ARITHMETIC

FOR EVENING SCHOOLS

WILLIAM · E · CHANCELLOR

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EVENING SCHOOLS

BY

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PREFACE

Most of the students in evening schools, for whom this text is designed, have studied arithmetic as far as fractions and denominate numbers. Few have gone farther. Most of them understand more than they can do. Their knowledge of arithmetic is beyond the extent of their skill in accurate and rapid computing. They need reviews of the fundamental operations and advanced instruction in percentage, measurements, interest, etc.

The purpose of this book is to present lessons adapted to the age, attainments, and practical experience of evening-school students. The text has been kept close to everyday affairs.

The lessons in this text were originally used in various city evening schools. In their present form, thoroughly revised, they represent a course sufficient in length for at least two years, in the case of most classes.

For assistance in the preparation of the text, I am indebted to the teachers in the Bloomfield Public Evening School, and in particular to Mr. Frederic N. Brown, the Principal.

W. E. C.

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90. ninety
100. one hundred

To express more than nine, we use tens combined with numbers less than ten. After ten we say eleven, which is ten and one; twelve, or ten and two; etc., to nineteen. Twenty means two tens; twenty-one is two tens and one. After twenty-nine comes thirty, or three tens.

Ten, twenty, thirty, forty to ninety are called the tens' numbers. One, two, three to nine are called the units' numbers.

1. Write neatly in figures the numbers from one to one hundred.

2. Write in words: 28, 14, 16, 37, 56, 91, 45, 48, 82, 93, 75, 60, 109.

3. Write in figures: fifteen, seventy-eight, sixty-one, nineteen, thirty.

I = 1 V = 5 L = 50 D = 500
IV = 4 X = 10 C = 100 M = 1000

4. Write in Roman numerals: 3, 6, 8, 14, 27, 48, 55, 101, 576, 1903.

5. Write in words: CCV, IX, XLI, MMX, MDCCCXL, XXIV, XXXVIII, LXXIII.

ADDITION

Add:

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
8	7	9	8	7	4	9	4	7	3	7	4	8	2
4	6	4	9	6	9	3	7	5	7	9	2	4	9
3	3	1	4	3	4	4	8	9	6	2	5	9	7
7	5	6	7	9	3	1	3	4	5	3	6	5	2

Addition of Numbers of More than One Figure

Rules. — 1. *Arrange the numbers to be added so that units shall stand under units, tens under tens, hundreds under hundreds, etc.*

2. *Add the units' column, and if the sum is less than ten, write it underneath. If it is equal to or greater than ten, place the right-hand digit of the sum underneath and add the left-hand digit to the numbers in the tens' column. Continue this process until all the columns have been added.*

Add:

15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
27	36	49	35	94	24	88	57	498	973
63	94	12	26	37	53	174	243	231	298
44	21	69	92	4[illegible]	62	25	456	956	431

25.	26.	27.	28.	29.	30.	31.
698	8	4895	9281	2457	28	1296
2980	2026	9456	4954	903	7493	9270
421	8999	6528	25	4697	784	5749

32.	33.	34.	35.	36.	37.
9468	56	93974	4	28464	79416
98321	398	36741	46936	99856	99999
46280	39008	9678	2147	34510	42834
516	92723	1836	68112	69524	48296

RAPID ADDITION

Try to add a column of figures as readily as you read a sentence. When you see a column of figures, try to call the total without reading it out figure by figure.

1. Add 12364 and 34842.

12364
34842

Do not say 4 and 2 are 6, 6 and 4 are 10; but call the totals 6, 10, 12, 7, 4.

After practicing columns of two figures, take columns of four figures in the same way.

2. Add 1234, 2345, 4226, and 5489.

1234
2345
4226
5489

Beginning at the bottom, do not say 9 and 6 are 15 and 5 are 20 and 4 are 24, but say 15, 24; put down the 4, and carry the 2. Then say 12, 19; put down the 9, and carry the 1. Then say 7, 12; put down the 2, and carry the 1. Then say 10, 13.

