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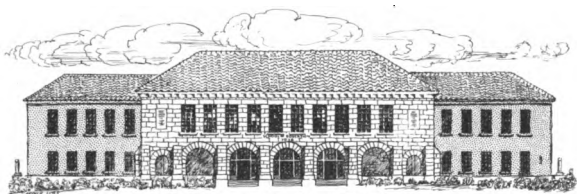


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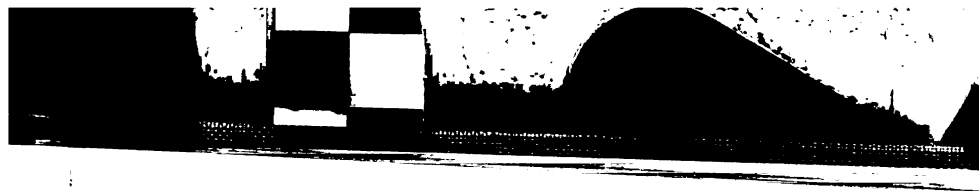
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GRADED

MENTAL ARITHMETIC

ARRANGED
FOR USE IN THE PUBLIC SCHOOLS
FROM THIRD TO EIGHTH GRADE, INCLUSIVE

BY

FRANK J. BROWNE

EX-SUPERINTENDENT PUBLIC INSTRUCTION, STATE OF WASHINGTON



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PREFACE.

ON GENERAL METHOD.—The author is permitted to quote a bulletin on "The Teaching of Primary Numbers," by Prof. Frank F. Bunker, of the San Francisco State Normal School.

"The study of every topic generally included in a course in arithmetic can be begun either from the objective side or the side of the purely formal. For instance, in beginning study of fractions the teacher can give a more or less extensive course wholly within the field of the concrete, or she may choose to begin with the formal and mechanical side,—the side which is concerned alone with the various manipulations of fraction symbols. Just so with square root, with division, with multiplication, or in fact with almost any phase of arithmetic. On the one hand, there is the field of the objective,—the concrete; on the other, the field of the formal. Careful observation of practical work will show, as we have just said, that facility in one will by no means give facility in the other. A child, by carrying out teaching in the field of the concrete, will soon acquire great facility in adding simple fractions, and yet he may never have facility in those same fractions expressed by figure symbols. He does this by reason of the fact that to him a fraction is as much a concrete thing as is his dog or his horse. To him, adding fractions is nothing more than calling up and counting mental images of familiar things. On the other hand, the mind is never devoid of mental images than when engaged in formal calculation. To have images of things floating around at such a distance means that attention is diverted, with ineffectiveness as a consequence. Obviously, the child needs training in both these fields. He needs to be accurate and tolerably rapid in the mechanical

From a standard work on arithmetic, published about forty years ago, is taken the following extract, which accords with the more recent authorities on number-teaching:—

“All reasoning is *comparison*. A comparison requires a standard, and this standard is the *fixed*, the *axiomatic*, the *known*. The law of correct reasoning, therefore, is to compare the *complex* to the *simple*, the *theoretic* to the *axiomatic*, the *unknown* to the *known*. The law is kept prominently before the mind in the development of this work, and upon it are based its solutions and explanations.”

AS TO SUBJECT-MATTER. — The book is graded to suit the mental capacity of the pupil as he moves upward, through the grammar grades of the public schools. Not all subjects to be found in other arithmetics are treated, but the matter of *relation* is presented so effectively, that it is believed the pupil will be able to apply the principles to the many details which may arise in his experience.

Though the book begins, nominally, with the third year of school, it is evident to any sensible teacher, that, in some schools, the book should not be in the hands of pupils below the fourth year. It is also true, that in schools that give emphasis to primary-number teaching, the first few pages of this book can be mastered readily in the latter part of the second year.

The teacher should always remember to provide inductive exercises, to make clear any principle not fully mastered by the pupil. There is no better test of a pupil's insight than original problems, which should be required at every step of progress.

AS TO TYPOGRAPHY. — Much care has been exercised to make this book superior to others in artistic finish. Its attractive style adds to its value as a text.

With the hope that this book will inspire deeper interest in the subject, and will be of service to all who may use it, the consideration of schools and teachers everywhere is invited.

FRANK J. BROWNE.

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THIRD GRADE.

1. How many shoes are in a pair?
2. How many weeks are in a month?
3. How many quarts are in a gallon?
4. How many cents are in a dime?
5. How many pecks are in a bushel?
6. How many feet are in a yard?
7. How many pints are in a quart?
8. A peck is what part of a bushel?
9. A quart is what part of a gallon?
10. A foot is what part of a yard?
11. Count by 2's from 2 to 20, and back from 20 to 2.
12. Count by 2's from 1 to 21, and back from 21 to 1.
13. Count by 3's from 3 to 15, and back from 15 to 3.
14. Count by 4's from 4 to 16, and back from 16 to 4.
15. The sum of 3 numbers is 10; the first is 4, the second is 3. What is the third?
16. Tom had 10 cents; he spent 5 cents, and then earned 4 more. How many did he have then?
17. Leta had 11 apples; she gave 5 to Henry and 5 to Willie. How many had she left?
18. Albert had 12 cents; he bought candy with 5 cents, and an orange with 3 cents. How many cents had he left?
19. Lowell paid 5 cents for a tablet, 2 cents for a pencil, and 3 cents for a picture; he had at first 15 cents. How much had he left?
20. If 2 quarts of milk cost 10 cents, what will 1 gallon cost?

1. Count by 4's from 4 to 48, and back from 48 to 4.
 2. Count by 4's from 3 to 47, and back from 47 to 3.
 3. Count by 4's from 5 to 49, and back from 49 to 5.
 4. One foot is what part of a yard? Two feet is what part of a yard?
 5. Two and one-third yards equal how many feet?
 6. Three and two-thirds yards equal how many feet?
 7. Five and two-thirds yards equal how many feet?
 8. If 4 hats cost \$12, how many can be bought for \$48?
-
- | | |
|---|---|
| 9. $1\frac{1}{4} + 2\frac{1}{4} = \dots$ | 13. $1\frac{1}{8} + 1\frac{3}{8} = \dots$ |
| 10. $2\frac{3}{4} + 3\frac{1}{4} = \dots$ | 14. $2\frac{1}{8} - 1\frac{1}{8} = \dots$ |
| 11. $3\frac{1}{4} + 1\frac{1}{4} = \dots$ | 15. $2\frac{2}{8} - 1\frac{2}{8} = \dots$ |
| 12. $2\frac{3}{4} - 1\frac{1}{4} = \dots$ | 16. $3\frac{2}{8} - 2\frac{1}{8} = \dots$ |
-
17. If 9 pencils cost 36 cents, what will 3 pencils cost?
 18. If a tree 24 feet high casts a shadow 30 feet long, how long a shadow will be cast by a tree 12 feet high?
 19. If 3 yards of ribbon cost 10 cents, what is the cost of 12 yards?
 20. If 10 men can do a piece of work in 5 days, how many men can do the same work in 10 days?
 21. If 5 pencils cost 20 cents, what will 15 pencils cost?
 22. A boy earns \$3 a week. How much will he earn in a month?
 23. A farmer sold apples for 10 cents a peck. What did he get for a bushel?
 24. What part of a dime is a cent?
 25. What part of a dime is a 5-cent piece?
 26. What part of a 5-cent piece is 1 cent?
 27. A man rode 3 miles an hour for 5 hours, and then walked 2 miles. How far did he travel?

THIRD GRADE.

1. Commit to memory —

12 inches make 1 foot.

3 feet make 1 yard.

36 inches make 1 yard.

2. What part of a foot are 3 inches?
3. Four inches make what part of a foot?
4. Six inches make what part of a foot?
5. Eight inches make what part of a foot?
6. Nine inches make what part of a foot?
7. One-half of a foot equals how many inches
8. One-third of a foot equals how many inches
9. One-fourth of a foot equals how many inches
10. One-sixth of a foot equals how many inches
11. Two-thirds of a foot equals how many inches
12. Three-fourths of a foot equals how many inches
13. Two-sixths of a foot equals how many inches
14. Three-sixths of a foot equals how many inches
15. Four-sixths of a foot equals how many inches
16. Two-fourths of a foot equals how many inches
17. Three-thirds of a foot equals how many inches
18. How many things make $\frac{1}{2}$ of a dozen?
19. How many things make $\frac{1}{3}$ of a dozen?
20. How many things make $\frac{2}{3}$ of a dozen?
21. How many things make $\frac{1}{4}$ of a dozen?
22. How many things make $\frac{3}{4}$ of a dozen?
23. How many things make $\frac{1}{6}$ of a dozen?
24. How many things make $\frac{5}{6}$ of a dozen?
25. A suit of clothes cost \$24, and a pair of shoes one-third as much. Find the cost of both together.
26. If 5 men can do a piece of work in 3 days, in time can 1 man do the same work?

1. Two times 3 feet 3 inches equal feet inches.
2. Two times 3 feet 6 inches equal feet inches.
3. Two times 4 feet 4 inches equal feet inches.
4. Two times 5 feet 8 inches equal feet inches.
5. Two times 7 feet 9 inches equal feet inches.
6. Two times 6 feet 2 inches equal feet inches.
7. Two times 7 feet 2 inches equal feet inches.
8. One-half of 4 ft. 4 in. equals ft. . . . in.
9. One-half of 5 ft. equals ft. . . . in.
10. One-half of 5 ft. 6 in. equals ft. . . . in.
11. One-half of 7 ft. 8 in. equals ft. . . . in.
12. One-half of 9 ft. 9 in. equals ft. . . . in.
13. One-half of 1 yd. equals ft. . . . in.
14. One-half of 3 yds. equals ft. . . . in.

What is the sum of—

- | | |
|---------------------------------|---------------------------------|
| 15. 3 and $\frac{1}{8}$ of 3? | 27. 4 and $\frac{1}{4}$ of 4? |
| 16. 4 and $\frac{1}{8}$ of 4? | 28. 5 and $\frac{1}{4}$ of 5? |
| 17. 5 and $\frac{1}{8}$ of 5? | 29. 6 and $\frac{1}{4}$ of 6? |
| 18. 6 and $\frac{1}{8}$ of 6? | 30. 7 and $\frac{1}{4}$ of 7? |
| 19. 7 and $\frac{1}{8}$ of 7? | 31. 8 and $\frac{1}{4}$ of 8? |
| 20. 8 and $\frac{1}{8}$ of 8? | 32. 9 and $\frac{1}{4}$ of 9? |
| 21. 9 and $\frac{1}{8}$ of 9? | 33. 10 and $\frac{1}{4}$ of 10? |
| 22. 10 and $\frac{1}{8}$ of 10? | 34. 11 and $\frac{1}{4}$ of 11? |
| 23. 11 and $\frac{1}{8}$ of 11? | 35. 12 and $\frac{1}{4}$ of 12? |
| 24. 12 and $\frac{1}{8}$ of 12? | 36. 13 and $\frac{1}{4}$ of 13? |
| 25. 13 and $\frac{1}{8}$ of 13? | 37. 14 and $\frac{1}{4}$ of 14? |
| 26. 14 and $\frac{1}{8}$ of 14? | 38. 15 and $\frac{1}{4}$ of 15? |

39. 2 gal. 3 qt. and 3 gal. 2 qt. equal gal. . . . qt.
40. 3 gal. 2 qt. and 5 gal. 3 qt. equal gal. . . . qt.

1. Count by 5's from 5 to 100, and back from 100 to 5.
2. Count by 10's from 10 to 100, and back from 100 to 10.
3. Count by 10's from 1 to 101, and back from 101 to 1.
4. Count by 10's from 2 to 102, and back from 102 to 2.

5.	6.	7.	8.
$2 \times 22 = \dots$	$2 \times 22\frac{1}{2} = \dots$	$\frac{1}{2}$ of 20 = $\dots$	$\frac{1}{3}$ of 30 = $\dots$
$2 \times 33 = \dots$	$2 \times 32\frac{1}{2} = \dots$	$\frac{1}{2}$ of 25 = $\dots$	$\frac{1}{3}$ of 33 = $\dots$
$2 \times 44 = \dots$	$2 \times 42\frac{1}{2} = \dots$	$\frac{1}{2}$ of 40 = $\dots$	$\frac{1}{3}$ of 36 = $\dots$
$3 \times 22 = \dots$	$3 \times 22\frac{1}{2} = \dots$	$\frac{1}{2}$ of 45 = $\dots$	$\frac{1}{3}$ of 69 = $\dots$
$3 \times 33 = \dots$	$3 \times 33\frac{1}{2} = \dots$	$\frac{1}{2}$ of 65 = $\dots$	$\frac{1}{3}$ of 90 = $\dots$
$4 \times 22 = \dots$	$4 \times 22\frac{1}{2} = \dots$	$\frac{1}{2}$ of 85 = $\dots$	$\frac{1}{3}$ of 99 = $\dots$

9. How many times 5 are 3 times 10?
10. How many times 2 are 6 times 3?
11. How many times 4 are 2 times 6?
12. How many times 3 are 6 times 5?
13. How many times 6 are 2 times 9?
14. Show how to tell the time of day by the clock.
15. The sun rose at 6 o'clock this morning. That was 3 hours ago. What time is it now?
16. If the sun rose at 6 o'clock this morning, what was the time 5 hours after sunrise? 4 hours after? 3 hours before sunrise? 4 hours before?
17. If 2 peaches cost 6 cents, how many cents will 1 peach cost? How many cents will 3 peaches cost?
18. If 2 oranges cost 10 cents, how many cents will 1 orange cost? How many cents will 3 oranges cost?
19. If 3 tops cost 9 cents, how many cents will 1 top cost? How many cents will 4 tops cost?
20. Henry bought 3 flags at 10 cents each, and 3 more at 3 cents each. How much did they cost?

1. Commit to memory —

16 ounces make one pound.

100 pounds make one hundredweight.

2. One ounce equals what part of a pound?
3. Two ounces equal what part of a pound?
4. Three ounces equal what part of a pound?
5. Four ounces equal what part of a pound?
6. Eight ounces equal what part of a pound?
7. Twelve ounces equal what part of a pound?
8. One-half of a pound plus one-fourth of a pound equal ounces.
9. One-half of a pound plus one-eighth of a pound equal ounces.
10. One-half of a pound plus one-sixteenth of a pound equal ounces.
11. One-half of a pound plus three-sixteenths of a pound equal ounces.
12. One-half of a pound minus one-fourth of a pound equals ounces.
13. One-half of a pound minus one-eighth of a pound equals ounces.
14. One-half of a pound minus one-sixteenth of a pound equals ounces.
15. One-fourth of a pound plus one-eighth of a pound equal ounces.
16. One-fourth of a pound plus one-sixteenth of a pound equal ounces.
17. One-fourth of a pound plus three-sixteenths of a pound equal ounces.
18. One-fourth of a pound minus one-eighth of a pound equals ounces.

1. 5 ft. 8 in. and 5 ft. 5 in. equal ft. in.
2. 3 pt. 3 gills and 3 pt. 1 gill equal pt. gills.
3. 5 yd. 2 ft. and 5 yd. 2 ft. equal yd. ft.
4. $1\frac{1}{2}$ gal. and $2\frac{1}{2}$ gal. equal gal. qt.
5. $\frac{1}{2}$ of a ft. and $\frac{1}{4}$ of a ft. equal in.
6. $\frac{1}{2}$ of a yd. and $\frac{1}{3}$ of a yd. equal inches.
7. $\frac{1}{7}$ of a week and $\frac{3}{7}$ of a week equal days.
8. If 3 cakes cost 12 cents, how many cents will 1 cake cost? How many cents will 4 cakes cost?
9. If 4 pens cost 8 cents, how many cents will 1 pen cost? How many cents will 5 pens cost?
10. If 5 cents buy 1 top, how many tops will 25 cents buy? How many cents will 4 tops cost?
11. If 4 apples cost 1 cent, how many cents will 16 apples cost? How many apples will 5 cents pay for?
12. One-fourth of a pound minus one-sixteenth of a pound equals ounces.
13. Three-fourths of a pound plus one-eighth of a pound equal ounces.
14. Three-fourths of a pound plus one-sixteenth of a pound equal ounces.
15. Three-fourths of a pound minus one-half of a pound equals ounces.
16. Three-fourths of a pound minus one-fourth of a pound equals ounces.
17. Three-fourths of a pound minus one-sixteenth of a pound equals ounces.
18. Three-fourths of a pound minus three-eighths of a pound equals ounces.
19. 5 dimes and 5 cents plus 5 dimes and 5 cents equal cents.
20. 5 dimes and 6 cents plus 5 dimes and 6 cents equal cents.

1. 1 ten and 1 unit equal units.
2. 2 tens and 3 units equal units.
3. 3 tens and 5 units equal units.
4. 6 tens and 6 units equal units.
5. 5 tens and 5 units equal units.
6. 8 tens and 5 units equal units.
7. 9 tens and 8 units equal units.
8. 8 tens and 9 units equal units.
9. 25 equals tens and units.
10. 36 equals tens and units.
11. 47 equals tens and units.
12. 58 equals tens and units.
13. 69 equals tens and units.
14. 70 equals tens and units.
15. 1 hundred, 2 tens, and 3 units equal
16. 2 hundreds, 3 tens, and 4 units equal
17. 3 hundreds, 4 tens, and 5 units equal
18. 5 hundreds, 0 tens, and 0 units equal
19. 8 hundreds, 9 tens, and 5 units equal
20. 125 equals hundreds, tens, and units.
21. 236 equals hundreds, tens, and units.
22. 347 equals hundreds, tens, and units.
23. 458 equals hundreds, tens, and units.
24. \$1.10 equal 1 dollar and 1 dime.
25. \$1.25 equal dollar, dimes, and cents.
26. \$2.35 equal dollars, dimes, and cents.
27. \$4.75 equal dollars, dimes, and cents.
28. \$5.25 equal dollars, dimes, and cents.
29. \$8.45 equal dollars, dimes, and cents.
30. 120 cents equal dollars, dimes, cents.
31. $233\frac{1}{2}$ cents equal dollars, dimes, cents.

THIRD GRADE.

1.	2.	3.
$\frac{1}{2}$ of 160 =	$\frac{1}{3}$ of 210 =	$\frac{1}{4}$ of 280 =
$\frac{1}{2}$ of 180 =	$\frac{1}{3}$ of 240 =	$\frac{1}{4}$ of 320 =
$\frac{1}{2}$ of 200 =	$\frac{1}{3}$ of 270 =	$\frac{1}{4}$ of 360 =
$\frac{1}{2}$ of 220 =	$\frac{1}{3}$ of 300 =	$\frac{1}{4}$ of 400 =
$\frac{1}{2}$ of 240 =	$\frac{1}{3}$ of 330 =	$\frac{1}{4}$ of 440 =

4. If 5 oranges sell for 10 cents, how much will 1 orange sell for? What will 6 oranges cost?

5. If 5 oranges are worth 10 pears, how many pears is 1 orange worth? How many pears are 7 oranges worth?

6. If 1 cord of wood costs \$5, what will $\frac{1}{2}$ cord cost?

7. If 1 cord of wood costs \$5, how many cords will \$25 buy?

8. If 1 cord of wood costs \$5, how many cords can \$22.50 buy?

9. How many apples at 5 cents each will pay for 12 peaches at 6 cents each?

10. How many pencils at 5 cents each will pay for 6 books at 10 cents each?

11. How many pencils at 4 cents each will pay for 12 lemons at 6 cents each?

12. How many pears at 5 cents each will pay for 4 strawberries at 10 cents each?

13. I bought 3 quarts of strawberries at 10 cents a quart and paid for them with chestnuts at 6 cents a quart. How many quarts of chestnuts did it take?

14. I bought 8 dozen eggs at 20 cents a dozen, and paid for them with chickens at 20 cents each. How many chickens did I give?

1. Explain by the clock face that a day has 24 hours.
2. One hour equals what part of a day?
3. Two hours equal what part of a day?
4. Three hours equal what part of a day?
5. Four hours equal what part of a day?
6. Six hours equal what part of a day?
7. Eight hours equal what part of a day?
8. Twelve hours equal what part of a day?
9. How many hours equal one-third of a day?
10. How many hours equal one-sixth of a day?
11. How many hours equal one-fourth of a day?
12. How many hours equal two-thirds of a day?
13. How many hours equal three-fourths of a day?
14. How many hours equal five-sixths of a day?
15. How many hours equal one-twelfth of a day?
16. One-half of 24 and one-third of 24 equal
17. One-third of 24 and one-sixth of 24 equal
18. One-fourth of 24 and one-eighth of 24 equal
19. Two-thirds of 24 and three-fourths of 24 equal
20. Five-sixths of 24 and five-twelfths of 24 equal
21. Seven-twelfths of 24 and two-thirds of 24 equal
22. One-half of 24 and one-sixth of 24 equal
23. One-half of 24 and one-eighth of 24 equal
24. One-half of 24 and one-twelfth of 24 equal
25. One-third of 24 and one-fourth of 24 equal
26. One-third of 24 and one-eighth of 24 equal
27. One-third of 24 and one-twelfth of 24 equal
28. One-fourth of 24 and one-sixth of 24 equal
29. One-fourth of 24 and one-twelfth of 24 equal
30. One-sixth of 24 and one-eighth of 24 equal
31. How many slates at 3 dimes each will pay for 2 books at 6 dimes each?

1. Memorize—

2 pints make 1 quart.

8 quarts make 1 peck.

4 pecks make 1 bushel.

2. 1 peck, 1 quart, 1 pint, equal pints.
3. 2 pecks, 1 pint, equal pints.
4. 3 pecks, 3 quarts, 1 pint, equal pints.
5. 4 pecks, 4 quarts, equal pints.
6. 5 pecks, 2 quarts, equal pints.
7. 5 pecks, $\frac{1}{2}$ quart, 1 pint, equal pints.
8. 6 pecks, 3 quarts, 1 pint, equal pints.
9. 1 qt. 1 pt. 2 gills, plus 1 qt. 1 pt. 2 gills, equal
10. 2 qt. 2 gills, plus 2 qt. 1 pt. 3 gills, equal

Add—

11.

1 pk. 4 qt. 1 pt.
 1 pk. 3 qt. 1 pt.
1 pk. 1 qt.

12.

1 yd. 1 ft. 5 in.
 2 yd. 1 ft. 4 in.
1 yd. 3 in.

13. If 1 gill is taken from 1 quart, there remain how many pints and gills?
14. If 3 gills are taken from 1 quart, there remain how many pints and gills?
15. If 1 quart is taken from 1 peck, there remain how many quarts?
16. If 1 pint is taken from 1 peck, there remain how many quarts and pints?
17. How many bottles of ink at 10 cents each will pay for 10 oranges at 4 cents each?
18. How many oranges at 4 cents each will pay for 2 books at 10 cents each?

1. Count by 10's from 10 to 500, and back from 500 to 10.
2. Count by 25's from 25 to 500, and back from 500 to 25.
3. Count by 50's from 50 to 500, and back from 500 to 50.
4. Count by 2's from 1 to 30, and back from 30 to 1.
5. Count by 3's from 1 to 31, and back from 31 to 1.
6. Count by 3's from 3 to 32, and back from 32 to 3.
7. Count by 4's from 3 to 31, and back from 31 to 3.
8. Count by 4's from 4 to 32, and back from 32 to 4.
9. Count by 5's from 1 to 31, and back from 31 to 1.
10. Count by 5's from 2 to 32, and back from 32 to 2.
11. Count by 5's from 3 to 33, and back from 33 to 3.
12. Count by 5's from 4 to 34, and back from 34 to 4.
13. Count by 6's from 6 to 72, and back from 72 to 6.
14. How many pints in 2 gallons?
15. How many gallons in 2 times 8 pints?
16. How many gallons in 4 times 3 pints?
17. How many gallons in 2 times 4 pints?
18. How many gallons in 8 pints plus 8 pints?
19. How many pints in 2 gallons less 6 pints?
20. How many gallons in 16 pints less 4 pints?
21. How many pints in 2 gallons less $\frac{1}{4}$ of a gallon?
22. How many half-gallons in 12 pints?
23. How many yards in 13 feet?
24. How many times 4 feet in 5 yards?
25. How many times 6 inches in $3\frac{1}{2}$ feet?
26. How many ounces in 2 times $\frac{3}{8}$ of a pound?
27. How many 4-ounce packages can be made from 2 times $\frac{3}{8}$ of a pound?
28. James has 6 marbles, and his brother has 5 times as many. How many have both?
29. Lucy had 15 beads; she lost all but 3, and found half the number she lost. How many had she then?

THIRD GRADE.

1. 5 dimes and 5 cents less 5 dimes and 3 cents =
2. 6 dimes and 3 cents less 5 dimes and 4 cents =
3. 7 dimes and 5 cents less 6 dimes and 6 cents =
4. 8 dimes and 7 cents less 7 dimes and 8 cents =
5. Two times 2 pints 2 gills equals what?
6. Three times 2 pints 2 gills equals what?
7. Four times 1 pint 3 gills equals what?
8. Four times 2 pints 1 gill equals what?
9. Five times 1 pint 2 gills equals what?
10. Six times 1 pint 1 gill equals what?
11. Seven times 2 pints 1 gill equals what?
12. Eight times 1 pint 2 gills equals what?
13. If 5 books cost \$15, what will 15 books cost?
14. If 3 yards of cloth cost \$5, what will 9 yards cost?
15. If 5 apples cost 10 cents, what will 15 apples cost?

- | | |
|-----------------------------|----------------------------|
| 16. $\$300 + \$600 = \dots$ | 23. $\$900 + \$90 = \dots$ |
| 17. $\$400 + \$900 = \dots$ | 24. $\$300 + \$60 = \dots$ |
| 18. $\$500 + \$100 = \dots$ | 25. $\$300 + \$56 = \dots$ |
| 19. $\$600 + \$400 = \dots$ | 26. $\$400 + \$72 = \dots$ |
| 20. $\$700 + \$700 = \dots$ | 27. $\$500 + \$83 = \dots$ |
| 21. $\$600 + \$70 = \dots$ | 28. $\$600 + \$64 = \dots$ |
| 22. $\$700 + \$50 = \dots$ | 29. $\$700 + \$53 = \dots$ |

- | | |
|---------------------------------|---------------------------------|
| 30. $60 + 70 + 30 + 80 = \dots$ | 32. $90 + 20 + 60 + 30 = \dots$ |
| 31. $80 + 90 + 80 + 40 = \dots$ | 33. $80 + 70 + 50 + 90 = \dots$ |

- | | | | |
|---|---|------------------|---|
| 34. | 35. | 36. | 37. |
| $225\frac{3}{8}$ | $\$2.25\frac{1}{4}$ | $333\frac{1}{3}$ | $567\frac{3}{8}$ |
| $564\frac{1}{8}$ | $\$7.74\frac{3}{4}$ | $666\frac{2}{3}$ | $432\frac{3}{8}$ |
| <hr style="width: 50%; margin: 0 auto;"/> | <hr style="width: 50%; margin: 0 auto;"/> | | <hr style="width: 50%; margin: 0 auto;"/> |

1. Memorize—

7 days make 1 week.
 30 days make 1 month.
 12 months make 1 year.

2. Three days equal what part of a month?
3. Five days equal what part of a month?
4. Six days equal what part of a month?
5. Ten days equal what part of a month?
6. How many days in $\frac{1}{2}$ of a month?
7. How many days in $\frac{1}{3}$ of a month?
8. How many days in $\frac{1}{5}$ of a month?
9. How many days in $\frac{1}{6}$ of a month?
10. How many days in $\frac{1}{10}$ of a month?
11. How many days in $\frac{2}{5}$ of a month?

Read, and fill the following blanks properly:—

- | | |
|---|---|
| 12. $\frac{1}{2}$ of 11 is .. | 17. $\frac{1}{2}$ of .. is $8\frac{1}{2}$ |
| 13. .. of 12 is 4 | 18. $\frac{1}{5}$ of 16 is .. |
| 14. $\frac{1}{8}$ of .. is 6 | 19. $4\frac{1}{2}$ is $\frac{1}{3}$ of .. |
| 15. $\frac{1}{2}$ of 15 is .. | 20. $3\frac{1}{4}$ is $\frac{1}{4}$ of .. |
| 16. $\frac{1}{8}$ of .. is $3\frac{1}{2}$ | 21. $4\frac{1}{5}$ is $\frac{1}{5}$ of .. |

22. Two times 1 foot 6 inches equals what?
23. Three times 2 feet 4 inches equals what?
24. Four times 3 feet 3 inches equals what?
25. Five times 2 feet 6 inches equals what?
26. Six times 2 feet 2 inches equals what?
27. Eight times 1 foot 3 inches equals what?
28. If coal costs \$5 a ton, what is the cost of $2\frac{1}{2}$ tons?
29. A hen has 7 members, and his brother has 4 times as many.

1. Count by 6's from 1 to 67, and back from 67 to 1.
2. Count by 6's from 2 to 68, and back from 68 to 2.
3. Count by 6's from 3 to 69, and back from 69 to 3.
4. Count by 6's from 4 to 70, and back from 70 to 4.
5. Count by 6's from 5 to 71, and back from 71 to 5.
6. Three times 1 yard 1 foot equals what?
7. Six times 1 yard 1 foot equals what?
8. Three times 2 yards $1\frac{1}{2}$ feet equals what?
9. Four times 3 yards 2 feet equals what?
10. Two times 4 yards $1\frac{1}{2}$ feet equals what?
11. Four times 2 yards $2\frac{1}{4}$ feet equals what?
12. One-third of $6+\frac{1}{2}$ of 6=....
13. One-half of $8+\frac{1}{4}$ of 8=....
14. One-half of $12+\frac{1}{3}$ of 12=....
15. One-half of $12+\frac{1}{4}$ of 12=....
16. One-third of $12+\frac{1}{4}$ of 12=....
17. One-third of $15+\frac{1}{5}$ of 15=....
18. One-fourth of $20+\frac{1}{5}$ of 20=....
19. One-half of $18+\frac{1}{3}$ of 18=....
20. One-half of $12+\frac{1}{3}$ of $12+\frac{1}{4}$ of 12=....
21. One-half of $6+\frac{1}{4}$ of $8+\frac{1}{5}$ of 10=....
22. One-half of 24 hours is $\frac{1}{3}$ of how many hours?
23. One-third of 24 hours is $\frac{1}{2}$ of how many hours?
24. One-half of 24 hours is $\frac{1}{4}$ of how many hours?
25. One-fourth of 24 hours is $\frac{1}{2}$ of how many hours?
26. One-fourth of 24 hours is $\frac{1}{3}$ of how many hours?
27. One-sixth of 24 hours is $\frac{1}{2}$ of how many hours?
28. One-sixth of 24 hours is $\frac{1}{3}$ of how many hours?
29. One-sixth of 24 hours is $\frac{1}{4}$ of how many hours?
30. One-half of 24 hours is $\frac{1}{6}$ of how many hours?
31. One-third of 24 hours is $\frac{1}{6}$ of how many hours?
32. One-fourth of 24 hours is $\frac{1}{6}$ of how many hours?

1. One-fourth of a yard is $\frac{1}{2}$ of how many inches?
2. One-fourth of a yard is $\frac{1}{3}$ of how many inches?
3. One-half of a yard is $\frac{1}{3}$ of how many inches?
4. One-third of a yard is $\frac{1}{2}$ of how many inches?
5. One-third of a yard is $\frac{1}{4}$ of how many inches?
6. One-third of a yard is $\frac{1}{6}$ of how many inches?
7. One-fourth of a yard is $\frac{1}{6}$ of how many inches?
8. One-sixth of a yard is $\frac{1}{3}$ of how many inches?
9. One-sixth of a yard is $\frac{1}{4}$ of how many inches?
10. One-sixth of a yard is $\frac{1}{2}$ of how many inches?
11. One-ninth of a yard is $\frac{1}{2}$ of how many inches?
12. One-ninth of a yard is $\frac{1}{3}$ of how many inches?
13. One-ninth of a yard is $\frac{1}{4}$ of how many inches?
14. One-ninth of a yard is $\frac{1}{5}$ of how many inches?
15. One-ninth of a yard is $\frac{1}{6}$ of how many inches?
16. One-twelfth of a yard is $\frac{1}{2}$ of how many inches?
17. One-twelfth of a yard is $\frac{1}{3}$ of how many inches?
18. One-twelfth of a yard is $\frac{1}{4}$ of how many inches?
19. One-twelfth of a yard is $\frac{1}{5}$ of how many inches?
20. One-twelfth of a yard is $\frac{1}{6}$ of how many inches?
21. One-twelfth of a yard is $\frac{1}{9}$ of how many inches?
22. If a boy buys a hat for 60 cents, and gives the merchant a dollar, in how many ways can the merchant make the proper "change"?
23. An orchard contains 8 rows of trees, and 6 in a row. If there were but 4 rows, how many trees would there be in a row, to make the same number of trees?

- | | | |
|-----------------|-----------------|-----------------|
| 24. 400—240=... | 28. 800—240=... | 32. 500—180=... |
| 25. 600—130=... | 29. 500—450=... | 33. 400—290=... |
| 26. 800—220=... | 30. 700—260=... | 34. 600—370=... |

1. One-half of a pound is $\frac{1}{2}$ of how many ounces?
2. One-half of a pound is $\frac{1}{4}$ of how many ounces?
3. One-fourth of a pound is $\frac{1}{2}$ of how many ounces?
4. One-fourth of a pound is $\frac{1}{8}$ of how many ounces?
5. One-half of a pound is $\frac{1}{6}$ of how many ounces?
6. One-half of a pound is $\frac{1}{6}$ of how many ounces?
7. One-fourth of a pound is $\frac{1}{6}$ of how many ounces?
8. One-fourth of a pound is $\frac{1}{6}$ of how many ounces?
9. One-eighth of a pound is $\frac{1}{2}$ of how many ounces?
10. One-eighth of a pound is $\frac{1}{8}$ of how many ounces?
11. One-eighth of a pound is $\frac{1}{4}$ of how many ounces?
12. One-eighth of a pound is $\frac{1}{5}$ of how many ounces?
13. One-eighth of a pound is $\frac{1}{6}$ of how many ounces?
14. One-fourth of a pound is $\frac{1}{8}$ of how many ounces?
15. One-fourth of a pound is $\frac{1}{9}$ of how many ounces?
16. One-fourth of a pound is $\frac{1}{10}$ of how many ounces?
17. One-fourth of a pound is $\frac{1}{11}$ of how many ounces?
18. One-fourth of a pound is $\frac{1}{12}$ of how many ounces?
19. One-half of a month is $\frac{1}{3}$ of how many days?
20. One-third of a month is $\frac{1}{2}$ of how many days?
21. One-third of a month is $\frac{1}{5}$ of how many days?
22. One-third of a month is $\frac{1}{6}$ of how many days?
23. One-fifth of a month is $\frac{1}{2}$ of how many days?
24. One-fifth of a month is $\frac{1}{3}$ of how many days?
25. One-fifth of a month is $\frac{1}{4}$ of how many days?
26. One-fifth of a month is $\frac{1}{6}$ of how many days?
27. One-fifth of a month is $\frac{1}{7}$ of how many days?
28. One-sixth of a month is $\frac{1}{2}$ of how many days?
29. One-sixth of a month is $\frac{1}{3}$ of how many days?
30. One-sixth of a month is $\frac{1}{4}$ of how many days?
31. One-sixth of a month is $\frac{1}{5}$ of how many days?
32. One-sixth of a month is $\frac{1}{7}$ of how many days?

1. Memorize —

60 seconds make 1 minute.

60 minutes make 1 hour.

24 hours make 1 day.

30 days make 1 month.

2. How many minutes in $\frac{1}{3}$ of an hour?
3. How many minutes in $\frac{1}{2}$ of an hour?
4. How many minutes in $\frac{1}{4}$ of an hour?
5. How many minutes in $\frac{1}{5}$ of an hour?
6. How many minutes in $\frac{1}{6}$ of an hour?
7. How many minutes in $\frac{1}{10}$ of an hour?
8. How many minutes in $\frac{1}{12}$ of an hour?
9. How many minutes in $\frac{2}{3}$ of an hour?
10. How many minutes in $\frac{3}{4}$ of an hour?
11. How many minutes in $\frac{5}{6}$ of an hour?
12. Five minutes make what part of an hour?
13. Fifteen minutes make what part of an hour?
14. Twenty-five minutes make what part of an hour?
15. Six minutes make what part of an hour?
16. Eighteen minutes make what part of an hour?
17. Twenty-four minutes make what part of an hour?
18. Thirty-six minutes make what part of an hour?
19. Ten minutes make what part of an hour?
20. Twenty minutes make what part of an hour?
21. If a man works for 60 cents an hour, how much does he earn in 10 minutes? In 5 minutes? In 25 minutes?
22. If a boy works for 20 cents an hour, what will he earn in 15 minutes? In 3 hours?
23. Count by $1\frac{1}{2}$'s from $1\frac{1}{2}$ to 18, and back from 18 to $1\frac{1}{2}$.
24. Count by $2\frac{1}{2}$'s from $2\frac{1}{2}$ to 30, and back from 30 to $2\frac{1}{2}$.
25. Count by $3\frac{1}{2}$'s from $3\frac{1}{2}$ to 42, and back from 42 to $3\frac{1}{2}$.

1. Draw a square 2 in. on each side; divide it into squares 1 in. on each side. How many squares in the figure?
2. How many sq. in. in a square 4 in. on each side?
3. How many sq. in. in a rectangle 3 in. by 5 in.?
4. How many sq. in. in a square 5 in. on each side?
5. How many sq. in. in a rectangle 4 in. by 6 in.?
6. How many inches around a square 5 in. on each side?
7. How many inches around a rectangle 4 in. by 6 in.?

Find the area in square inches, and the perimeter,—*

8. Of a rectangle 3 inches by 4 inches.
9. Of a rectangle 2 inches by 6 inches.
10. Of a rectangle 4 inches by 5 inches.
11. Of a rectangle 4 inches by 6 inches.
12. Of a rectangle 5 inches by 6 inches.
13. Of a rectangle 4 inches by 10 inches.
14. Of a rectangle 5 inches by 10 inches.
15. Of a rectangle 4 inches by 12 inches.
16. Of a square 10 inches on each side.
17. Of a square 12 inches on each side.
18. Draw a 1-inch square, a 2-inch square, and a rectangle 2 inches by 4 inches.
19. How many times larger is the 2-inch square than the 1-inch square?
20. How many times larger is the rectangle than the 2-inch square?
21. What part of the rectangle is the 1-inch square?
22. What part of the rectangle is the 2-inch square?
23. Show two ways to divide the rectangle into halves.

* The number of square inches in a surface is called the *area*. The distance around a surface is called the *perimeter*.

