$2x = 12$.

$x = 6$, Ans.

PAGE 131, PROB. 1.

SOL.—

Let $x =$ B's age.

$3x =$ A's age.

$x + 10 =$ B's age in 10 years.

$3x + 10 =$ A's age in 10 years.

$3x + 10 = (x + 10) \times 2$.

$3x + 10 = 2x + 20$.

$x + 10 = 20$.

$x = 10$, B's age.

$3x = 30$ A's age

15

PAGE 133, PROB. 1.

SOL.—

Let $x =$ time past midnight.

$\frac{x}{2} =$ time to noon.

$x + \frac{x}{2} = 12$ hours.

$\frac{3x}{2} = 12$.

$\frac{x}{2} = 4$.

$x = 8$.

PAGE 134, PROB. 15.

SOL.—Let $x =$ distance the minute hand goes.

Then, $\frac{x}{12} =$ distance the hour hand goes.

And $x - \frac{x}{12} = 10$, the number of minute spaces they are apart at 2 o'clock.

$$\frac{11x}{12} = 10.$$
$$11x = 120.$$
$$x = 10\tfrac{10}{11}, \text{ Ans.}$$

PAGE 136, PROB. 1.

SOL.—Let $x =$ the distance.

Then, $\frac{x}{10} =$ time in going.

And $\frac{x}{6} =$ time in returning.

Hence, $\frac{x}{6} + \frac{x}{10} = 8.$

And $5x + 3x = 240.$
$$8x = 240.$$
$$x = 30, \text{ Ans.}$$

PAGE 136, PROB. 6.

SOL.—Let $x =$ what they pay for the coach

Then, $\frac{x}{8} =$ what each of eight pay.

And $\frac{x}{12} =$ what each of twelve pay.

Then, $\frac{x}{8} - \frac{x}{12} = \frac{3}{4}.$
$$3x - 2x = 18.$$
$$x = 18 \text{ Ans.}$$

PAGE 140, PROB. 1.

SOL.—Let $G =$ value of the gold watch
$C =$ value of the chain.

Then, $2G = C + 30.$

And $G + C = 30 \times 4 = 120.$

Or, $C = 120 - G.$

Putting this in the 1st, $2G = 120 - G + 30.$

Transposing, $3G = 150.$
$$G = 50 \text{ Ans.}$$
$$C = 120 - 50 = 70 \text{ Ans}$$

PAGE 145, PROB. 1.

SOL.—Let $x =$ what he had at first.
Then, $x - 15 =$ sum after losing 15 cents,
And $\frac{1}{3}(x - 15) =$ sum after finding $\frac{1}{3}$ of remainder

Then, $\frac{1}{3}(x - 15) = \frac{x}{2}$.

Or, $\frac{4}{3}x - 20 = \frac{x}{2}$.

Hence, $\frac{5}{6}x = 20$.

$\frac{x}{6} = 4$.

$x = 24$ Ans.

PAGE 150, PROB. 14.

SOL.—Let $S =$ the value of the silver watch,
$G =$ the value of the gold watch,
$C =$ the value of the chain.

Then, $G = 3S + 3C$.
And $7S = G + C$. Putting for G its value we have
$7S = 3S + 3C + C$.
Or, $4S = 4C$.
$S = C = 20$, Ans.
$G = 40 \times 3 = 120$, Ans.

The following equations are a brief statement of the rules for all the cases of Simple Interest. The rate is expressed as a fraction; thus, 5 per cent. is used as $\frac{5}{100}$ or .05.

Let $p =$ principal.
$i =$ interest.
$r =$ rate.
$t =$ time.
$A =$ amount.

(1) $i = p \times r \times t$.
(2) $p = \frac{i}{r \times t}$.
(3) $t = \frac{i}{p \times r}$.
(4) $r = \frac{i}{p \times t}$.
(5) $A = p + p \times r \times t$.

EXPLANATION.—The 1st denotes that the interest equals the product of the *principal*, *rate*, and *time*. Thus the interest of \$40 for 5 yrs. at 6 per cent. equals $\$40 \times \frac{6}{100} \times 5 = \$12$. The 2d denotes that the *principal* equals the *interest* divided by the product of the *rate* and *time*, etc.

To Teachers.—The author presents this little treatise upon Mental Algebra to his friends who have exhibited such a kind appreciation of his former labors, with the following remarks and suggestions :—

The plan of combining Mental Arithmetic and Mental Algebra in one book, is, so far as the author knows, a new one, and is therefore a distinctive feature of this work. Its advantages are supposed to be important, a few of which will be briefly stated.

First, There is an economy in time and money;—secondly, there is greater convenience in teaching;—thirdly, it is in accordance with the logical relation of the subjects;—fourthly, the arithmetical solution will assist in understanding the algebraic, and the algebraic will often throw light upon the arithmetical.

Methods of Teaching. For those who desire to try the plan here presented, developing the twin sisters together, we present the following methods of instruction :—

1st. The same problem may be solved first arithmetically and then algebraically, by the same or different pupils.

2d. The algebraic solution may be deferred until several or all of a class of problems have been solved arithmetically.

3d. The book may first be completed arithmetically and then reviewed algebraically. It is probable that the second method will be preferred by most teachers.

If the pupils are carefully drilled upon the problems under the several classes which we have solved, they will be able to apply the algebraic method to other problems not included in these classes

THE END.

Keno

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