Add, according to the plan illustrated above:

3.	4.	5.	6.
1245	3425	4869	4829
2346	2432	3226	8453

7.	8.	9.	10.
32425	55928	88943	46944
25689	44328	67854	32395
22468	68942	89348	19629

11.	12.	13.	14.
42943	424382	689728	468932
45698	684543	454321	454872
56973	998468	268498	192498
98467	554369	448256	754326

SUBTRACTION

By **subtraction** we find the difference between two numbers. The **minuend** is the number from which another number is subtracted. The **subtrahend** is the number to be subtracted from the minuend.

RULES. — 1. *Place the subtrahend under the minuend so that units shall stand under units, tens under tens, etc.*

2. *Begin at the right-hand column and subtract each term of the subtrahend from the one above it.*

3. *If any term of the minuend is less than the term to be subtracted, add* 10 *to it, remembering that the next term of the minuend must be made smaller by* 1.

1. Subtract 21 from 98.

$$\begin{array}{r} 98 \\ 21 \\ \hline 77 \end{array}$$

2. Subtract 169 from 311.

$$\begin{array}{r} {}^{2}{}^{10}{}^{11} \\ 311 \\ 169 \\ \hline 142 \end{array}$$

PROOF. — *Add the remainder to the subtrahend. If the sum is equal to the minuend, the work is correct.*

Subtract:

3.	4.	5.	6.	7.	8.	9.	10.	11.
89	69	71	54	621	934	200	756	644
25	34	28	25	443	621	167	729	598

12.	13.	14.	15.	16.	17.	18.
1428	9267	88943	2247	88534	6896	3158
956	4621	2767	1691	29214	3427	1425

19.	20.	21.	22.	23.	24.	25.
82678	4238	9367	1111	6794	46721	98743
74225	1924	205	999	3987	34216	25555

MULTIPLICATION

The number which is multiplied is called the **multiplicand.** The number by which we multiply is called the **multiplier.** The result obtained is called the **product.**

RULES. — 1. *Place the multiplier under the multiplicand. If the multiplier consists of only one term, multiply each term of the multiplicand by it, beginning at the right and carrying as in addition.*

1. Multiply 256 by 4.

256
4
1024

$6 \times 4 = 24$. Write down the right-hand figure 4 and carry the 2. $5 \times 4 = 20$; $20 + 2 = 22$. Write down the 2 and carry the 2. $2 \times 4 = 8$; $8 + 2 = 10$. Write down the 10.

2.	3.	4.	5.	6.	7.	8.	9.
734	423	924	634	291	845	267	954
7	8	2	5	6	8	4	7

10. Multiply 684 by 21.

684
21
684
1368
14364

2. *If the multiplier contains more than one term, multiply separately by each term, as above, placing the right-hand figure of each partial product in the same column as the term by which you are multiplying. Add the partial products. The sum will be the entire product.*

11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
756	954	846	953	734	432	658	498	671	738
43	29	57	69	47	82	73	18	58	43

21.	22.	23.	24.	25.	26.	27.	28.	29.
876	2895	4724	8954	6529	7957	9579	4328	9937
28	23	62	58	73	84	36	47	92

DIVISION

By **division** we find how many times one number contains another, or we separate a number into equal parts.

The number to be divided is called the **dividend**. The number by which we divide is called the **divisor**. The **quotient** shows how many times the divisor is contained in the dividend. $8 \div 4 = 2$. Eight divided by four is two.

1. Divide 696 by 3.

$$\begin{array}{r} 3)696 \\ \hline 232 \end{array}$$

3 is contained in 6 hundreds, 2 (hundreds) times. Write 2 in hundreds' place in quotient. 3 is contained in 9 tens, 3 (tens) times. Write 3 in tens' place in quotient. 3 is contained in 6 units 2 (units) times. Write 2 in units' place in quotient.