1. Memorize—

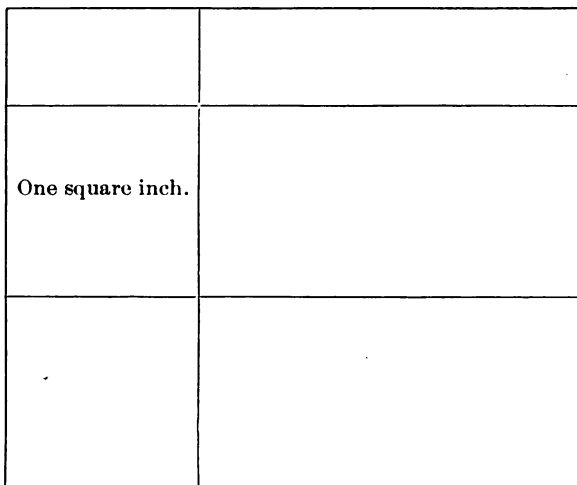
12 inches make 1 foot.

3 feet make 1 yard.

 $5\frac{1}{2}$ yards make 1 rod. $16\frac{1}{2}$ feet make 1 rod.

2. How many inches in $2\frac{1}{2}$ feet? In $5\frac{1}{4}$ feet?
3. How many inches in $\frac{1}{2}$ a yard? In $\frac{1}{3}$ of a yard?
4. How many yards in 2 rods? In 3 rods? In 5 rods?
5. How many feet in 2 rods? In $\frac{1}{2}$ of a rod?
6. How many yards in 3 rods? In 5 rods? In 11 rods?
7. How many rods in 11 yards? In 22 yards? In 33 feet?
8. Give the perimeter of a square rod in yards. In feet.
9. How many inches in the perimeter of a 2-foot square?
10. How many feet in the perimeter of a square rod?
11. How many 1-inch cubes in a 2-inch cube?
12. How many 1-inch cubes in a 3-inch cube?
13. How many 1-in. cubes in a solid 2 in. by 3 in. by 3 in.?
14. How many 1-in. cubes in a solid 4 in. by 4 in. by 2 in.?
15. How many 1-in. cubes in a solid 3 in. by 3 in. by 5 in.?
16. How many 1-in. cubes in a solid 3 in. by 3 in. by 6 in.?
17. How many 1-in. cubes in a solid 5 in. by 5 in. by 2 in.?
18. How many 1-in. cubes in a solid 3 in. by 4 in. by 5 in.?
19. How many 1-in. cubes in a solid 4 in. by 5 in. by 6 in.?
20. How many 1-in. cubes in a solid 3 in. by 6 in. by 5 in.?
21. If a man earns \$8 in 4 days, how much can he earn in 5 days?
22. Twenty \$2 bills equal how many \$5 bills?
23. If 8 pounds cost a dollar, what will 48 pounds cost?
24. If 8 pounds cost 24 cents, what will 24 pounds cost?
25. If 16 pounds cost 48 cents, what will 8 pounds cost?
26. If 16 pounds cost 48 cents, what will 24 pounds cost?

THIRD GRADE.



1. How many square inches in the surface of this rectangle?

Find the area of —

2. A rectangle 2 inches by $5\frac{1}{2}$ inches.
3. A rectangle 4 inches by $2\frac{1}{2}$ inches.
4. A rectangle 4 inches by $3\frac{1}{2}$ inches.
5. A rectangle 4 inches by $4\frac{1}{2}$ inches.
6. A rectangle $2\frac{1}{2}$ inches by 6 inches.
7. A rectangle $2\frac{1}{2}$ inches by 8 inches.
8. A rectangle $3\frac{1}{2}$ inches by 6 inches.
9. A rectangle $4\frac{1}{2}$ inches by 6 inches.
10. A rectangle $6\frac{1}{2}$ inches by 4 inches.
11. A rectangle $6\frac{1}{2}$ inches by 3 inches.

1. How many cents in a dollar?
2. What part of a dollar is 1 cent?
3. How many cents in a half-dollar?
4. How many cents in a quarter-dollar?

In many problems relating to hundredths, the words *per cent* is used. As 1 cent is $\frac{1}{100}$ of a dollar, we say that it is 1 *per cent* of a dollar. As 50 cents is $\frac{50}{100}$ of a dollar, it is also 50 *per cent* of a dollar. As a half-dollar is 50 *per cent* of a dollar, so one-half of anything is 50 *per cent* of it, and one-fourth is 25 *per cent*. The whole of anything is *always 100 per cent* of itself.

50%

25%	

Notice how 50 per cent is written in the above figure.

5. What part of the figure is 50 % of it?
6. What part of the figure is 25 % of it?
7. What part of 50 % is 25 %?
8. What is 50 % of 10 books? Of 20 pencils?
9. What is 25 % of 100 boys? Of 40 girls?
10. How many minutes in 50 % of 2 hours?
11. How many minutes in 25 % of 2 hours?
12. How many months in 2 years, 4 months?
13. How many months in 25 % of 2 years, 4 months?
14. How many months in 50 % of 1 year, 6 months?
15. How many minutes in 25 % of an hour? In 50 % of

$\frac{1}{4}$	$\frac{1}{2}$

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

- How many fourths in a whole?
- How many sixths in a whole?
- How many sixths in one-half?
- One-half and $\frac{1}{2}$ are how many fourths?
- One-half and $\frac{1}{6}$ are how many sixths?
- One-half less $\frac{1}{4}$ equals what?
- One-half less $\frac{1}{6}$ equals what?
- One-half of $\frac{1}{2}$ equals what?
- One-third of $\frac{1}{2}$ equals what?
- One-third is how many times $\frac{1}{6}$?
- One-half and $\frac{1}{3}$ are how many sixths?
- How many hours in 50% of $1\frac{1}{2}$ days?
- How many hours in 25% of $2\frac{1}{2}$ days?
- How many months in 25% of $1\frac{1}{3}$ years?
- How many minutes in 25% of $1\frac{1}{3}$ hours?
- How many months in 50% of $1\frac{1}{3}$ years?
- How many minutes in 50% of $1\frac{1}{2}$ hours?

State the sum of —

20.	21.	22.	23.	24.
$15\frac{1}{2}$	$12\frac{1}{4}$	$33\frac{1}{3}$	$30\frac{1}{2}$	$11\frac{1}{2}$
$24\frac{1}{2}$	$23\frac{1}{2}$	$22\frac{2}{3}$	$35\frac{3}{6}$	$25\frac{1}{4}$
40	$44\frac{1}{4}$	44	64	63
—	—	—	—	—

18. Each pupil make an original problem.

$\frac{1}{12}$					
$\frac{1}{4}$					

1. How many twelfths in this figure?
2. How many twelfths in $\frac{1}{2}$ of the figure?
3. How many twelfths in $\frac{1}{3}$ of the figure?
4. How many twelfths in $\frac{1}{4}$ of the figure?
5. How many twelfths in $\frac{1}{6}$ of the figure?
6. One-half and $\frac{1}{3}$ are how many twelfths?
7. One-half less $\frac{1}{3}$ equals what?
8. One-half less $\frac{1}{4}$ equals what?
9. One-half less $\frac{1}{6}$ equals what?
10. One-half less $\frac{1}{12}$ equals what?
11. One-third less $\frac{1}{4}$ equals what?
12. One-third less $\frac{1}{6}$ equals what?
13. One-third less $\frac{1}{12}$ equals what?
14. One-fourth less $\frac{1}{6}$ equals what?
15. One-fourth less $\frac{1}{12}$ equals what?
16. One-sixth less $\frac{1}{12}$ equals what?
17. How many twelfths in $\frac{2}{3}$?
18. How many twelfths in $\frac{3}{4}$?
19. How many twelfths in $\frac{3}{4} + \frac{2}{3}$?
20. How many twelfths in $\frac{3}{4} - \frac{1}{3}$?
21. How many twelfths in $\frac{3}{4} - \frac{2}{3}$?
22. How many twelfths in $\frac{3}{4} - \frac{1}{12}$?
23. How many twelfths in $\frac{1}{4} + \frac{5}{12}$?
24. How many twelfths in $\frac{1}{3} + \frac{5}{12}$?
25. How many twelfths in $\frac{5}{12} - \frac{1}{4}$?
26. How many twelfths in $\frac{5}{12} - \frac{1}{3}$?

THIRD GRADE.

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

- How many eighths in $\frac{1}{2}$?
- How many eighths in $\frac{1}{4}$?
- How many eighths in $\frac{1}{2} + \frac{1}{8}$?
- How many eighths in $\frac{1}{4} + \frac{1}{8}$?
- How many eighths in $\frac{1}{2} - \frac{1}{8}$?
- How many eighths in $\frac{1}{4} - \frac{1}{8}$?
- How many eighths in $\frac{5}{8} - \frac{1}{4}$?
- How many eighths in $\frac{3}{8} + \frac{1}{4}$?

$\frac{1}{9}$		

- How many ninths in $\frac{1}{3}$?
- How many ninths in $\frac{1}{3} - \frac{1}{9}$?
- How many ninths in $\frac{2}{3} - \frac{1}{9}$?
- How many ninths in $\frac{5}{9} - \frac{1}{3}$?
- How many ninths in $\frac{1}{3} + \frac{1}{9}$?
- How many ninths in $\frac{2}{3} + \frac{1}{9}$?
- $10\frac{1}{2} + 21\frac{1}{4} = \dots$
- $25\frac{1}{3} - 15\frac{1}{2} = \dots$
- $20\frac{1}{3} + 31\frac{1}{2} = \dots$
- $25\frac{1}{3} - 15\frac{1}{4} = \dots$

$\frac{1}{10}$				

1. How many tenths in $\frac{1}{2}$?
2. How many tenths in $\frac{1}{5}$?
3. How many tenths in $\frac{1}{2} + \frac{1}{10}$?
4. How many tenths in $\frac{1}{2} + \frac{1}{5}$?
5. How many tenths in $\frac{1}{5} + \frac{1}{10}$?
6. How many tenths in $\frac{1}{2} - \frac{1}{10}$?
7. How many tenths in $\frac{1}{2} - \frac{1}{5}$?
8. How many tenths in $\frac{1}{5} - \frac{1}{10}$?
9. How many tenths in $\frac{1}{2} + \frac{2}{5}$?
10. How many tenths in $\frac{1}{2} - \frac{2}{5}$?
11. How many tenths in $\frac{4}{5} - \frac{3}{10}$?
12. $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} = \dots$
13. $\frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \dots$
14. $\frac{1}{2} + \frac{1}{5} + \frac{1}{10} = \dots$
15. $\frac{1}{2} + \frac{1}{6} + \frac{1}{12} = \dots$
16. $\frac{1}{2} + \frac{1}{3} + \frac{1}{12} = \dots$
17. $\frac{1}{2} + \frac{1}{4} + \frac{1}{12} = \dots$
18. $\frac{1}{2} + \frac{1}{3} + \frac{1}{4} = \dots$
19. $\frac{1}{3} + \frac{1}{4} + \frac{1}{12} = \dots$
20. Count by 7's from 7 to 84, and back from 84 to 7.
21. One-half of 14 and $\frac{1}{7}$ of 14 are how many?
22. One-third of 21 and $\frac{1}{7}$ of 21 are how many?
23. One-half of 28 and $\frac{1}{4}$ of 28 are how many?
24. One-fourth of 28 and $\frac{1}{7}$ of 28 are how many?
25. One-fifth of 35 and $\frac{1}{7}$ of 35 are how many?
26. One-half of 42 and $\frac{1}{6}$ of 42 are how many?
27. One-half of 42 and $\frac{1}{7}$ of 42 are how many?
28. One-sixth of 42 and $\frac{1}{7}$ of 42 are how many?
29. One-seventh of 49 and $\frac{1}{7}$ of 42 are how many?

THIRD GRADE.

33

1. Count by 8's from 8 to 96, and back from 96 to 8.
2. Count by 8's from 7 to 95, and back from 95 to 7.
3. Count by 8's from 6 to 94, and back from 94 to 6.
4. Count by 8's from 5 to 93, and back from 93 to 5.
5. Count by 8's from 4 to 92, and back from 92 to 4.
6. Count by 8's from 3 to 91, and back from 91 to 3.
7. Count by 8's from 2 to 90, and back from 90 to 2.
8. Count by 8's from 1 to 89, and back from 89 to 1.
9. What is one-eighth of 24? 16? 40? 32? 56?

State the sum of—

10. One-half of 16 and one-eighth of 16.
11. One-fourth of 16 and one-eighth of 16.
12. One-half of 24 and one-eighth of 24.
13. One-third of 24 and one-eighth of 24.
14. One-quarter of 24 and one-eighth of 24.

The sum of—

15. One-seventh of 56 and one-eighth of 56 is what?
16. One-seventh of 49 and one-eighth of 56 is what?
17. One-seventh of 56 and one-eighth of 64 is what?
18. One-eighth of 56 and one-eighth of 64 is what?
19. One-sixth of 72 and one-eighth of 72 is what?

Show by a simple drawing the value of—

- | | | |
|------------------------------------|------------------------------------|------------------------------------|
| 20. $\frac{1}{2}$ of $\frac{1}{2}$ | 26. $\frac{1}{2}$ of $\frac{3}{5}$ | 32. $\frac{1}{4}$ of $\frac{1}{2}$ |
| 21. $\frac{1}{2}$ of $\frac{1}{4}$ | 27. $\frac{1}{2}$ of $\frac{3}{4}$ | 33. $\frac{1}{4}$ of $\frac{1}{3}$ |
| 22. $\frac{1}{2}$ of $\frac{1}{4}$ | 28. $\frac{1}{2}$ of $\frac{5}{6}$ | 34. $\frac{1}{4}$ of $\frac{2}{3}$ |
| 23. $\frac{1}{2}$ of $\frac{1}{5}$ | 29. $\frac{1}{3}$ of $\frac{1}{2}$ | 35. $\frac{1}{5}$ of $\frac{1}{2}$ |
| 24. $\frac{1}{2}$ of $\frac{1}{6}$ | 30. $\frac{1}{3}$ of $\frac{1}{4}$ | 36. $\frac{1}{6}$ of $\frac{1}{2}$ |
| 25. $\frac{1}{2}$ of $\frac{1}{8}$ | 31. $\frac{1}{3}$ of $\frac{1}{3}$ | 37. $\frac{1}{6}$ of $\frac{2}{3}$ |

1. One-seventh of 49 and $\frac{1}{7}$ of 56 are how many?
 2. One-seventh of 70 and $\frac{1}{7}$ of 77 are how many?
 3. Count by 7's from 6 to 83, and back from 83 to 6.
 4. Count by 7's from 5 to 82, and back from 82 to 5.
 5. Count by 7's from 4 to 81, and back from 81 to 4.
 6. Count by 7's from 3 to 80, and back from 80 to 3.
 7. How many times 7 in 15? 23? 36? 43? 50? 57?
 8. One-tenth of a month is $\frac{1}{10}$ of how many days?
 9. One-tenth of a month is $\frac{1}{10}$ of how many days?
 10. One-tenth of a month is $\frac{1}{12}$ of how many days?
 11. If 2 pints of milk cost 10 cents, how many pints will 20 cents buy?
 12. If 8 barrels of flour cost \$24, what will be the cost of 4 barrels?
 13. Count by $1\frac{1}{2}$'s from $1\frac{1}{2}$ to 16, and back from 16 to $1\frac{1}{2}$.
 14. Count by $2\frac{1}{2}$'s from $2\frac{1}{2}$ to 28, and back from 28 to $2\frac{1}{2}$.
 15. Count by $3\frac{1}{2}$'s from $3\frac{1}{2}$ to 40, and back from 40 to $3\frac{1}{2}$.
 16. Count by $4\frac{1}{2}$'s from $4\frac{1}{2}$ to 45, and back from 45 to $4\frac{1}{2}$.
 17. Count by $4\frac{1}{2}$'s from $4\frac{1}{2}$ to 39, and back from 39 to $4\frac{1}{2}$.
- | | | |
|--------------------|---------------------|--------------------------------|
| 18. | 19. | 20. |
| 4 ft. 9 in. | 10 lb. 9 oz. | 2 bu. 2 pk. 5 qt. 1 pt. |
| <u>5 ft. 8 in.</u> | <u>11 lb. 7 oz.</u> | <u>3 bu. 1 pk. 2 qt. 1 pt.</u> |
-
21. $12\frac{1}{2} + 12\frac{1}{6} = \dots$
 22. $15\frac{1}{3} + 15\frac{1}{6} = \dots$
 23. $25\frac{5}{6} - 15\frac{1}{2} = \dots$
 24. $25\frac{5}{6} - 15\frac{1}{4} = \dots$
 25. What is one-ninth of 27? 18? 45? 36? 63? 54?
 26. How many inches in $\frac{1}{9}$ of a yard? $\frac{2}{9}$? $\frac{4}{9}$? $\frac{5}{9}$?
 27. How many times 9 in 19? 28? 37? 47? 57?
 28. A box contains 60 oranges, which are sold 3 for 5

FOURTH GRADE.

Drill on the following table until all numbers less than 100 are factored without hesitation.

4 is 2 times 2.	25 is 5 times 5.	55 is 5 times
6 is 2 times 3.	26 is 2 times 13.	56 is 7 times
8 is 2 times 4.	27 is 3 times 9.	60 is 5 times
9 is 3 times 3.	28 is 4 times 7.	60 is 6 times
10 is 2 times 5.	30 is 3 times 10.	63 is 7 times
12 is 3 times 4.	30 is 5 times 6.	64 is 8 times
12 is 2 times 6.	32 is 4 times 8.	66 is 6 times
14 is 2 times 7.	33 is 3 times 11.	70 is 7 times
15 is 3 times 5.	35 is 5 times 7.	72 is 6 times
16 is 4 times 4.	36 is 6 times 6.	72 is 8 times
16 is 2 times 8.	36 is 4 times 9.	77 is 7 times
18 is 2 times 9.	36 is 3 times 12.	80 is 8 times
18 is 3 times 6.	40 is 4 times 10.	81 is 9 times
20 is 2 times 10.	40 is 5 times 8.	84 is 7 times
20 is 4 times 5.	42 is 6 times 7.	88 is 8 times
21 is 3 times 7.	44 is 4 times 11.	90 is 9 times
22 is 2 times 11.	45 is 5 times 9.	96 is 8 times
24 is 2 times 12.	49 is 7 times 7.	99 is 9 times
24 is 3 times 8.	50 is 5 times 10.	100 is 10 times
24 is 4 times 6.	54 is 6 times 9.	144 is 12 times

1.	2.	3.	4.
4 ft. 9 in.	3 gal. 1 qt.	35 lb. 9 oz.	2 rd. 3 yd. 1
5 ft. 3 in.	5 gal. 3 qt.	15 lb. 7 oz.	5 rd. 5

1. Count by 9's from 9 to 99, and back from 99 to 9.
2. Count by 9's from 8 to 98, and back from 98 to 8.
3. Count by 9's from 7 to 97, and back from 97 to 7.
4. Count by 9's from 6 to 96, and back from 96 to 6.
5. Count by 9's from 5 to 95, and back from 95 to 5.
6. Count by 9's from 4 to 94, and back from 94 to 4.
7. Count by 9's from 3 to 93, and back from 93 to 3.
8. Count by 9's from 2 to 92, and back from 92 to 2.
9. Count by 9's from 1 to 91, and back from 91 to 1.

What is the sum of—

10. One-third of 18 and one-ninth of 18?
11. One-fourth of 36 and one-ninth of 36?
12. One-fifth of 45 and one-ninth of 45?
13. One-sixth of 54 and one-ninth of 54?
14. One-seventh of 56 and one-ninth of 63?
15. One-eighth of 72 and one-ninth of 72?
16. One-ninth of 81 and one-ninth of 99?
17. One-eighth of 96 and one-ninth of 108?
18. One-fifth of 20 and one-tenth of 20?
19. One-sixth of 30 and one-tenth of 30?
20. One-ninth of 90 and one-tenth of 90?
21. One-half of 22 and one-eleventh of 22?
22. One-third of 33 and one-eleventh of 33?
23. One-fourth of 44 and one-eleventh of 44?
24. One fifth of 55 and one-eleventh of 77?
25. One-sixth of 66 and one-eleventh of 66?
26. One-seventh of 77 and one-eleventh of 88?
27. One-eighth of 88 and one-eleventh of 99?
28. One-tenth of 110 and one-eleventh of 121?
29. Divide by 13: 14, 27, 40, 53, 66, 79, 92.
30. Divide by 14: 15, 29, 43, 57, 71, 85, 99.

1. Add 6 to 4, to 24, to 234. Add 4 to 6, to 16, to 236.
2. Subtract 6 from 10, from 50, from 100, from 240.
3. Subtract 4 from 10, from 50, from 100, from 240.
4. Add 7 to 4, to 24, to 34, to 84, to 94, to 154, to 344.
5. Subtract 7 from 11, from 31, from 151, from 221.
6. Subtract 4 from 11, from 21, from 131, from 331.
7. Add 5 to 9, to 19, to 39, to 59, to 79, to 129, to 169.
8. Add 9 to 5, to 15, to 35, to 55, to 75, to 165, to 225.
9. Subtract 9 from 14, from 74, from 84, from 444.
10. Subtract 5 from 14, from 64, from 94, from 424.
11. Add 3 to 8, to 38, to 58, to 128, to 228, to 368, to 668.
12. Subtract 3 from 11, from 51, from 221, from 271.
13. Subtract 8 from 11, from 31, from 91, from 111.
14. Add 4 to 9, to 19, to 29, to 49, to 69, to 119, to 229.
15. Add 9 to 4, to 14, to 54, to 74, to 94, to 114, to 224.
16. Subtract 4 from 13, from 33, from 133, from 333.
17. Subtract 9 from 13, from 33, from 133, from 223.
18. Add 6 to 8, to 18, to 28, to 68, to 228, to 238, to 368.
19. Add 8 to 6, to 16, to 66, to 96, to 226, to 236 to 666.
20. Subtract 6 from 14, from 34, from 74, from 324.
21. Subtract 8 from 14, from 34, from 74, from 324.
22. Add 5 to 7, to 27, to 97, to 127, to 237, to 267, to 697.
23. Add 7 to 5, to 25, to 55, to 95, to 1005, to 1215.
24. Subtract 7 from 12, from 52, from 92, from 102.
25. Subtract 5 from 12, from 52, from 92, from 102.
26. Add 9 to 2, to 32, to 72, to 122, to 192, to 292, to 662.
27. Add 2 to 9, to 19, to 29, to 99, to 269, to 299, to 669.
28. Subtract 9 from 11, from 31, from 91, from 101.
29. Subtract 2 from 11, from 31, from 91, from 101.
30. Add 8 to 7, to 27, to 77, to 187, to 197, to 557, to 997.
31. Add 7 to 8, to 28, to 88, to 178, to 188, to 558, to 678.
32. Subtract 8 from 15, from 25, from 75, from 155.

1. 4 times $\frac{1}{5}$ of 15=....
2. 5 times $\frac{1}{6}$ of 18=....
3. 6 times $\frac{1}{7}$ of 21=....
4. 7 times $\frac{1}{8}$ of 24=....
5. 8 times $\frac{1}{9}$ of 27=....
6. 9 times $\frac{1}{10}$ of 30=....
7. 10 times $\frac{1}{11}$ of 44=....
8. 11 times $\frac{1}{10}$ of 40=....
9. $\frac{1}{2}$ of 4 is $\frac{1}{4}$ of....
10. $\frac{1}{3}$ of 9 is $\frac{1}{4}$ of....
11. $\frac{3}{4}$ of 12 is $\frac{1}{5}$ of....
12. $\frac{2}{5}$ of 20 is $\frac{1}{6}$ of....
13. $\frac{4}{7}$ of 14 is $\frac{1}{8}$ of....
14. $\frac{3}{8}$ of 24 is $\frac{1}{9}$ of....
15. $\frac{5}{9}$ of 27 is $\frac{1}{2}$ of....
16. $\frac{7}{10}$ of 30 is $\frac{1}{10}$ of....
17. $\frac{2}{3}$ of 9 is $\frac{3}{4}$ of....
18. $\frac{3}{4}$ of 12 is $\frac{3}{5}$ of....
19. $\frac{3}{5}$ of 25 is $\frac{3}{7}$ of....
20. $\frac{3}{4}$ of 24 is $\frac{3}{7}$ of....
21. $\frac{3}{7}$ of 49 is $\frac{3}{5}$ of....
22. $\frac{5}{8}$ of 64 is $\frac{5}{9}$ of....
23. $\frac{5}{9}$ of 81 is $\frac{5}{6}$ of....
24. 3 times 10 and $\frac{2}{5}$ of 10 are....
25. 4 times 9 and $\frac{2}{3}$ of 9 are....
26. 5 times 12 and $\frac{3}{4}$ of 12 are....
27. 6 times 12 and $\frac{5}{6}$ of 12 are....
28. 7 times 12 and $\frac{3}{4}$ of 12 are....
29. 8 times 10 and $\frac{4}{5}$ of 10 are....
30. 9 times 10 and $\frac{3}{5}$ of 10 are....
31. How much more is $\frac{2}{3}$ of 9 than $\frac{3}{4}$ of 8?
32. How much more is $\frac{2}{5}$ of 20 than $\frac{2}{5}$ of 15?
33. How much more is $\frac{2}{3}$ of 24 than $\frac{3}{5}$ of 20?
34. How much more is $\frac{3}{5}$ of 30 than $\frac{3}{7}$ of 28?
35. How much more is $\frac{3}{4}$ of 32 than $\frac{4}{7}$ of 35?
36. How much more is $\frac{5}{9}$ of 36 than $\frac{3}{10}$ of 40?
37. How much more is $\frac{5}{8}$ of 40 than $\frac{3}{7}$ of 42?
38. How much more is $\frac{7}{9}$ of 45 than $\frac{4}{7}$ of 49?
39. How much more is $\frac{3}{4}$ of 48 than $\frac{4}{7}$ of 49?
40. How much more is $\frac{3}{5}$ of 50 than $\frac{2}{3}$ of 60?
41. How much more is $\frac{5}{6}$ of 48 than $\frac{5}{8}$ of 56?
42. How much more is $\frac{2}{3}$ of 60 than $\frac{3}{7}$ of 70?
43. How much more is $\frac{5}{9}$ of 63 than $\frac{4}{7}$ of 56?
44. How much more is $\frac{3}{4}$ of 64 than $\frac{5}{9}$ of 72?
45. How much more is $\frac{2}{3}$ of 66 than $\frac{3}{4}$ of 48?

In writing dollars and cents, remember —

1. To place the sign (\$) before the figure.
2. To place a point (.) between dollars and cents.
3. To place a cipher between the point and any number of cents less than 10.

- | | |
|--|--------------------------------|
| 1. One dollar equals 100 cents. | 13. $\$ \frac{1}{2} =$. . . |
| 2. 4 cents equal what part of a dollar? | 14. $\$ \frac{1}{4} =$ |
| 3. 5 cents equal what part of a dollar? | 15. $\$ \frac{1}{5} =$ |
| 4. 25 cents equal what part of a dollar? | 16. $\$ \frac{2}{5} =$ |
| 5. 10 cents equal what part of a dollar? | 17. $\$ \frac{1}{5} =$ |
| 6. 75 cents equal what part of a dollar? | 18. $\$ \frac{3}{4} =$ |
| 7. $33\frac{1}{3}$ cents equal what part of a dollar? | 19. $\$ \frac{1}{8} =$ |
| 8. 20 cents equal what part of a dollar? | 20. $\$ \frac{3}{8} =$ |
| 9. 60 cents equal what part of a dollar? | 21. $\$ \frac{3}{5} =$ |
| 10. $66\frac{2}{3}$ cents equal what part of a dollar? | 22. $\$ \frac{2}{5} =$ |
| 11. $12\frac{1}{2}$ cents equal what part of a dollar? | 23. $\$ \frac{2}{5} =$ |
| 12. $37\frac{1}{2}$ cents equal what part of a dollar? | 24. $\$ \frac{4}{8} =$ |
25. How many books at $12\frac{1}{2}$ cents each can be bought for \$1.25?
 26. How many at 20 cents each can be bought for \$2.40?
 27. How many at 25 cents each can be bought for \$5.50?
 28. How many at $33\frac{1}{3}$ cents each can be bought for \$9.00?
 29. How many at $12\frac{1}{2}$ cents each can be bought for \$2.50?
 30. How many at 5 cents each can be bought for \$2.50?
 31. How many at 4 cents each can be bought for \$2.00?
 32. How many at 20 cents each can be bought for \$4.00?
 33. How many at $12\frac{1}{2}$ cents each can be bought for \$5.00?
 34. Find the cost of 2 hats at $\$1\frac{1}{4}$ each.
 35. Find the cost of 3 coats at $\$12\frac{1}{2}$ each.
 36. Find the cost of 5 pairs of shoes at $\$3\frac{2}{5}$ a pair.

1. Memorize —

2 pints make 1 quart.

8 quarts make 1 peck.

4 pecks make 1 bushel.

2. How many pints in 1 quart? 2 quarts? $2\frac{1}{2}$ quarts?
1 peck? 1 peck 1 quart? 1 peck 2 quarts? 2 pecks 4 quarts?
1 bushel? 1 bushel 1 peck? $\frac{1}{2}$ bushel $\frac{1}{2}$ peck $\frac{1}{2}$ quart?

3. How many quarts in 1 peck? $2\frac{1}{2}$ pecks? 1 bushel?
 $1\frac{1}{2}$ bushels? 2 bushels 1 peck? 2 bushels 2 pecks.

4. How many inches in $1\frac{1}{2}$ feet? 1 yard? 1 yard 1 foot?
 $1\frac{1}{2}$ yards? 1 yard $1\frac{1}{2}$ feet?

5. How many feet in $1\frac{1}{2}$ yards? 1 rod? 2 rods 1 yard?
2 rods $3\frac{2}{3}$ yards?

6. One-half of 5 quarts equals . . . quarts . . . pint.

7. One-half of 3 yards 1 foot equals . . . yards . . . feet.

8. One-half of $5\frac{1}{2}$ yards equals . . . feet.

9. One-half of 1 rod equals . . . feet . . . inches.

10. One-half of $1\frac{1}{2}$ days equals . . . hours.

11. One-third of $1\frac{1}{2}$ days equals . . . hours.

12. One-half of $1\frac{1}{2}$ days equals . . . hours.

13. One-fourth of $1\frac{1}{2}$ days equals . . . hours.

14. One-fourth of $1\frac{1}{2}$ days equals . . . hours.

15. One-third of $1\frac{1}{2}$ days equals . . . hours.

16. Multiply $5\frac{1}{2}$ by 2, 3, and 4, and add the products.

17. Multiply $5\frac{1}{3}$ by 2, 3, and 4, and add the products.

18. Multiply $4\frac{1}{2}$ by 2, 3, and 4, and add the products.

19. Multiply $6\frac{1}{2}$ by 2, 3, and 4, and add the products.

20. Multiply $6\frac{2}{3}$ by 2, 3, and 4, and add the products.

21. Multiply $5\frac{1}{3}$ by 2, 3, and 4, and add the products.

22. Multiply $3\frac{1}{4}$ by 2, 3, and 4, and add the products.

1. How many square inches in the surface of a 1-inch cube? 2-inch cube? 3-inch cube? 4-inch cube? 5-inch cube?
2. How many 1-inch cubes in a 2-inch cube? How many, if the 2-inch cube is doubled in length? If it is doubled in length and width?
3. How many 1-inch cubes in a 3-inch cube? How many, if the 3-inch cube is doubled in length? If it is doubled in length and width?
4. A crayon-box is 4 inches by 4 inches by 6 inches. How many square inches on each end? How many on each side? How many on the top? On the bottom? What is the whole surface of the box?
5. How many 1-inch cubes will make a pile the size and shape of the box?
6. *Cord-wood* is 4 feet long. It is laid in piles 4 feet high, and 8 feet long. Such a pile is called a *cord*. How many square feet on each end of a cord? On each side of a cord? On the top? On the bottom?
7. How many 1-foot cubes in a cord?
8. How many cords of 4-foot wood in a pile 4 feet high and 8 feet long? In a pile 4 feet high and 16 feet long? 4 feet high and 4 feet long? 4 feet high and 12 feet long? 4 feet high and 24 feet long?
9. How many cubic feet in 50 per cent of a cord of wood? In 25 per cent of a cord of wood?
10. A common brick is 2 inches by 4 inches by 8 inches. Find the cubic inches in it.
11. What is the surface of a common brick?
12. Draw a rectangle 3 inches by 4 inches. Draw another having the same surface, 2 inches wide.
13. Draw a rectangle 4 inches by 6 inches. Draw another having the same surface, 3 inches wide.

1. Memorize—

4 gills make 1 pint.
 2 pints make 1 quart.
 4 quarts make 1 gallon.

2. How many gills in 1 pint? In $\frac{1}{2}$ pint?
3. How many gills in 1 quart?
4. How many gills in 1 quart 1 pint?
5. How many gills in 1 gallon?
6. How many gills in 1 gallon 1 quart?
7. How many gills in 1 gallon 1 quart 1 pint?
8. How many pints in 1 gallon? In 50 % of a gallon?
9. How many pints in $1\frac{1}{2}$ gallons?
10. How many pints in 2 gallons 1 quart?
11. Find the sum of 50 % of a pint and 25 % of a quart.
12. Find the sum of $33\frac{1}{3}$ % of a yard and 25 % of a foot.
13. Find the sum of 10 % of 50 and 50 % of 10.

14. Memorize—

60 minutes make 1 hour.
 24 hours make 1 day.
 30 days make 1 month.
 12 months make 1 year.

Find the sum of—

15. $33\frac{1}{3}$ % of an hour and 10 % of an hour.
16. 10 % of a month and 50 % of a month.
17. 25 % of a day and $33\frac{1}{3}$ % of a day.
18. 50 % of a year and 25 % of a year.
19. 10 % of a month and $33\frac{1}{3}$ % of a month.
20. 20 % of an hour and 25 % of an hour.

[illegible]

There are two ways to write one one-hundredth: $\frac{1}{100}$, .01.

In writing numbers to represent money, the decimal method is used. Thus, 5 cents are .05 of a dollar; 10 cents are .10 of a dollar; 1 dollar and 15 cents is written \$1.15.

1. Write the following

2. How many tenths and hundredths in .25? In .16?
In .38? In .09? In .05? In .83?

Add —

5.
.10
5.50
4.46

6.
55.5
5.05
62.25

$$\begin{array}{r} 7. \\ 35.3 \\ 86 \\ \hline 49.15 \end{array}$$

8.

900.9

90.09

1. In the number 4,444, how many times is the third figure from the right greater than the second? The third than the first? The fourth than the second? The fourth than the third? The fourth than the first? How many times is the first contained in the second? In the fourth? In the third? How many times is the second contained in the fourth? In the third? How many times is the third contained in the fourth?

2. In the number 203, what is the use of the cipher? Why is there none in the place of thousands? Does the cipher stand for any number? What would this number be, if the cipher were omitted? If another cipher were placed beside the first, what effect would it produce on the 2? What effect would be produced on the 3? If a cipher were placed after the 3, what effect would be produced on the number? Would both the 2 and the 3 be increased?

3. In the number 1,012, if another cipher were introduced between the two 1's, what figures would change their value? Add a cipher after the 2. What change is thus produced on each figure severally, and on the whole number?

4. In the number 1,560, what effect would a cipher produce if placed to the left of the 1? To the right of the 1? Between the 5 and 6? After the 6?

5. Mention the effect that would be produced on each of the following numbers by a removal of the point: 25.07; 38.206; 52.5.

6. Mention the effect that would be produced on each of the following numbers by placing a point after the first figure on the left: 2,346; 18; 398; 27,945.

7. Mention in which of the following numbers are found

1. At 4 cents a pound, how many ounces will 1 cent buy? What part of a pound will 3 cents buy? What part will 5 cents buy? 8 cents? 9 cents? 11 cents? 13 cents? 24 cents? 32 cents? 65 cents? 96 cents? 87 cents?

2. If a barrel of flour costs \$5, what part of a barrel can be bought for \$1? \$8? How many barrels can be bought for \$10? \$12? \$15? \$18? \$24? \$27? \$39? \$96? \$152?

3. If a barrel of beef costs \$6, what would $\frac{1}{6}$ of it be worth? $\frac{2}{6}$? $\frac{3}{6}$? $\frac{5}{6}$? How much could be bought for \$7? \$9? \$10? \$12? \$15? \$17? \$23? \$24? \$27? \$35?

4. At \$7 for a barrel of flour, find how much could be bought for \$1. For \$5. How much is $\frac{1}{7}$ of a barrel worth? How much could be bought for \$8? \$9? \$15? \$18? \$23? \$27? \$28? \$29? \$35? \$46? \$65? \$53? \$57? \$81? \$63?

5. If sugar is 8 cents a pound, how much can be bought for 1 cent? 3 cents? 4 cents? 5 cents? 7 cents?

6. Nine times 9 and $\frac{3}{9}$ of 9 are how many? 8 times 9 and $\frac{6}{9}$ of 9? 7 times 9 and $\frac{5}{9}$ of 9? 5 times 9 and $\frac{8}{9}$ of 9? 2 times 9 and $\frac{3}{9}$ of 9? 9 times 9 and $\frac{7}{9}$ of 9? 6 times 9 and $\frac{4}{9}$ of 9?

7. Eight times 10 and $\frac{7}{10}$ of 10 are how many? 10 times 10 and $\frac{3}{10}$ of 10? 14 times 50 and $\frac{8}{10}$ of 50?

8. Eleven times 7 and $\frac{5}{7}$ of 7 are how many? 8 times 7 and $\frac{6}{7}$ of 21? 7 times 9 and $\frac{3}{9}$ of 9?

9. Three times 4 are how many times 6? How many times 2?

10. Four times 4 are how many times 2? 8? 5? 7?

11. Three times 5 and $\frac{3}{5}$ of five are how many times 7? How many times 4? 6? 8? 14? 9? 17?

12. Six times 9 and $\frac{3}{9}$ of 9 are how many times 12?

13. Nine times 6 and $\frac{1}{6}$ of 6 are how many times 7? 4?

1. A room is 15 feet wide, 21 feet long, and 9 feet high. Find the square feet on each side wall. On each end wall.
2. Change the dimensions of the room to yards. Find the square yards on each side. On each end. On the ceiling.
3. Find the cost of plastering the walls and ceiling at \$.30 a square yard.
4. Find the cost of painting the floor at \$.20 a square yard?
5. Find the cost of papering the ceiling at \$.30 a square yard.

Find the other dimension of—

6. A floor 20 ft. on one side, and containing 200 sq. ft.
7. A floor 25 ft. on one side, and containing 200 sq. ft.
8. A floor 40 ft. on one side, and containing 200 sq. ft.
9. A floor 20 ft. on one side, and containing 400 sq. ft.
10. A floor 25 ft. on one side, and containing 400 sq. ft.
11. A floor 40 ft. on one side, and containing 400 sq. ft.
12. A floor 50 ft. on one side, and containing 400 sq. ft.

16 rods.

10 rods.

One acre.

How many square rods?

13. An acre of land is 10 by 16 rods. In what ways can the dimensions of one-half acre?

1. Memorize—

12 inches make 1 foot.

3 feet make 1 yard.

 $5\frac{1}{2}$ yards make 1 rod. $16\frac{1}{2}$ feet make 1 rod.

2. How many feet in 2 rods? In 3 rods?
3. How many feet in 2 yards? In 3 yards?
4. How many sq. rd. in 1 acre? In $\frac{1}{2}$ acre? In $\frac{1}{4}$ acre?
5. Give in two or more ways dimensions for an acre lot.
6. How many acres in a lot 32 rd. long and 10 rd. wide?
7. How many acres in a lot 8 rd. long and 20 rd. wide?
8. How many acres in a lot 16 rd. long and 20 rd. wide?
9. How many acres in a lot 8 rd. long and 30 rd. wide?
10. How many acres in a lot 30 rd. long and 16 rd. wide?
11. How many acres in a lot 40 rd. long and 16 rd. wide?
12. How many acres in a lot 20 rd. long and 16 rd. wide?
13. How many acres in a lot 32 rd. long and 20 rd. wide?
14. How many acres in a lot 80 rd. long and 16 rd. wide?
15. How many acres in a lot 32 rd. long and 40 rd. wide?
16. How many acres in a lot 80 rd. long and 32 rd. wide?
17. If an acre of land is worth \$50, what will be the value of $2\frac{1}{2}$ acres of such land?
18. A field containing $20\frac{1}{2}$ acres was sold at the price of \$50 an acre. What did it bring?
19. If an acre of land costs \$150, what will be the cost of $3\frac{1}{2}$ acres? Of $3\frac{3}{4}$ acres? Of $5\frac{1}{2}$ acres?
20. An acre lot 40 rods long is how many rods wide?
21. An acre lot 8 rods long is how many rods wide?
22. An acre lot 5 rods long is how many rods wide?
23. An acre lot 32 rods long is how many rods wide?
24. At \$100 an acre, find the value of a lot 10 by 12 rods. 12 by 20 rods.

1. Memorize—

100 pounds make 1 cental.
2000 pounds make 1 ton.

2. How many pounds of grain in $\frac{1}{2}$ of a ton?
3. How many pounds of grain in $\frac{1}{4}$ of a ton?
4. How many pounds of grain in $\frac{3}{4}$ of a ton?
5. How many pounds of grain in $\frac{1}{5}$ of a ton?
6. How many pounds of grain in $\frac{2}{5}$ of a ton?
7. How many pounds of grain in $\frac{3}{5}$ of a ton?
8. How many pounds of grain in $\frac{1}{10}$ of a ton?
9. How many centals of wheat in $\frac{1}{2}$ of a ton?
10. How many centals of wheat in $\frac{1}{4}$ of a ton?
11. How many centals of wheat in $\frac{1}{5}$ of a ton?
12. How many centals of wheat in $\frac{1}{10}$ of a ton?
13. How many centals of wheat in $\frac{1}{20}$ of a ton?
14. How many centals of wheat in 1 ton?
15. How many centals of wheat in $1\frac{1}{2}$ tons?
16. How many centals of wheat in $1\frac{1}{4}$ tons?
17. How many centals of wheat in $1\frac{1}{5}$ tons?
18. How many centals of wheat in 50 pounds?
19. How many centals of wheat in 75 pounds?
20. How many centals of wheat in 1250 pounds?
21. Find the cost of 500 lb. of grain at \$.50 per cental.
22. Find the cost of 1000 lb. of grain at \$.60 per cental.
23. Find the cost of $\frac{2}{5}$ of a ton of grain at \$.75 per cental.
24. Find the cost of $\frac{3}{5}$ of a ton of grain at \$.75 per cental.
25. Find the cost of $\frac{1}{4}$ of a ton of grain at \$.50 per cental.
26. Find the cost of 4 centals of grain at \$15 a ton.
27. Find the cost of 5 centals of grain at \$12 a ton.
28. Find the cost of 10 centals of grain at \$16 a ton.
29. Find the cost of 15 centals of grain at \$20 a ton.

1. What part of a ton is 1000 pounds?
2. What part of a ton is 500 pounds?
3. What part of a ton is 100 pounds?
4. What part of a ton is 200 pounds?
5. What part of a ton is 50 pounds?
6. What part of a ton is 150 pounds?
7. What part of a ton is 300 pounds?
8. What part of a ton is 250 pounds?
9. What part of a ton is 400 pounds?
10. What part of a ton is 600 pounds?
11. What part of a ton is 800 pounds?
12. What part of a ton is 1200 pounds?
13. What part of a ton is 1250 pounds?
14. What part of a ton is 1600 pounds?
15. Find the cost of 100 pounds at the rate of \$2.00 a ton.
SUGGESTION. — 1000 pounds cost; 100 pounds cost
16. Find the cost of 100 pounds at the rate of \$3.00 a ton.
17. Find the cost of 100 pounds at the rate of \$5.00 a ton.
18. Find the cost of 100 pounds at the rate of \$2.50 a ton.
19. Find the cost of 100 pounds at the rate of \$9.00 a ton.
20. At \$4 a ton, how many pounds will cost \$.50?
SUGGESTION. — \$1.00 will buy; \$.50 will buy
21. At \$4 a ton, how many pounds will cost \$.10?
22. At \$4 a ton, how many pounds will cost \$.25?
23. At \$4 a ton, how many pounds will cost \$.30?
24. At \$4 a ton, how many pounds will cost \$.45?
25. At \$4 a ton, how many pounds will cost \$1.75?
26. At \$4 a ton, how many pounds will cost \$1.60?
27. At \$6 a ton, find the cost of 2100 pounds.
28. At \$6 a ton, find the cost of 2500 pounds.
29. At \$6 a ton, find the cost of 2250 pounds.
30. At \$60 a ton, find the cost of 2250 pounds.

1. Express in decimal form one-tenth of —

A yard in inches.	A peck in pints.
A foot in inches.	A peck in quarts.
A yard in feet.	A bushel in pints.
A quart in pints.	A bushel in quarts.
2. Express $\frac{1}{2}$ as a decimal and as a per cent.
3. Express $\frac{1}{4}$ as a decimal and as a per cent.
4. Express $\frac{1}{10}$ as a decimal and as a per cent.
5. How many tenths in $\frac{1}{5}$? In $\frac{2}{5}$? In $\frac{3}{5}$?
6. Express $\frac{1}{5}$ as a decimal, in tenths.
7. What part of 100 is 20? How many hundredths?
8. Express one-fifth as a decimal in hundredths.
9. At \$50 an acre, what will 2 acres cost? One-tenth of an acre? Five-tenths of an acre? 2.5 acres?
10. At \$150 an acre, what will 2.2 acres cost?

What will be the cost of —

11. 12 combs at \$.25 each?
12. 6 quires of paper at \$.10 a quire?
13. 8.5 pounds of meat at \$.12 a pound?
14. \$15 is ... per cent of \$ 60 and ... per cent of \$150
15. \$ 5 is ... per cent of \$ 20 and ... per cent of \$ 25
16. \$20 is 50 per cent of \$... and 20 per cent of \$...
17. \$15 is ... per cent of \$ 45 and 20 per cent of \$...
18. \$50 is ... per cent of \$100 and ... per cent of \$150
19. \$40 is ... per cent of \$120 and ... per cent of \$200
20. ... is 75 per cent of \$ 12 and 50 per cent of \$...
21. ... is 25 per cent of \$240 and 10 per cent of \$...
22. 100 yards is per cent of 300 yards and 20 per cent of feet.
23. 8 yards is per cent of 40 yards and 50 per cent of ...

1. How many tenths of a foot are 3 times .2 of a foot?
How many in 4 times .2? .3? .4? .5? .6?

2. How many are 7 times .4? 7 times .03? 9 times .04?
12 times .6?

3. How many are $5 \times .1$? $7 \times .7$? $9 \times .05$? $9 \times .08$?

4. How many are $.2 \times .3$? $.04 \times .02$? $.02 \times .02$?

5. Find the product of $.4 \times .9$; $.3 \times .04$; $.05 \times .05$.

6. 2.5 are how many tenths? 2.5 are how many times .5?

7. If 1 yard of cloth costs \$.70, what will be the cost of
5 yards?

8. Find the cost of .02 of a ton of straw at \$5 a ton.

9. What will .5 of an article cost, if the entire article
costs \$.20?

10. How many .3 of a dollar are there in .9 of a dollar?
In .8, how many .2? How many .5 are there in 20 tenths?
In 12 tenths, how many .3? How many .7 in 4.9? In 5.6,
how many .8? How many .05 in .45? In .72, how many .08?

11. Divide \$9 among some boys so as to give each boy
\$.3. How many boys required?

12. If a ton of coal costs \$5.60, what does .8 of it cost?
.08 of it? .7? .07?

13. At \$2.20 each, what will 2 hats cost? 3? 4? 7?

14. At .5 of a dollar each, how many books may be
bought for \$5? \$15? \$18? \$25?

15. Divide .24 of a pound of candy among 3 boys.
What is the share of each?

16. Divide .49 by 7. By .7. By .07.

17. Divide .40 by 5. By .4. By .04. By 2.

Divide —

18.	19.	20.	21.	22.
2) <u>1.2</u>	3) <u>1.5</u>	4) <u>2.4</u>	5) <u>2.5</u>	6) <u>3.0</u>

1. How many square rods in $12\frac{1}{2}\%$ of an acre?
2. How many hours in $33\frac{1}{3}\%$ of a day?
3. How many days in .5 of 2 weeks?
4. How many inches in .25 of a yard?
5. How many feet in $2.66\frac{2}{3}$ yards?
6. How many pints in 3.50 gallons?
7. How many days in $2.33\frac{1}{3}$ months?
8. How many pounds in 50% of a ton?
9. How many pecks in 1.5 bushel?
10. How many minutes in 1.5 hours?
11. How many minutes in 75% of an hour?
12. How many ounces in 2.5 pounds?
13. 40 yd. is 10% of yd. and % of 200 yd.
14. 8 oz. is % of 1 lb. and 10% of lb.
15. 12 oz. is % of 3 lb. and 50% of lb.
16. ... oz. is 75% of 1 lb. and % of 3 lb.
17. in. is 25% of 1 yd. and % of 1 ft.
18. in. is 50% of $\frac{1}{2}$ yd. and 20% of in.
19. 12 in. is of 1 yd. and of 48 in.
20. 8 in. is $33\frac{1}{3}\%$ of and % of 40.
21. days is 20% of 60 days and 25% of days.
22. 12 min. is % of 1 hour and 75% of min.
23. $.8 \div 4$ $.016 \div 8$ $1.08 \div 12$
24. $.125 \div 5$ $.0040 \div 20$ $.9 \div .3$
25. $.49 \div .07$ $.018 \div .006$ $1.250 \div 125$
26. $10.10 \div 1.5$ $1.25 - .3$ $16.04 \div 4$
27. $.008 \div 50$ $12.125 \div 2.5$ $.00015 \div .15$
28. $10 \div .1$ $10 \div .01$ $.01 \div 10$
29. $100 \div .001$ $10.10 \div .001$ $5 \div 25$
30. $36 \div 1.20$ $14 \div 70$ $160 \div 400$
31. What decimal is ten times the sum of five thousandths and five hundredths?

1. Add 6 and 18, 16 and 28, 36 and 78, 116 and 128.
2. Subtract 6 from 14, 16 from 44, 36 from 84.
3. Subtract 8 from 14, 18 from 44, 38 from 84.
4. Add 9 and 7, 19 and 17, 29 and 37, 129 and 127.
5. Subtract 9 from 36, 19 from 56, 29 from 86.
6. Subtract 7 from 26, 17 from 66, 27 from 96.
7. Add 2 and 19, 22 and 29, 52 and 69, 132 and 139.
8. Subtract 2 from 11, 12 from 31, 52 from 91.
9. Subtract 9 from 11, 19 from 41, 39 from 91.
10. Add 5 and 9, 15 and 19, 65 and 59, 125 and 139.
11. Subtract 5 from 24, 15 from 44, 75 from 104.
12. Subtract 9 from 24, 19 from 44, 79 from 104.
13. Add 70 and 80, 73 and 45, 72 and 76, 64 and 93.
14. Add 60 and 70, 67 and 35, 56 and 36, 92 and 57.
15. Subtract 60 from 130, 65 from 148, 36 from 129.
16. Subtract 70 from 240, 76 from 157, 47 from 138.
17. Add 80 and 90, 83 and 94, 154 and 282, 229 and 290.
18. Subtract 80 from 170, 90 from 170, 73 from 135.
19. Subtract 90 from 180, 85 from 266, 293 from 343.
20. Add 62 and 82, 236 and 182, 271 and 184, 595 and 373.
21. Subtract 70 from 130, 62 from 144, 282 from 418.
22. Add 64 and 75, 254 and 365, 472 and 253, 815 and 194.
23. Subtract 65 from 135, 254 from 619, 472 from 725.
24. Add 43 and 93, 167 and 361, 344 and 394, 568 and 361.
25. Subtract 52 from 135, 167 from 628, 383 from 837.
26. Add 76 and 53, 156 and 683, 496 and 263, 876 and 193.
27. Subtract 76 from 119, 43 from 119, 683 from 939.
28. Add 79 and 65, 239 and 385, 159 and 385, 379 and 385.
29. Subtract 79 from 174, 65 from 144, 385 from 624.

Find the results —

30. $.15 + 6 = \dots$ 31. $3 \times 2.5 = \dots$ 32. $2 + .15 \div .3 = \dots$

GRADED MENTAL ARITHMETIC.

1. Subtract 85 from 164, 275 from 344, 455 from 844.
2. Add 63 and 87, 173 and 97, 123 and 277, 443 and 455.
3. Subtract 63 from 150, 123 from 210, 87 from 150.
4. Subtract 54 from 150, 154 from 220, 267 from 1000.
5. Add 56 and 67, 166 and 187, 236 and 287.
6. Subtract 56 from 123, 156 from 343, 187 from 453.
7. Add 79 and 37, 159 and 156, 269 and 166.
8. Subtract 36 from 115, 78 from 125, 256 from 345.
9. Add 127 and 94, 237 and 184, 417 and 294.
10. Subtract 94 from 223, 134 from 423, 454 from 643.
10. Add 94 and 99, 124 and 189, 344 and 279.
12. Subtract 54 from 113, 94 from 163, 264 from 483.
13. Add 65 and 147, 135 and 187, 245 and 377.
14. Subtract 65 from 112, 145 from 212, 255 from 343.
15. Subtract 47 from 112, 147 from 222, 257 from 442.
16. Add 36 and 188, 156 and 258, 366 and 448.
17. Subtract 46 from 144, 156 from 324, 246 from 434.
18. Subtract 58 from 144, 148 from 324, 258 from 434.
19. Add 47 and 48, 67 and 98, 117 and 208, 387 and 488.

In adding columns of two figures, add the tens, then the units. The first column below is added thus: 41, 43, 63, 66, etc.

Add by columns and lines—

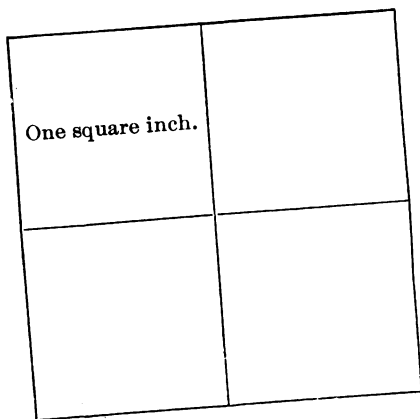
	20.	21.	22.	23.	24.	25.
26.	21	31	41	61	71	81
27.	22	32	42	62	72	82
28.	23	33	43	63	73	83
29.	42	53	34	54	64	74
30.	35	36	56	72	55	85
31.	64	64	67	83	46	96
32.	36	58	73	29	73	17
		47	48	88	28	28

1. Add 14 and 16, 24 and 26, 14 and 86, 214 and 316.
2. Subtract 16 from 30, from 50, from 160, from 660.
3. Add 18 and 15, 28 and 35, 118 and 225, 168 and 115.
4. Subtract 5 from 23, 25 from 53, 45 from 93.
5. Subtract 8 from 23, 28 from 53, 48 from 93.
6. Add 17 and 14, 27 and 24, 37 and 54, 117 and 124.
7. Subtract 17 from 31, 27 from 51, 57 from 91.
8. Subtract 14 from 41, 34 from 61, 74 from 91.
9. Add 16 and 26, 36 and 86, 126 and 236, 236 and 346.
10. Subtract 16 from 22, 36 from 52, 16 from 102.
11. Add 17 and 18, 27 and 28, 57 and 68, 127 and 129.
12. Subtract 7 from 15, 17 from 55, 87 from 105.
13. Subtract 8 from 15, 18 from 45, 78 from 105.
14. Add 9 and 14, 19 and 24, 36 and 64, 129 and 244.
15. Subtract 9 from 23, 16 from 43, 69 from 123.
16. Subtract 4 from 23, 14 from 43, 64 from 123.

RAPID MENTAL WORK FOR DICTATION.

17. $12, -3, -5, +6, -7, +9, \times 2, +6, \div 3, +8 = \dots$
18. $3, \times 2, +4, \times 3, \div 5, +3, \times 2, \div 9, \times 4, -7, +5 = \dots$
19. $4, \times 3, +3, \div 5, +6, \times 2, +4, \div 11, +6, \times 2, +4 = \dots$
20. $7, \times 3, -5, \div 4, +1, \times 8, \div 10, \times 3, +2, \div 7, \times 10 = \dots$
21. $9, \times 6, -4, \div 10, +3, \times 4, +3, \div 7, +2, \times 4, -7 = \dots$
22. $6, \times 5, +5, \div 7, -5, +4, \times 10, +8, \div 6, -6, +12 = \dots$
23. $11, +5, \div 8, +5, \times 4, +5, \div 11, +5, \div 4, +5, +11 = \dots$
24. $21, \div 3, +3, \times 3, -3, \div 3, +3, \times 4, -4, \div 4, +4 = \dots$
25. $35, \div 5, +5, \times 5, -5, \div 5, +1, \div 6, +6, \times 6, -8 = \dots$
26. $60, -4, \div 7, +3, \times 4, -2, \div 6, +5, \times 6, \div 9, +2 = \dots$
27. $12, \times 5, +3, \div 9, \times 7, +5, \div 6, +1, \times 10, +8, \div 9 = \dots$
28. Make a problem requiring addition.
29. Make a problem requiring subtraction.
30. Make a problem requiring multiplication.
31. Make a problem requiring division.

1. A square 1 inch on each side is a square inch.
2. A square 2 inches on each side contains 4 square inches.



3. The square of a number is the number multiplied by itself.
4. The square of 2 is 4. The square of 3 is 9.
5. Draw a figure to show the square of 3.
6. Draw a figure to show the square of 4.

Use blocks to make a square.

From the square build a cube.

The cube of a number is the number multiplied by its square; thus the cube of 2 is $2 \times 2 \times 2$, or 8.

The square of 2 is also expressed, 2^2 .

The cube of 2 is also expressed, 2^3 .

The square of a number is called the *second power* of the number.

The cube of a number is called the *third power* of the number.

- | | |
|------------------------------|------------------------------------|
| 1. $3^2 + 4^2$ equal | 6. $3^2 \times 4^2$ equal |
| 2. $2^2 + 5^2$ equal | 7. $6^2 \times 2^2$ equal |
| 3. $4^2 + 6^2$ equal | 8. $4^2 \times 5^2$ equal |
| 4. $5^2 - 4^2$ equal | 9. $5^2 \times 3^2$ equal |
| 5. $6^2 - 3^2$ equal | 10. $6^2 \times 3^2$ equal |

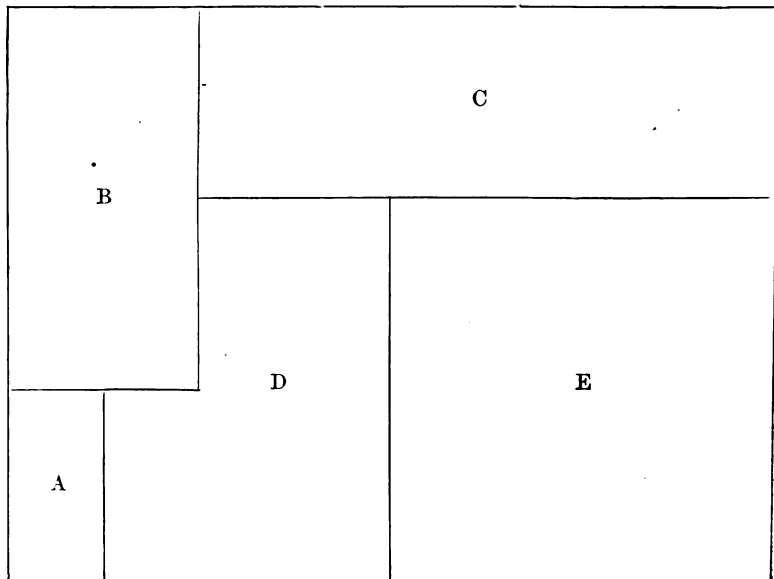
11. Arrange the squares and cubes of the digits in this form, and memorize, —

Digits:	2	3	4	5	6	7	8	9	10
Squares:	4	9	16	25	36	49	64	81	100
Cubes:	8	27	64	125	216	343	512	729	1000

12. How many sq. ft. in a sq. yd.? In $\frac{1}{8}$ of a sq. yd.?
13. Find the sum of 3 square feet and 3 feet square.
14. Find the sum of 4 square feet and 4 feet square.
15. Find the sum of 5 square feet and 5 feet square.
16. If a pile of 1-inch cubes is 4 inches long and 3 inches wide, how high must it be to contain 48 cubic inches?
17. How deep is a box 6 inches square if it contains 72 cubic inches?
18. How many square yards in a floor 24 feet by 18 feet?
19. How many cubic feet in a bin 10 feet long, 4 feet wide, and 6 feet high?
20. How many square feet in 8 square yards?

In a cellar 4 yards square and 6 feet deep —

21. How many square yards on the bottom?
22. How many square feet on the bottom?
23. How many square feet on each wall?
24. How many square yards on each wall?
25. How many 1-foot cubes will cover the bottom?
26. How many 1-foot cubes will fill the cellar?



4 inches.

1. Compare the area of B with that of A.
2. Compare the area of C with that of A.
3. Compare the area of D with that of A.
4. Compare the area of E with that of A.
5. Compare the area of D with that of B.
6. Compare the area of C with that of D.
7. Compare the area of C with that of B.
8. Compare the area of E with each of the other parts.
9. What part of the entire figure is each part?
10. What part of the entire figure is $A+B$?
11. What part of the entire figure is $D-A$?
12. What part of the entire figure is $B+C$?
13. What part of the entire figure is $C-A$?

FIFTH GRADE.

1. Add to 50 by 2's, beginning with 0; with 1.
2. Add to 50 by 3's, beginning with 0; with 1; with 2.
3. Add to 60 by 4's, beginning with 0; with 1; with 2; with 3.
4. Add to 60 by 5's, beginning with 0; with 1; with 2; with 3.
5. Add to 60 by 6's, beginning with 0; with 1; with 2; with 3.
6. Add to 70 by 7's, beginning with 0; with 1; with 2; with 3; with 4; with 5; with 6.
7. Add to 80 by 8's, beginning with 0; with 1; with 2; with 3; with 4; with 5; with 6; with 7.
8. Add to 90 by 9's, beginning with 0; with 1; with 2; with 3; with 4; with 5; with 6; with 7; with 8.
9. Subtract by 3's from 50 to 2; from 49 to 1.
10. Subtract by 4's from 50 to 2; from 49 to 1; from 48 to 0; from 47 to 3.
11. Subtract by 5's from 50 to 0; from 49 to 4; from 48 to 3.
12. Subtract by 6's from 50 to 2; from 49 to 1; from 48 to 0; from 47 to 5; from 46 to 4; from 45 to 3.
13. Subtract by 7's from 50 to 1; from 49 to 0; from 48 to 6; from 47 to 5; from 46 to 4; from 45 to 3; from 44 to 2.
14. Subtract by 8's from 50 to 2; from 49 to 1; from 48 to 0; from 47 to 7; from 46 to 6; from 45 to 5; from 44 to 4; from 43 to 3.
15. Subtract by 9's from 50 to 5; from 49 to 4; from 48 to 3; from 47 to 2; from 46 to 1; from 45 to 0; from 44 to 8; from 43 to 7; from 42 to 6.
16. A lady bought sugar for 10 cents and eggs for 12 cents, and gave the clerk 25 cents. How much change should she receive?
17. A boy who had 10 marbles bought 15 more, and he then lost 12. How many had he then?

1. If 6 men do a piece of work in 1 day, how long will it take 1 man to do it?
 2. A ton of hay lasts 8 horses for 6 days. How many days will it last 1 horse?
 3. If a bird flies 2 miles a minute, how far will it fly in an hour, at the same rate?
 4. At 10 cents a peck, what will 4 bushels of apples cost?
 5. Two men start at the same time, from the same place, to travel in opposite directions. One travels 4 miles an hour, the other travels 5 miles an hour. How far apart will they be in 6 hours?
 6. Two men were 100 miles apart. They traveled toward each other, one at the rate of 3 miles an hour, the other at the rate of 4 miles an hour. How far apart were they after traveling for 10 hours?
 7. Two men started in the same direction, from the same place, at the same time, one at the rate of 12 miles an hour, the other at the rate of 5 miles an hour. How far apart were they in 12 hours?
 8. Beginning with 7, add 6, subtract 3, multiply by 4, subtract 10, multiply by 3, add 8, subtract 18. What is the result?
- NOTE. — Pupils should practice on original drill problems like this one until they can perform the operations with speed and accuracy.
9. A man earns \$20 a week, and he spends \$6 a week. How much money will he save in 3 months?
 10. A boy left home on his bicycle at 8 o'clock in the morning riding 6 miles an hour. At 1 o'clock he turned, and rode toward home at the rate of 3 miles an hour. How far from home was he at 5 o'clock in the evening?
 11. A merchant has cloths worth \$2, \$3, and \$5 a yard. What will be the cost of 10 yards of each kind?
 12. A boy borrowed 25 cents from his father, and then earned 5 times as much. He then bought a cap for 75 cents, and a book for 50 cents. How much money had he left?
 13. Let each pupil make the multiplication table to 12×12 .

To multiply a whole number by 10, we annex one cipher to the multiplicand; to multiply by 100, we annex two ciphers; to multiply by 1,000, we annex three ciphers; and so on. Thus—

$$75 \times 10 = 750; 34 \times 100 = 3,400; 87 \times 1,000 = 87,000.$$

If the multiplicand is a decimal, move the decimal point as many places to the right as there are ciphers in the multiplier. If there are not as many decimal places in the multiplicand as ciphers in the multiplier, ciphers must be annexed to the multiplicand, that the point may be moved as required.

If the figure of the multiplier followed by ciphers is greater than 1, we first multiply the digits and then annex the ciphers.

What is the product of —

- | | |
|------------------|---------------------------|
| 1. 3 times 5? | 7. 5 multiplied by 3? |
| 2. 30 times 5? | 8. 5 multiplied by 30? |
| 3. 300 times 5? | 9. 5 multiplied by 300? |
| 4. 3 times 25? | 10. 25 multiplied by 3? |
| 5. 30 times 25? | 11. 25 multiplied by 30? |
| 6. 300 times 25? | 12. 25 multiplied by 300? |

Multiply —

- | | |
|---------------|------------------------|
| 13. 18 by 20 | 19. 8 by 700 |
| 14. 14 by 900 | 20. 8.756 by 10 |
| 15. 15 by 500 | 21. 356.4 by 100 |
| 16. 175 by 80 | 22. 89.657 by 1,000 |
| 17. 74 by 300 | 23. 843.96 by 10,000 |
| 18. 41 by 70 | 24. 362.748 by 100,000 |

In the following exercises find the "change":—

- | | | |
|--------------------|-------------------|---------------------|
| 25. \$10.00—\$2.14 | 30. \$5.00—\$1.90 | 35. \$40.00—\$23.18 |
| 26. \$15.00—\$2.13 | 31. \$1.00—\$0.45 | 36. \$25.00—\$15.65 |
| 27. \$30.00—\$9.94 | 32. \$2.00—\$1.20 | 37. \$20.00—\$13.21 |
| 28. \$10.00—\$7.16 | 33. \$2.00—\$1.03 | 38. \$15.00—\$11.15 |
| 29. \$20.00—\$2.95 | 34. \$7.00—\$2.65 | 39. \$50.00—\$22.68 |

1. If coal is \$3 a ton, how many tons can be bought for \$39?
2. If a horse goes 8 miles an hour, how long will it take him to go 72 miles?
3. Divide 48 apples equally among 6 boys. How many will each boy receive?

NOTE. — Each boy will receive $\frac{1}{6}$ of 48 apples, which is 8 apples.

4. How many years in 24 months? In 96 months?
5. How many quarts in 64 pints? In 64 gills?
6. How many peck-baskets can be filled from 60 quarts of nuts?
7. If a train runs 80 miles in 4 hours, how far will it run in 12 hours?
8. 6×8 are how many times 12?
9. 12×6 are how many times 8?
10. If you change 75 cents for dimes, how many will you get, and what will remain?
11. How many \$10 bills will pay for 24 pairs of shoes at \$2.50 a pair?
12. A newsboy sold 10 papers at 5 cents each, and 5 papers at 2 cents each. How many quarts of nuts could he buy with his money, at 6 cents a quart?
13. If 3 men do a piece of work in 10 days, how long will it take 6 men to do it?
14. A father is 42 years of age, which is 3 years more than 3 times his son's age. How old is the son?
15. The product of 3 numbers is 105. If two of the numbers are 3 and 5, what is the third?
16. A and B are 144 miles apart. How long will it take them to meet, if they travel toward each other, A at the rate of 5 miles an hour, and B at the rate of 7 miles an hour?
17. If 12 coats cost \$96, what will 4 coats cost?
18. If 10 bicycles cost \$350, what will 20 bicycles cost?
19. If 10 wagons cost \$400, what will 12 wagons cost?
20. How many feet in 8 times 15 inches? 6 times 10 feet?

FIFTH GRADE.

1. What is $\frac{1}{4}$ of 36? $\frac{1}{5}$ of 40? $\frac{1}{6}$ of 54?
2. What is $\frac{1}{7}$ of 63? $\frac{1}{8}$ of 72? $\frac{1}{9}$ of 81?
3. What is $\frac{1}{10}$ of 100? $\frac{2}{11}$ of 88? $\frac{3}{12}$ of 120?

Find—

- | | | |
|------------------------|------------------------|-------------------------|
| 4. $\frac{2}{3}$ of 72 | 7. $\frac{4}{9}$ of 54 | 10. $\frac{3}{4}$ of 32 |
| 5. $\frac{4}{9}$ of 36 | 8. $\frac{5}{6}$ of 42 | 11. $\frac{4}{9}$ of 27 |
| 6. $\frac{7}{8}$ of 48 | 9. $\frac{3}{5}$ of 45 | 12. $\frac{7}{8}$ of 32 |

Consider any problem in division; as, $24 \div 6 = 4$.

13. Multiply the dividend by 2. What is the effect on the quotient?

14. Multiply the divisor by 2. What is the effect on the quotient?

15. Multiply both dividend and divisor by 2. What is the effect on the quotient?

16. Divide the dividend by 2. What is the effect on the quotient?

17. Divide the divisor by 2. What is the effect on the quotient?

18. Divide both dividend and divisor by 2. What is the effect on the quotient?

19. If the dividend and divisor are like numbers, what kind of number will be the quotient? (Example.—24 apples divided by 4 apples.)

20. If the dividend is concrete, and the divisor is not, what kind of number will be the quotient? (Example.—Divide 24 apples by 4.)

21. How is the dividend found when the divisor and quotient are given?

22. What will 80 acres of land cost at \$25 per acre?

23. What will 800 acres cost at \$12 per acre?

24. What is the second power of 5?

25. What is the third power of 5?

State the rules and principles for the following problems, and illustrate each one by an example.

1. Given several numbers, to find their sum.
2. Given the sum of several numbers and all of them but one, to find that one.
3. Given the parts, to find the whole.
4. Given the whole and all the parts but one, to find that one.
5. Given the greater of two numbers and their difference, to find the less.
6. Given the less of two numbers and their difference, to find the greater.
7. Given the minuend and subtrahend, to find the remainder.
8. Given the minuend and remainder, to find the subtrahend.
9. Given the subtrahend and remainder, to find the minuend.
10. Given two numbers, to find their product.
11. Given the product and one of two factors, to find the other factor.
12. Given the multiplicand and multiplier, to find the product.
13. Given the product and multiplicand, to find the multiplier.
14. Given the product and multiplier, to find the multiplicand.
15. Given the divisor and dividend, to find the quotient.
16. Given the divisor and quotient, to find the dividend.
17. Given the dividend and quotient, to find the divisor.

$$18. 21 - 9 + (4 \times 3) = ?$$

$$19. (27 + 9 \div 12) \times (14 - 8) = ?$$

$$20. (11 \times 8 - 16) \div 9 = ?$$

$$21. 72 - (30 \div 5 + 30) = ?$$

$$22. (15 + 25 - 23) \times 2 = ?$$

$$23. 56 - 16 \div 10 \div 10 = ?$$

$$24. (72 \div 9) \times (75 + 25) = ?$$

$$25. 100 - (11 \times 5) \div 5 = ?$$

Tell how many 8's, and what remainder, —

$$26. \text{ In } 29, 49, 69, 19, 39, 59, \text{ and } 79.$$

$$27. \text{ In } 40, 60, 10, 30, 50, 70, \text{ and } 9.$$

Tell how many 7's, and what remainder, —

$$28. \text{ In } 47, 67, 17, 37, 57, \text{ and } 27.$$

$$29. \text{ In } 62, 12, 32, 52, 42, \text{ and } 22.$$

How many —

1. Pints in 2 quarts? In $4\frac{1}{2}$ quarts? In a peck?
2. Pecks in $\frac{1}{2}$ bushel? In 4 bushels? In 8 quarts? In 16 quarts?
3. Quarts in 2 pecks? In 1 bushel? In 20 pints? In 40 pints?
4. Inches in $\frac{1}{2}$ foot? In 3 feet? In 1 yard? In $2\frac{1}{2}$ feet?
5. Feet in 24 inches? In 30 inches? In 6 inches? In $2\frac{1}{2}$ yards?
6. Pints in 1 peck, 2 quarts? In 2 pecks, 1 quart?
7. Minutes in 1 hour? In $\frac{1}{2}$ hour? In $\frac{1}{4}$ hour? In 3 hours?
8. Hours in $\frac{1}{2}$ day? In 3 days? In $\frac{1}{2}$ week? In 1 week?
9. Hours in $\frac{3}{4}$ of a day? In $\frac{2}{3}$ of a day? In 30 minutes? In 180 minutes?
10. Quarts in 2 bushels, 2 pecks, 2 quarts?
11. Bushels in 64 quarts? In 26 pecks?
12. Ounces in 1 pound avoirdupois? In 3 pounds? In $\frac{1}{2}$ pound? In $1\frac{1}{2}$ pounds?
13. Pounds in 32 ounces avoirdupois? In 8 ounces? In 40 ounces? In 12 ounces?
14. Cents in 2 dollars? In $\frac{1}{2}$ dollar? In $\frac{1}{4}$ dollar? In $\frac{1}{5}$ dollar? In $\frac{3}{4}$ dollar? In $\frac{4}{5}$ dollar?
15. How many yards around a room 9 feet square?
16. How many rods around a lot $5\frac{1}{2}$ rods wide and $8\frac{1}{2}$ rods long?
17. What is the cost of 2 pounds, 8 ounces of butter at 20 cents a pound?
18. $2\frac{1}{2}$ pounds of tea are how many times 4 ounces?
19. What is the cost of 3 bushels, 2 pecks of corn, at 30 cents a bushel?
20. Find the sum of 2 quarts, 1 pint, and 4 quarts, 1 pint.
21. Find the difference between 4 yards 2 feet and 1 yard 1 foot.
22. Multiply 10 minutes 20 seconds by 3. Multiply 2 feet 6 inches by 2; by 3.

Read the following decimals: —

1. .003	6. .314	11. .0320	16. .0008
2. .07	7. .105	12. .08	17. 7.6534
3. .000123	8. .0105	13. .060	18. 14.8765
4. .005	9. .0035	14. .240	19. 0.31459
5. .032	10. .0009	15. .1250	20. 7.64328

21. Multiply .4 by 6.

SOLUTION.

.4 The multiplication of decimals does not differ from
6 the multiplication of integers, except in the use of the
2.4 decimal point. As in integers, 6 times 4 tenths are 24
tenths. Reduced to the next higher order, it is read 2
and 4 tenths. As many decimal places are pointed off in the
product as are in the multiplicand.

22. Multiply .4 by .6.

SOLUTION.

.4 If the 6 were an integer, the product would be 2.4; but .6
.6 is one-tenth as large as 6, and the product is therefore one-
.24 tenth as large as 2.4, which is found by removing the deci-
mal point one place to the left. As many decimal places
are pointed off as are in both multiplier and multiplicand.

Multiply —

23. .75 by 3; 7.5 by 3; 7.5 by .3; 75 by .03.

24. 24 by .3; .24 by 3; 2.4 by .3; 24 by .03.

25. Multiply .75 by .03.

SOLUTION.

.75 By multiplying by 3 as an integer, the product is 2.25.
.03 But as the multiplier is one-hundredth of 3, the product
.0225 is found by moving the decimal point two places to the

FIFTH GRADE.

Since, in multiplication of decimals, the product must have as many decimal places as are in both the multiplier and multiplicand, it follows that in division of decimals the dividend must contain as many decimal places as are in both divisor and quotient.

1. Divide .6 by 6; .6 by .6.
2. Divide 3.6 by 6; by .6.
3. Divide .36 by .3; by .2; by .4.
4. Divide .036 by 4; by .4; by .04; by .004.
5. Divide .4 by 8; 2 by .5; .48 by .06; .16 by .4.
6. Divide 6 by .5; 3 by .5; 4.9 by .07; .21 by 7.
7. Divide .8 by 4; 7.2 by .09; 6.3 by 90; 35 by .07.
8. Divide 15 by .1; by .001; by 100; by 1000.
9. Divide .05 by 1; by .01; by 50; by 1000.
10. In what does multiplication of decimals differ from multiplication of integers? Illustrate by example.
11. If the multiplier is an integer, how many decimal places are in the product?
12. If the multiplier is a decimal, how many decimal places are in the product?
13. How is the product written when there are not as many figures as the required number of decimal places? Illustrate by example.
14. Explain how to divide by 10; by 100; by 1000.
15. In what does division of decimals differ from division of integers?
16. How many decimal places must be in the quotient?
17. When are ciphers prefixed to the quotient?
18. When are ciphers annexed to the quotient?

A *decimal* is a number of tenths, hundredths, thousandths, etc. or a fraction whose denominator is 10 or some power of 10.