2. Divide 9880 by 2, 3, 4, 5, 6, and 7.

3. Divide 14,528 by 3, 6, 8, 2, 4, and 7.

Long Division

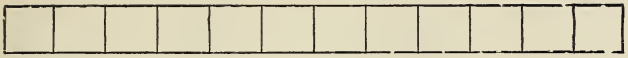
1. Divide 4635 by 13.

$$\begin{array}{r} 13)4635(356\frac{7}{13} \\ 39 \\ \hline 73 \\ 65 \\ \hline 85 \\ 78 \\ \hline 7 \end{array}$$

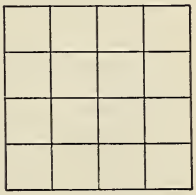
13 is contained in 46 hundreds, 3 (hundreds) times, and 7 hundreds remaining. Bring down the 3. 13 is contained in 73 tens, 5 (tens) times, and 8 tens remaining. Bring down the 5. 13 is contained in 85 units, 6 (units) times, and 7 remaining. The quotient is $356\frac{7}{13}$.

2. Divide 84,695 by 15.
3. Divide 16,844 by 26.
4. Divide 98,367 by 48.
5. Divide 68,489 by 53.
6. Divide 208,479 by 34.
7. Divide 491,608 by 42.
8. Divide 638,415 by 75.
9. Divide 944,721 by 31.

FRACTIONS



1. Point out $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{12}$ of this oblong.
2. See that $\frac{1}{2} = \frac{2}{4} = \frac{6}{12}$.
3. See that $\frac{1}{3} = \frac{2}{6} = \frac{4}{12}$.



4. Point out $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{16}$ of this square.
5. See that $\frac{1}{2} = \frac{2}{4} = \frac{4}{8} = \frac{8}{16}$.
6. See that $\frac{1}{4} = \frac{2}{8} = \frac{4}{16}$.
7. See that $\frac{3}{4} = \frac{6}{8} = \frac{12}{16}$.
8. See that $\frac{5}{8} = \frac{10}{16}$, $\frac{7}{8} = \frac{14}{16}$, $\frac{2}{16} = \frac{1}{8}$, $\frac{8}{16} = \frac{4}{8}$, $\frac{3}{8} = \frac{6}{16}$.
9. There are 16 ounces in a pound. $\frac{1}{4}$ of a pound is how many ounces?
10. How many days are there in $\frac{1}{5}$ of a year?
11. Which is the larger fraction, $\frac{1}{4}$ or $\frac{1}{6}$ of the same thing?
12. George is 15 years old and his brother John is $\frac{1}{3}$ as old. How old is John?
13. How many fourths are there in an orange? How many fourths are there in two oranges? How many eighths are there in two oranges?
14. If $\frac{2}{9}$ of a boy's money equal 18¢, how much does $\frac{1}{9}$ equal?
15. How many apples are there in $\frac{3}{4}$ of a dozen?
16. If $\frac{1}{12}$ of a pound of butter is worth 2¢, how much is a pound worth?
17. $\frac{1}{4}$ of 64 cents = how many cents? $\frac{1}{2}$? $\frac{1}{8}$? $\frac{1}{16}$? $\frac{1}{32}$?
18. If you had $\frac{9}{9}$ of anything, should you have $\frac{4}{4}$ of it?

REVIEW

Subtract:

1.	2.	3.	4.
804,697	9,693,419	46,821	896,675
38,915	7,799,655	23,916	254,783

Add:

5.	6.	7.	8.
68,405	2,914,608	9,642,314	8,463,024
945,716	4,685,715	1,207,608	2,755,698
3,910	9,424,836	6,935,296	8,433,954
1,213,459	8,005,607	8,468,781	3,938,618
395,824	7,234,721	933,677	6,753,439

9. Write in words: 7, 234, 721, 636, 455, 807, 917, 981. 476, 1776, 4208, 6895.

10. Write in figures: M, CCXLI, LXXXIV, CMIX, MCMI, XXXIX, DCXLVIII, LIII, XXVI, LXV.

Multiply:

11.	12.	13.	14.	15.	16.	17.	18.	19.
814	837	757	387	507	630	293	698	495
27	91	24	57	32	46	47	93	53

Find how many times the divisor is in the dividend:

20. 6 in 246.
21. 9 in 819.
22. 7 in 497.
23. 4 in 648.
24. 284 in 684.
25. 56 in 295.
26. 14 in 416.
27. 87 in 910.
28. 625 in 3125.
29. 481 in 4286.
30. 317 in 689.
31. 436 in 1026.