The denominator of a decimal fraction is indicated by a point written at the left of the numerator; thus, $.5 = \frac{5}{10}$; $.05 = \frac{5}{100}$. The point is called a decimal point, or separator.

GRADED MENTAL ARITHMETIC.

1. What two numbers multiplied together make 6?
2. What make 12? 15? 21? 35? 49?
3. What factors compose 63? 36? 81? 39?
4. What factors are common to 14 and 35?
5. What are the factors of 11? 15? 17? 19?
6. What numbers under 20 have no factors?
7. What numbers from 20 to 40 have no factors?
8. What are the common factors of 18 and 24?
9. What is the largest common factor of 18 and 24?
10. What is the largest common factor of 15, 30, and 45?
11. What is the largest common factor of 24, 36, and 48?
12. What is the largest common factor of 50, 75, and 60?
13. What is the smallest number having both 5 and 6 as factors? 4 and 6? 3 and 7?
14. Find the least common multiple of 6, 8, and 12.
15. Find the least common multiple of 10, 25, and 100.
16. Find the least common multiple of 24, 36, and 18.
17. Find the least common multiple of 16, 24, and 12.
18. Divide the product of 72 and 25 by 45.

SOLUTION.

$$\frac{72 \times 25}{45} = \frac{8 \times 9 \times 5 \times 5}{9 \times 5}$$

Find the factors of the numbers composing the dividend, and also of the divisor. Cancel the common factors, and find the product of the remaining factors.

19. Divide $2 \times 3 \times 4$ by 6.
20. Divide $2 \times 5 \times 7$ by 10.
21. Divide $3 \times 4 \times 5$ by 12.
22. Divide $4 \times 5 \times 7$ by 14.
23. Divide $5 \times 6 \times 7$ by 15.

24. Divide $3 \times 6 \times 6$ by 27.
25. Divide $5 \times 8 \times 3$ by 12.
26. Divide $7 \times 3 \times 8$ by 21.
27. Divide $7 \times 8 \times 9$ by 12.
28. Divide $3 \times 7 \times 9$ by 27.

29. Divide 30×42 by $5 \times 7 \times 6$.
30. Divide 21×33 by $11 \times 7 \times 3$.
31. Divide $5 \times 18 \times 49$ by 7×9 .

FIFTH GRADE.

1. How many fifths in 3?

SOLUTION.

A unit, or 1 whole thing, = $\frac{5}{5}$. 3 units = $3 \times \frac{5}{5}$, or $\frac{15}{5}$.

2. How many tenths in 8? In 9? In 10?

3. How many fifths in $4\frac{1}{5}$? In $5\frac{1}{5}$? In $6\frac{3}{5}$?

4. Reduce to improper fractions, $4\frac{1}{6}$, $6\frac{5}{6}$, $7\frac{2}{7}$, $6\frac{7}{8}$, $8\frac{3}{8}$, $12\frac{1}{2}$, $16\frac{3}{4}$, 6

5. A wheelman goes $16\frac{3}{4}$ miles an hour. How far does he go in $\frac{1}{5}$ of an hour? In $\frac{1}{2}$ hour? In 3 hours?

6. If three persons share equally $\$4\frac{1}{2}$, how much does each receive?

7. If nine persons earn $\$7\frac{1}{5}$ in a day, how much will 6 persons earn in a day?

8. A workman earned $\$2\frac{1}{5}$ in 17 hours. How much did he earn in 1 hour?

9. A man hired some boys to work for one day, and paid each of them $\$1\frac{1}{4}$. He paid out to all of them $\$9\frac{3}{4}$. How many boys were there?

10. What denominator is written below a whole number? How do you express it in a fractional form?

11. How is the fraction changed to another denominator?

12. In changing a mixed number to an improper fraction, what is done with the numerator of the given fraction?

13. How many bushels in 17 pecks?

SOLUTION.

1 peck = $\frac{1}{4}$ bushel.

17 pecks = $17 \times \frac{1}{4}$ bushels, or $\frac{17}{4}$ bushels.

$\frac{17}{4}$ bushels = $4\frac{1}{4}$ bushels.

14. How many feet in 37 in.? In 45 in.? In 64 in.?

15. At $\$1\frac{1}{2}$ a bushel, how much will 4 bushels cost?

1. Change $\frac{4}{3}$ to twelfths.

SOLUTION.

To change 4 to 12, it must be multiplied by 3.

To preserve the same value of the fraction, the numerator must also be multiplied by 3.

2. Change $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{5}$, and $\frac{2}{10}$ to fortieths.
 3. Change $\frac{1}{2}$, $\frac{2}{3}$, $\frac{5}{6}$, and $\frac{1}{9}$ to eightieths.
 4. Reduce $\frac{2}{3}$, $\frac{5}{6}$, $\frac{2}{5}$, and $\frac{7}{15}$ to thirtieths.
 5. Reduce $\frac{1}{8}$, $\frac{4}{5}$, $\frac{3}{10}$, and $\frac{3}{20}$ to fortieths.
 6. Reduce $\frac{1}{5}$, $\frac{7}{8}$, $\frac{5}{16}$, and $\frac{7}{20}$ to eightieths.

7. To what common denominators can $\frac{1}{2}$ and $\frac{1}{3}$ be reduced?

Reduce to least common denominator —

8. $\frac{1}{3}$ and $\frac{1}{4}$
 9. $\frac{1}{4}$ and $\frac{1}{6}$
 10. $\frac{2}{3}$ and $\frac{5}{8}$
 11. $\frac{3}{5}$ and $\frac{6}{8}$
 12. $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$
 13. $\frac{1}{3}$, $\frac{1}{5}$, and $\frac{1}{6}$
 14. $\frac{3}{4}$, $\frac{4}{7}$, and $\frac{5}{12}$
 15. $\frac{5}{14}$, $\frac{3}{7}$, and $\frac{1}{21}$
 16. $\frac{3}{4}$, $\frac{5}{16}$, and $\frac{9}{32}$
 17. $\frac{1}{3}$, $\frac{5}{21}$, and $\frac{1}{14}$

18. $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{1}{6}$
 19. $\frac{2}{3}$, $\frac{4}{5}$, and $\frac{7}{10}$
 20. $\frac{3}{8}$, $\frac{4}{9}$, and $\frac{5}{12}$
 21. $\frac{2}{3}$, $\frac{3}{8}$, and $\frac{5}{12}$
 22. $\frac{3}{10}$, $\frac{5}{12}$, and $\frac{7}{15}$
 23. $\frac{1}{8}$, $\frac{2}{3}$, and $\frac{3}{4}$
 24. $\frac{3}{8}$, $\frac{5}{12}$, and $\frac{7}{24}$
 25. $\frac{7}{15}$, $\frac{2}{5}$, and $\frac{7}{30}$
 26. $\frac{8}{11}$, $\frac{3}{22}$, and $\frac{5}{33}$
 27. $\frac{5}{12}$, $\frac{7}{6}$, and $\frac{3}{8}$

28. Change $\frac{12}{16}$ to lowest terms.

SOLUTION.

Dividing both terms by 2, and the result by 2 again, the resulting fraction is $\frac{3}{4}$. These terms have no common divisor, and hence are the *lowest* terms of the fraction. Illustrate by a square or a line on the blackboard, divided into fourths and sixteenths.

Reduce to lowest terms —

29. $\frac{10}{15}$ and $\frac{10}{16}$

31. $\frac{35}{49}$ and $\frac{39}{60}$
 32. $\frac{77}{88}$ and $\frac{64}{96}$

33. $\frac{45}{84}$, $\frac{42}{90}$, and $\frac{32}{63}$
 34. $\frac{40}{96}$, $\frac{63}{72}$, and $\frac{68}{98}$

1. Three-fifths and two-fifths and four-fifths are how many fifths?
2. $\frac{2}{9} + \frac{4}{9} + \frac{5}{9} = ?$
3. $\frac{1}{2} + \frac{2}{4} + \frac{2}{4} + \frac{4}{4} = ?$
4. Find the sum of $\frac{1}{2}$ and $\frac{2}{3}$.

SOLUTION.

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

$$\frac{2}{3} = \frac{4}{6}$$

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

Find the sum of—

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

8. $\frac{2}{3}$ and $\frac{4}{5}$

11. $\frac{3}{4}$ and $\frac{5}{7}$

14. $\frac{2}{5}$ and $\frac{5}{8}$

6. $\frac{1}{2}$ and $\frac{1}{10}$

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

12. $\frac{3}{4}$ and $\frac{2}{9}$

15. $\frac{2}{5}$ and $\frac{5}{9}$

7. $\frac{1}{2}$ and $\frac{1}{11}$

10. $\frac{3}{4}$ and $\frac{5}{6}$

13. $\frac{2}{5}$ and $\frac{5}{7}$

16. $\frac{5}{6}$ and $\frac{4}{7}$

17. Find the sum of $2\frac{1}{2}$ and $3\frac{1}{3}$.

NOTE.—Add the integer and fractions separately, then add the two sums; or, reduce the fractions to improper fractions, and add as in proper fractions.

What is the sum of—

18. $2\frac{1}{3}$ and $3\frac{2}{3}$

21. $5\frac{1}{5}$ and $4\frac{2}{7}$

24. $10\frac{1}{6}$ and $5\frac{3}{8}$

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

22. $7\frac{3}{5}$ and $1\frac{8}{9}$

25. $6\frac{1}{7}$ and $8\frac{7}{8}$

20. $5\frac{1}{3}$ and $3\frac{1}{6}$

23. $8\frac{1}{6}$ and $9\frac{5}{7}$

26. $12\frac{1}{8}$ and $12\frac{1}{9}$

27. A triangular piece of land had sides $8\frac{1}{2}$ rods, $6\frac{1}{3}$ rods, and $7\frac{1}{4}$ rods in length. How many rods around the land?

28. A coat cost $\$22\frac{1}{2}$ dollars, a vest cost $\$8\frac{1}{2}$, and trousers cost \$11. What did the whole suit cost?

29. A lady went shopping, and spent at one store $\$4\frac{3}{4}$, at a second store $\$5\frac{1}{2}$, and at a third store $\$2\frac{1}{4}$. How much did she spend at the three stores?

30. A traveler walked $23\frac{1}{3}$ miles one day, $15\frac{1}{2}$ miles another day, and $10\frac{1}{4}$ miles the third day. How many miles did he walk in the three days?

1. A man owned $\frac{7}{8}$ of a mill and sold $\frac{5}{8}$ of it. What part of the mill did he still own?

2. A boy had a dollar and spent $\frac{3}{5}$ of it. How much did he then have?

SOLUTION.

In \$1 there are $\frac{5}{5}$.

$$\frac{5}{5} - \frac{3}{5} = \frac{2}{5}$$

3. Find the difference between $\frac{2}{3}$ and $\frac{3}{5}$.

SOLUTION.

$$\frac{2}{3} = \frac{10}{15}$$

$$\frac{3}{5} = \frac{9}{15}$$

$$\frac{10}{15} - \frac{9}{15} = \frac{1}{15}$$

Find the difference between—

4. $\frac{3}{4}$ and $\frac{2}{5}$

8. $\frac{8}{9}$ and $\frac{9}{11}$

12. $4\frac{1}{4}$ and $3\frac{1}{3}$

5. $\frac{4}{5}$ and $\frac{4}{7}$

9. $\frac{8}{11}$ and $\frac{11}{12}$

13. $5\frac{1}{2}$ and $4\frac{1}{5}$

6. $\frac{3}{4}$ and $\frac{8}{9}$

10. $2\frac{1}{2}$ and $1\frac{1}{3}$

14. $4\frac{1}{5}$ and $3\frac{1}{6}$

7. $\frac{8}{9}$ and $\frac{9}{10}$

11. $3\frac{1}{3}$ and $2\frac{1}{4}$

15. $3\frac{1}{3}$ and $2\frac{3}{4}$

16. Find the difference between $54\frac{2}{7}$ and $31\frac{3}{5}$.

SOLUTION.

The subtrahend fraction being larger, a unit is taken from the 4 and added to $\frac{10}{35}$.

$$\frac{35}{35} + \frac{10}{35} = \frac{45}{35}$$

$$\frac{45}{35} - \frac{21}{35} = \frac{24}{35}$$

$$54\frac{2}{7} = 54\frac{10}{35}$$

$$31\frac{3}{5} = 31\frac{21}{35}$$

The complete remainder is found to be

$$22\frac{24}{35}$$

17. $346\frac{2}{3} - 42\frac{1}{4} = \dots$ 19. $212\frac{1}{2} - 112\frac{1}{3} = \dots$ 21. $291\frac{1}{3} - 14\frac{2}{5} = \dots$

18. $422\frac{1}{2} - 13\frac{3}{5} = \dots$ 20. $423\frac{1}{4} - 314\frac{1}{2} = \dots$ 22. $363\frac{3}{4} - 18\frac{1}{2} = \dots$

Add the lines and the columns—

23. $\frac{2}{3} + \frac{4}{5} + \frac{5}{6} + \frac{3}{8} = \dots$

$$\frac{4}{7} + \frac{3}{4} + \frac{1}{5} + \frac{1}{6} =$$

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

$$\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} =$$

1. $\frac{1}{5} + \frac{1}{5} + \frac{1}{5} = ?$ What is $3 \times \frac{1}{5}$?

2. What is $5 \times \frac{2}{7}$?

SOLUTION.

$$5 \times \frac{2}{7} = \frac{10}{7}, \text{ or } 1\frac{3}{7}$$

3. What is $4 \times \frac{3}{16}$?

SOLUTION.

$$4 \times \frac{3}{16} = \frac{12}{16}, \text{ or } \frac{3}{4}.$$

Or, by dividing the denominator, $4 \times \frac{3}{16} = \frac{4}{4} = 1$.

4. Find $3 \times \frac{5}{18}$; $4 \times \frac{9}{16}$; $5 \times \frac{3}{20}$.

5. Find $6 \times 3\frac{1}{2}$.

SOLUTION.

$$6 \times 3 = 18$$

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

$$18 + 3 = 21$$

6. Find $4 \times 4\frac{5}{8}$; $5 \times 4\frac{7}{10}$; $6 \times 9\frac{1}{2}$.

What is the cost of—

7. 10 pounds of sugar at $5\frac{1}{2}$ cents a pound?

8. 6 blank books at $12\frac{1}{2}$ cents each?

9. 11 yards of ribbon at $6\frac{1}{4}$ cents a yard?

10. 10 sheep at $\$3\frac{1}{2}$ a head?

11. 10 tons of hay at $\$12\frac{1}{2}$ a ton?

12. 6 dozen oranges at $16\frac{2}{3}$ cents a dozen?

13. 5 acres of land at $\$42\frac{2}{3}$ an acre?

14. 12 hats at $\$3\frac{3}{4}$ apiece?

15. 10 cords of wood at $\$3\frac{1}{4}$ a cord?

16. At 90 cents a pound, what will $\frac{2}{3}$ of a pound of tea cost?

SOLUTION.

$$\frac{1}{3} \text{ of a pound will cost } \frac{1}{3} \text{ of 90 cents, or 30 cents.}$$

$$\frac{2}{3} \text{ of a pound will cost 2 times 30 cents, or 60 cents.}$$

1. Show by illustration that $\frac{3}{10}$ is the result of dividing $\frac{9}{10}$ by 3.
2. Divide $2\frac{1}{7}$ by 5.

SOLUTION.

$$2\frac{1}{7} = \frac{15}{7}$$

$$\frac{1}{5} \text{ of } \frac{15}{7} = \frac{3}{7}$$

3. What is the cost of 1 ton of coal, if 7 tons cost \$31 $\frac{1}{2}$?
4. If 10 barrels of fruit cost \$37 $\frac{1}{2}$, what is the cost of 1 barrel?
5. If 7 men can mow 11 $\frac{2}{3}$ acres in a day, how many acres can 1 man mow in a day?
6. A boy earned \$9 $\frac{2}{3}$ in 12 days. How much did he earn in a day?
7. If a boy earns \$3 $\frac{1}{3}$ dollars a day, how many days will be required to earn \$10?
8. At \$ $\frac{2}{7}$ a pound, how many pounds can be bought for \$10?
9. What is the cost of a ton of hay, if $\frac{5}{6}$ ton cost \$10?

SOLUTION.

$\frac{5}{6}$ ton cost \$12; $\frac{1}{6}$ costs . . . ; $\frac{6}{6}$ cost . . .

10. How many coats can be made from 30 yards of cloth, if one coat requires 2 $\frac{1}{2}$ yards?
11. If 1 arithmetic costs \$ $\frac{2}{3}$, how many arithmetics can be bought for \$ $\frac{8}{3}$?

SOLUTION.

As many as $\frac{2}{3}$ are contained times in $\frac{8}{3}$; or 4 arithmetics.

12. Divide $\frac{3}{4}$ by $\frac{5}{6}$.

SOLUTION.

The divisor is $\frac{5}{6}$ of 1, or $\frac{1}{6}$ of 5. Dividing $\frac{3}{4}$ by 5 gives $\frac{3}{20}$. But the divisor is $\frac{1}{6}$ of 5. Having divided by a divisor 6 times the true divisor, the quotient is only $\frac{1}{6}$ as large as it ought to be. Hence, multiply by 6 to obtain the true quotient. It is observed

1. *Quantity*, in business transactions, is the amount of any thing considered, or of any commodity bought or sold.
2. *Price* is the value in money of *one*, or of a *given unit* of any commodity.
3. *Cost* is the value in money of the *entire quantity* bought or sold.
4. An *aliquot part* of a number is an exact divisor of that number; or, it is *one* of the *equal parts* of the number.
5. When comparisons are made with 100, the operation is called *percentage*, and the part is called a certain *per cent* of the whole.

Per cent means *by the hundred*. The whole of a number is called 100 per cent of that number; and just as $\frac{1}{2}$ of a dollar is 50 cents, so $\frac{1}{2}$ of any number is 50 per cent of that number.

Per cent is indicated by the sign %. This is but another method of expressing *hundredths*, which may be expressed by a *decimal*, a *common fraction*, or by the term *per cent*, indicated by the sign %. Pupils will understand the application of percentage when they note that their standing in their class is indicated by 80%, 90%, etc., when a perfect record is indicated by 100. Often the given *per cent* or *decimal* may be changed to a common fraction, and the work becomes easier and shorter.

This is of special value in business transactions involving the use of aliquot parts of a dollar, as shown by the following:—

TABLE.

100 % of a dollar	= \$1.00.
50 % of a dollar	= \$.50 = $\frac{1}{2}$ of a dollar.
$33\frac{1}{3}$ % of a dollar	= \$.33 $\frac{1}{3}$ = $\frac{1}{3}$ of a dollar.
$66\frac{2}{3}$ % of a dollar	= \$.66 $\frac{2}{3}$ = $\frac{2}{3}$ of a dollar.
25 % of a dollar	= \$.25 = $\frac{1}{4}$ of a dollar.
75 % of a dollar	= \$.75 = $\frac{3}{4}$ of a dollar.
20 % of a dollar	= \$.20 = $\frac{1}{5}$ of a dollar.
40 % of a dollar	= \$.40 = $\frac{2}{5}$ of a dollar.
60 % of a dollar	= \$.60 = $\frac{3}{5}$ of a dollar.
80 % of a dollar	= \$.80 = $\frac{4}{5}$ of a dollar.

1. At 20 cents a foot, what will it cost to dig a ditch 400 feet long?

SOLUTION.

20 cents = $\frac{1}{5}$ of a dollar.

If 1 foot costs $\frac{1}{5}$ of a dollar,

400 feet will cost 400 times $\frac{1}{5}$ of a dollar, or \$80.

2. A bin of wheat contained 40 bushels. It was sold at \$.25 a bushel. What was received for it?

SOLUTION.

\$.25 = $\frac{1}{4}$ of a dollar.

If one bushel is worth $\frac{1}{4}$ of a dollar,

40 bushels are worth 40 times $\frac{1}{4}$ of a dollar, or \$10.

3. If 25% of a yard of cloth is worth \$1, what is a yard worth?
4. Find the cost of 8 pounds of sugar at 25 cents a pound.
5. Find the cost of 8 yards of cloth at \$4.25 cents a yard.
6. What is $12\frac{1}{2}$ per cent of 320 pounds of butter?
7. Find the cost of 12 barrels of flour at \$5.50 a barrel.

Find the cost of—

8. 50 bushels of potatoes at 50 cents a bushel.
9. 50% of 48 yards at $12\frac{1}{2}$ cents a yard.
10. $12\frac{1}{2}$ % of 24 pounds at $33\frac{1}{3}$ cents a pound.
11. $33\frac{1}{3}$ % of 39 bushels at 50 cents a bushel.
12. 42 pounds of coffee at $16\frac{2}{3}$ cents a pound.
13. 150 first readers at 20 cents each.
14. 150 arithmetics at 40 cents each.
15. 15 bushels of wheat at $33\frac{1}{3}$ cents a bushel.
16. 20% of 40 pounds of coffee at 25 cents a pound.
17. 40% of 100 bushels of wheat at 25 cents a bushel.
18. 36 dozen eggs at $16\frac{2}{3}$ cents a dozen.
19. 50% of 50 yards of cloth at 50 cents a yard.

FIFTH GRADE.

1. At \$10 a ton, find the cost of 4,600 pounds of hay.

SOLUTION.

2,000 pounds = 1 ton, will cost \$10.00.

2,000 pounds = 1 ton, will cost 10.00.

500 pounds = $\frac{1}{4}$ ton, will cost 2.50.

100 pounds = $\frac{1}{20}$ ton, will cost .50.

4,600 pounds will cost \$23.00.

2. At \$16 a ton, find the cost of 2,250 pounds of hay.

3. At \$12 a ton, find the cost of 3,600 pounds of hay.

4. What will 100 pounds cost at \$4 a ton? At \$5 a ton? At \$6 a ton? At \$7 a ton? At \$8 a ton? At \$9 a ton?

5. At \$6 a ton, what is the cost of 2,200 pounds of hay?

SOLUTION.

2,000 pounds cost \$6.00.

200 pounds cost .60.

2,200 pounds cost \$6.60.

6. At \$8 a ton, find the cost of 2,700 lb. Of 3,300 lb.

7. At \$16 a ton, find the cost of 2,500 lb. Of 3,600 lb.

8. At \$5 a ton, find the cost of 2,260 pounds of coal.

SOLUTION.

2,000 pounds will cost \$5.00.

100 pounds will cost .25.

100 pounds will cost .25.

50 pounds will cost .125.

10 pounds will cost .025.

2,260 pounds will cost \$5.65.

9. At \$5.00 a ton, find the cost of 4,370 pounds of coal.

10. At \$4.50 a ton, find the cost of 3,600 pounds of coal.

GRADED MENTAL ARITHMETIC.

1. At 12 cents a lb., find the cost of 2 lb. 12 oz. of meat.
2. At 8 cents a lb., find the cost of 3 lb. 10 oz. of lard.
3. Find the cost of 25% of 1,200 bushels of wheat at 20 cents a bushel.

4. Find the cost of 24 cows at \$25 a head.

NOTE. — Since \$25 is $\frac{1}{4}$ of 100, multiply by 100 by annexing ciphers, and take $\frac{1}{4}$ of the product.

5. Find the cost of 32 boys' suits at \$12 $\frac{1}{2}$ each.
6. At \$20 each, find the cost of 45 bicycles.
7. What is the cost of 96 Winchester rifles at \$16 $\frac{3}{4}$ each?
8. At \$12 a thousand feet, what is the cost of 100 feet of lumber? Of 500 feet? Of 250 feet? Of 750 feet?
9. A dealer bought 40 silver watches. For 50 per cent of them he paid \$25 each; for 25 per cent of them he paid \$20 each; for the remainder he paid \$12 $\frac{1}{2}$ each. What did they all cost him?
10. Find the cost of 36 yards of cloth at 16 $\frac{3}{4}$ cents a yard.

SOLUTION.

16 $\frac{3}{4}$ = $\frac{1}{6}$ of a dollar.

If 1 yard costs $\frac{1}{6}$ dollar,

36 yards will cost $36 \times \frac{1}{6}$ dollar = \$6.

11. At 12 $\frac{1}{2}$ cents a pound, how much sugar can be bought for \$12?

SOLUTION.

At 12 $\frac{1}{2}$ cents a pound, \$1 will buy 8 pounds.
\$12 will buy 12×8 pounds, or 96 pounds.

12. Find the cost of 12 pairs of shoes at \$1.75 a pair.

SOLUTION.

The cost at \$1.00 a pair = \$12.

The cost at .50 a pair = 6.

The cost at .25 a pair = 3.

The cost at \$1.75 a pair = \$21.

1. Find the cost of 8 tons of hay, if 5 tons cost $\$52\frac{1}{2}$.
2. How far will Bertie walk in 5 hours, at the rate of $6\frac{2}{3}$ miles in 4 hours?
3. Find the cost of a ton of hay at the rate of $\frac{2}{3}$ of a ton for $\$4$.
4. How much will 7 barrels of flour cost at the rate of 2 barrels for $\$9\frac{1}{3}$?
5. If $\frac{3}{4}$ the cost of a coat is $\$9$, what will be the cost of 5 coats?
6. What will 1 yard of cloth cost at the rate of $\$16$ for $2\frac{2}{3}$ yards?
7. If $\frac{3}{4}$ of a barrel of flour costs $\$6$, what will be the cost of 12 barrels?
8. Find the cost of 8 hats, if 5 hats cost $\$11\frac{1}{4}$.
9. If 9 pounds of sugar costs 45 cents, what will $4\frac{2}{5}$ pounds cost?
10. If 12 pounds of beef cost $\$1.80$, what will be the cost of $5\frac{2}{3}$ pounds?
11. If 3 cords of wood cost $\$6\frac{2}{3}$, what will be the cost of 9 cords?
12. If $\frac{5}{8}$ of a man's age is 30 years, what is $\frac{4}{9}$ of his age?
13. Find the cost of 7 apples at the rate of 9 apples for $2\frac{1}{4}$ cents.
14. If $4\frac{1}{2}$ cents will buy 5 pencils, how many will 9 cents buy?
15. At the rate of 3 pounds of meat for 48 cents, how much will $3\frac{3}{8}$ pounds cost?
16. A boat went 22 miles in $3\frac{1}{7}$ hours. How far did it go in 5 hours?
17. Find the cost of $5\frac{3}{8}$ tons of hay, when $\frac{2}{3}$ of a ton costs $\$4\frac{2}{3}$.
18. Find the cost of 4 yards of calico, when $2\frac{1}{2}$ yards cost 20 cents.
19. If $3\frac{1}{4}$ quarts of meal cost 13 cents, find the cost of $5\frac{1}{2}$ quarts.
20. Twice 20 is $\frac{2}{3}$ of what number?
21. One-half of $\frac{4}{5}$ of Willie's money is $\$.60$. How much has he?
22. If $2\frac{1}{2}$ pounds of sugar cost 15 cents, what will be the cost $5\frac{1}{8}$ pounds?
23. What is $\frac{1}{3}$ of two times a number, if 8 is $\frac{2}{3}$ the number?
24. If a farmer's hay will last 4 horses for 10 weeks, how long will it last 5 horses?

1. A man owned $\frac{5}{8}$ of a store, and sold $\frac{3}{4}$ of his share. What part of the store did he sell?
2. Lowell had $\frac{4}{5}$ of a dollar, and gave Bertie $\frac{3}{10}$ of a dollar. What part of his money did he give away?
3. Bryant had $\frac{3}{4}$ of a dollar, and lost $\frac{1}{2}$ of a dollar. What part of his money remained?
4. A gardener had $\frac{5}{8}$ of an acre, and tilled all but $\frac{1}{8}$ of an acre. What part of his land did he till?
5. A man owned $\frac{2}{3}$ of a mill, and sold $\frac{1}{4}$ of his share. What part of the mill did he then own?
6. What will 6 oranges cost at the rate of 5 oranges for $12\frac{1}{2}$ cents?
7. If 12 men earn $\$16\frac{4}{5}$ a day, how much will 5 men earn in a day?
8. Find the cost of 10 pounds of tea at the rate of 7 pounds for $\$4\frac{1}{5}$.
9. $\$18$ is $\frac{2}{3}$ of the cost of a watch-chain, and the chain cost $\frac{1}{3}$ the cost of the watch. What was the cost of both?
10. A merchant had 40 yards of cloth and sold $\frac{3}{8}$ of it. How many yards remained?
11. How old will Bertie be in 4 years, if $\frac{2}{3}$ of his age now is 8 years?
12. A lady owed a grocer $\frac{3}{5}$ of a dollar, and gave him $\frac{1}{4}$ of a dollar. How much change should she get back?
13. Bryant had 36 cents. After spending $\frac{3}{4}$ of his money, his father gave him $\frac{2}{3}$ as much as he then had. How much money had he then?
14. $\frac{3}{5}$ of $\$40$ is 4 times what a gentleman gave for a picture. What did the picture cost?
15. Edwin has 27 marbles, and $\frac{2}{3}$ of that number equals $\frac{2}{5}$ of what Willie has. How many has Willie?
16. In an orchard of 80 fruit trees, $\frac{4}{10}$ are apple trees, $\frac{1}{2}$ of the remainder are pear trees, and the rest are plum trees. How many trees of each kind?

1. If $\frac{2}{3}$ of a man's age added to his age is 35 years, how old is he?

SOLUTION.

$\frac{2}{3}$ = his age.

$\frac{2}{3} + \frac{2}{3} = \frac{4}{3}$ of his age = 35 years.

$\frac{1}{3}$ of his age = $\frac{1}{4}$ of 35 years = 5 years.

$\frac{2}{3}$ of his age = 5 times 5 years, or 25 years.

Therefore, he is 25 years of age.

2. What number increased by its $\frac{1}{2}$ will be 48?
3. What number increased by its $\frac{2}{3}$ will be 120?
4. 3 times a number $\times \frac{2}{3}$ of the number equals 66. What is the number?
5. Albert's age doubled, and increased by $\frac{2}{3}$ of his age, equals 33 years. What is his age?
6. Albert's age diminished by its $\frac{1}{3}$ and its $\frac{1}{4}$ is 5 years. How old is he?
7. Leta's age increased by its $\frac{1}{2}$ and its $\frac{1}{3}$ is 11 years. How old is she?
8. $\frac{3}{4}$ of a pole is standing in the mud, $\frac{3}{7}$ is in the water, and the rest is in the air. What part is in the air?
9. If the part of the pole in the air is 16 feet, how long is the pole?
10. If $\frac{2}{3}$ of a bushel of corn can be bought for $\$ \frac{2}{3}$, how many bushels can be bought for \$8?
11. A boy spent $\frac{3}{5}$ of his money, lost $\frac{1}{10}$ of it, and then had 18 cents left. How much had he at first?
12. A boy 12 years of age was asked his father's age. He replied, "Five-sixths of my age is one-fourth of my father's age." How old was his father?
13. Edwin lost $\frac{1}{4}$ of his money, and spent $\frac{2}{3}$ of what was left, and then had 8 cents. How much did he have at first?
14. A farmer sold $\frac{2}{3}$ of his chickens, and bought $\frac{1}{2}$ as many as he had left. He then had 27. How many had he at first?
15. $\frac{1}{3}$ of 16 is how many times $\frac{1}{2}$ of 12?

1. $\frac{4}{5}$ of 45 is how many times $\frac{3}{5}$ of 15?
 $\frac{6}{7}$ of 42 is how many times $\frac{6}{7}$ of 14?
 $\frac{5}{8}$ of 48 is how many times $\frac{4}{8}$ of 18?

2. A coat cost $2\frac{2}{3}$ as much as a vest, and both cost \$33. Find the cost of each.

3. After giving away $\frac{1}{2}$ of his money, a boy had 40 cents left. How much had he at first?

4. A farmer lost $\frac{3}{8}$ of his sheep, and had 50 remaining. How many had he at first?

5. A girl spent $\frac{1}{2}$ and $\frac{1}{3}$ of her money, and had \$10 left. How much had she at first?

6. What number increased by its $\frac{1}{2}$ and $\frac{1}{3}$ will equal 30?

7. A merchant gave to his clerks $\frac{1}{3}$ and $\frac{1}{4}$ of his week's earnings, and had \$87 left. How much did he earn in the week?

8. Three-fifths of what number less $\frac{1}{3}$ of the number equals 32?

9. Ten is $\frac{2}{3}$ of $\frac{1}{2}$ of what number?

10. What number being doubled and then diminished by its $\frac{1}{4}$ will equal 50?

11. What number decreased by 4 and increased by 10 will equal $\frac{3}{2}$ of itself?

12. Edwin spent $\frac{3}{4}$ of his money, and found that \$16 was $\frac{2}{3}$ of what remained. How much had he at first?

13. A gentleman is 27 years of age. Two thirds of his age is 4 years more than $\frac{2}{3}$ of his wife's age. How old is she?

14. A lady is 36 years of age, and $\frac{4}{5}$ of her age is $\frac{2}{3}$ of her husband's age 6 years ago. How old is he?

15. What number diminished by its $\frac{1}{2}$ and increased by its $\frac{1}{3}$ will equal 50?

16. Leta had 20 roses, which number is 6 times $\frac{2}{3}$ of what her mamma has. How many roses has her mamma?

17. Twice a man's money is \$12 more than $\frac{2}{3}$ of 60. How much has he?

18. Three-fourths of a boy's age is 8 years less than 17 years. How old is he?

19. Four times what number is 20 less than 60?

SIXTH GRADE.

1. How many inches in 3 feet? In 5 feet? In 2 yards? In $\frac{1}{2}$ yard? In 25 per cent of a foot? In 50 per cent of a yard?
2. How many feet in 60 inches? In 96 inches? In 108 inches? In 6 rods? In 20 per cent of 120 inches?
3. How many yards in 45 feet? In 56 feet? In 72 inches? In 3 rods? In 4 rods?
4. How many furlongs in 320 rods? In 50 per cent of 440 rods? In 9 miles?
5. How many miles in $33\frac{1}{2}$ per cent of 120 furlongs? In 25 per cent of 640 furlongs? In 20 per cent of 1,660 rods?
6. What part of 1 yard is 2 feet? What per cent of 1 yard is 2 feet? What part of 1 furlong is $5\frac{1}{2}$ yards?
7. In $\frac{1}{4}$ of a mile, how many rods? How many yards? Feet?
8. How many rods in .2 of a mile? In .3? In .6? In .8?
9. What part of a foot are 3 inches? 4 inches? 6 inches? 8 inches? 9 inches?
10. What per cent of a mile is 40 rods? 80 rods? 160 rods?
11. How many chains in a mile? In $\frac{1}{16}$ mile? In $\frac{3}{8}$ mile? In 3 miles? In $2\frac{1}{2}$ miles? In 10 miles? In .75 mile? In 50 per cent of a mile?
12. How many chains in 8 rods? In 10 rods? In 1 rod? In 50 per cent of a furlong? In 48 rods?
13. How many feet and inches high is a horse 16 hands high? $15\frac{3}{4}$ hands high? $16\frac{1}{2}$ hands high?
14. How many feet and inches in $2\frac{1}{2}$ fathoms of water? In $3\frac{1}{4}$ fathoms? In $5\frac{3}{4}$ fathoms?
15. Explain the difference in size between a No. 6 shoe and a No. 10 shoe, men's size.
16. What must I pay for 780 envelopes at \$2 per hundred?

Pupils should be required to illustrate each problem by drawing, or by paper-cutting, until they have manifested a clear conception of the principles and relations involved.

1. How many square feet in 6 square yards? In 8 square yards? In 10 square yards?

2. How many square yards in 36 square feet? In 63 square feet? In 108 square feet?

3. How many square rods in $60\frac{1}{2}$ square yards? In 121 square yards?

4. How many square rods in 3 acres? In 5 acres? In 25 per cent of an acre? In 75 per cent of an acre?

5. What is the difference between 3 feet square and 3 square feet? 4 inches square and 4 square inches?

State how many—

6. Square inches in 2 square feet. In 50% of a square foot.

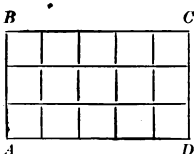
7. Square yards in 81 square feet. In $12\frac{1}{2}\%$ of 144 square feet.

8. Square feet in 11 square yards. In $33\frac{1}{3}\%$ of 3 square yards.

9. Square rods in $3\frac{1}{2}$ acres. In 10 acres. In 10% of an acre. In $12\frac{1}{2}\%$ of an acre.

TO FIND THE AREA OF A RECTANGLE.

Let $A B C D$ be a rectangle whose base $A D$ is 5 inches in length, and whose altitude $A B$ is 3 inches. If $A D$ is divided



into 5 equal parts, and $A B$ into 3, and lines are drawn through the points of division, the rectangle will be divided into squares, each containing 1 square inch; and the rectangle will evidently contain 5×3 square inches = 15

square inches. Therefore, the area of a rectangle is found by multiplying the square units on one dimension by the other dimension considered abstractly. Conversely, the area of a rectangle divided by the number of square units on one dimension will give the number of square units on the other dimension. Both dimensions must be of the same denomination.

How many—

1. Acres in 480 square rods? In 640 square rods? In 80 square rods? In 60 per cent of 800 square rods?
2. Square yards in 4 square rods? In 6 square rods? In 50 per cent of 2 rods square?
3. Acres in $\frac{1}{16}$ square mile? In $\frac{1}{4}$ square mile? In $\frac{5}{8}$ square mile? In $\frac{1}{2}$ square mile?
4. Acres in 5 per cent of a square mile? In $12\frac{1}{2}$ per cent?
5. Square feet in a board 6 feet 6 inches long and 2 feet wide?
6. A board 18 inches long contains half a square foot. How wide is it?
7. How many square rods in $\frac{1}{2}$ acre? In $\frac{1}{4}$ acre? In $\frac{5}{8}$ acre? In $\frac{3}{16}$ acre? In 5 per cent of an acre? 20 per cent of an acre?
8. How many acres in a half-section of land? In a quarter-section? In $\frac{1}{4}$ of $\frac{1}{2}$ of an acre?
9. How many square feet of surface in a blackboard 4 feet wide and 9 feet long?
10. If a slate has a surface of 80 square inches, what is the length if it is 8 inches wide?
11. How many square inches in $\frac{1}{4}$ square foot? In $\frac{3}{4}$ square foot? In $\frac{1}{8}$ square foot? In $\frac{5}{8}$ square foot?
12. How many square feet in 3 square yards? In 5 square yards? In 40 per cent of 15 yards?
13. How many square inches in a board 4 inches long and 3 inches wide? How can the board be divided to obtain $33\frac{1}{3}$ per cent of it? 25 per cent of it?
14. A square yard of carpet is 3 feet long and 3 feet wide. How many square feet in it?
15. How many square feet in a piece of carpet 2 feet wide and $2\frac{1}{2}$ feet long? How can it be divided to obtain 20 per cent of it? 25 per cent of it?
16. How many square feet in a floor 12 feet by 15 feet? How divide it to get 20 per cent of it? $33\frac{1}{3}$ per cent of it?
17. How many square rods in $\frac{1}{8}$ acre? In $\frac{3}{8}$ acre?

1. If a square lot measures 1 chain on a side, how many square rods does it contain? How divide it to get 25 per cent of it?
2. If a square chain contains 16 square rods, how many square chains make an acre? $\frac{1}{2}$ acre? 10 per cent of an acre?
3. What per cent of an acre are 4 square chains? 5 square chains? 8 square chains? $\frac{1}{2}$ square chain?
4. What per cent of a chain are 50 links? 25 links? 20 links? 10 links? 3 rods? 2 rods? $\frac{1}{2}$ rod?
5. How many square rods in a square garden plat measuring 75 links on a side? How divide it to get $33\frac{1}{3}$ per cent of it?
6. The distance between two places is found to be 320 chains. Express the distance in miles. In rods.
7. A rectangular piece of paper contains 24 square inches. It is 3 inches wide. How long is it?
8. Think of a box 4 inches wide, 4 inches high, and 4 inches long. How many square inches on one side? On all sides?
9. If another box has the same width and length, but is one-half as high, what surface has it?

Think of a box 12 inches long, 6 inches wide, and 4 inches high.

10. Find the area of the top and bottom.
11. Find the area of the two sides.
12. Find the area of the two ends.
13. Find the whole area of the box.
14. Find the increase of area if the length be doubled.

Think of a room 12 feet wide, 9 feet high, 15 feet long.

15. Find the area of the floor.
16. Find the area of the ceiling.
17. Find the area of two sides.
18. Find the area of the two ends.

19. Find the cost of 16,000 shingles at \$5.75 per thousand.
Find the cost of 1875 feet of scantling at \$10 per thousand.

1. How many cubic inches in a 10-inch cube?
2. How many cubic feet in a cubical block whose edge is 2 feet?
3. How many cubic feet in 50 per cent of a cord? In $12\frac{1}{2}$ per cent? In 25 per cent? In $33\frac{1}{3}$ per cent?
4. How many cord feet in 48 cubic feet of wood?
5. How many cord feet in 3 cords of wood? In 21 cords? In $\frac{1}{2}$ cord? In $4\frac{1}{2}$ cords?
6. What will 4 cords of wood cost if 4 cord feet cost \$4?
7. How many cubic feet in 3 cord feet 8 cubic feet?
8. How many cubic feet in 2 perches? In 4 perches? In $\frac{1}{8}$ perch?
9. What part of a cord foot are 4 cubic feet? 12 cubic feet?
10. A brick is 2 by 4 by 8 inches. Find its volume.
11. How many cubic feet in 2 cubic yards? In 3 cubic yards? In $\frac{1}{2}$ cubic yard? In $2\frac{2}{3}$ cubic yards?
12. How many cubic yards in 81 cubic feet? In 54 cubic feet? In 18 cubic feet? In 9 cubic feet? In 108 cubic feet?
13. What per cent of a cubic yard is 9 cubic feet? 18 cubic feet?
14. How many cords in 40 cord feet? In 16 cord feet? In 25 per cent of 80 cord feet?
15. How many cords in a pile of wood 32 feet long, 4 feet wide, and 4 feet high?
16. How many cubic feet in a wall 10 feet long, 6 feet high, and $1\frac{1}{2}$ feet thick?
17. How many cords in a pile of wood 40 feet long, 4 feet wide, and 4 feet high?
18. How many cords in a pile of wood 24 feet long, 4 feet wide, and 6 feet high?
19. How many loads of earth, each 1 cubic yard, must be removed in digging a ditch 21 feet long, 3 feet wide, and 3 feet deep? What per cent is in 7 feet of the length of the ditch?
20. How many cubic feet in a stick of timber 12 inches wide, 6 inches thick, and 24 feet long?
21. How many cubic feet in a stick of timber 16 inches wide, 9 inches thick, and 21 feet long?

How many—

1. Quarts in $2\frac{1}{2}$ gallons? In $3\frac{1}{2}$ gallons? In 4.25 gallons?
In 5.5 gallons?

2. Pints in 2 gills? In 5 gills? In 15 gills? In 40 gills?

3. Gallons in 24 pints? In 12 pints? In 4 pints? In 16 pints? In 20 pints?

4. Quarts in 32 gills? In 20 gills? In 8 gills? In 12 gills?

5. Quarts in $\frac{1}{2}$ bushel? In $1\frac{1}{4}$ bushels? In $1\frac{1}{2}$ bushels? In .75 bushel?

6. Pints in $3\frac{1}{2}$ quarts? In $8\frac{1}{2}$ quarts? In 6.5 quarts? In 9.5 quarts?

7. Bushels in 10 pecks? In 16 pecks? In 22 pecks? In 28 pecks? In 17 pecks?

8. Pecks in $2\frac{1}{2}$ bushels? In $4\frac{1}{4}$ bushels? In $3\frac{3}{4}$ bushels? In 5.75 bushels?

9. Quarts in 5 pints? In $6\frac{1}{2}$ pints? In $8\frac{1}{2}$ pints? In 32.6 pints?

10. Gills in 6 quarts? In $7\frac{1}{2}$ quarts? In 10.25 quarts? In 75 per cent of a quart?

11. At 8 cents a quart, what will 2 gallons 3 quarts of milk cost?

12. At 10 cents a peck, what will 3.5 bushels of apples cost?

13. At 25 cents a pint, what will 1 gallon 1 pint of wine cost?

14. At 60 cents a gallon, what will 2 gallons 3 quarts 1 pint of vinegar cost?

15. I paid \$1 for 5 pecks of potatoes. What was the price per bushel?

16. How many baskets holding $2\frac{1}{2}$ pecks each will 10 bushels of apples fill?

17. How many gills in $1\frac{1}{2}$ gallons? In 25 per cent of a gallon? In 72 per cent of a gallon.

18. If a pint of milk costs 4 cents, what will $1\frac{1}{2}$ gallons cost?

19. How many pints in 25 per cent of $8\frac{1}{2}$ bushels?

20. A 2-gallon measure of molasses lacks 4 pints of being full.

What is it worth at 50 cents a gallon?

How many—

1. Pennyweights in $3\frac{1}{4}$ ounces? In 5.3 ounces? In $6\frac{3}{4}$ ounces? In 9.2 ounces?
2. Ounces in $1\frac{1}{2}$ pounds? In $3\frac{1}{4}$ pounds? In $4\frac{1}{2}$ pounds? In $7\frac{1}{2}$ pounds? In 50 per cent of a pound?
3. Pounds in 16 ounces? In 30 ounces? In 27 ounces? In 9 ounces? In 40 ounces?
4. Grains in $\frac{1}{8}$ pennyweight? In 1.5 pennyweights? In $2\frac{1}{4}$ pennyweights?
5. Ounces in 45 pennyweights? In 56 pennyweights? In 90 pennyweights? In 50 pennyweights?
6. Ounces of pure gold in $4\frac{1}{2}$ ounces of watch-cases, 18 carats fine? What per cent is alloy?
7. Of how many carats is a mixture of 27 ounces gold and $13\frac{1}{2}$ ounces alloy?
SUGGESTION.—One-third is alloy.
8. How many pennyweights of alloy must be put with 25 pennyweights of pure gold to make a mixture of 20 carats? (4 carats alloy.)
9. How many grains in 2 pennyweights? In 2 pennyweights 9 grains? In 3 pennyweights 7 grains?
10. How many ounces in 2 pounds? In 5 pounds? In $\frac{1}{2}$ pound? In $3\frac{1}{2}$ pounds?
11. How many ounces in $\frac{1}{4}$ of a pound? In $\frac{3}{4}$ of a pound? In $\frac{1}{8}$ of a pound? In $\frac{5}{8}$ of a pound?
12. What per cent of a pound is 4 ounces? 2 ounces? 8 ounces? 6 ounces? 12 ounces?
13. How many pounds in 48 ounces? In 36 ounces? In 24 ounces?
14. How many hundredweight in 2 tons? In 3 tons?
15. How many 4-ounce packages of nutmegs can be put up from $2\frac{1}{4}$ pounds?
16. If hay is \$20 a ton, how many pounds can be bought for \$5? \$7? \$10?
17. If hay is \$16 a ton, what are 500 pounds worth?

1. How many bushels of wheat in $5\frac{1}{2}$ cents?
2. How many pounds of beef in $2\frac{1}{2}$ barrels? In $3\frac{1}{4}$ barrels?
3. What is the cost of 2 bushels of soft coal at 5 cents a pound?
4. Find the cost of $2\frac{1}{2}$ kegs of nails at 3 cents a pound.
5. What is the difference between the value of a bushel of potatoes at \$1 a bushel, and a bushel of wheat at \$1 a cental?
6. What per cent of a bushel of barley, in weight, is a bushel of oats?
7. How many bushels of corn meal will weigh as much as 5 bushels of beans?
8. A farmer sold 2,500 pounds of oats at 32 cents a bushel. What did he get for the oats?
9. A grocer bought 2,400 pounds of potatoes at 50 cents a bushel. What did he pay for them?
10. A bushel of wheat is what per cent, in weight, of 2 bushels timothy seed?
11. How many degrees in 2 right angles? In 4 right angles?
12. How many minutes in $3\frac{1}{2}^\circ$? In 4° ?
13. How many degrees in $\frac{1}{2}$ circle? In $\frac{1}{3}$? In $\frac{1}{4}$? In $\frac{1}{6}$?
14. How many geographic miles in 2° ? In 3° ? In 4° ?
15. How many common miles in 6 geographic miles?
16. How many degrees in 360 nautical miles?
17. How many degrees in $\frac{1}{2}$ quadrant? In $\frac{1}{2}$ sextant?
18. How many degrees in $\frac{1}{4}$ circumference?
19. What per cent of a circumference is 60° ? 90° ? 180° ? 120° ? 45° ?
20. How many units in 2 dozen? In $3\frac{1}{2}$ dozen? In $\frac{1}{2}$ gross? In $12\frac{1}{2}\%$ of a gross?
21. What is meant by "threescore years and ten"?
22. How many quires in 36 sheets? In 96 sheets? In 144 sheets?
23. How many pages in a quarto book containing 25% of a ream of paper?
24. How many pages in an 8-volume book containing $\frac{1}{3}$ of a

SIXTH GRADE.

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State the number of—

1. Seconds in $\frac{1}{2}$ minute. In $\frac{2}{3}$ minute. In 75% of a minute.
2. Minutes in 120 seconds. In 180 seconds. In 90 seconds.
In 40 seconds.
3. Hours in 90 minutes. In 120 minutes. In 200 minutes.
In 20 minutes.
4. Hours in 2 days. In $\frac{2}{3}$ day. In $\frac{1}{2}$ day. In $3\frac{1}{2}$ days.
5. Hours from 6 A. M. to 5 P. M. From 9 A. M. to midnight.
6. Minutes from 10 minutes past 9 o'clock A. M. to 25 minutes
past 10 o'clock A. M.
7. How much time from 20 minutes before 11 A. M. to half-
past 10 o'clock P. M.?
8. Name the leap years: 1874, 1876, 1880, 1886, 1900.
9. How many centuries and years since the birth of Christ?
10. How many leap years in every century?
11. How many days in 3 weeks? In 5 weeks? In 4 weeks 5
days?
12. How many weeks in 28 days? In 35 days? In 63 days?
13. How many minutes in $\frac{1}{2}$ hour? In $\frac{1}{4}$ hour? In $\frac{3}{4}$ hour?
In $\frac{2}{3}$ hour? In $\frac{5}{6}$ hour?
14. What per cent of an hour is 30 minutes? 20 minutes?
12 minutes? 15 minutes? 6 minutes?
15. What per cent of a day is 6 hours? 8 hours? 12 hours?
16 hours?
16. How many minutes in 2 hours? In $3\frac{1}{2}$ hours? In $5\frac{1}{2}$ hours?
17. What part of a week is 1 day? 3 days? 6 days? $3\frac{1}{2}$ days?
18. How many days from January 1 to March 5, inclusive?
From May 10 to July 16? From January 1 to April 17?
19. How many months from August 9 to November 9? From
March 5 to September 5? From April 4 to October 4?
20. If a man can do a piece of work in 30 minutes, how many
hours will it take him to do 4 times as much? 7 times as much?
21. If a man can walk a mile in 15 minutes, how many hours
will it take him to walk 24 miles?

GRADED MENTAL ARITHMETIC.

TABLE OF LATITUDE AND LONGITUDE.

<i>Cities.</i>	<i>Latitude.</i>	<i>Longitude.</i>
Albany	42° 39' 50" N.	73° 44' 56" W.
Atlanta	33° 45' N.	84° 25' W.
Berlin	52° 30' N.	13° 24' E.
Boston	42° 21' N.	71° 4' W.
Buenos Ayres	34° 36' S.	58° 22' W.
Calcutta	22° 34' 49" N.	88° 27' 16" E.
Chicago	41° 50' N.	87° 37' 30" W.
Cleveland	41° 31' N.	81° 46' 30" W.
Denver	39° 47' N.	104° 59' 23" W.
Havana, Cuba	23° 8' N.	82° 22' W.
Honolulu	21° 18' 12" N.	157° 52' W.
Manila	14° 36' N.	120° 58' E.
Melbourne	37° 48' S.	144° 58' E.
Montreal	45° 31' N.	73° 35' W.
New Orleans	29° 57' N.	90° 3' 28" W.
New York	40° 42' 43" N.	74° 3' W.
Paris	48° 50' 12" N.	2° 20' 22" E.
Pekin	39° 54' 13" N.	116° 28' 54" E.
Pretoria	25° 24' S.	28° 45' E.
Quito	13' S.	78° 43' W.
Rio Janeiro	22° 54' S.	43° 10' W.
Rome	41° 53' 52" N.	12° 28' 40" E.
St. Petersburg	59° 56' 30" N.	30° 19' E.
San Francisco	37° 47' 55" N.	122° 24' 32" W.
Seattle	47° 36' N.	122° 20' W.
Valparaiso	31° 1' 56" S.	71° 41' 45" W.
Washington, D. C.	38° 53' 39" N.	77° 00' 36" W.
Wellington, N. Z.	41° 17' S.	174° 47' E.

SIXTH GRADE.

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Find the difference in longitude between—

1. Wellington and Paris.
2. Albany and Berlin.
3. Atlanta and Boston.
4. Seattle and St. Petersburg.
5. San Francisco and Honolulu.
6. Buenos Ayres and Chicago.
7. Calcutta and Manila.
8. Denver and Rome.
9. Cleveland and New Orleans.
10. Havana and Valparaiso.
11. Melbourne and Montreal.
12. New York and Pretoria.

Find the difference in latitude between—

13. Albany and New Orleans.
14. Chicago and Havana.
15. Valparaiso and San Francisco.
16. Seattle and Manila.
17. Washington and Montreal.
18. Atlanta and Rio Janeiro.
19. Berlin and Wellington.
20. Rome and Melbourne.
21. Honolulu and Calcutta.
22. New York and Buenos Ayres.
23. Denver and Pekin.
24. Boston and Cleveland.
25. Paris and Quito.
26. St. Petersburg and Pretoria.

27. How many cubic feet in a block 3 feet wide, 3 feet long, and 2 feet thick? How divide it to get 50 per cent of the block?

28. How many cubic feet in a block 3 feet wide, 3 feet long, and 5 feet thick? How divide it to get 20 per cent of it?

29. How many cubic inches in a block 6 inches long, 6 inches wide, and 6 inches thick? How divide it to get $16\frac{2}{3}$ per cent of it? $33\frac{1}{3}$ per cent? 50 per cent?

30. What part of a solid foot is a block 6 inches high, 6 inches wide, and 6 inches long? How many such blocks equal 75 per cent of a solid foot?

31. What is the difference between 4 cubic inches and a 4-inch cube?

32. How many blocks, each containing 1 cubic foot, are equal to a block 6 feet long, 5 feet wide, and 3 feet thick? How may the block be divided to find its $\frac{1}{2}$? $\frac{1}{3}$? $\frac{1}{5}$? $\frac{1}{6}$?

33. Make an original problem in latitude and longitude.

34. Make an original problem in surface measure.

35. Make an original problem in solid measure.

GRADED MENTAL ARITHMETIC.

1. Find the missing term in the proportion, $5 : 30 :: 10 : x$.

SOLUTION.

The consequent 30 is 6 times the antecedent 5; hence,

The consequent desired is 6 times the antecedent 10, or 60.

Or,

The antecedent 10 is twice the antecedent 5; hence,

The consequent desired is twice the consequent 30, or 60.

2. Find the missing term in the proportion $9 : x :: 12 : 36$.

SOLUTION.

The consequent 36 is 3 times the antecedent 12; hence,

The consequent desired is 3 times the antecedent 9, or 27.

Or,

The antecedent 9 is $\frac{3}{4}$ of the antecedent 12; hence,

The consequent desired is $\frac{3}{4}$ of the consequent 36, or 27.

3. Find the missing term in the proportion, $\$5 : \$15 :: x : 27$.

SOLUTION.

The antecedent $\$5$ is $\frac{1}{3}$ the consequent $\$15$;

The antecedent desired is $\frac{1}{3}$ of 27, or 9.

Find the missing terms in the following:—

4. $7 : 21 :: 6 : x$.

5. $4 : 20 :: 11 : x$.

6. $x : 30 :: 12 : 72$.

7. $x : 6 :: 5 : 15$.

8. $8 : 24 :: x : 45$.

9. $12 : x :: 6 : 36$.

10. $\frac{3}{4} : 2\frac{1}{4} :: \frac{3}{8} : x$.

11. $2 : 8 :: 6 : x$.

12. $5 : 7 :: 10 : x$.

13. $x : 8 :: 6 : 16$.

14. $5 : x :: 6 : 12$.

15. $3 : 7 :: x : 14$.

17. $x : 8 :: 65 : 13$.

18. $10 : x :: 15 : 6$.

19. $\$.16\frac{2}{3} : \$.50 :: x \text{ quarts} : 6 \text{ quarts}$.

20. $x \text{ ounces} : 12 \text{ ounces} :: \$8 : \$18$.

21. $21 : x :: 9 \text{ yards} : 3 \text{ yards}$.

22. $27 : 9 :: 9 : x$.

23. $\$30 : \$6 :: x : 8$.

24. $48 : x :: \$67\frac{1}{4} : \$201\frac{1}{4}$.

25. $2 \text{ bu. } 3 \text{ pks.} : x :: \$3.50 : \$10.50$.

26. $\$x : \$15 :: 8 \text{ bu. } 2 \text{ pks.} : 34 \text{ bu.}$

27. $1 \text{ hour } 12 \text{ minutes} : x :: 16 : 5$.

28. $\$18 : x :: \frac{1}{4} : \frac{5}{8}$.

29. $4\frac{1}{2} \text{ yd.} : x \text{ yd.} :: \$9.50 : \$28.50$.

SIXTH GRADE.

Find the missing term:—

1. $12 : 9 :: 16 : x$.
2. $18 : 24 :: 24 : x$.
3. $\frac{1}{6} : x :: 4 : 8$.
4. $\$45 : \$24 :: 15 \text{ yards} : x$.
5. $\$x : \$9 :: 15 \text{ men} : 27 \text{ men}$.
6. $5 \text{ tons} : \frac{1}{2} \text{ tons} :: x : \7.50 .
7. $12 : x :: 21 : 14$.
8. $20 : 80 :: \begin{cases} 3 : 4. \\ 7 : x. \end{cases}$
9. $10 : x \begin{cases} \\ 2 : 3 \end{cases} :: 4 : 9$.
10. $4 : 6 :: 6 : x$.
11. $x : \frac{5}{8} :: \frac{1}{8} : \frac{3}{4}$.
12. $\frac{5}{16} : \frac{3}{8} :: x : \frac{2}{5}$.
13. $7 : 10 \begin{cases} \\ 5 : x \end{cases} :: 7 : 8$.
14. $x : 72 :: \begin{cases} 4 : 6. \\ 5 : 7. \end{cases}$
15. $2 : 3 \begin{cases} \\ 5 : 6 \end{cases} :: 20 : x$.
16. $\frac{5}{16} : x :: \frac{1}{8} : \frac{2}{5}$.
17. $x : 4\frac{2}{3} :: 7\frac{1}{2} : 10\frac{1}{2}$.
18. $10 : x \begin{cases} \\ 2 : 6 \end{cases} :: 4 \text{ lb.} : 9 \text{ lb.} 4 \text{ c}$

19. If 4 yards of cloth cost \$10, what will 8 yards cost?

SOLUTION.

Since the number of yards have the same relation as the cost, a simple proportion may be formed, as follows:—

$$4 \text{ yds.} : 8 \text{ yds.} :: \$10 : ?$$

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

Find the cost of—

21. 6 bunches of grapes, if 3 bunches cost 8 cents.
22. 12 combs, if 6 combs cost 9 cents.
23. 5 books, if 20 books cost \$16.
24. 21 apples, if 7 apples cost 8 cents.
25. 6 coats, if 18 coats cost \$24
26. 15 hats, if 5 hats cost \$9.
27. 20 pens, if 4 pens cost 11 cents.
28. 3 pencils, if 21 pencils cost 35 cents.
29. 32 hens, if 8 hens cost \$5.
30. 30 pigs, if 5 pigs cost \$7.

Find the cost of—

1. 40 silver cups, if 4 cups cost \$3.
2. 20 dozen eggs, if 100 dozen cost \$15.
3. 5 bottles ink, if 15 bottles cost 18 dimes.
4. 3 score hens, if 10 hens cost \$5.
5. 12 oranges, if 42 oranges cost \$.50.
6. 30 tables, if 5 tables cost \$3½.
7. If a man rides 60 miles in 1½ days on his bicycle, how far can he ride in 9 days?
8. If 7 men dig a ditch 10 rods long in 14 days, how many rods will 35 men dig in the same time? How long will it take 35 men to dig 10 rods?
9. A lady bought 6 yards of silk for \$11. How many yards could she have purchased for \$55?
10. If 8 men earn \$12 in 3 days, what can they earn in 15 days? What will 1 man earn in 1 day?
11. If 5 apples are worth 3 oranges, how many apples are worth 21 oranges?
12. If \$8 is the price of 5 fountain-pens, how many pens will \$72 buy?
13. A traveler walked 150 miles in 5 days. How far will he travel, at that rate, in 12½ days? How long will it take him to travel 75 miles?
14. How many calves will \$120 buy, at the rate of \$24 for 7 calves?
15. If five men can do a piece of work in 20 days, how long will it take 20 men to do it?
16. If 6 boys can pick 5 bushels of berries in 3 days, how many bushels can 24 boys pick in the same time? How many boys required to pick 5 bushels in 1 day?
17. If a family consumes 3 pounds 8 ounces of butter in 5 days, how long will it require to consume 14 pounds?
18. If 12 yards of cloth cost \$48, how many yards will \$72 buy?
19. If 50 bushels of oats cost \$16½, what will 300 bushels cost?

SIXTH GRADE.

1. If 16 horses eat 24 bushels of oats in 6 days, how long will it last 4 horses? How many horses required to eat it in 2 days?
2. If 10 per cent of the cost of a residence was \$400, what was 25 per cent of its cost?
3. If 15 per cent of the cost of an article is 10 per cent of the selling price, what per cent of the cost is the selling price?
4. If a laborer earns \$72 in 8 weeks, how many dollars will he earn in 12 weeks?
5. A railway train moves at the rate of 40 miles an hour. How far does it go in 48 minutes?
6. How many tons of hay can be cut from a field of 10 acres at the rate of 15 tons to 4 acres?
7. If 20 acres of land is worth \$700, how many acres will \$2,450 buy at the same price?
8. What is the distance traveled in 3 hours by a steamboat that travels 39 miles in 6 hours 30 minutes?
9. Find the cost of 150 pounds of cheese, if 6 pounds 4 ounces cost 60 cents?
10. If a man rides on his bicycle at the rate of 20 miles in 2 hours 15 minutes, how long a time will it require for him to travel 160 miles?
11. If 8 men can build a certain wall in 25 days, how long will it take 12 men to build the same wall?

SOLUTION.

12 : 8 :: 25 : x. In this case the number of days decreases in the same ratio as the number of men increases.
Ans. $16\frac{2}{3}$ d.

12. If 8 hats cost \$24, what will 112 hats cost, at the same rate?
13. If 5 barrels of flour cost \$15, what will 12 barrels cost?
14. If I walk 168 miles in 6 days, how far can I walk, at the same rate, in 18 days.
15. If 16 pounds of sugar cost \$1.28, what will 12 pounds cost?
16. If 300 barrels of flour cost \$2,100, what will 125 barrels cost?

1. \$12 are \$16 less than $\frac{4}{7}$ of how much money?
2. The cost of a horse diminished by $\frac{1}{4}$ of itself and \$20 will equal \$52. What is the cost?
3. A man sold $\frac{1}{3}$ of his farm, then bought 40 acres, and then had 140 acres. How many acres had he at first?
4. Two-thirds of what number is 10 more than $\frac{1}{4}$ of the number?
5. Three times a number plus 6 equals 2 times the number plus 10. What is the number?
6. One half a number plus 10 equals $\frac{2}{3}$ the number plus 8. What is the number?
7. Find the cost of 30 yards of cloth at $12\frac{1}{2}$ cents a yard.
8. Albert had 48 cents, and gave $\frac{3}{8}$ of his money to his mamma. He bought nuts with the rest, at 6 cents a quart. How many quarts did he buy?
9. If I sell a horse at $\frac{1}{15}$ of the cost and lose \$20, what was the cost of the horse?
10. The sum of two numbers is 50, and one is $\frac{1}{4}$ of the other. Find the numbers.
11. A tree 72 feet in length is broken into two pieces, so that one piece is $\frac{2}{7}$ of the other. Find the length of each piece.
12. A horse and buggy cost \$100, and the buggy cost $\frac{2}{3}$ as much as the horse. Find the cost of each.
13. Five-sixths of 12 is what part of $\frac{4}{5}$ of 72?
14. A horse, cow, and pig cost \$130. The cow cost 5 times the cost of the pig, and the horse cost 4 times the cost of the cow. Find the cost of each.
15. Divide \$45 into two numbers, one being \$9 more than the other.
16. Two boys had the same amount of money; one spent 15 cents, and the other spent 25 cents, and they together then had 40 cents. What had each at first?
17. Two boys had equal sums of money. One lost \$5 and the other lost \$8, and they together then had \$25. How much

SIXTH GRADE.

1. A man dug a well at the rate of 5 feet a day. How long did it require to dig it, if 15 feet was $\frac{2}{3}$ the depth of the well?
2. A boy was 15 years of age. Four times $\frac{2}{3}$ of his age was $2\frac{1}{2}$ times his sister's age. How old was she?
3. A boy spent $\frac{2}{3}$ of his money and lost $\frac{1}{2}$ of the remainder and had 12 cents left. How much money had he at first?
4. A pupil was 14 years old, and $\frac{5}{7}$ of his age was $\frac{2}{3}$ of his teacher's age. How old was the teacher?
5. If $\frac{3}{4}$ of a farm costs \$3,000, what will $\frac{5}{8}$ of the farm cost?
6. If $\frac{3}{4}$ of a pound of meat is worth $\frac{2}{3}$ of a pound of cheese, how much cheese is worth a pound of meat?
7. One-half of a man's fortune was given to his wife, $\frac{2}{3}$ of the rest was given to his son, $\frac{1}{2}$ of what then remained was given to his daughter, and \$8,000 was still left for charities. What did each receive?
8. At $\$ \frac{1}{8}$ a quart, what part of a bushel of seed can be bought for \$2 $\frac{1}{2}$?
9. The sum of two numbers is 40, and their difference is 6. Find the numbers.
10. If the cost of .5 of a quantity is given, how is found the cost of $16\frac{2}{3}$ per cent of the quantity?
11. If $12\frac{1}{2}$ per cent of a stock of goods costs \$200, what is the value of $\frac{5}{8}$ of the stock?
12. If $.37\frac{1}{2}$ of a number is given, how is found $.87\frac{1}{2}$ of the number?
13. At the rate of $16\frac{2}{3}$ cents for 5 pencils, how many can be bought for \$.50?

Find the cost of—

14. 1,128 bushels of oats at $\$.33\frac{1}{3}$ a bushel.
15. 1,350 bushels of corn at \$.50 a bushel.
16. 1,600 yards of cloth at $\$.87\frac{1}{2}$ a yard.
17. 1,230 pounds of tea at $\$.66\frac{2}{3}$ a pound.
18. 1,360 dozen of eggs at $\$.12\frac{1}{2}$ a dozen.
19. 120 bushels of wheat at \$1.25 a bushel.

GRADED MENTAL ARITHMETIC.

1. If $12\frac{1}{2}$ per cent of a quantity is given, how may $\frac{2}{3}$ of it be found? .50? .62 $\frac{1}{2}$?

SOLUTION.

$12\frac{1}{2}$ per cent of a quantity = $\frac{1}{8}$ of it.

$\frac{2}{3} = 3 \times 12\frac{1}{2}$ per cent.

.50 = $\frac{4}{8} = 4 \times 12\frac{1}{2}$ per cent.

.62 $\frac{1}{2}$ = $\frac{5}{8} = 5 \times 12\frac{1}{2}$ per cent.

2. If .08 $\frac{1}{3}$ of a quantity is given, how may $\frac{1}{4}$ of it be found?
 $\frac{1}{3}$? $\frac{1}{2}$?

3. If $37\frac{1}{2}$ per cent of a quantity is given, how may 25 per cent of it be found?

4. If .5 of a quantity is given, how may $33\frac{1}{3}$ per cent of it be found? $16\frac{2}{3}$ per cent?

5. If 5 per cent of a quantity is given, how may .08 $\frac{1}{3}$ be found? .37 $\frac{1}{2}$? .62 $\frac{1}{2}$?

6. If $\frac{2}{3}$ of a quantity is given, how may .16 $\frac{2}{3}$ be found? $33\frac{1}{3}$ per cent?

7. If from a gallon of milk $\frac{3}{4}$ of a quart is taken, what part of a gallon remains?

8. Find the cost of $\frac{5}{8}$ of a ton of hay at \$.75 a hundredweight.

9. If a boy earns \$6 $\frac{3}{4}$ in 9 days, what does he earn in 1 day?

10. A farmer cultivated $\frac{3}{7}$ of his land, and the part not cultivated was 10 acres more than the part he cultivated. How many acres had he?

11. A, B, and C have together \$60. A has twice as much as B, and B has 3 times as much as C. Find each one's share.

12. The difference between two numbers is 7, and their sum is 37. Find the numbers.

13. If .62 $\frac{1}{2}$ of a bin contains 45 bushels of wheat, how many bushels in $87\frac{1}{2}$ per cent of the bin?

14. $37\frac{1}{2}$ is what part of $87\frac{1}{2}$?

15. What is $\frac{1}{8}$ of a hundred? $\frac{1}{8}$? $\frac{3}{8}$? $\frac{5}{8}$?

16. What is $\frac{1}{4}$ of a hundred? $\frac{3}{4}$? $\frac{5}{4}$? $\frac{7}{4}$?

17. What is $\frac{1}{2}$ of a hundred? $\frac{1}{2}$? $\frac{3}{2}$? $\frac{5}{2}$?

SIXTH GRADE.

1. If 25 per cent of a number is given, how may $31\frac{1}{4}$ per cent of it be found?

NOTE. — Find $\frac{1}{4}$ of 25. How many times $\frac{1}{4}$ of 25 in $31\frac{1}{4}$?

2. Multiply $6\frac{1}{4}$ per cent by 1 to 12, inclusive.

3. Find the ratio between $6\frac{1}{4}$ and 75. Between $6\frac{1}{4}$ and 3

4. Find the ratio between $66\frac{2}{3}$ and $16\frac{2}{3}$. Between $62\frac{1}{2}$ and

Memorize the following: —

5. $2 \times 6\frac{1}{4}\% = 12\frac{1}{2}\%$

$3 \times 6\frac{1}{4}\% = 18\frac{3}{4}\%$

$4 \times 6\frac{1}{4}\% = 25\%$

$5 \times 6\frac{1}{4}\% = 31\frac{1}{4}\%$

$6 \times 6\frac{1}{4}\% = 37\frac{1}{2}\%$

$7 \times 6\frac{1}{4}\% = 43\frac{3}{4}\%$

$8 \times 6\frac{1}{4}\% = 50\%$

$9 \times 6\frac{1}{4}\% = 56\frac{1}{4}\%$

$10 \times 6\frac{1}{4}\% = 62\frac{1}{2}\%$

$11 \times 6\frac{1}{4}\% = 68\frac{3}{4}\%$

$12 \times 6\frac{1}{4}\% = 75\%$

$13 \times 6\frac{1}{4}\% = 81\frac{1}{4}\%$

$14 \times 6\frac{1}{4}\% = 87\frac{1}{2}\%$

$15 \times 6\frac{1}{4}\% = 93\frac{3}{4}\%$

$16 \times 6\frac{1}{4}\% = 100\%$

6. $2 \times 8\frac{1}{3}\% = 16\frac{2}{3}\%$

$3 \times 8\frac{1}{3}\% = 25\%$

$4 \times 8\frac{1}{3}\% = 33\frac{1}{3}\%$

$5 \times 8\frac{1}{3}\% = 41\frac{2}{3}\%$

$6 \times 8\frac{1}{3}\% = 50\%$

$7 \times 8\frac{1}{3}\% = 58\frac{1}{3}\%$

$8 \times 8\frac{1}{3}\% = 66\frac{2}{3}\%$

$9 \times 8\frac{1}{3}\% = 75\%$

$10 \times 8\frac{1}{3}\% = 83\frac{1}{3}\%$

$11 \times 8\frac{1}{3}\% = 91\frac{2}{3}\%$

$12 \times 8\frac{1}{3}\% = 100\%$

Give the ratio of—

7. $12\frac{1}{2}\%$ to $18\frac{3}{4}\%$

25 % to $43\frac{3}{4}\%$

$31\frac{1}{4}\%$ to 50 %

$37\frac{1}{2}\%$ to $81\frac{1}{4}\%$

$31\frac{1}{4}\%$ to $93\frac{3}{4}\%$

$33\frac{1}{3}\%$ to 100%

8. $18\frac{3}{4}\%$ to $93\frac{3}{4}\%$

50 % to $87\frac{1}{2}\%$

$43\frac{3}{4}\%$ to 100%

$87\frac{1}{2}\%$ to 100%

$12\frac{1}{2}\%$ to $93\frac{3}{4}\%$

50 % to $62\frac{1}{2}\%$

9. $8\frac{1}{3}\%$ to 25 %

$8\frac{1}{3}\%$ to 75 %

$16\frac{2}{3}\%$ to $58\frac{1}{3}\%$

25 % to $91\frac{2}{3}\%$

$33\frac{1}{3}\%$ to $83\frac{1}{3}\%$

$16\frac{2}{3}\%$ to $66\frac{2}{3}\%$

10. $41\frac{2}{3}\%$ to $66\frac{2}{3}\%$

$41\frac{2}{3}\%$ to 100%

75 % to $91\frac{2}{3}\%$

50 % to $83\frac{1}{3}\%$

$58\frac{1}{3}\%$ to $91\frac{2}{3}\%$

$66\frac{2}{3}\%$ to $91\frac{2}{3}\%$

Give the ratio of—

1. $93\frac{3}{4}\%$ to $31\frac{1}{4}\%$
 $87\frac{1}{2}\%$ to $43\frac{3}{4}\%$

$56\frac{1}{4}\%$ to $12\frac{1}{2}\%$
 75% to $43\frac{3}{4}\%$

$87\frac{1}{2}\%$ to 25%
 $41\frac{3}{8}\%$ to 50%

2. $81\frac{1}{4}\%$ to $12\frac{1}{2}\%$
 75% to $62\frac{1}{2}\%$

100% to $87\frac{1}{2}\%$
 $66\frac{2}{3}\%$ to 25%

100% to $41\frac{3}{8}\%$
 75% to $33\frac{3}{8}\%$

What part of 100 is—

3.

$6\frac{1}{4}?$

$93\frac{3}{4}?$

$56\frac{1}{4}?$

$75?$

$37\frac{1}{2}?$

4.

$12\frac{1}{2}?$

$87\frac{1}{2}?$

$68\frac{3}{4}?$

$43\frac{3}{4}?$

$81\frac{1}{4}?$

5.

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

$91\frac{3}{8}?$

$50?$

$16\frac{2}{3}?$

$83\frac{1}{3}?$

6.

$62\frac{1}{2}?$

$31\frac{1}{4}?$

$66\frac{2}{3}?$

$75?$

$58\frac{1}{3}?$

7. Given .5 of a quantity, how find $6\frac{1}{4}$ per cent of it?
8. Given $\frac{3}{4}$ of a quantity, how find $37\frac{1}{2}$ per cent of it?
9. Given $\frac{1}{4}$ of a quantity, how find $6\frac{1}{4}$ per cent of it?
10. Given 25 per cent of a quantity, how find $33\frac{1}{3}$ per cent of it?
11. Given $12\frac{1}{2}$ per cent of a quantity, how find $31\frac{1}{4}$ per cent of it?
12. Given $\frac{1}{8}$ of a quantity, how find $8\frac{1}{8}$ per cent of it?
13. Given $37\frac{1}{2}$ per cent of a quantity, how find 25 per cent of it?
14. Given 25 per cent of a quantity, how find $31\frac{1}{4}$ per cent of it?
15. Given $1\frac{1}{8}$ times a quantity, how find $16\frac{2}{3}$ per cent of it?
16. Given $66\frac{2}{3}$ per cent of a quantity, how find 50 per cent of it?
17. Given 50 per cent of a quantity, how find $66\frac{2}{3}$ per cent of it?
18. Given 50 per cent of a quantity, how find $41\frac{3}{8}$ per cent of it?
19. Given 75 per cent of a quantity, how find $62\frac{1}{2}$ per cent of it?
20. Given 75 per cent of a quantity, how find $87\frac{1}{2}$ per cent of it?
21. Divide \$120 between A and B so that their shares will be as 2 to 4.
22. Divide 72 into two parts to each other as 4 to 5.
23. Divide 90 into two parts to each other as 4 to 5.
24. Divide 128 into two parts to each other as 5 to 3.
25. A school of 1,470 children are in three buildings, in the proportion of 2 and 4. How many are in each building?