32. What is the ratio of 16 to 64? Of 64 to 16?

33. What is the ratio of 8 to 24? Of 1 to 3? Show by drawings that the ratio of 8 to 24 = the ratio of 1 to 3.

REVIEW PROBLEMS

1. Mr. Smith has 438 acres of land, Mr. Jones has 256 acres, and Mr. Williams has 916 acres. How many have they all together?

2. How many ounces are there in 352 pounds, when there are 16 ounces in a pound?

3. How many years are there in 2920 days?

4. The population of New York City is 3,437,202; that of Chicago is 1,698,575. How much greater is the population of New York than that of Chicago?

5. What number multiplied by 24 will give 1080?

6. A quire of paper has 24 sheets. How many quires are there in 5640 sheets? In 1464 sheets?

7. How many hours are there in 254 days?

8. A train of 11 cars has in each car 69 passengers, of whom 25 are children. How many passengers are there all together? How many children?

9. A congregation intends to build a church which is to cost $18,500. The collections already made are $478, $915, $691, $436, and $2174. How much is lacking?

10. A butcher buys hogs weighing 294, 386, 275, 268, 314, 336, 354, and 318 pounds. What is their average weight?

11. If a man earns $4 a day, how many weeks will it take him, working 6 days a week, to earn $432?

12. When a child's pulse beats 79 times a minute, how many times does it beat in a day?

FACTORING

The **factors** of a number are those numbers which, multiplied together, produce that number.

2, 3, and 5 are factors of 30. $2 \times 3 \times 5 = 30$.

An **exact divisor** of a number is an integer (whole number) that will divide it without a remainder.

A number is said to be **divisible** by another when the latter is an exact divisor of the former.

Numbers are prime or composite.

A **prime** number is divisible only by itself and unity.

1, 2, 3, 5, 7, 11 are prime numbers.

A **composite** number is divisible by other numbers besides itself and unity.

4, 6, 9, 12 are composite numbers.

Prime factors are prime numbers. The prime factors of 24 are 3, 2, 2, and 2; the composite factors are 4 and 6.

A **common factor** is common to two or more numbers.

5 is a common factor (divisor) of 15 and 20; 7 is a common factor of 14, 35, and 42.

A number is divisible by 2 when the unit figure is divisible by 2.

A number is divisible by 3 or by 9 when the sum of its digits is divisible by 3 or by 9. Thus, 684 is divisible by 3 or by 9, for $4 + 6 + 8 = 18$, and 18 is divisible by 3 and by 9.

1. What is the largest common factor of 18 and 42? What is the smallest?

2. Define prime number, prime factor, composite number. Give examples of each.

3. What factor is common to the denominators of these fractions: $\frac{5}{6}$, $\frac{5}{12}$, $\frac{8}{21}$, $\frac{5}{42}$? What factor is common to only two of them?

$$\begin{array}{r|l} 3 & 534 \\ 2 & 178 \\ & 89 \end{array}$$

$89 \times 3 \times 2 = 534$.

4. Find the prime factors of 534.

5. Find the prime factors of 180.

6. Find the prime factors of 234, 747, 209, 119, 473.

7. What factors are common to 42, 63, and 105?

CANCELLATION

1. Divide 63 by 28.

We may write the factors of 63 above a horizontal line and the factors of 28 below the line, thus $\frac{7 \times 3 \times 3}{7 \times 2 \times 2}$, and "strike out" or cancel the factors common to both; the products of the remaining factors equal $\frac{9}{4} = 2\frac{1}{4}$.