1. A father is three times his son's age, and the sum of their ages is 60 years. What is the age of each?
2. Divide 200 into two parts so that one will be $\frac{3}{5}$ of the other.
3. Divide 300 into two parts to each other as $\frac{1}{2}$ to $\frac{1}{3}$.
4. Of a school having 96 pupils, the number of boys is 3 times the number of girls. Find the number of each.
5. A earned $2\frac{2}{3}$ times as many dollars as B, and they together earned \$1,100. How many dollars did each earn?
6. A and B each bought an acre of land, the price for both being \$2,000. A's acre was 3 miles from the post-office building and B's acre was 2 miles from the post-office building. They paid in reverse ratio to their respective distances. What did each pay for his acre?
7. Two men rent a pasture into which one puts 10 horses and the other puts 12 horses. How much should each pay of an annual rental of \$110?
8. William had 10 cents, John had 7 cents, and Henry had 5 cents. With their money together they bought 75 apples. How many belonged to each?
9. Three men went fishing. Together they caught 80 trout in proportion to $\frac{1}{2}$, $1\frac{1}{2}$, and 2. How many did each catch?
10. Divide 25 into 2 parts so that one will be 5 greater than the other.
11. A suit of clothes cost \$20 more than a set of books, and both together cost \$40. What was the cost of each?
12. The age of one man is $\frac{4}{5}$ the age of another, and the sum of their ages is 90 years. What is the age of each?
13. A horse, cow, and pig cost \$150. The horse cost two times the cost of the cow, and the cow cost 3 times the cost of the pig. Find the cost of each.
14. A teacher bought 3 books for \$3. The second cost 2 times the cost of the first, and the third cost $1\frac{1}{2}$ times the second. What is the cost of each?
15. Divide 30 into two parts so that $\frac{1}{3}$ of one part will equal $\frac{1}{2}$ of the other.

1. If a boy can do a piece of work in 5 days, what part of the work can he do in 1 day? In 2 days? In 3 days? In 4 days?
2. If a piece of work is done by a man in 7 days, what part of the work is done in 4 days?
3. A can build a fence in 5 days, and B can build it in 3 days. In what time can both build it, working together?

SOLUTION.

A can build $\frac{1}{5}$ of it in 1 day.

B can build $\frac{1}{3}$ of it in 1 day.

Together they can build $\frac{1}{5} + \frac{1}{3} = \frac{8}{15}$ of it in 1 day.

Both require as many days as $\frac{8}{15}$ is contained in $1\frac{5}{8}$, or $1\frac{7}{8}$ days.

4. A can mow a field in 8 days, and B can do it in 9 days. How long will it take them together to mow the field?
5. A boy can do a piece of work in 8 days and his father can do it in 4 days. In what time can they do it, working together?
6. B and C can build a fence in 12 days, which will for B alone require 20 days. In what time can C build it?
7. James and John dug a ditch in .5 weeks, which would require James alone 12 weeks. In what time could John alone dig it?
8. If A earns \$1 in $\frac{1}{2}$ of a day and B earns \$1 in $\frac{1}{3}$ of a day, how much will both earn in 2 days?
9. If A can do a piece of work in $\frac{1}{3}$ of a day and B can do it in $\frac{1}{4}$ of a day, in what time can they together do it?

SOLUTION.

A can do 3 times the work in a day.

B can do 4 times the work in a day.

Together they can do 7 times the work in a day.

Together they can do the work in $\frac{1}{7}$ of a day.

10. A can build a fence in $\frac{1}{4}$ of a day, and B can build it in $\frac{1}{5}$ of a day. In what part of a day can they together build it?

SIXTH GRADE.

1. In a partnership, A put in \$500 and B put in \$600. They gained \$330. What was the share of each?
2. In a partnership, one man put in \$2,000 and another put in \$3,000. They gained \$900. Find the share of each.
3. If A puts 4 times as much as B into a business, what is each one's share of a profit of \$1,500?
4. If 12 men and 16 boys do a piece of work for \$80, and one boy does $\frac{1}{2}$ what a man does, what shall each man and boy receive?
5. A can do a piece of work in $\frac{3}{4}$ of a day, and B can do it in $\frac{2}{3}$ of a day. In what time can they do it when working together?
6. A can mow $\frac{3}{4}$ of a field in a day, and B can mow the entire field in $\frac{2}{3}$ of a day. In what time can they mow the entire field when working together?
7. A can do $\frac{3}{4}$ of a piece of work in a day, and B can do the work in $\frac{2}{3}$ of a day. In what time can they do it when working together?
8. Three boys earned \$63. One worked 5 days, another worked 7 days, and the third worked 9 days. Find each boy's share.
9. Two men in partnership gained \$400. One man owned \$100 less than $\frac{3}{4}$ of the business and gained \$250. Find each man's share of the business.
10. Two men in partnership gained \$600. One man owned \$100 more than $\frac{3}{4}$ of the business and gained \$420. Find each man's share of the business.
11. A and B bought a farm, A paying for $\frac{1}{3}$ of it, and \$500 more. They sold it, and gained \$1,500, of which A got \$600. How much did the farm cost?
12. A and B gained in partnership \$300. A owns \$200 less than $\frac{2}{3}$ of the business, and his share of the gain was \$60. Find each one's share of the business.
13. The cost of plowing a field was \$30. A plowed $\frac{1}{3}$ of the field, and 2 acres more, and received \$14. How many acres in the field?

1. I spent $\frac{5}{9}$ of my income for board, $\frac{1}{6}$ of it for clothes, and save \$60 a year. What is my annual income?
2. A captain, owning $\frac{2}{3}$ of a ship, sold $\frac{1}{3}$ of his share for \$1,200. What was the value of the ship?
3. In a school there are 91 boys, and $\frac{6}{13}$ of the number of pupils are girls. How many pupils in the school?
4. A man sold $\frac{2}{7}$ of his farm and gave $\frac{2}{3}$ of the remainder to his son, who received 120 acres. How many acres had the man remaining?
5. If $\frac{3}{4}$ of 9 bushels of wheat cost \$6 $\frac{3}{4}$, what will $\frac{7}{8}$ of a bushel cost?
6. If $\frac{3}{4}$ of an apple cost $\frac{9}{10}$ of a cent, what will $\frac{5}{6}$ of an apple cost?
7. What must I pay for 15 acres of land, if I pay \$25 for 2 $\frac{1}{2}$ acres?
8. Mary sold 12 $\frac{1}{2}$ per cent of 4 gallons 2 quarts, at 10 cents a pint. How much did she receive?
9. A borrows a certain sum, and B twice as much. A repays $\frac{1}{2}$ of his and B $\frac{1}{2}$ of his, making \$300 repaid by both. What sum did each borrow?
10. What is the difference between the area of a floor 25 feet square, and that of two others, each of which is 12 feet 6 inches square?
11. A boy lost $\frac{1}{2}$ his kite-line. He added 30 feet to it and found that it was then just $\frac{5}{8}$ of its original length. How long was the line at first?
12. The base of a rectangle is 16 inches and the altitude is 12 inches. What is the area?
13. The sum of the base and the altitude of a rectangle is 20 inches, and the base is 3 times the altitude. Find the area.
14. How many square yards in a room 12 by 18 feet, and how many feet of molding will go around the room, deducting for 2 doors, each 4 feet wide?
15. The altitude of a rectangle is 8.5 inches, and the area is 85 square inches. What is the base?

SEVENTH GRADE.

1. $\frac{2}{3}$ of \$60 is what per cent of $\frac{1}{2}$ of 50? 11%
2. $\frac{1}{2}$ of 20 per cent is what per cent of 40 per cent? 25%
3. $\frac{2}{3}$ of 10 per cent is what per cent of 48 per cent? 12½%
4. What per cent of 60 is 36? 60%

Find the number of—

5. Pounds of which 15 pounds is 20 per cent. 75
6. Cows of which 30 cows is 25 per cent. 120
7. Minutes of which 15 minutes is 12½ per cent. 120
8. Weeks of which 4.5 weeks is 10 per cent. 45
9. Miles of which 110 miles is 120 per cent. 91½
10. Acres of which 100 acres is 150 per cent. 66½

11. What number increased by 20 per cent of itself will equal 240?

SOLUTION I.

100% = the number.

100% + 20% = 120%.

120% = 240.

1% = $\frac{1}{120}$ of 240.

100% = $100 \times \frac{1}{120}$ of 240 = 200, the number.

SOLUTION II.

20% increase = $\frac{1}{5}$ of itself.

$\frac{5}{5} + \frac{1}{5} = \frac{6}{5} = 240$, etc.

SOLUTION III.

The number + the gain = 120%.

100% : 120% :: x : 240.

1. 40 is 20 per cent less than what number? 50
2. 88 is 25 per cent less than what number? 117 $\frac{1}{3}$
3. After using 75 per cent of a piece of ribbon, 20 $\frac{1}{2}$ inches remained. How long was the piece at first?
4. Tea sold at \$.90 loses 10 per cent of the cost. Find the cost.
5. 30 is 25 per cent less than what number? 40 25 per cent more than what number? 24
6. What sum diminished by 12 $\frac{1}{2}$ per cent of itself equals \$140? 160
7. What number decreased by 5 per cent of itself equals 38? 40

Give an original problem to show —

8. How to find the percentage, when the base and rate are given.
9. How to find the rate, when the base and percentage are given.
10. How to find the base, when the percentage and rate are given.
11. How to find the base, when the rate of increase and the resulting number are given.
12. How to find the base, when the rate of decrease and the resulting number are given.
13. A horse cost \$240. If it was sold at a gain of 25 per cent, how many dollars were gained by selling it?

SOLUTION I.

$$1\% \text{ of the cost} = \$2.40.$$

$$25\% \text{ of the cost} = 25 \times \$2.40 = \$60, \text{ gain.}$$

SOLUTION II.

$$25\% = .25 \text{ of the cost.}$$

$$.25 \times \$240 = \$60, \text{ gain.}$$

SOLUTION III.

$$25\% = \frac{1}{4} \text{ of the cost.}$$

$$\frac{1}{4} \text{ of } \$240 = \$60, \text{ gain.}$$

SOLUTION IV.

$$100\% : 25\% :: \$240 : \text{gain.}$$

SEVENTH GRADE.

1. A boy gave \$20 for a bicycle and sold it for \$25. What per cent did he gain?

SOLUTION I.

$$100\% : \text{gain per cent} :: \$20 : \$5 \text{ (gain).}$$

SOLUTION II.

$$\$25 - \$20 = \$5, \text{ the gain.}$$

$$\$5 = \frac{1}{4} \text{ of } \$20.$$

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

Find the per cent gain or loss—

2. In buying a knife for 40 cents and selling it for 50 cents.
3. In buying shoes at \$2 a pair and selling them for \$2.50 a pair.
4. In buying \$24 worth of nuts and selling them for \$32.
5. In buying 1 dozen suits at \$8 each, selling $\frac{3}{4}$ of them for \$10 apiece, and the rest at cost.
6. In buying a cow for \$45 and selling her for \$63.
7. A dealer sold flour at a profit of \$2 a barrel, and gained thereby 25 per cent. What was the cost of the flour?

SOLUTION I.

$$100\% : 25\% :: \text{cost} : \$2.$$

SOLUTION II.

$$25\% = \frac{1}{4}.$$

$$\frac{1}{4} = \$2.$$

$$\frac{1}{4}, \text{ or the whole, } = 4 \times \$2 = \$8, \text{ the cost.}$$

Find the cost and selling price of—

8. Men's hats, when losing $16\frac{2}{3}$ per cent by selling \$1 below cost.
9. A yard of silk, when 40 per cent is gained by selling at \$1 $\frac{1}{2}$ profit.
10. A bushel of corn, when 30 per cent is gained by a profit of 21 cents.

1. A dealer sold a bicycle for \$55, and gained 10 per cent. What was the cost?

SOLUTION I.

$$100\% + 10\% = 110\%, \text{ the selling price.}$$

$$110\% = \$55.$$

$$1\% = \frac{1}{110} \text{ of } \$55 = \$.50.$$

$$100\% = 100 \times \$.50 = \$50, \text{ the cost.}$$

SOLUTION II.

$$100 \text{ per cent} : 110 \text{ per cent} :: \text{cost} : \$55.$$

SOLUTION III.

$$10\% \text{ gain} = \frac{1}{10} \text{ gain.}$$

$$\frac{1}{10}, \text{ the whole, } + \frac{1}{10} = \frac{11}{10}, \text{ the selling price.}$$

$$\frac{11}{10} = \$55, \frac{1}{10} = \frac{1}{11} \text{ of } \$55 = \$5, \frac{1}{10} = 10 \times \$5 = \$50, \text{ the cost.}$$

Find the cost of—

2. A hat sold for \$7, at a loss of 30 per cent.
3. A calf sold for \$9, at a gain of 80 per cent.
4. A yard of silk sold for \$1.80, at a gain of 20 per cent.
5. Tea sold at \$.90 cents a pound, at a gain of 25 per cent.
6. A newspaper sold for 4 cents, at a gain of $33\frac{1}{3}$ per cent.
7. A horse and buggy sold for \$330, at a gain of 10 per cent.
8. By selling at \$.60 a cental, 20 per cent is lost on a cental of wheat. For what must it be sold to gain 20 per cent?
9. An agent lost 40 per cent on a wagon by selling it for \$60. For what would he have sold it to gain 40 per cent?
10. If 25 per cent is gained by selling a hat for \$4, what must be the price when sold at a loss of 15 per cent?
11. A farmer sold 2 horses for \$99 each. On one he gained 10 per cent, and on the other he lost 10 per cent. What was his whole gain or loss per cent?
12. A commission merchant received a consignment of 100 tons of hay, to be sold at \$12 a ton. He charged the consignor 2 per cent for putting the business. What was his commission?

Very often, *two or more discounts are deducted from the marked price of an article*. Thus 10 per cent and 5 per cent off—or as is generally expressed in business, 10 and 5 off—means a discount of 10 per cent, and then 5 per cent from what is left; 20, 10, and 5 off means three successive discounts.

1. Goods are marked at \$100. What will be the selling price if they are discounted 20 per cent and 10 per cent off the marked price?

SOLUTION I.

$$20\% \text{ of } \$100 = \$20.$$

$$\$100 - \$20 = \$80.$$

$$10\% \text{ of } \$80 = \$8.$$

$$\$80 - \$8 = \$72, \text{ the cost.}$$

SOLUTION II.

A discount of 20% leaves 80% of \$100 = \$80.

A discount of 10% leaves 90% of \$80 = \$72, the cost.

SOLUTION III.

$$100\% - 20\% = 80\%.$$

$$100\% - 10\% = 90\%.$$

$$80\% \times 90\% \times \$100 = \$72, \text{ the cost.}$$

2. What is the cost of a bill of goods listed at \$100, sold at a discount of 20 and 10 off?

3. A lot of farm implements were sold at a discount of 10 and 5 off a list price of \$1,000. What price did they bring?

4. A gentleman bought a library from a book dealer at a discount of 30 and 10 off a marked price of \$2,000. What did he pay for the library?

5. A stock of rubber goods was sold to a boot and shoe dealer at a discount of 20 and 5 off a list price of \$2,000. What did the dealer pay?

6. What is $12\frac{1}{2}\%$ of 128?

7. What is 25% of \$5,000?

1. What is the market value of 10 shares of stock, when sold at 5 per cent above par?
2. What is the market value of 10 shares of stock, when sold at 5 per cent below par?
3. What is the cost of a share of stock at 5 per cent above par, if I pay a stock-broker $\frac{1}{2}$ per cent for buying it for me?
4. What is the cost of a share of stock at 5 per cent below par, if I pay a stock-broker $\frac{1}{2}$ per cent for buying it for me?
5. A company with a capital of \$10,000 gained in one year \$1,000 above all expenses. What per cent dividend was made to each stockholder?
6. I wish to secure myself against loss by fire of my home, which is worth \$4,000. I find that I must pay to an insurance company 1 per cent annually on the amount I wished insured. What will be the cost to insure the house for its full value? For $\frac{3}{4}$ of its value?
7. What is the value of 10 shares of stock having a face value of \$100 each, at 20 per cent discount? At 25 per cent premium?
8. A stock of goods worth \$10,000 is insured for $\frac{4}{5}$ of its value at 1 per cent. What is the annual cost, or premium?
9. I paid \$50 for insuring $\frac{1}{2}$ my property at $\frac{1}{2}$ per cent. What is the property worth?
10. What is the premium on \$2,400 at $\frac{3}{8}$ per cent? At $\frac{3}{4}$ per cent? At $1\frac{5}{8}$ per cent?
11. A house is worth \$7,500, and the furniture is worth \$1,500. What will it cost to insure both at 2 per cent?
12. A store is insured for $\frac{4}{5}$ its value at 1 per cent. What is the value of the store if the premium is \$48?

Give an original problem to illustrate—

13. The meaning of profit and loss.
14. How to find the cost, the rate per cent and gain or loss being given.

1. At 20 cents an hour, how much wages should be paid for 12 hours' labor?
2. At \$7.50 a week, how much rent should a farmer pay for the use of a team and wagon for 7 weeks?
3. At 5 cents a week, how much should be paid for the use of a book for 7 weeks?
4. At \$12 a month, how much rent should be paid for the use of a house for 7 months?
5. At \$6 a year, how much interest should be paid for the use of \$100 for three years?
6. What is the interest of \$50 at 6 per cent for 3 years?

SOLUTION I.

Interest at 6% for 1 year is $.06 \times \$50 = \3 .

Interest at 6% for 3 years is $3 \times \$3 = \9 .

SOLUTION II.

Interest at 1% for 1 year = \$.50.

Interest at 1% for 3 years = $3 \times \$.50 = \1.50 .

Interest at 6% for 3 years = $6 \times \$1.50 = \9.00 .

SOLUTION III.

Interest on \$ 1 at 6% for 1 year is \$.06.

Interest on \$ 1 at 6% for 3 years is $3 \times \$.06 = \$.18$.

Interest on \$50 at 6% for 3 years is $50 \times \$.18 = \9.00 .

7. At 7 per cent a year, what should be paid for the use of \$100 for 2 years? Of \$200 for 3 years? Of \$250 for 4 years?
8. If \$500 is loaned for 3 years, what should be paid for its use, at 5 per cent a year? At 6 per cent a year? At $6\frac{1}{2}$ per cent a year?

Give an original problem to illustrate

9. How to find *gain or loss, rate per cent and cost* being given

GRADED MENTAL ARITHMETIC.

To find the interest at 6 per cent of any given principal,—

1. For 2 months (60 days), remove the decimal point two places to the left.

2. For 6 days, remove it three places to the left.

3. Add multiples or parts of these results for any given time.

1. Find the interest of \$80 for 72 days at 5 per cent.

SOLUTION.

Interest for 60 days at 6% = \$.80.

Interest for 12 days at 6% = .16.

Interest for 72 days at 6% = \$.96.

Interest at 1% = $\frac{1}{6}$ of \$.96 = .16.

Interest at 5% (subtracting) = \$.80.

Find the interest at 6 per cent of—

2. \$100 for 90 days.

3. \$ 90 for 60 days.

4. \$ 90 for 48 days.

5. \$ 50 for 120 days.

6. \$100 for 72 days.

7. \$ 72 for 60 days.

8. \$ 60 for 60 days.

9. \$100 for 1 year 8 months.

10. \$200 for 2 years 9 months.

11. \$300 for 1 year 5 months.

12. \$400 for 3 years 2 months.

13. \$500 for 2 years 6 months.

14. \$600 for 2 years 7 months.

15. \$700 for 3 years 3 months.

Find the interest of—

16. \$70 for 6 yrs. at 5%.

17. \$50 for 4 yrs. at 5%.

18. \$60 for 5 yrs. at 4%.

19. \$75 for 8 yrs. at 6%.

20. \$75 for 9 yrs. at 8%.

21. \$36 for 10 yrs. at 5%.

22. \$400 for 11 yrs. at 5%.

23. \$200 for 6½ yrs. at 6%.

24. \$600 for 2 yrs. 3 mos. at 8%.

25. \$400 for 4 yrs. 6 mos. at 6%.

26. \$200 for 3 yrs. 9 mos. at 8%.

27. \$600 for 7 yrs. 1 mo. at 2%.

28. \$700 for 5 yrs. 4 mos. at 9%.

29. \$300 for 7 yrs. 6 mos. at 6%.

30. \$420 for 8 yrs. 4 mos. at 3%.

31. \$640 for 6 yrs. 3 mos. at 8%.

Find selling price of goods marked \$8, 5 and 10 off.

SEVENTH GRADE.

11

1. What is the interest of \$120 for 2 years 4 months 15 days at 6 per cent?

SOLUTION.

Interest for 1 year = $.06 \times \$120 = \7.20 .

Interest for 2 years = $2 \times \$7.20 =$

Interest for 1 month = $\$7.20 \div 12 = \$.60$.

Interest for 4.5 months = $4.5 \times \$.60 =$

Interest for 2 years 4 months 15 days = $\$14.40 + \2.70 , or $\$17.10$.

NOTE.—Since 30 days make a month, any number of days are as many thirtieths of a month, which is reduced to 10ths by dividing by 3. Thus 15 days make .5 of a month, 12 days make .4 of a month, etc.

Find the interest of—

2. \$300 for 3 years 6 months 24 days at 6 per cent.

3. \$250 for 4 years 4 months 18 days at 6 per cent.

4. \$200 for 3 years 7 months at 6 per cent.

5. \$400 for 2 years 5 months at 6 per cent.

6. \$200 for 1 year 9 months 18 days at 6 per cent.

7. \$480 for 3 years 7 months 6 days at 5 per cent.

8. \$300 for 5 years 3 months 18 days at 8 per cent.

9. \$400 for 2 years 3 months 9 days at 6 per cent.

10. Find the amount of \$50 at 8 per cent for 5 years.

SOLUTION.

Interest at 8% for 5 years = 40%, or \$20.

The amount = $\$50 + \20 , or $\$70$.

Find the amount of—

11. \$300 for 2 years 8 months at 6 per cent.

12. \$200 for 7 years 6 months at 6 per cent.

13. \$200 for 3 years 9 months at 8 per cent.

14. \$600 for 8 years 10 months at 6 per cent.

15. \$400 for 8 years 4 months at 9 per cent.

16. \$500 for 4 years 6 months at 10 per cent.

17. \$1,000 for 4 years 6 months at 12 per cent.

18. \$1,000 for 5 years 8 months at 12 per cent.

1. What principal will gain \$210 in 2 years 4 months at 6 per cent?

SOLUTION I.

Interest for $2\frac{1}{3}$ years at 6 per cent will be \$.14 on each dollar.

The required principal will be \$1 taken as many times as \$.14 is contained times in the given interest.

$\$210 \div \$.14 = 1,500$. The required principal = $1,500 \times \$1$, or \$1,500.

SOLUTION II.

Interest for $2\frac{1}{3}$ years = \$210.

Interest for 1 year will be $\$210 \div 2\frac{1}{3} = \90 .

6% of the principal = \$90.

1% of the principal =

100% of the principal =

SOLUTION III.

Principal : principal :: interest : interest.

$x : \$1 :: \$210 : \$.14$.

Find the principal which will give an interest of—

2. \$ 21 in 7 yrs. at 5%.

3. \$ 12 in 8 yrs. at 6%.

4. \$ 60 in 3 yrs. at 8%.

5. \$ 70 in 7 yrs. at 5%.

6. \$ 60 in 8 yrs. at 5%.

7. \$ 80 in 3 yrs. at 6%.

8. \$360 in 1 yr. at 5%.

9. \$150 in 1 yr. at 6%.

10. \$ 10 in 4 yr. at 5%.

11. \$ 32 in 2 yrs. at 4%.

12. \$ 60 in 6 yrs. at 5%.

13. \$ 24 in 8 yrs. at 6%.

14. \$140 in 7 yrs. at 4%.

15. \$120 in 8 yrs. at 5%.

16. \$ 96 in 5 yrs. at 8%.

17. \$150 in 5 yrs. at 6%.

18. \$210 in 5 yrs. at 7%.

19. \$600 in 5 yrs. at 8%.

20. \$240 in 4 yrs. at 10%.

21. \$600 in 4 yrs. at 6%.

22. \$180 in 5 yrs. at 8%.

23. \$250 in 6 yrs. 3 mos. at 4%.

24. \$320 in 5 yrs. 4 mos. at 6%.

25. \$220 in 3 yrs. 8 mos. at 3%.

26. \$8.40 in 7 mos. at 6%.

27. \$8.40 in 6 mos. at 7%.

28. \$48 in 2 yrs. 8 mos. at 6%.

29. \$90 in 3 yrs. 4 mos. at 6%.

30. \$65 in 10 yrs. 10 mos. at 6%.

31. \$78 in 8 yrs. 8 mos. at 9%.

1. What principal will amount to \$224 in 2 years at 6 per cent

SOLUTION I.

The principal = 100%.

Interest for 2 years = 12%.

The amount = 112% = \$224.

1% =

100% =

SOLUTION II.

The interest in 2 years at 6 per cent = $\frac{12}{100}$, or $\frac{3}{25}$ of the principal

The amount $\frac{25}{25} + \frac{3}{25} = \frac{28}{25}$ of the principal = \$224.

$\frac{1}{25}$ of the principal =

$\frac{25}{25}$ of the principal =

SOLUTION III.

Amount of \$1 in 2 years at 6 per cent = \$1.12.

Amount : amount :: principal : principal.

\$1.12 : \$224 :: \$1 : x.

Find the principal which will amount to—

2. \$284 in 7 years at 6 per cent.
3. \$560 in 4 years at 10 per cent.
4. \$900 in 6 years 3 months at 8 per cent.
5. \$650 in 3 years 4 months at 6 per cent.
6. \$387 in 4 years 10 months at 9 per cent.
7. \$960 in 3 years 4 months at 6 per cent.
8. \$910 in 6 years at 5 per cent.
9. \$555 in 3 years 8 months at 3 per cent.
10. \$560 in 3 years 6 months at 4 per cent.
11. \$852 in 4 years 8 months at 9 per cent.
12. \$405 in 2 years 11 months at 12 per cent.
13. \$990 in 7 years 6 months at 5 per cent.

GRADED MENTAL ARITHMETIC.

1. At what rate will \$300 gain \$18 in 2 years?

SOLUTION I.

Interest for 2 years = \$18.00.

Interest for 1 year = \$ 9.00.

\$9 divided by \$300 = .03, or 3%.

SOLUTION II.

At 1% the interest for 1 year = \$3.

At 1% the interest for 2 years = \$6.

If \$6 = 1%, \$18 = 3%.

Find the rate at which —

2. \$ 80 in 5 years will produce \$ 20 interest.
3. \$ 40 in 3 years will produce \$ 72 interest.
4. \$ 30 in 4 years will produce \$120 interest.
5. \$200 in 1 year will produce \$ 18 interest.
6. \$300 in 4 years will produce \$ 60 interest.
7. \$150 in 2 years will produce \$ 24 interest.
8. \$ 80 in 10 years will produce \$ 64 interest.
9. \$150 in 10 years will produce \$ 90 interest.
10. \$500 in 5 years will produce \$100 interest.
11. \$ 60 in 7 years will produce \$ 21 interest.
12. \$180 in 5 years will produce \$ 72 interest.
13. \$400 in 3 years will produce \$ 84 interest.
14. \$100 in 4 years will produce \$120 interest.
15. \$120 in $2\frac{1}{2}$ years will produce \$ 18 interest.
16. \$200 in $1\frac{1}{2}$ years will produce \$ 9 interest.
17. \$150 in 10 years will produce \$150 interest.
18. \$400 in 2 years will amount to \$432.
19. Any principal will double itself in 10 years.
20. Any principal will double itself in $12\frac{1}{2}$ years.
21. Any principal will double itself in 16 years.
22. Any principal will double itself in $16\frac{2}{3}$ years.

23. What is the face of a note which will amount to \$5,200 in

1. In what time will \$200 at 6 per cent gain \$42 interest?

SOLUTION I.

In 1 year the interest = \$12.

It will require as many years to produce \$42 interest as \$12 is contained times in \$42, or $3\frac{1}{2}$ years.

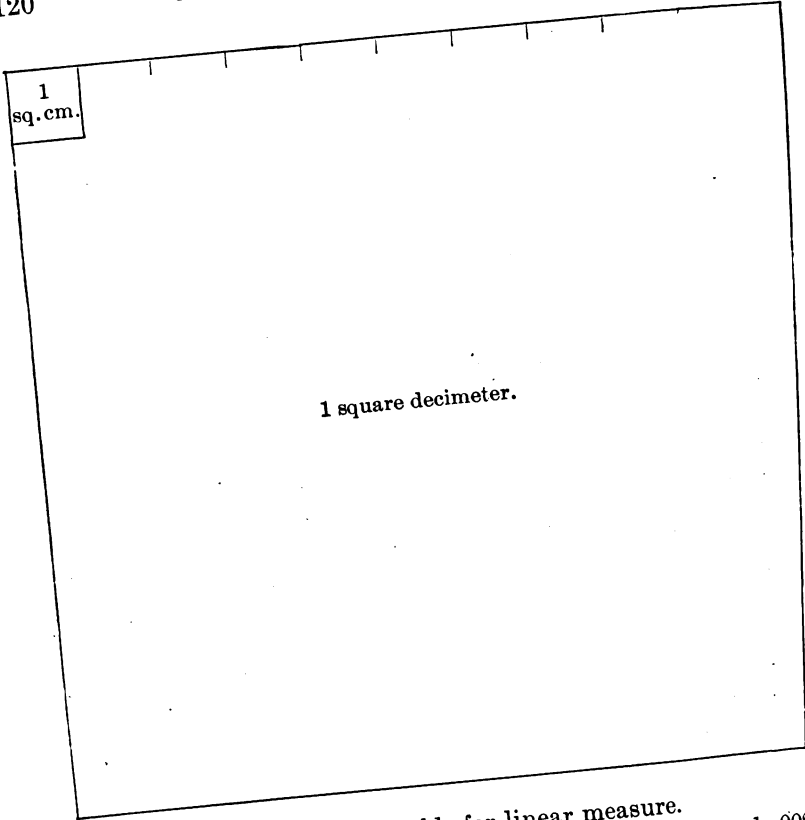
SOLUTION II.

Interest : interest :: time : time.

\$42 : \$12 :: x : 1 year.

Find the time in which—

2. \$40 will produce \$10 at 5 per cent.
3. \$100 will produce \$21 at 6 per cent.
4. \$200 will produce \$45 at $4\frac{1}{2}$ per cent.
5. \$500 will produce \$100 at 4 per cent.
6. \$100 will produce \$14 at 7 per cent.
7. \$15 will produce 25 cents at $3\frac{1}{3}$ per cent.
8. \$200 will produce \$40 at 10 per cent.
9. \$300 will produce \$15 at 12 per cent.
10. \$5 will produce 90 cents at 6 per cent.
11. \$200 will produce \$48 at 8 per cent.
12. \$50 will produce \$12.50 at 10 per cent
13. \$1200 will produce \$75 at 5 per cent.
14. \$200 will amount to \$420 at 10 per cent.
15. \$60 will amount to \$71 at 5 per cent.
16. \$31 will double itself at 5 per cent.
17. \$200 will amount to \$312 at 8 per cent.
18. \$25 will amount to \$45 at 6 per cent.
19. \$300 will amount to \$450 at 6 per cent.
20. Any principal will double itself at 10 per cent.
21. Any principal will double itself at 4%. At 5%.
22. Any principal will double itself at 6%. At 8%.
23. Any principal will double itself at 12%. At 16%.



1
sq. cm.

1 square decimeter.

1. Memorize the metric table for linear measure.
2. A 5-cent nickel piece is .02 meter in diameter, and .002 meters in thickness. The sum of the diameter of how many nickels equals 1 meter? The thickness of how many nickels equals 1 meter?

With a meter-stick find—

3. Length and width of the schoolroom.
4. Height and width of the schoolroom door.
- Height and width of the schoolroom window.
- Of the desk.

The *meter*. "The fundamental unit of length in the metric system, originally defined as one ten-millionth of the distance on the earth's surface from the pole to the equator, now as the distance between two lines on a certain metallic rod preserved in the archives of the International Metric Commission at Paris."—*Standard Dictionary*.

1. Memorize the metric table for square measure.
2. How many square centimeters in a square decimeter?
3. How many square decimeters in a square meter?
4. What part of a square decimeter is a square centimeter?
5. What part of a square meter is a square decimeter?
6. What part of a square meter is a square centimeter?
7. Memorize the metric table for land measure.
8. Find the area in square centimeters of this page.
9. Find the area in square decimeters of the top of your desk.
10. Find the area in square meters of the schoolroom floor.
11. Find the area in ares of the school-yard.
12. Find the area in square meters of the blackboard.
13. Find the area in centares of the outside measurement of the schoolhouse.
14. Memorize the metric table for solid measure.
15. How many decimeters in a meter?
16. How many square decimeters in a square meter?
17. How many cubic decimeters in a cubic meter?
18. What ratio exists between each unit of volume and the next higher denomination?
19. Express in cubic meters 3 cu. dm., 5 cu. cm., 4 cu. dm. 6 cu. Hm.
20. Compute the volume of your schoolroom.
21. Cut and fold paper in the form of a cubic decimeter.
22. Cut and fold paper in the form of a cubic centimeter.
23. How many decasteres of wood can be put into this room?
24. Find the value of wood in a pile 30 meters long, 1.5 meters wide, and 2.5 meters high, at 75 cents a stere.

1. Memorize the metric table for capacity.

2. The unit of capacity for measuring liquids, grains, etc., is the *liter*, containing 1 cubic decimeter. Draw on the board a liter in the form of a cube. Is a liter necessarily in the form of a cube?

3. Change to liters 1 cubic meter, $\frac{1}{2}$ cubic meter, $\frac{1}{4}$ cubic meter, .01 cubic meter.

4. Pour a quart of water into a liter measure. Note the difference.

5. Compute the capacity in liters of a crayon-box.

6. Take the dimensions of a box at home, and give them to the class to compute the capacity in liters.

7. Reduce to liters 20 cubic centimeters, 500 cubic centimeters, $\frac{3}{4}$ hectoliters, .01 dekaliter.

8. How many liters in a tank 1 meter by $\frac{1}{2}$ meter by $\frac{2}{3}$ meter?

9. Compare a kiloliter with a stere.

10. How many liters in a vessel 40 centimeters by 35 centimeters by 75 centimeters?

11. A vessel 1 meter square contains water 15 centimeters deep. How many liters of water in it?

12. How many hectoliters of grain in a bin 3 meters square and 2 meters high?

13. Memorize the metric table for weights.

14. Draw on the board a cubic centimeter.

15. A cubic centimeter of water, at its greatest density (39.2°) weighs 1 gram. What is the weight of a liter of water?

16. A nickel 5-cent piece weighs 5 grams. What is the weight of \$10 in 5-cent pieces?

17. A silver dollar weighs 25 grams. How many dollars required to weigh a kilo?

18. Express in grams 20 dekagrams, 20 hectograms, 5 kilograms, 200 decigrams, 200 centigrams.

19. Express in different denominations 230,550 grams; 200.02 grams.

SEVENTH GRADE.

1

1. The rent charged for a storeroom was \$36 a month, and was increased $8\frac{1}{2}$ per cent. What was the rent after the increase?
2. A paid 60 cents a yard for cloth, which he sold to B at a loss of 60 per cent. B afterwards sold it at a gain of 75 per cent. What price did B receive?
3. Find the value of property on which \$700 tax is levied at a rate of $1\frac{1}{4}$ per cent.
4. What is the per cent gain, if the profit is $\frac{1}{2}$ the selling price?

SOLUTION.

Profit $= \frac{1}{2}$ selling price.

Cost must $= \frac{1}{2}$ selling price.

$\frac{1}{2}$ selling price = cost (100%).

Selling price = 200%.

200% (selling price) $- 100\%$ (cost) $= 100\%$ gain.

What is the per cent gain, if the profit is—

- | | |
|--------------------------------------|--------------------------------------|
| 5. $\frac{1}{8}$ the selling price? | 13. $\frac{4}{5}$ the selling price? |
| 6. $\frac{1}{4}$ the selling price? | 14. $\frac{2}{7}$ the selling price? |
| 7. $\frac{1}{5}$ the selling price? | 15. $\frac{3}{7}$ the selling price? |
| 8. $\frac{1}{6}$ the selling price? | 16. $\frac{8}{9}$ the selling price? |
| 9. $\frac{2}{3}$ the selling price? | 17. $\frac{8}{9}$ the selling price? |
| 10. $\frac{2}{3}$ the selling price? | 18. $\frac{1}{3}$ the selling price? |
| 11. $\frac{3}{5}$ the selling price? | 19. $\frac{4}{5}$ the selling price? |
| 12. $\frac{1}{7}$ the selling price? | 20. $\frac{2}{5}$ the selling price? |

21. What per cent is gained when the cost is $\frac{2}{3}$ of the selling price?

SOLUTION.

$\frac{2}{3}$ = the cost.

$\frac{2}{3}$ = selling price.

$\frac{1}{3}$ = gain.

$\frac{1}{3} = \frac{1}{3}$ of $\frac{2}{3}$ (the cost) $= 33\frac{1}{3}\%$.

22. What per cent is lost by selling at $\frac{2}{3}$ the cost?

- | | | | |
|------------|-------------|--------------|---------------|
| 1. 2 to 3? | 6. 5 to 6? | 11. 6 to 7? | 17. 8 to 12? |
| 2. 3 to 4? | 7. 5 to 7? | 12. 6 to 8? | 18. 10 to 12? |
| 3. 4 to 5? | 8. 5 to 8? | 13. 6 to 10? | 19. 12 to 10? |
| 4. 3 to 2? | 9. 6 to 5? | 14. 8 to 6? | 20. 12 to 8? |
| 5. 5 to 4? | 10. 8 to 5? | 15. 8 to 7? | |

21. The sum of two numbers is 50, and their difference is 12. What are the numbers?

22. A tank has two pipes, one of which will fill it in 4 hours, and the other will empty it in 8 hours. If both pipes are running, how long will it take to fill the tank?

23. A messenger was sent on a journey, and traveled at the rate of 12 miles an hour. Seven hours later, another messenger was sent in the same direction at the rate of 20 miles an hour. How long before the second overtook the first?

What is the gain or loss per cent if you buy—

- | | |
|-----------------------------------|--|
| 24. For \$.02 and sell for \$.03? | 36. For \$.08 and sell for \$.10? |
| 25. For \$.03 and sell for \$.02? | 37. For \$.08 and sell for \$.09? |
| 26. For \$.03 and sell for \$.04? | 38. For \$.10 and sell for \$.11? |
| 27. For \$.03 and sell for \$.05? | 39. For \$.10 and sell for \$.08? |
| 28. For \$.05 and sell for \$.04? | 40. For \$.10 and sell for \$.12? |
| 29. For \$.05 and sell for \$.02? | 41. For \$.10 and sell for \$.15? |
| 30. For \$.05 and sell for \$.06? | 42. For \$.10 and sell for \$.60? |
| 31. For \$.06 and sell for \$.05? | 43. For $\$1\frac{1}{2}$ and sell for $\$1\frac{1}{2}$? |
| 32. For \$.06 and sell for \$.08? | 44. For $\$1\frac{1}{2}$ and sell for $\$1\frac{1}{2}$? |
| 33. For \$.06 and sell for \$.09? | 45. For $\$1\frac{1}{2}$ and sell for $\$1\frac{1}{2}$? |
| 34. For \$.06 and sell for \$.10? | 46. For 50 cents and sell for $\$1\frac{1}{2}$? |
| 35. For \$.08 and sell for \$.06? | 47. For $\$1\frac{1}{2}$ and sell for 75 cents? |

Give an original problem to show—

48. How to find the percentage, when the base and rate are given.

SEVENTH GRADE.

A *board foot* is the unit of lumber measurement. It consists of a board 1 foot square and 1 inch thick. It contains, therefore, 144 cubic inches. A board 12 feet long will contain as many board feet as it is inches wide. Thus a 12-foot board 2 inches wide contains 2 board feet; one 4 inches wide contains 4 board feet, etc. If a board is less than 1 inch thick, it is considered as if it were 1 inch thick. If lumber is more than 1 inch in thickness, the amount is found as in 1-inch lumber, and then multiplying by the number of inches in the thickness.

1. Find the board feet in 5 12-foot boards, having a width of 12, 10, 18, 7, and 9 inches, respectively.

2. How many feet of lumber in 6 12-inch boards 6, 8, 9, 12, and 15 inches wide, respectively, and 12 feet long?

NOTE.—If the boards are 14 feet long, find the board feet for 12-foot boards and add $\frac{1}{3}$ of the result to itself. The 2 feet over 12 is $\frac{1}{3}$ of 12. In like manner, to find the amount of lumber in 15-inch boards, find it for 12-inch boards and add $\frac{1}{4}$ of the result; for 16-foot boards, add $\frac{1}{3}$ of the result; for 18-foot boards, add $\frac{1}{2}$ of the result; for 10-foot boards, subtract $\frac{1}{3}$ of the result; for 9-foot boards, subtract $\frac{1}{4}$ of the result, etc.

3. How many feet in 5 14-foot boards 12, 10, 14, 7, and 9 inches wide, respectively?

4. Find the feet of lumber in 6 boards 8, 9, 10, 12, 14, and 16 inches wide, respectively, all being 16 feet long.

5. How many feet of lumber in 5 boards 18 feet long and 10, 12, 14, and 15 inches wide, respectively?

6. What would the answer to the preceding problem be if the board were 10 feet long?

Find the board feet in the following boards:—

7. 12 feet long, 18 inches wide, $1\frac{1}{2}$ inches thick.
8. 18 feet long, 14 inches wide, 2 inches thick.
9. 16 feet long, 15 inches wide, $1\frac{3}{4}$ inches thick.
10. 15 feet long, 12 inches wide, 2 inches thick.

A *section* of land is one mile square, and contains 640 acres.

A *quarter-section* is one-half a mile square, and contains 160 acres.

A *quarter* of a *quarter* of a section is one-fourth of a mile square, and contains 40 acres.

A *quarter* of a *quarter* of a *quarter* of a section is one-eighth of a mile square, and contains 10 acres.

1. Pupils will draw a diagram illustrating the section and the fractions of a section mentioned above.

2. My farm consists of the northeast quarter and the north half of the southeast quarter of section 21. Draw a diagram of the farm. How many acres in it? How many rods of fence required to inclose it?

3. A farm consists of the southwest quarter of the southeast quarter and the east half of the southeast quarter of the southwest quarter of section 21. Make a diagram of the section and the farm. How many acres in the farm? How many rods of fence required to inclose it?

4. How many rods required to inclose a section? A half-section? A quarter-section? A quarter of a quarter of a section? Ten acres off one side of a quarter of a quarter of a section? A square ten-acre lot?

5. Are 4 times as many rods required to inclose 40 acres as are required to inclose 10 acres? Prove by diagram.

6. Are the same number of rods required to inclose a square field containing 40 acres as are required to inclose an oblong field containing 40 acres? Prove by diagram.

7. An *acre* contains 160 square rods. It may be —

1 rod by 160 rods.

.. rods by 80 rods.

.. rods by 40 rods.

.. rods by 20 rods.

16 rods by 10 rods.

20 rods by 8 rods.

SEVENTH GRADE.

12

A surveyor's chain is 4 rods (66 feet) long. It is divided into 100 links. Chains and links may be expressed as chains and hundredths of chains; as, 4 chains 15 links are 4.15 chains.

1. Express in acres: 1 square chain; 1 chain by 2 chains; chains by 3 chains; 5 chains by 4 chains; 6 chains by 8 chains; 5 chains by 9 chains.

2. How many acres in a piece of land 6 chains 20 links by 6 chains by 6 chains 50 links?

NOTE. — Since there are 4 rods in a chain, any number of rods may be reduced to chains by dividing by 4.

3. How many acres in a field 48 rods by 28 rods?

SOLUTION.

48 rods = 12 chains. 28 rods = 7 chains.

$7 \times 12 = 84$ square chains = the area of the field.

Since 10 square chains = 1 acre, 84 square chains = 8.4 acres.

How many acres in a field —

- | | |
|-------------------------|-----------------------------|
| 4. 50 rods by 40 rods? | 13. 24 chains by 10 chains? |
| 5. 36 rods by 40 rods? | 14. 36 chains by 25 chains? |
| 6. 25 rods by 60 rods? | 15. 96 chains by 25 chains? |
| 7. 80 rods by 36 rods? | 16. 50 chains by 45 chains? |
| 8. 48 rods by 50 rods? | 17. 40 chains by 70 chains? |
| 9. 75 rods by 32 rods? | 18. 75 chains by 96 chains? |
| 10. 84 rods by 20 rods? | 19. 96 rods by 200 chains? |
| 11. 96 rods by 60 rods? | 20. 216 rods by 50 chains? |
| 12. 38 rods by 80 rods? | 21. 200 rods by 96 chains? |
22. What part of an acre is a lot 16 rods by 8 rods?

SOLUTION.

Draw an outline to represent 16 rods by 10 rods

Draw a line across the figure, making one part 16 rods by 8 rods.

What part of an acre is a lot —

- | | |
|-------------------------------------|------------------------------------|
| 23. 16 rods by $2\frac{1}{2}$ rods? | 25. 8 rods by $6\frac{3}{4}$ rods? |
| 24. 16 rods by $7\frac{1}{2}$ rods? | 26. 8 rods by $3\frac{1}{2}$ rods? |

Read to the class the following problems, to drill in speed and accuracy of mental operations:—

1. Square 4, add 4, multiply by 2, add 9, square root, less 3 multiply by 10, divide by 5, square, equals what?
2. Square 5, add 11, divide by 4, square root, multiply by 8 add 1, square root, cube, subtract 4, square root, equals what?
3. Cube 3, add 9, divide by 9, square, add 9, square root, add 4, square root, cube, subtract 2, square root, equals what?
4. Square 5, multiply by 3, subtract 3, divide by 8, square root, multiply by 8, add 1, square root, multiply by 2, square, divide by 2, equals what?
5. If 7 men can earn \$28 in 4 days, how many dollars can 8 men earn in 3 days?

SOLUTION.

If 7 men can earn \$28 in 4 days,
 1 man can earn $\frac{1}{7}$ of \$28, or \$4, in 4 days,
 1 man can earn $\frac{1}{4}$ of \$4, or \$1, in 1 day,
 8 men can earn 8 times \$1, or \$8, in 1 day,
 8 men can earn 3 times \$8, or \$24, in 3 days.

6. If 4 boys can earn \$20 in 4 days, how many days will it take 5 boys to earn \$50?
7. If four persons pay \$36 for 3 weeks' board, how much will 6 persons pay for 5 weeks' board?
8. If \$200 in 6 months produce \$6 interest, how much interest will \$500 produce in 8 months at the same rate?
9. A cow was worth $5\frac{1}{2}$ times as much as a calf, and both were worth \$65. Find the value of each.
10. What is the ratio between 4 feet square and 4 square feet?
11. George can do a piece of work in 5 hours, and Frank can do it in $2\frac{3}{4}$ hours. In what time can both do it when working together?
12. A can do a piece of work in $\frac{1}{2}$ of a day, and B can do it in $\frac{1}{3}$ of a day. How much can both do in one day when working

SEVENTH GRADE.

1. $\frac{3}{4}$ of Frank's money equals $\frac{2}{7}$ of George's. They together have 66 cents. Find what each has.

SOLUTION.

$\frac{3}{4}$ of Frank's = $\frac{2}{7}$ of George's.

$\frac{1}{4}$ of Frank's = $\frac{1}{7}$ of George's.

$\frac{4}{4}$, or all of Frank's, = $\frac{4}{7}$ of George's.

$\frac{4}{7}$ of George's + $\frac{3}{7}$ of George's = $\frac{7}{7}$ of George's = 66 cents.

$\frac{1}{7}$ of George's = $\frac{1}{7}$ of 66 cents, or 6 cents.

$\frac{7}{7}$, or all of George's, = 7×6 cents, or 42 cents.

$\frac{4}{7}$ of 42, or Frank's, = 4×6 cents, or 24 cents.

Find the numbers, if—

2. $\frac{5}{8}$ of one equals $\frac{5}{4}$ of the other, and their sum is 168.

3. $\frac{2}{3}$ of one equals $\frac{2}{3}$ of the other, and their sum is 120.

4. $\frac{2}{3}$ of one equals $\frac{2}{7}$ of the other, and their sum is 72.

5. $\frac{4}{5}$ of one equals $\frac{3}{5}$ of the other, and their sum is 198.

6. Find the time of day if the time past noon is $\frac{1}{2}$ the time to midnight.

SOLUTION.

From noon to midnight is 12 hours, divided into 2 periods.

$\frac{1}{2}$ of the time to midnight equals the time past noon.

$\frac{2}{2}$ of the time to midnight equals the time to midnight.

$\frac{3}{2}$ of the time to midnight equals the whole 12 hours.

$\frac{1}{2}$ of the time to midnight equals $\frac{1}{3}$ of 12 hours, or 4 hours past noon.

$\frac{2}{2}$ of the time to midnight equals 2 times 4 hours, or 8 hours, the time to midnight.

Find the time of day, if—

7. The time past noon equals $\frac{1}{3}$ the time to midnight.

8. $\frac{2}{3}$ the time past noon equals $\frac{2}{7}$ the time to midnight.

9. $\frac{3}{4}$ the time past noon equals $\frac{3}{8}$ the time to midnight.

10. $\frac{1}{2}$ the time past noon equals $\frac{1}{3}$ the time to midnight.

11. $\frac{3}{5}$ the time past noon equals $\frac{2}{7}$ the time to midnight.

Read to the class the following problems, to drill in speed and accuracy of mental operations:—

1. Square 4, add 4, multiply by 2, add 9, square root, less 3, multiply by 10, divide by 5, square, equals what?
2. Square 5, add 11, divide by 4, square root, multiply by 8, add 1, square root, cube, subtract 4, square root, equals what?
3. Cube 3, add 9, divide by 9, square, add 9, square root, add 4, square root, cube, subtract 2, square root, equals what?
4. Square 5, multiply by 3, subtract 3, divide by 8, square root, multiply by 8, add 1, square root, multiply by 2, square, divide by 2, equals what?
5. If 7 men can earn \$28 in 4 days, how many dollars can 8 men earn in 3 days?

SOLUTION.

If 7 men can earn \$28 in 4 days,

1 man can earn $\frac{1}{7}$ of \$28, or \$4, in 4 days,

1 man can earn $\frac{1}{4}$ of \$4, or \$1, in 1 day,

8 men can earn 8 times \$1, or \$8, in 1 day,

8 men can earn 3 times \$8, or \$24, in 3 days.

6. If 4 boys can earn \$20 in 4 days, how many days will it take 5 boys to earn \$50?

7. If four persons pay \$36 for 3 weeks' board, how much will 6 persons pay for 5 weeks' board?

8. If \$200 in 6 months produce \$6 interest, how much interest will \$500 produce in 8 months at the same rate?

9. A cow was worth $5\frac{1}{2}$ times as much as a calf, and both were worth \$65. Find the value of each.

10. What is the ratio between 4 feet square and 4 square feet?

11. George can do a piece of work in 5 hours, and Frank can do it in $2\frac{3}{4}$ hours. In what time can both do it when working together?

12. A can do a piece of work in $\frac{1}{2}$ of a day, and B can do it in $\frac{1}{3}$ of a day. How much can both do in one day when working together?

SEVENTH GRADE.

12

1. $\frac{3}{4}$ of Frank's money equals $\frac{3}{7}$ of George's. They together have 66 cents. Find what each has.

SOLUTION.

$\frac{3}{4}$ of Frank's = $\frac{3}{7}$ of George's.

$\frac{1}{4}$ of Frank's = $\frac{1}{7}$ of George's.

$\frac{1}{4}$, or all of Frank's, = $\frac{1}{7}$ of George's.

$\frac{4}{7}$ of George's + $\frac{1}{7}$ of George's = $\frac{5}{7}$ of George's = 66 cents.

$\frac{1}{7}$ of George's = $\frac{1}{5}$ of 66 cents, or 6 cents.

$\frac{4}{7}$, or all of George's, = 4×6 cents, or 24 cents.

$\frac{1}{4}$ of 42, or Frank's, = 4×6 cents, or 24 cents.

Find the numbers, if—

2. $\frac{5}{8}$ of one equals $\frac{5}{4}$ of the other, and their sum is 168.
3. $\frac{2}{3}$ of one equals $\frac{2}{3}$ of the other, and their sum is 120.
4. $\frac{2}{3}$ of one equals $\frac{2}{7}$ of the other, and their sum is 72.
5. $\frac{3}{4}$ of one equals $\frac{3}{3}$ of the other, and their sum is 198.

6. Find the time of day if the time past noon is $\frac{1}{2}$ the time to midnight.

SOLUTION.

From noon to midnight is 12 hours, divided into 2 periods.

$\frac{1}{2}$ of the time to midnight equals the time past noon.

$\frac{2}{2}$ of the time to midnight equals the time to midnight.

$\frac{3}{2}$ of the time to midnight equals the whole 12 hours.

$\frac{1}{2}$ of the time to midnight equals $\frac{1}{3}$ of 12 hours, or 4 hours past noon.

$\frac{2}{2}$ of the time to midnight equals 2 times 4 hours, or 8 hours, the time to midnight.

Find the time of day, if—

7. The time past noon equals $\frac{1}{3}$ the time to midnight.
8. $\frac{2}{3}$ the time past noon equals $\frac{2}{7}$ the time to midnight.
9. $\frac{3}{4}$ the time past noon equals $\frac{3}{8}$ the time to midnight.
10. $\frac{1}{5}$ the time past noon equals $\frac{1}{3}$ the time to midnight.
11. $\frac{3}{5}$ the time past noon equals $\frac{3}{7}$ the time to midnight.

Read to the class the following problems, to drill in speed and accuracy of mental operations:—

1. Square 4, add 4, multiply by 2, add 9, square root, less 3, multiply by 10, divide by 5, square, equals what?
2. Square 5, add 11, divide by 4, square root, multiply by 8, add 1, square root, cube, subtract 4, square root, equals what?
3. Cube 3, add 9, divide by 9, square, add 9, square root, add 4, square root, cube, subtract 2, square root, equals what?
4. Square 5, multiply by 3, subtract 3, divide by 8, square root, multiply by 8, add 1, square root, multiply by 2, square, divide by 2, equals what?

5. If 7 men can earn \$28 in 4 days, how many dollars can 8 men earn in 3 days?

SOLUTION.

If 7 men can earn \$28 in 4 days,
 1 man can earn $\frac{1}{7}$ of \$28, or \$4, in 4 days,
 1 man can earn $\frac{1}{4}$ of \$4, or \$1, in 1 day,
 8 men can earn 8 times \$1, or \$8, in 1 day,
 8 men can earn 3 times \$8, or \$24, in 3 days.

6. If 4 boys can earn \$20 in 4 days, how many days will it take 5 boys to earn \$50?
7. If four persons pay \$36 for 3 weeks' board, how much will 6 persons pay for 5 weeks' board?
8. If \$200 in 6 months produce \$6 interest, how much interest will \$500 produce in 8 months at the same rate?
9. A cow was worth $5\frac{1}{2}$ times as much as a calf, and both were worth \$65. Find the value of each.
10. What is the ratio between 4 feet square and 4 square feet?
11. George can do a piece of work in 5 hours, and Frank can do it in $2\frac{3}{4}$ hours. In what time can both do it when working together?
12. A can do a piece of work in $\frac{1}{2}$ of a day, and B can do it in $\frac{1}{3}$ of a day. How much can both do in one day when working together?

SEVENTH GRADE.

12

1. $\frac{3}{4}$ of Frank's money equals $\frac{2}{3}$ of George's. They together have 66 cents. Find what each has.

SOLUTION.

$\frac{3}{4}$ of Frank's = $\frac{2}{3}$ of George's.

$\frac{1}{4}$ of Frank's = $\frac{1}{3}$ of George's.

$\frac{1}{4}$, or all of Frank's, = $\frac{1}{3}$ of George's.

$\frac{1}{4}$ of George's + $\frac{1}{3}$ of George's = $\frac{1}{12}$ of George's = 66 cents.

$\frac{1}{12}$ of George's = $\frac{1}{11}$ of 66 cents, or 6 cents.

$\frac{1}{3}$, or all of George's, = 7×6 cents, or 42 cents.

$\frac{1}{4}$ of 42, or Frank's, = 4×6 cents, or 24 cents.

Find the numbers, if—

2. $\frac{5}{8}$ of one equals $\frac{5}{4}$ of the other, and their sum is 168.

3. $\frac{2}{3}$ of one equals $\frac{2}{3}$ of the other, and their sum is 120.

4. $\frac{2}{3}$ of one equals $\frac{2}{7}$ of the other, and their sum is 72.

5. $\frac{3}{4}$ of one equals $\frac{3}{5}$ of the other, and their sum is 198.

6. Find the time of day if the time past noon is $\frac{1}{2}$ the time to midnight.

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$\frac{1}{2}$ of the time to midnight equals $\frac{1}{3}$ of 12 hours, or 4 hours past noon.

$\frac{2}{2}$ of the time to midnight equals 2 times 4 hours, or 8 hours, the time to midnight.

Find the time of day, if—

7. The time past noon equals $\frac{1}{3}$ the time to midnight.

8. $\frac{2}{3}$ the time past noon equals $\frac{2}{7}$ the time to midnight.

9. $\frac{3}{4}$ the time past noon equals $\frac{3}{8}$ the time to midnight.

10. $\frac{1}{5}$ the time past noon equals $\frac{1}{3}$ the time to midnight.

11. $\frac{3}{5}$ the time past noon equals $\frac{2}{7}$ the time to midnight.

Read to the class the following problems, to drill in speed and accuracy of mental operations:—

1. Square 4, add 4, multiply by 2, add 9, square root, less 3 multiply by 10, divide by 5, square, equals what?
2. Square 5, add 11, divide by 4, square root, multiply by 8 add 1, square root, cube, subtract 4, square root, equals what?
3. Cube 3, add 9, divide by 9, square, add 9, square root, add 4, square root, cube, subtract 2, square root, equals what?
4. Square 5, multiply by 3, subtract 3, divide by 8, square root, multiply by 8, add 1, square root, multiply by 2, square divide by 2, equals what?

5. If 7 men can earn \$28 in 4 days, how many dollars can 8 men earn in 3 days?

SOLUTION.

If 7 men can earn \$28 in 4 days,
 1 man can earn $\frac{1}{7}$ of \$28, or \$4, in 4 days,
 1 man can earn $\frac{1}{4}$ of \$4, or \$1, in 1 day,
 8 men can earn 8 times \$1, or \$8, in 1 day,
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12. A can do a piece of work in $\frac{1}{2}$ of a day, and B can do it in $\frac{1}{3}$ of a day. How much can both do in one day when working together?

SEVENTH GRADE.

1. $\frac{3}{4}$ of Frank's money equals $\frac{2}{7}$ of George's. They together have 66 cents. Find what each has.

SOLUTION.

$\frac{3}{4}$ of Frank's = $\frac{2}{7}$ of George's.

$\frac{1}{4}$ of Frank's = $\frac{1}{7}$ of George's.

$\frac{4}{4}$, or all of Frank's, = $\frac{4}{7}$ of George's.

$\frac{4}{7}$ of George's + $\frac{7}{7}$ of George's = $\frac{11}{7}$ of George's = 66 cents.

$\frac{1}{7}$ of George's = $\frac{1}{11}$ of 66 cents, or 6 cents.

$\frac{7}{7}$, or all of George's, = 7×6 cents, or 42 cents.

$\frac{4}{7}$ of 42, or Frank's, = 4×6 cents, or 24 cents.

Find the numbers, if—

2. $\frac{5}{3}$ of one equals $\frac{5}{4}$ of the other, and their sum is 168.

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$\frac{2}{2}$ of the time to midnight equals 2 times 4 hours, or 8 hours, the time to midnight.

Find the time of day, if—

7. The time past noon equals $\frac{1}{3}$ the time to midnight.

8. $\frac{2}{3}$ the time past noon equals $\frac{2}{7}$ the time to midnight.

9. $\frac{3}{4}$ the time past noon equals $\frac{3}{8}$ the time to midnight.

10. $\frac{1}{3}$ the time past noon equals $\frac{1}{3}$ the time to midnight.

11. $\frac{3}{5}$ the time past noon equals $\frac{3}{7}$ the time to midnight.

1. From what place is latitude reckoned?
2. From what place is longitude reckoned?
3. What is the latitude of the south pole? Of the north pole?
4. Find from your maps the latitude of Quito; of San Francisco; of Portland, Oregon; of Tacoma.
5. What place on the globe has neither latitude nor longitude?
6. Locate the point on the earth from which, if you travel southward in a direct line for 1,000 miles, thence eastward 1,000 miles, thence northward 1,000 miles, you will arrive at the point from which you started.
7. What is the latitude of a place lying $\frac{1}{2}$ the distance from the equator to the north pole? $\frac{1}{3}$ the distance? $\frac{1}{4}$ the distance? $\frac{2}{3}$ the distance? $\frac{1}{5}$ the distance? $\frac{3}{5}$ the distance?
8. If Mr. Brown travels 180° east, and Mr. Jones, starting from the same point, journeys 180° west, how many degrees will their positions differ in longitude?
9. What is the longitude 200° east from Greenwich? 200° west? 250° east? 250° west?
10. How many degrees of the earth's surface pass under the sun in one complete revolution of the earth? How many hours of time in a complete revolution of the earth? What part of the revolution is made in 1 hour? How many degrees are passed in 1 hour? What difference in longitude causes a difference of 1 hour in time? What difference in time is caused by a difference of 1° in longitude? Of 75° ? Of 90° ? Of 180° ? Of 15° ? Of 30° ? Of 45° ?
11. What difference in longitude makes a difference of 2 hours in time? Of 5 hours? Of 3 hours? Of 7 hours? Of 1 hour? Of $\frac{1}{2}$ hour? Of $\frac{1}{4}$ hour? Of $\frac{1}{3}$ hour? Of $\frac{1}{5}$ hour?
12. When it is noon in Boston, what is the hour, reckoning by standard time, in Buffalo? In Cincinnati? In Chicago? In Denver? In St. Paul? In Seattle?
13. A and B start from opposite points and travel towards each other. When they meet, A's watch is 40 minutes slow and B's watch is 40 minutes fast. How many degrees apart were they at first? In

EIGHTH GRADE.

1. Divide 65 into two parts so that one part is 15 more than the other.

SOLUTION.

Let (1) x = the smaller part,
and (2) $x + 15$ = the larger part.

$$(3) 2x + 15 = 65.$$

Subtracting 15, (4) $2x = 50.$

$$(5) x = 25, \text{ one part.}$$

$$(6) 25 + 15 = 40, \text{ the other part.}$$

2. In a school of 40 pupils, there were 8 more girls than boys. How many of each?

3. Find two numbers whose sum is 60 and whose difference is 8.

4. Divide 83 into three parts so that the second is 5 more than the first, and the third is 7 more than the second.

5. The sum of two numbers is 50, and one is 1 less than twice the other. Find the numbers.

SOLUTION.

Let (1) x = one number,
and (2) $2x - 1$ = the other number.

$$(3) 3x - 1 = 50.$$

Adding 1, (4) $3x = 51.$

$$(5) x = 17, \text{ one number.}$$

$$(6) 50 - 17 = 33, \text{ the other number.}$$

6. Find two numbers whose sum is 45 and difference 9.

1. If Willie's age be multiplied by 3, and 30 be added, the sum will be 6 times his age in years. What is his age?

SOLUTION.

Let (1) x = Willie's age.

(2) $3x + 30$ years = $6x$.

Subtracting $3x$, (3) 30 years = $3x$.

(4) 10 years = x , his age.

2. A boy found 3 times as many marbles as he at first had, and bought 40 more, and then had 8 times as many as he had at first. How many had he at first?

3. Albert is 3 years older than his brother, and twice his age is equal to three times his brother's age. How old is each?

4. Divide 95 into three parts so that the second is one more than the first, and the third is twice the second.

SOLUTION.

Let (1) x = the first part,

and (2) $x + 1$ = the second part,

and (3) $2x + 2$ = the third part.

(4) $4x + 3 = 95$.

Subtracting 3, (5) $4x = 92$.

(6) $x = 23$, the first part.

(7) $x + 1 = 24$, the second part.

(8) $2x + 2 = 48$, the third part.

5. A half-section of land is divided among 3 persons so that the second owns 20 acres more than the first, and the third twice as many as the second. How many acres had each?

6. A farmer had a sheep, a cow, and a horse. The cow was worth twice as much as the sheep, and the horse was worth twice as much as the cow. They all were worth \$140. Find the value of each.

7. Three horses together are worth \$540, and their respective

1. Roger is $\frac{1}{4}$ as old as his father, and the sum of their ages is 50 years. Find the age of each.

SOLUTION.

Let (1) x = father's age,

and (2) $\frac{1}{4}x$ = Roger's age.

Adding, (3) $\frac{5}{4}x = 50$ years.

Dividing by 5, (4) $\frac{1}{4}x = 10$ years, Roger's age.

Multiplying by 4, (5) $x = 40$ years, the father's age.

Or,

Multiplying by 4, (4) $5x = 200$ years.

Dividing by 5, (5) $x = 40$ years.

Dividing by 4, (6) $\frac{1}{4}x = 10$ years.

2. A wheelman went $\frac{1}{2}$ as far in the forenoon as he went in the afternoon, and he traveled 96 miles in the day. How far did he travel in each part of the day?

3. What number diminished by $\frac{1}{5}$ of itself equals 60?

4. The sum of $\frac{1}{2}$ and $\frac{1}{4}$ of a number equals 150. What is the number?

SOLUTION.

Let (1) x = the number.

(2) $\frac{1}{2}x + \frac{1}{4}x = 150$.

(3) $\frac{3}{4}x = 150$.

(4) $3x = 600$.

(5) $x = 200$.

5. One man owned $\frac{1}{8}$ of a store, and another owned $\frac{3}{8}$ of it. The value of what they both owned was \$28,000. Find the value of the store.

6. What number increased by its $\frac{1}{2}$ and $\frac{1}{4}$ equals 350?

7. Three times a plus $\frac{1}{2}a$ equals 42. Find the value of a .

8. A number increased by its $\frac{1}{4}$ and $\frac{1}{5}$, and 12 more, equals 70. Find the number.

9. A number increased by its $\frac{1}{3}$ and $\frac{1}{4}$, and 17, equals 3 times itself. Find the number.

1. $x+16=24$. Find the value of x .

SOLUTION.

Subtracting 16 from the first member leaves x ; but if 16 is subtracted from the first member, it must also be subtracted from the second. Note that 16 has been transposed from one member to the other member, and the sign is changed.

- (1) $x+16=24$.
 (2) $x=24-16$.

2. $3x=x+18$. Find the value of x .

SOLUTION.

Subtracting x from both members, x is transposed from the second member to the first, and the sign is changed.

- (1) $3x=x+18$.
 (2) $3x-x=18$.
 (3) $2x=18$.
 (4) $x=9$.

Find the value of x —

3. $2x=x+8$.

4. $3x=32-x$.

5. $x+20=8x-8$.

6. $5x-5=3x+3$.

7. $5x+6=x+26$.

8. $8x-8=2+6x$.

9. $57-3x=6x+22-2x$.

10. $20-2x=x+2$

11. $6+6x=54-2x$.

12. $18-2x=4x-24$.

13. $8x+44=163-9x$.

14. $3x+\frac{1}{2}x=6x-16$.

15. $30-7x=10-\frac{1}{2}x$.

16. $6x+4x=156-3x$.

17. Find the sum of $5a$; $-2a$; $6a$; $-4a$.

SOLUTION.

$+5a$

$-2a$

$+6a$

$-4a$

$\hline 5a$

The sum of the positive quantities $=+11a$.
 The sum of the negative quantities $= -6a$.

The sum $= 5a$.

Notice that the sum takes the sign of the larger coefficient.

18.

$13x$

x

$-5x$

19.

$14y^2$

$-2y^2$

$7y^2$

20.

$13ab$

$16ab$

$-4ab$

21.

$24y$

$-13y$

$20y$

22.

$25(a-6)$

$-50(a-6)$

$30(a-6)$

23.

$-8(x+y)$

$-4(x+y)$

$17(x+y)$

1. One boy earned 15 cents on a certain day, and another boy lost 10 cents. What was the difference between their earnings of the day?

SOLUTION.

$$\begin{array}{r} +15 \text{ cents.} \\ -10 \text{ cents.} \\ \hline 25 \text{ cents.} \end{array}$$

It is evident that the resulting 25 cents is the difference. That is, $15 \text{ cents} - (-10 \text{ cents}) = 25 \text{ cents.}$

Subtract—

2.	3.	4.	5.	6.
$10x$	$6x$	$-4xy$	$27axy$	$-4ab$
$\underline{6x}$	$\underline{10x}$	$\underline{27xy}$	$\underline{-4axy}$	$\underline{-13ab}$
7.	8.	9.	10.	11.
$-13ab$	$+6c$	$-18c$	$-25xy$	$9xy$
$\underline{-4ab}$	$\underline{-18c}$	$\underline{+6c}$	$\underline{9xy}$	$\underline{-25xy}$

Two or more quantities may be combined and considered as a single quantity. Thus, $3a + 3b$ may be expressed by combining a and b , and giving the coefficient to the resulting quantity, as $3(a + b)$. The expression, $a - (b + c)$, indicates that both b and c or the *sum* of b and c , is subtracted from a . It is apparent that if the parenthesis is removed without changing the value of the expression, the signs must be changed to indicate the subtraction of both quantities, as $a - (b + c) = a - b - c$.

Remove parentheses and combine the similar terms—

<p>12. $a + (b - c - d) = \dots$</p> <p>13. $a + b - (c - d) = \dots$</p> <p>14. $a + b - (c + d) + c = \dots$</p> <p>15. $a - (b + c + d) + b = \dots$</p> <p>16. $a - (b + c - d) - a + b = \dots$</p>	<p>17. $a + b - (a + b) = \dots$</p> <p>18. $a + b - (a - b) = \dots$</p> <p>19. $a - b + (a - b) = \dots$</p> <p>20. $a - b - (a - b) = \dots$</p> <p>21. $a - b - (a + b) = \dots$</p>
--	--

Add—

22.

$$\begin{array}{r} -7a + 3y - 4b + 3z \\ 6a - y + 4b - 3z \end{array}$$

In multiplication we have for the sign of the product the general principle, that *like signs give +*; *unlike signs give -*.

Hence the product of an *even* number of negative factors is positive; of an *odd* number, negative.

When a literal factor is repeated in a product, the number of times the factor occurs is indicated by a small figure written a little above and to the right of the letter.

Thus the product of $4a$ and $5a$ is written $20a^2$; the product of a^2 and $a^3 = a^5$ (add the exponents).

1. Multiply $6x + 5x$ by 3.

SOLUTION.

$6x + 5x$		
$6x + 5x$	$3x + 5x = 11x$	The product of 3 times $6x = 18x$
$6x + 15x$	$\begin{array}{r} 3 \quad 3 \end{array}$	The product of 3 times $5x = 15x$
<hr/> $18x + 15x$	<hr/> $18x + 15x = 33x$	The product of 3 times $11x = 33x$

2. Multiply $6x - 5x$ by 3.

SOLUTION.

$6x - 5x$		
$6x - 5x$	$3x - 5x$	The product of 3 times $6x = 18x$
$6x - 5x$	$\begin{array}{r} 3 \end{array}$	The product of 3 times $5x = 15x$
<hr/> $18x - 15x$	<hr/> $18x - 15x = 3x$	The product of 3 times $x = 3x$

Multiply—

3. $a + b$ by x .

4. $3c + 5d$ by m .

5. $2a + 3b$ by $-2x$.

6. $c + d$ by m .

7. $2a + 3b$ by $4x$.

8. $3c + 5d$ by $-3m$.

9. $2a + 3b$ by x .

10. $3c + 5d$ by $10m$.

12. $2c - 4d$ by 4.

13. $x^2 + x$ by $2x$.

14. $x^2 + 2x + 1$ by x .

15. $x^2 + xy + y^2$ by x^2 .

16. $x^2 + xy + y^2$ by y^2 .

17. $2x^2 - 3x$ by $3x$.

18. $x^2 - 2x - 2$ by $-xy$.

19. $x^2 - xy + y^2$ by xy .

1. Find the product of $(a+b)$ and $(a+b)$.

SOLUTION.

$$\begin{array}{rcl} a & \text{times } (a+b) & = a^2 + ab. \\ b & \text{times } (a+b) & = ab + b^2. \\ \hline (a+b) & \text{times } (a+b) & = a^2 + 2ab + b^2. \end{array}$$

2. $(2x+3y)$ times $(3x-2y)$.

SOLUTION.

$$\begin{array}{r} 2x + 3y. \\ 3x - 2y. \\ \hline \text{Multiplying by } 3x, \quad 6x^2 + 9xy. \\ \text{Multiplying by } -2y, \quad -4xy + 6y^2. \\ \hline 6x^2 + 5xy - 6y^2. \end{array}$$

Find the product of—

- | | |
|----------------------------|----------------------------|
| 3. $a + 6$ and $a + 15$. | 15. $x - 4$ and $x + 5$. |
| 4. $x + 4$ and $x + 15$. | 16. $x + 3$ and $x + 20$. |
| 5. $x + 2$ and $x + 30$. | 17. $x + 1$ and $x + 60$. |
| 6. $x - 12$ and $x - 5$. | 18. $x - 6$ and $x - 10$. |
| 7. $x - 4$ and $x - 15$. | 19. $x - 3$ and $x - 20$. |
| 8. $x - 2$ and $x - 30$. | 20. $x - 1$ and $x - 60$. |
| 9. $x - 12$ and $x + 5$. | 21. $x + 12$ and $x - 5$. |
| 10. $x - 4$ and $x + 15$. | 22. $x + 4$ and $x - 15$. |
| 11. $x - 6$ and $x + 10$. | 23. $x + 6$ and $x - 10$. |
| 12. $x - 3$ and $x + 20$. | 24. $x + 3$ and $x - 20$. |
| 13. $x - 2$ and $x + 30$. | 25. $x + 2$ and $x - 30$. |
| 14. $x - 1$ and $x + 60$. | 26. $x + 1$ and $x - 60$. |

Find the product * of—

- | | |
|------------------------------|-------------------------------|
| 27. $2x + 3y$ and $x + 2y$. | 31. $3x + y$ and $2x + 5y$. |
| 28. $2a + 3b$ and $a + 2b$. | 32. $3p + q$ and $2p + 5q$. |
| 29. $2m + 3n$ and $m + 2n$. | 33. $3x - 2y$ and $2x - 3y$. |
| 30. $2a - b$ and $a + 2b$. | 34. $3m - 2n$ and $3m - 3n$. |

Notice how the *square* of these quantities is expressed:—

$$\begin{array}{r} a+b. \\ a+b. \\ \hline a^2+ab. \\ +ab+b^2. \\ \hline a^2+2ab+b^2. \end{array}$$

$$\begin{array}{r} a-b. \\ a-b. \\ \hline a^2-ab. \\ -ab+b^2. \\ \hline a^2-2ab+b^2. \end{array}$$

1. What is the square of the sum of two quantities?
2. What is the square of the difference between two quantities?

Find, by inspection, the square of the following binomials:—

- | | | |
|-------------|----------------------|----------------------|
| 3. $x+y.$ | 11. $m-4a.$ | 19. $x-2y.$ |
| 4. $m+n.$ | 12. $x+\frac{2}{3}.$ | 20. $2+2x.$ |
| 5. $y+3z.$ | 13. $x-\frac{3}{5}.$ | 21. $20+3.$ |
| 6. $x-y.$ | 14. $x+\frac{3}{2}.$ | 22. $30+4.$ |
| 7. $m-n.$ | 15. $x+\frac{1}{2}.$ | 23. $50+2.$ |
| 8. $2y-3z.$ | 16. $y+z.$ | 24. $101.$ |
| 9. $3m-4n.$ | 17. $2x+y.$ | 25. $10\frac{1}{2}.$ |
| 10. $ab+c.$ | 18. $m+4n.$ | 26. $9\frac{1}{2}.$ |

27. What must be added to x^2+y^2 to make the square of $x+y$?
28. What must be added to x^2+y^2 to make the square of $x-y$?
29. What must be added to x^2+2xy to make the square of $x+y$?
30. What must be added to x^2+4xy to make the square of $x+2y$?
31. Form a complete square by adding a term to x^2-4xy .
32. Form a complete square by adding a term to x^2+4y^2 .
33. Form a complete square by adding a term to x^2-10x .

Express each of the following as the square of a binomial:—

- | | |
|---------------------|----------------------------|
| 34. $x^2+2xy+y^2.$ | 38. $x^2-2xy+y^2.$ |
| 35. $x^2+4xy+4y^2.$ | 39. $4m^2+4m+1.$ |
| 36. $4x^2+4x+1.$ | 40. $9x^2-24x+16.$ |
| 37. $a^2+2ab+b^2.$ | 41. $(a+b)^2+2(a-b)c+c^2.$ |

Form a square by adding a term to each of the following, and state the expression of which each is then the square:—

1. $m^2 + 2mn$.

SOLUTION.

Adding n^2 , $m^2 + 2mn + n^2 = (m + n)^2$.

2. $m^2 + 6m$.

10. $p^2 + 2pq$.

18. $4x^2 + 12x$.

3. $m^2 - 2mn$.

11. $p^2 - 8p$.

19. $4x^4 - 4xy$.

4. $m^2 + 2mn$.

12. $y^2 + 2y$.

20. $4x^2 - 12x$.

5. $m^2 - 6m$.

13. $y^2 - 2y$.

21. $z^2 - 4z$.

6. $x^2 - 16x$.

14. $y^2 - 4y$.

22. $4z^2 + 4z$.

7. $x^2 + 3x$.

15. $4a^2b^2 + 8ab$.

23. $p^2q^2 - 4pq$.

8. $x^2y^2 + 4xy$.

16. $p^2 + q^2$.

9. $m^2 + n^2$.

17. $4x^2 + 4xy$.

24. What is the product of the sum and difference of two quantities?

SOLUTION.

$a + b$ = sum of a and b .