2. Divide the product of $3 \times 2 \times 5 \times 7$ by $5 \times 4 \times 5 \times 6$.

$$\frac{\cancel{3} \times \cancel{2} \times \cancel{5} \times 7}{\cancel{5} \times \cancel{4} \times \cancel{5} \times \cancel{6}} = \frac{7}{20}.$$

3. Find the continued product of $\frac{3}{5}$, $\frac{10}{21}$, $\frac{1}{2}$, $\frac{7}{8}$, and $\frac{5}{6}$.

$$\frac{\cancel{3}}{\cancel{5}} \times \frac{\overset{2}{\cancel{10}}}{\underset{7}{\cancel{21}}} \times \frac{1}{\cancel{2}} \times \frac{\cancel{7}}{8} \text{ of } \frac{5}{\cancel{6}} = \frac{5}{48}.$$

In case all the numbers in the numerators are canceled, the number 1 should be retained; for, in canceling we are simply dividing both numerator and denominator (dividend and divisor) by the same number, $\frac{3}{3 \times 7} = \frac{1}{7}$, same as $3\overline{)\frac{3}{21}} = \frac{1}{7}$.

4. $\frac{11 \times 24 \times 35}{22 \times 70} = ?$

5. $\frac{3}{5} \times \frac{10}{21}$ of $\frac{7}{8} \times \frac{4}{35} = ?$

6. $\frac{44 \times 45 \times 49}{28 \times 33 \times 35} = ?$

7. $\frac{54 \times 56 \times 60}{42 \times 45 \times 48} = ?$

FACTORING

The **highest common factor** (H. C. F.) of two or more numbers is the highest number that will exactly divide each of them. 6 is the H. C. F. of 12, 18, and 24.

A **common multiple** of two or more numbers is one that will contain each of them without a remainder. 36 is a common multiple of 6 and 9.

The **least common multiple** (L. C. M.) of two or more numbers is the least number that will contain each of them without a remainder. 18 is the L. C. M. of 6 and 9.

1. Find the H. C. F. and L. C. M. of 12, 18, and 96.

2	12	18	96
3	6	9	48
2	2	3	16
	1	3	8

To find the H. C. F., take the product of all the prime numbers that are common factors of 12, 18, and 96. This will be $2 \times 3 = 6$, H. C. F.

To find the L. C. M., take the continued product of all the divisors and the numbers in the last line.

2. What is the shortest distance in which each of three wheels will make an exact number of revolutions, the wheels being respectively 64, 96, and 216 inches in circumference?

3. What is the largest number of pupils among whom 437 apples and 1691 peaches can be divided equally?

4. What is the least number that will contain 6, 9, and 18 evenly?

5. What is the least common denominator of $\frac{3}{4}$, $\frac{5}{6}$, $\frac{2}{3}$, $\frac{7}{8}$?

A fraction is reduced to its **lowest terms** by dividing both terms by their greatest common divisor.

6. Reduce to lowest terms $\frac{4}{8}$, $\frac{2}{6}$, $\frac{3}{9}$, $\frac{6}{24}$, $\frac{18}{20}$, $\frac{15}{25}$, $\frac{45}{60}$, $\frac{25}{125}$.

ADDITION OF FRACTIONS

The **least common denominator** (L. C. D.) of two or more fractions is the least common denominator to which they can all be reduced. The least common denominator must be the least common multiple of the denominators.

Before finding the least common denominator, reduce the fractions to their lowest terms.

1. Reduce $\frac{2}{6}$, $\frac{1}{4}$, and $\frac{3}{8}$ to a common denominator.

$$\begin{array}{r|l} 2 & 3\ 4\ 8 \\ 2 & 3\ 2\ 4 \\ \hline & 3\ 1\ 2 \end{array}$$

$2 \times 2 \times 3 \times 2 = 24.$

$\frac{2}{6}$ in its lowest terms is $\frac{1}{3}$.

We find the least common multiple of the denominators 3, 4, and 8 and divide it by the denominator of each fraction.

$3)\underline{24}$ $8 \times 1 = 8$. $\frac{1}{3} = \frac{8}{24}$.
$\quad 8$

$4)\underline{24}$ $6 \times 1 = 6$. $\frac{1}{4} = \frac{6}{24}$.
$\quad 6$

$8)\underline{24}$ $3 \times 3 = 9$. $\frac{3}{8} = \frac{9}{24}$.
$\quad 3$

Each quotient multiplied by the numerator of the fraction gives the new numerator for the fraction.