$a - b$ = difference of a and b .

$$\begin{array}{r} a^2 + ab. \\ \hline \end{array}$$

$$\begin{array}{r} -ab - b^2. \\ \hline \end{array}$$

$a^2 - b^2$ = difference of the square of a and b .

Find the product of—

25. $x + y$ and $x - y$.

33. $2 + 2x$ and $2 - 2x$.

26. $b + c$ and $b - c$.

34. $a^2 + b^2$ and $a^2 - b^2$.

27. $m + n$ and $m - n$.

35. $a + \frac{1}{2}$ and $a - \frac{1}{2}$.

28. $b + 2c$ and $b - 2c$.

36. $x + 2$ and $x - 2$.

29. $x + 4$ and $x - 4$.

37. $ab + \frac{1}{2}$ and $ab - \frac{1}{2}$.

30. $x + 7$ and $x - 7$.

38. $3 - 2x$ and $3 + 2x$.

31. $x + 1$ and $x - 1$.

39. $4a - 5b$ and $4a + 5b$.

32. $1 + 2x$ and $1 - 2x$.

Divide—

- | | |
|----------------------------------|--|
| 1. $x^2 + 8x + 15$ by $x + 3$. | 14. $m^2 - m - 2$ by $m + 1$. |
| 2. $x^2 - 8x + 15$ by $x - 3$. | 15. $x^2 + 2xy + y^2$ by $x + y$. |
| 3. $x^2 + 2x - 15$ by $x + 5$. | 16. $x^2 + 5xy + 6y^2$ by $x + 3y$. |
| 4. $x^2 - 2x - 15$ by $x - 5$. | 17. $a^2 - 11ab - 12b^2$ by $a + b$. |
| 5. $x^2 + 9x + 14$ by $x + 2$. | 18. $x^2 + 4x + 4$ by $x + 2$. |
| 6. $x^2 + 7x + 12$ by $x + 3$. | 19. $a^2 + 5a + 4$ by $a + 4$. |
| 7. $x^2 - 2x - 63$ by $x + 7$. | 20. $x^2 + 7x + 6$ by $x + 1$. |
| 8. $x^2 - 9x - 22$ by $x + 2$. | 21. $x^2 - 5x - 14$ by $x + 2$. |
| 9. $x^2 + 3x + 2$ by $x + 1$. | 22. $x^2 - 7x - 18$ by $x - 9$. |
| 10. $x^2 + 5x + 6$ by $x + 2$. | 23. $c^2 - 3c - 18$ by $c + 3$. |
| 11. $x^2 + 8x + 15$ by $x + 5$. | 24. $x^2 + 3xy + 2y^2$ by $x + 2y$. |
| 12. $a^2 - 7a + 12$ by $a - 3$. | 25. $x^2 - 5xy - 14y^2$ by $x - 7y$. |
| 13. $a^2 - 7a + 12$ by $a + 3$. | 26. $m^2 - 12mn + 35n^2$ by $m - 5n$. |

Find the factors of—

- | | |
|----------------------|--------------------------|
| 27. $c^2 - d^2$. | 36. $x^2y^2 - z^2w^2$. |
| 28. $m^2 - n^2$. | 37. $4a^2b^2 - x^2y^2$. |
| 29. $q^2 - r^2$. | 38. $25 - 16p^2q^2$. |
| 30. $4 - x^2$. | 39. $a^4 - b^4$. |
| 31. $9 - 4y^2$. | 40. $25x^6 - y^4$. |
| 32. $16 - a^2$. | 41. $4m^2 - n^2$. |
| 33. $27^2 - 23^2$. | 42. $9p^2 - 4q^2$. |
| 34. $a^2x^2 - y^2$. | 43. $16x^4 - 9y^4$. |
| 35. $x^2 - y^2z^2$. | |

By actual multiplication, $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$.Also, $(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$.

(Note the order of the signs.)

Expand *—

- | | |
|------------------|---------------------------|
| 44. $(x+y)^3$. | 48. $(1-2x)^3$. |
| 45. $(x-y)^3$. | 49. $(2a+3)^3$. |
| 46. $(x+2y)^3$. | 50. $(2a-3)^3$. |
| 47. $(x-2y)^3$. | 51. $(a+\frac{1}{2})^3$. |

* Use pencil.

Consider the following products:—

$$\begin{array}{r} x + 5 \\ x + 7 \\ \hline x^2 + 5x \\ + 7x + 35 \\ \hline x^2 + 12x + 35 \end{array}$$

$$\begin{array}{r} x - 5 \\ x - 7 \\ \hline x^2 - 5x \\ - 7x + 35 \\ \hline x^2 - 12x + 35 \end{array}$$

$$\begin{array}{r} x + 5 \\ x - 7 \\ \hline x^2 + 5x \\ - 7x - 35 \\ \hline x^2 - 2x - 35 \end{array}$$

These products consist of three terms:—

- (1) *The square of the common term.*
- (2) *The product of the common term and the sum of the unlike terms.*
- (3) *The product of the unlike terms.*

Find, by inspection, the product of—

- | | |
|-------------------------|--------------------------|
| 1. $x+2$ and $x+3$. | 11. $x+3$ and $x+5$. |
| 2. $x+7$ and $x+11$. | 12. $x-2$ and $x-3$. |
| 3. $x-3$ and $x-5$. | 13. $x-7$ and $x-11$. |
| 4. $z+2$ and $z-3$. | 14. $z+3$ and $z-5$. |
| 5. $a+7$ and $a-11$. | 15. $a-2$ and $a+3$. |
| 6. $a-3$ and $a+5$. | 16. $a-7$ and $a+11$. |
| 7. $m+9$ and $m-7$. | 17. $d+9$ and $d-7$. |
| 8. $y+9$ and $y-7$. | 18. $mn+9$ and $mn-7$. |
| 9. $cd-9$ and $cd+7$. | 19. $yz+9$ and $yz-7$. |
| 10. $2b+3$ and $2b-5$. | 20. $3y+11$ and $3y-7$. |

Conversely, the factors of x^2+5x+6 can be found, if there are two numbers whose sum equals 5 and whose product equals 6.

Find the factors of—

- | | |
|------------------------|------------------------|
| 21. $x^2 + 4x^2 + 3$. | 27. $x^2 + 6x + 5$. |
| 22. $y^2 + 10y + 21$. | 28. $y^2 + 8y + 7$. |
| 23. $m^2 - 8m + 16$. | 29. $m^2 + 10m + 24$. |
| 24. $m^2 - 10m + 21$. | 30. $m^2 - 10m + 16$. |
| 25. $a^2 - 14 + 24$. | 31. $a^2 - 10a + 24$. |

1. Find the value of x in the equation, $\frac{x}{3} - 2 = \frac{x}{6} + 1$.

SOLUTION.

- (1) $\frac{x}{3} - 2 = \frac{x}{6} + 1$. Multiply by 6, the least common multiplier of the denominators, and it will give $2x - 12 = x + 6$, an equation without a fraction term.
- (2) $2x - 12 = x + 6$.
- (3) $x = 18$.

Find the value of x —

2. $\frac{3}{4}x = 8$.

3. $\frac{3}{4}x = 10$.

4. $\frac{3}{4}x + 10 = \frac{4}{5}x + 2\frac{1}{2}$.

5. $\frac{2x}{3} = 12$.

6. $\frac{2x}{4} = 15$.

7. $\frac{2x}{5} = 6$.

8. $\frac{3x}{4} + \frac{2x}{5} = 10\frac{1}{2} + x$.

9. $\frac{4x}{5} + 10 = \frac{7x}{10} + 13$.

Using x to represent the unknown quantity, write an algebraic expression to represent—

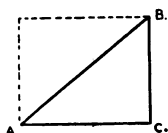
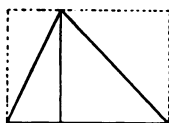
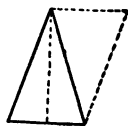
10. The quantity doubled.
11. The quantity to the third power.
12. The sum of 5 and the quantity.
13. The quantity less one-half the quantity.
14. The sum of 10 and twice the quantity.
15. The excess of the quantity over 100.
16. The excess of 100 over the quantity.
17. The quantity increased by one.
18. The next three consecutive larger quantities.
19. The amount to be added to the quantity to equal 40.
20. The amount to be added to 40 to equal the quantity.
21. The square of the sum of twice the quantity and 3 equals nine times the square of the quantity.

22. The sum of two numbers is 45. If x represents one of the

1. The sum of two numbers is 54, and their difference is 22. Find the numbers.
2. If x and $2x+6$ represent two numbers whose difference is 22, what are the numbers?
3. One boy has 22 marbles more than his brother, which number also equals 6 more than double as many as his brother has. Find how many each has.
4. The result of adding 5 to double a certain number is the same as subtracting 15 from 4 times the number. Find the number.
5. One number is greater than another by 2, and their sum is 50. Find the greater number.
6. One number is less than another by 3, and their sum is 39. Find the numbers.
7. The sum of two numbers is 50, and one is greater than the other by 10. What are the numbers?
8. Divide 100 into two numbers whose difference is 10.
9. A father is 52 years old and his son is 4 years old. In how many years will the father be exactly 7 times as old as his son?
10. If 42 be added to a certain number, the result is 4 times that number. Find the number.
11. A person has \$630. Part of it he loans at the rate of 4 per cent, and the remainder at the rate of 5 per cent, and he received equal sums as interest from the two parts. How much did he loan at each rate?
12. Find a number such that its fifth part may exceed its seventh part by 12.
13. A father's age is six times as great as that of his son, but 4 years ago it was 11 times as great. Find the age of each.
14. What number minus 5 plus 8 equals 24?
15. How long is a 5-acre field 15 rods wide?
16. How many cubic feet in a piece of timber 50 feet long, 1 foot thick, and $1\frac{1}{2}$ feet wide?
17. At a school election, one director had a majority over the other candidate of 17 votes, and the whole number of ballots was 51. Find the votes cast for each.

What per cent of—

1. 3 bushels are 6 pecks? 2 bushels is 1 peck?
2. 5 quarts are 3 pints? 10 quarts are 2 pints?
3. 6 feet are 6 inches? 5 feet are 10 inches?
4. .5 of a day are 3 hours? $\frac{1}{3}$ of a day is $\frac{2}{3}$ of an hour?
5. 4 square yards are 12 square feet? 5 square yards are _____ square feet?
6. 3 days are $\frac{2}{3}$ of a day? 6 days are 18 hours?
7. $\frac{2}{3}$ of a ton are 80 pounds? 1,000 pounds is $\frac{1}{3}$ of a ton?
8. 1 acre are 32 square rods? $\frac{1}{2}$ of an acre are 20 square rods?
9. What per cent of the square of 2 is the square of 1?
10. What per cent of the square of 4 is the square of 2?
11. Show by drawing on the blackboard that any number squared is $\frac{1}{4}$ of the square of twice the number.
12. Show by drawing on the blackboard that the square of a number is $\frac{1}{16}$ of the square of 4 times the number.
13. Give the square of the numbers from 1 to 16.
14. Square $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{3}{5}$, $\frac{5}{6}$.
15. Square $1\frac{1}{2}$ inches. Illustrate by drawing.
16. Square $2\frac{1}{2}$, $3\frac{1}{2}$, $4\frac{1}{2}$, $5\frac{1}{2}$, $6\frac{1}{2}$, $7\frac{1}{2}$.
17. Show that the square of .1 requires two decimal places both by drawing on the board and by changing to common fractions.
18. Give the cubes of all numbers from 1 to 10.
19. Show by two methods that the cube of .1 requires three decimal places.
20. What is the ratio of a 2-inch cube to a 4-inch cube?
21. How many square yards of surface in a piece of wall-paper 24 feet long and 18 inches wide?
22. Divide an acre of land into lots 2 rods by 132 feet. How many lots are in the acre? Draw a sketch to illustrate.
23. If the acre mentioned in the preceding problem cost \$200, what is the gain per cent by selling the lots at \$300 each?
24. How many rods of fence required to inclose a rectangular



A right-angled triangle is equal to one-half a rectangle having the same base and altitude. Any triangle is one-half of a parallelogram. From the method of finding the area of a parallelogram, what method is suggested for finding the area of a triangle?

Find the area of a triangle having—

1. A base of 40 feet and an altitude of 36 feet.
2. A base of 30 rods and an altitude of 24 rods.
3. A base of 40 feet and an altitude of 25 feet.
4. A base of 75 yards and an altitude of 40 yards.
5. A base of 25 rods and an altitude of 16 feet.

6. A section of land is divided into 4 farms of 160 acres each, as follows:—

1. N. $\frac{1}{2}$ of the N.W., the S.W. of the N.W., and the N.W. of the N.E.
2. E. $\frac{1}{2}$ of the N.E., the S.W. of the N.E., and the S.E. of the N.W.
3. S. $\frac{1}{2}$ of the S.E., the N.E. of the S.E., and the S.E. of the S.W.
4. W. $\frac{1}{2}$ of the S.W., the N.E. of the S.W., and the N.W. of the S.E.

7. Draw a diagram of the 4 farms, and find the cost of fencing them at 50 cents a rod.

8. What per cent of the square of a number is the square of $\frac{1}{4}$ the number?

9. The square of 2 times a number is 32 more than 2 times the square of the number. What is the number?

SOLUTION.

The square of 2 times the number = 4 times the square of the number.

1. In a room 13 feet 10 inches wide and 14 feet 6 inches long, how many strips of carpet 1 yard wide are required, the strips to run the short way? How much to be turned under? How many strips required to run the long way? How much to be turned under? If there is no waste in matching, how many yards required, if the strips run the short way? How many, if they run the long way?

2. A room 15 feet by 16 feet 4 inches is to be covered with carpet $\frac{3}{4}$ of a yard wide. How shall it be laid that the least is turned under? How many yards required?

3. A room 14 feet 3 inches by $16\frac{1}{2}$ feet is to be covered with carpet 1 yard wide. If the strips run the long way, how many yards are required? How much turned under?

4. A room is 26 by 17 feet. How many strips of carpet required, if laid the long way of the room? If laid the short way? How much turned under in each case? How many yards of carpet required in each case to cover the room?

5. What factor squared will give 64?

6. What factor cubed will give 64?

7. What is the square root of 49? 100? 144? 81? 121?

NOTE. — The *square root* of a number is one of its *two* equal factors; the *cube root* is one of its *three* equal factors.

8. What is the square root of $\frac{9}{16}$? $\frac{4}{25}$? $\frac{1}{100}$? $\frac{81}{10000}$?

9. What is the square root of $2\frac{1}{4}$? $6\frac{1}{4}$? $12\frac{1}{4}$? $30\frac{1}{4}$?

10. 3 times the square of a number is 75. Find the number.

11. $\frac{3}{4}$ the square of a number is 27. Find the number.

12. What is the difference between $\frac{1}{2}$ of the square of 16 and the square of $\frac{1}{2}$ of 16?

13. The square of $\frac{2}{3}$ of a number is 100. Find the number?

14. The square of a number is 225. Find the square of $\frac{1}{2}$ the number.

15. The cube of twice a number is how many times the cube of the number?

16. The square of three times a number is how many times the square of the number?

To find the hypotenuse of a right-angled triangle, take the square root of the sum of the squares of the other two sides.

To find the base or perpendicular, take the square root of the difference of the squares of the hypotenuse and the other side.

1. The two sides of a right-angled triangle are 3 and 4 feet. What is the length of the hypotenuse?

SOLUTION.

$3^2 = 9$, the square on one side.

$4^2 = 16$, the square on the other side.

25, the square on the hypotenuse.

$\sqrt{25} = 5$, one side of the square, or the hypotenuse.

2. The floor of a room is 6 feet wide and 8 feet long. What is the diagonal distance from one corner to the opposite corner?

SOLUTION.

Length squared, $(6^2) = 36$ square feet.

Width squared, $(8^2) = 64$ square feet.

$36 + 64 = 100$ square feet.

Diagonal, $\sqrt{100} = 10$ feet.

3. The distance from the top of a post 8 feet high to the end of its shadow is 10 feet. Find the length of the shadow.

SOLUTION.

Square of the hypotenuse, $(10^2) = 100$.

Square of the perpendicular, $(8^2) = 64$.

Subtract to find the square of the base = 36.

Base equals the square root of 36 = 6 feet.

NOTE.—It is seen from these solutions that the sides of a right-angled triangle may readily be computed, if they are in the ratio of 3, 4, and 5.

4. How long must a ladder be to reach to the top of a house 40 feet high, when the foot of it is 30 feet from the house?

NOTE.—In this example it is obvious that the ladder forms the hypotenuse of a right-angled triangle whose sides are 30 and 40 feet, respectively.

1. Two persons start from the same place and go, the one due north, 60 miles, the other due west, 80 miles. How far apart are they?

2. A flagstaff was broken $\frac{4}{5}$ of its length above the ground, and the top struck the ground 27 feet from the foot. How high was the flagstaff?

3. If a ladder 35 feet long is placed 21 feet from the base of a wall, how high up the wall will it reach?

4. A rope 45 feet long, attached to the top of a telegraph pole, extended to the ground, 36 feet from its base. How high was the pole?

5. There is a wall 45 feet high, built upon the bank of a stream 60 feet wide. How long must a rope be that will reach from the one side of the stream to the top of the wall on the other?

6. The base is 5, the altitude is 12. What is the hypotenuse? (Observe this ratio in solving the next problem.)

7. Find the height of a pole, which, being broken 39 feet from the top, the end will strike the ground 15 feet from the foot.

8. Find rods of fence required to inclose 10 acres of land in the form of a square.

9. How much more will it cost to fence 10 acres of land in the form of a rectangle, the length of which is four times its breadth, than if it were in the form of a square, the cost of the fence being \$2.50 a rod?

10. A ladder 52 feet long stands close against the side of a building. How many feet must it be drawn out at the bottom, that the top may be lowered 4 feet? (Compare with problems 6 and 7.)

11. A flag-pole planted in a street is 50 feet high. If it should fall directly toward one side of the street, the top would strike the building 40 feet from the ground. If it should fall in the opposite direction, it would strike the building 30 feet from the ground. How wide is the street?

12. Show by cutting paper how to construct a square equal in area to the area of two given squares.

1. A note dated July 9 is payable in 60 days. What is the date of maturity?

SOLUTION.

60 days = time to run.

22 days remaining in July.

38 days after July.

31 days in August.

7 days after August = September 7, day of maturity.

NOTE. — When the time is given in days, the exact days are to be reckoned. Add 3 days of grace, if the law requires it.

The date of the note and time are given. Find the date of maturity.

- | | |
|-----------------------------|-----------------------------|
| 2. Oct. 12, time 15 days. | 12. Aug. 3, time 60 days. |
| 3. Dec. 23, time 20 days. | 13. July 4, time 90 days. |
| 4. Jan. 24, time 30 days. | 14. May 9, time 70 days. |
| 5. Feb. 18, time 35 days. | 15. June 3, time 65 days. |
| 6. Sept. 19, time 45 days. | 16. April 13, time 45 days. |
| 7. April 30, time 60 days. | 17. July 9, time 85 days. |
| 8. Nov. 21, time 18 days. | 18. June 16, time 47 days. |
| 9. March 13, time 40 days. | 19. May 15, time 35 days. |
| 10. Dec. 10, time 34 days. | 20. Jan. 9, time 90 days. |
| 11. April 19, time 30 days. | 21. July 5, time 20 days. |

22. A note is dated January 5, payable in 3 months. Find the date of maturity and days to run.

SOLUTION.

3 months after January 5 is April 5.

26 days remaining in January.

28 days remaining in February.

31 days remaining in March.

5 days remaining in April.

90 days to run.

The date of the note and the time in months are given. Find the days to run and the date of maturity.

- | | |
|----------------------------|------------------------------|
| 1. Nov. 9, time 2 months. | 8. April 15, time 3 months. |
| 2. Sept. 3, time 3 months. | 9. March 22, time 2 months. |
| 3. Oct. 10, time 4 months. | 10. May 20, time 4 months. |
| 4. Jan. 8, time 5 months. | 11. June 18, time 5 months. |
| 5. Sept. 7, time 3 months. | 12. July 29, time 3 months. |
| 6. Nov. 9, time 2 months. | 13. April 30, time 2 months. |
| 7. Dec. 1, time 5 months. | 14. May 30, time 3 months. |

The date of the note, the time it has to run, and the date of discount are given. Find the number of days *from the date of discount to the date of maturity*.

15. Date of note Dec. 13, time 5 months, discounted Jan. 13.
16. Date of note Nov. 21, time 4 months, discounted Nov. 21.
17. Date of note Jan. 18, time 3 months, discounted Jan. 18.
18. Date of note Mar. 14, time 2 months, discounted Mar. 18.
19. Date of note Aug. 22, time 3 months, discounted Sept. 14.
20. Date of note May 30, time 30 days, discounted June 15.
21. Date of note Jan. 28, time 30 days, discounted Jan. 31.
22. Date of note Nov. 14, time 60 days, discounted Nov. 20.
23. Date of note July 12, time 45 days, discounted July 20.
24. Date of note Sept. 19, time 90 days, discounted Oct. 10.

What are the *bank discount* and the *proceeds* of a note, using days of grace—

25. Of \$ 80 for 5 months 27 days at 7 per cent?
26. Of \$160 for 2 months 21 days at 6 per cent?
27. Of \$200 for 8 months 9 days at 7 per cent?
28. Of \$150 for 4 months 21 days at 5 per cent?
29. Of \$100 for 30 days at 5 per cent?

Find the per cent realized on investing in—

30. 4 per cent bonds at 80.
31. 5 per cent bonds at 125.
32. $4\frac{1}{2}$ per cent bonds at 90.
33. $5\frac{1}{2}$ per cent bonds at 110.

1. The time past noon equals $\frac{1}{3}$ of the time past midnight.
What is the time of day?

SOLUTION.

The time from midnight to noon is 12 hours.

The time past noon is $\frac{1}{3}$ of the time past midnight.

The time *before* noon is $\frac{2}{3}$ of the time past midnight.

$\frac{2}{3}$ the time past midnight is 12 hours.

$\frac{1}{3}$ the time past midnight is 6 hours, the time past noon.

6 hours past noon is 6 o'clock, P. M.

Find the time of day if—

2. The time past noon equals $\frac{1}{4}$ the time past midnight.

3. The time past noon equals $\frac{2}{5}$ the time past midnight.

4. The time past noon equals $\frac{3}{7}$ the time past midnight.

5. The time past noon equals $\frac{1}{9}$ the time past midnight.

6. The time past noon equals $\frac{3}{11}$ the time past midnight.

7. $\frac{1}{3}$ the time past noon equals $\frac{1}{9}$ the time past midnight.

8. $\frac{3}{4}$ the time past noon equals $\frac{3}{16}$ the time past midnight.

9. What is the hour if $\frac{2}{9}$ the time past midnight equals $\frac{2}{3}$ the time to midnight?

SOLUTION.

From midnight to midnight is 24 hours.

$\frac{2}{3}$ the time to midnight equals $\frac{2}{9}$ the time past midnight.

$\frac{1}{3}$ the time to midnight equals $\frac{1}{9}$ the time past midnight.

$\frac{2}{3}$ the time to midnight equals $\frac{2}{9}$ the time past midnight.

The 24 hours are divided into two parts, having the ratio of $\frac{3}{3}$ to $\frac{3}{9}$,
or 3 to 1, which are 18 hours and 6 hours.

6 hours past midnight equals 6 o'clock, A. M.

Find the time if—

10. $\frac{3}{10}$ the time past midnight equals $\frac{3}{5}$ the time to midnight.

11. $\frac{3}{5}$ the time past midnight equals $\frac{3}{10}$ the time to midnight.

12. $\frac{2}{5}$ the time past midnight equals $\frac{2}{3}$ the time to midnight.

1. A father is 30 years old, and his son is 5 years old. In how many years will the son be $\frac{1}{2}$ the father's age?

SOLUTION.

The difference between their ages is 25 years.

The son's age is to be $\frac{1}{2}$ the father's.

The difference of 25 years will be the other $\frac{1}{2}$ of the father's.

The father's age will then be 50 years.

He will be 50 years old in 25 years.

2. Two boys earn \$1 a day. One has worked 8 days and the other has worked 2 days. How long must they work, that one may have $\frac{1}{2}$ as much money as the other?

3. A father is 35 years old, and his son is 5 years old. In how many years will the son be $\frac{1}{3}$ the father's age?

4. A husband is 40 years old, and his wife 30 years old. In how many years will she be $\frac{2}{3}$ as old as he?

5. One line is 100 feet long, and another is 80 feet long. A piece must be cut off from each, of the same length, to leave the remaining parts in the ratio of 7 to 5. How long is the piece to be cut off?

6. At what time is $\frac{1}{2}$ the time after noon equal to the time before midnight?

7. Find the gain per cent if $\frac{3}{4}$ the gain equals $\frac{1}{8}$ the selling price.

8. What is the gain or loss per cent if $\frac{2}{3}$ the cost equals $\frac{3}{4}$ the selling price?

9. If the selling price is 4 times the gain, what is the gain per cent?

10. If the selling price is 11 times the loss, what is the loss per cent?

11. Compare in length the diagonal of a square and a line drawn from a corner of the square perpendicular to the diagonal.

12. Find the approximate length of one side of a square having a diagonal of 10 feet.

13. Find the approximate length of the diagonal of a square lot, one side of which is 25 rods.

1. Lowell's age is 4 years, Willie's age equals Lowell's and $\frac{1}{3}$ of Albert's, and Albert's age equals the sum of Lowell's and Willie's. Find the age of each.

SOLUTION.

Lowell's age equals 4 years.

Willie's age equals 4 years plus $\frac{1}{3}$ of Albert's.

Albert's age equals 8 years plus $\frac{1}{3}$ of Albert's.

8 years equal $\frac{2}{3}$ Albert's age.

4 years equal $\frac{1}{3}$ Albert's age.

12 years equal Albert's age.

4 years plus $\frac{1}{3}$ of 12 equal 8 years, Willie's age.

2. A owns 6 acres, B owns as much as A and $\frac{1}{4}$ as much as C, and C owns as much as A and B. How many acres does each own?

3. A traveled 9 miles, B traveled as far as A and $\frac{1}{4}$ as far as C, and C traveled as far as both A and B. How far did each travel?

4. A is 40 years old, B is as old as A and is $\frac{2}{3}$ of C's age, and C is as old as A and B. How old are B and C?

5. A earned \$24; B earned as much as A and $\frac{5}{8}$ as much as C, and C earned as much as A and B. How much did they earn together?

6. Three-fourths of A's money equals $\frac{9}{16}$ of B's, and $\frac{2}{3}$ of the difference of their money is \$200. How much has each?

7. Three-fifths of A's money equals $\frac{4}{5}$ of B's, and the difference of their money is \$14. How much has each?

8. A and B can do a piece of work in 6 days, and B can do it in 10 days. In what time can A do it?

9. A can do a piece of work in $\frac{3}{4}$ of a day, and A and B together can do it in $\frac{5}{12}$ of a day. In what time can B do it?

10. Three boys can do a piece of work in 4 days; the first and second can do it in 6 days, and the second and third can do it in 8 days. In what time can each do the work?

11. George can do in $2\frac{1}{2}$ days what he and his brother can do in $1\frac{1}{3}$ days. How long will it take his brother to do the same work?

1. The hour and minute hands of a clock are together at 12 o'clock. When are they next together?

SOLUTION.

When the minute-hand has returned to 12, the hour-hand will be at 1, and the minute-hand has then to gain 5 minute-spaces. As the distance to be gained is $\frac{1}{2}$ of the distance to be traveled, the minute-hand will require as many minutes as $\frac{1}{2}$ is contained times in 5, or $5\frac{5}{11}$ minutes. This added to 1 o'clock will give 1 hour, 5 minutes, and $27\frac{3}{11}$ seconds after 1 o'clock.

At what time will the hour and minute hands—

2. Be together after 5 o'clock? After 3 o'clock?
 3. Be opposite after 5 o'clock? After 8 o'clock?
 4. After 5 o'clock be 5 minute-spaces apart?
 5. After 5 o'clock be 5 minutes of time apart?
 6. If 1 pound of tea be equal in value to 50 oranges, and 70 oranges be worth 84 lemons, what is the value of a pound of tea when a lemon is worth 2 cents?
 7. A can do a certain piece of work in 3 weeks, B can do 3 times as much in 8 weeks, and C can do 5 times as much in 12 weeks. In what time can they all together do the first piece of work?
 8. A lady going out shopping spent at the first place she stopped one-half her money and half a dollar more; at the next place, half the remainder and half a dollar more; and at the next place, half the remainder and half a dollar more, when she found that she had but three dollars left. How much had she when she started? (Reckon back from the last amount.)
 9. A market-man bought a certain number of eggs at the rate of 4 for 3 cents, and sold them at the rate of 5 for 4 cents, by which he made 4 cents. What did he pay apiece for the eggs? What did he make on each egg? How many eggs did he sell?
 10. A square stick of timber contains 54 cubic feet, and is 16 times its width or thicknees. What are its dimensions?
- NOTE.—If the stick were cut crosswise into 16 equal parts, each part would be a cube.

APPENDIX.

TABLE FOR LINEAR MEASURE.

12 inches (<i>in.</i>)	= 1 foot (<i>ft.</i>)	16½ feet	= 1 rod.
3 feet	= 1 yard (<i>yd.</i>)	40 rods	= 1 furlong.
5½ yards	= 1 rod (<i>rd.</i>)	320 rods	= 1 mile (<i>m.</i>)
1 mile = 63,360 inches = 5,280 feet = 1,760 yards = 320 rods.			
3 barleycorns, or sizes = 1 inch (used by shoemakers.)			
4 inches = 1 hand (used in measuring height of horses.)			

TABLE FOR SURVEYOR'S MEASURE.

7.92 inches	= 1 link (<i>l.</i>)	4 rods	= 1 chain (<i>ch.</i>)
25 links	= 1 rod (<i>rd.</i>)	80 chains	= 1 mile (<i>mi.</i>)

TABLE FOR MARINER'S MEASURE.

9 inches	= 1 span (<i>sp.</i>)
8 spans, or 6 feet	= 1 fathom (<i>fath.</i>)
120 fathoms	= 1 cable's length (<i>c. l.</i>)
7½ cable lengths	= 1 common mile (<i>m.</i>)
1.15½ common miles	= 1 geographic mile (knot).
3 geographic miles	= 1 nautical league.

TABLE FOR SURFACE MEASURE.

144 square inches (<i>sq. in.</i>)	= 1 square foot (<i>sq. ft.</i>)
9 square feet	= 1 square yard (<i>sq. yd.</i>)
30½ square yards	= 1 square rod (<i>sq. rd.</i>)
272½ square feet	= 1 square rod.
160 square rods	= 1 acre (<i>a.</i>)
640 acres	= 1 square mile (<i>sq. mi.</i>)

The unit of Land Measure is the acre, subdivided as follows: —

625 square links	= 1 square rod (<i>sq. rd.</i>)
16 square rods	= 1 square chain (<i>sq. ch.</i>)
10 square chains	= 1 acre.
160 square rods	= 1 acre.

TABLE FOR CUBIC OR SOLID MEASURE.

1,728 cubic inches (<i>cu. in.</i>)	= 1 cubic foot (<i>cu. ft.</i>)
27 cubic feet	= 1 cubic yard (<i>cu. yd.</i>)
16 cubic feet	= 1 cord foot (<i>cd. ft.</i>)
8 cord feet	= 1 cord (<i>cd.</i>)
128 cubic feet	= 1 cord.

A pile of wood 8 feet long, 4 feet wide, and 4 feet high contains a *cord*. One foot of the length of such a pile is a *cord foot*. A perch of stone or masonry is 24.75 cubic feet.

TABLE FOR DRY MEASURE.

2 pints (<i>pt.</i>)	= 1 quart (<i>qt.</i>)
8 quarts	= 1 peck (<i>pk.</i>)
4 pecks	= 1 bushel (<i>bu.</i>)

The primary unit is 1 bushel, containing $2,150\frac{2}{3}$ cubic inches.

Four quarts, dry measure, contain 268.8 cubic inches.

TABLE FOR LIQUID MEASURE.

4 gills (<i>gi.</i>)	= 1 pint (<i>pt.</i>)
2 pints	= 1 quart (<i>qt.</i>)
4 quarts	= 1 gallon (<i>gal.</i>) = 231 cu. in.
$31\frac{1}{2}$ gallons	= 1 barrel (<i>bbl.</i>)
63 gallons	= 1 hogshead (<i>hhd.</i>)
2 barrels	= 1 hogshead.

The barrel and hogshead are not fixed quantities, but vary in commercial usage.

TABLE FOR TROY WEIGHT.

24 grains (<i>gr.</i>)	= 1 pennyweight (<i>pwt.</i>)
20 pennyweights	= 1 ounce (<i>oz.</i>)
12 ounces	= 1 pound (<i>lb.</i>)

TABLE FOR AVOIRDUPOIS WEIGHT.

16 drams (<i>drs.</i>)	= 1 ounce (<i>oz.</i>)
16 ounces	= 1 pound (<i>lb.</i>)
100 pounds	= 1 hundredweight (<i>cwt.</i>), or cental.
20 hundredweight	= 1 ton (<i>T.</i>)
112 pounds	= 1 long hundredweight.
2,240 pounds	= 1 long ton.

TABLE OF MISCELLANEOUS WEIGHTS.

A bushel of corn or rye	=	56 pounds.
A bushel of corn or rye meal	=	50 pounds.
A bushel of wheat or beans	=	60 pounds.
A bushel of potatoes	=	60 pounds.
A bushel of oats	=	32 pounds.
A bushel of barley	=	48 pounds.
A bushel of timothy seed	=	45 pounds.
A barrel of flour	=	196 pounds.
A barrel of pork or beef	=	200 pounds.
A cask of lime	=	240 pounds.
A quintal of fish	=	100 pounds.
A keg of nails	=	100 pounds.

The weight of a bushel of potatoes, corn, etc., varies slightly in different states.

TABLE FOR TIME MEASURE.

60 seconds (<i>sec.</i>)	=	1 minute (<i>min.</i>)
60 minutes	=	1 hour (<i>h.</i>)
24 hours	=	1 day (<i>d.</i>)
365 days	=	1 common year (<i>yr.</i>)
366 days	=	1 leap year (<i>l. yr.</i>)
7 days	=	1 week (<i>wk.</i>)
12 calendar months (<i>mo.</i>)	=	1 year (<i>yr.</i>)
100 years	=	1 century.

TABLE FOR ANGULAR MEASURE.

60 seconds (")	=	1 minute (').
60 minutes	=	1 degree (°).
30 degrees	=	1 sign.
12 signs	=	1 circle.
360 degrees	=	1 circumference (C).

A degree of the earth's equator contains 60 geographical miles or about $69\frac{1}{8}$ common miles.

TABLE FOR COUNTING.

12 units = 1 dozen (*doz.*)

12 gross = 1 great gross.

12 dozen = 1 gross

24 units = 1 score

TABLE FOR SIZES OF PAPER.

24 sheets = 1 quire (<i>qr.</i>)	2 reams = 1 bundle (<i>bun</i>)
20 quires = 1 ream (<i>rm.</i>)	5 bundles = 1 bale (<i>B.</i>)

TABLE FOR SIZES OF BOOKS.

A printed book folded in sheets of —

2 leaves is called a folio	= 4 pages (<i>pp.</i>)
4 leaves is called a quarto, 4to	= 8 pages.
8 leaves is called an octavo, 8vo	= 16 pages.
12 leaves is called a duodecimo, 12mo	= 24 pages.
16 leaves is called a 16mo	= 32 pages.
18 leaves is called an 18mo	= 36 pages.
24 leaves is called a 24mo	= 48 pages.

METRIC SYSTEM.

TABLE FOR LINEAR MEASURE.

10 millimeters (<i>mm.</i>)	= 1 centimeter (<i>cm.</i>)
10 centimeters	= 1 decimeter (<i>dm.</i>)
10 decimeters	= 1 meter (<i>m.</i>)
10 meters	= 1 dekameter (<i>Dm.</i>)
10 dekameters	= 1 hektometer (<i>Hm.</i>)
10 hektometers	= 1 kilometer (<i>Km.</i>)
10 kilometers	= 1 myriameter (<i>Mm.</i>)
1 meter	= 39.37 inches.

TABLE FOR SQUARE MEASURE.

100 square millimeters	= 1 square centimeter (<i>sq. cm.</i>)
100 square centimeters	= 1 square decimeter (<i>sq. dm.</i>)
100 square decimeters	= 1 square meter (<i>sq. m.</i>)
100 square meters	= 1 square dekameter (<i>sq. Dm.</i>)
100 square dekameters	= 1 square hektometer (<i>sq. Hm.</i>)
100 square hektometers	= 1 square kilometer (<i>sq. Km.</i>)

A square meter is also called a centare (*ca.*)

100 centares	= 1 are.
100 square meters	= 1 are.
100 ares (<i>a.</i>)	= 1 hektare (<i>Ha.</i>)
10,000 square meters	= 1 hektare.
1 hektare	= 2.471 acres (about 2½ acres)

TABLE FOR CUBIC MEASURE.

1,000 cubic millimeters (<i>cu. mm.</i>)	= 1 cubic centimeter (<i>cu. cm.</i>)
1,000 cubic centimeters	= 1 cubic decimeter (<i>cu. dm.</i>)
1,000 cubic decimeters	= 1 cubic meter (<i>cu. m.</i>)
10 decisteres	= 1 stere = 1 cubic meter.
10 steres	= 1 dekastere.
1 stere	= .2759 cord (about $\frac{1}{4}$ cord).

TABLE FOR CAPACITY.

10 milliliters (<i>ml.</i>)	= 1 centiliter (<i>cl.</i>)
10 centiliters	= 1 deciliter (<i>dl.</i>)
10 deciliters	= 1 liter (<i>l.</i>)
10 liters	= 1 dekaliter (<i>Dl.</i>)
10 dekaliters	= 1 hektoliter (<i>Hl.</i>)
10 hektoliters	= 1 kiloliter (<i>Kl.</i>)

The unit of capacity is the liter, containing 1 cubic decimeter, and equivalent to .908 quarts dry measure, or 1.0567 quarts liquid measure.

TABLE FOR WEIGHT.

10 milligrams (<i>mg.</i>)	= 1 centigram (<i>cg.</i>)
10 centigrams	= 1 decigram (<i>dg.</i>)
10 decigrams	= 1 gram (<i>g.</i>)
10 grams	= 1 dekagram (<i>Dg.</i>)
10 dekagrams	= 1 hektogram (<i>Hg.</i>)
10 hektograms	= 1 kilogram (<i>Kg.</i>)
10 kilograms	= 1 myriagram (<i>Mg.</i>)
10 myriagrams	= 1 quintal (<i>Q.</i>)
10 quintals	= 1 tonneau (<i>T.</i>)
1 kilogram	= 2.2046 pounds (about $2\frac{1}{8}$ pounds).

The unit of weight is the gram, the weight of a cubic centimeter of water at 39.2° F. (= 15.432 grains).

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