2. Add $\frac{2}{6}$, $\frac{1}{4}$, and $\frac{3}{8}$.

$\frac{2}{6} + \frac{1}{4} + \frac{3}{8} = \frac{8}{24} + \frac{6}{24} + \frac{9}{24} = \frac{23}{24}$.

To add fractions first reduce them to a common denominator; then add the numerators.

3. Add $\frac{1}{5} + \frac{2}{15} + \frac{1}{3} + \frac{3}{10}$.

4. Add $\frac{1}{12} + \frac{3}{18} + \frac{2}{9} + \frac{1}{3}$.

5. Add $\frac{1}{7} + \frac{2}{9} + \frac{5}{63} + \frac{1}{6}$.

6. Add $\frac{1}{6} + \frac{1}{4} + \frac{1}{3} + \frac{3}{8}$.

7. Add $\frac{3}{10} + \frac{5}{12} + \frac{7}{60} + \frac{9}{40}$.

8. Add $\frac{4}{5} + \frac{5}{6} + \frac{6}{7} + \frac{3}{8}$.

9. Add $\frac{1}{16} + \frac{3}{7} + \frac{9}{10} + \frac{3}{4}$.

10. Add $\frac{7}{8} + \frac{1}{4} + \frac{5}{6} + \frac{9}{10}$.

11. Add $\frac{7}{9} + \frac{2}{5} + \frac{1}{3} + \frac{6}{11}$.

12. Add $\frac{9}{12} + \frac{3}{4} + \frac{5}{6} + \frac{3}{48}$.

13. Add $\frac{8}{15} + \frac{11}{45} + \frac{18}{90} + \frac{17}{60}$.

14. Add $\frac{3}{18} + \frac{8}{21} + \frac{4}{10} + \frac{9}{42}$.

SUBTRACTION OF FRACTIONS

To subtract one fraction from another, reduce the fractions to equivalent fractions having the least common denominator. Then subtract the numerator of the subtrahend from the numerator of the minuend, and write the result over the common denominator.

1. Find the value of $\frac{5}{7} - \frac{2}{3}$.

$$\frac{5}{7} - \frac{2}{3} = \frac{15}{21} - \frac{14}{21} = \frac{1}{21}.$$

Find the value of:

2. $\frac{7}{8} - \frac{4}{21}$.

3. $\frac{19}{20} - \frac{11}{16}$.

4. $\frac{111}{200} - \frac{1}{10}$.

5. $\frac{1}{20} - \frac{1}{200}$.

6. $\frac{17}{24} - \frac{7}{20}$.

7. $\frac{11}{25} - \frac{1}{5}$.

8. $\frac{3}{5} - \frac{1}{6}$.

9. $\frac{9}{15} - \frac{3}{8}$.

10. $\frac{7}{8} - \frac{4}{5}$.

11. $\frac{11}{12} - \frac{5}{6}$.

12. $\frac{27}{36} - \frac{4}{9}$.

13. $\frac{35}{36} - \frac{5}{8}$.

14. $\frac{48}{90} - \frac{5}{20}$.

15. $\frac{60}{85} - \frac{7}{18}$.

16. $\frac{72}{81} - \frac{11}{36}$.

17. $\frac{96}{100} - \frac{41}{64}$.

18. $\frac{7}{8} - \frac{19}{40}$.

19. $\frac{9}{10} - \frac{38}{72}$.

20. $\frac{16}{18} - \frac{77}{36}$.

21. $\frac{2}{8} - \frac{30}{129}$.

22. From $92\frac{2}{11}$ take $61\frac{15}{16}$.

$$92\tfrac{2}{11} - 61\tfrac{15}{16} = 92\tfrac{32}{176} - 61\tfrac{165}{176} = 91 + 1\tfrac{32}{176} - 61\tfrac{165}{176}$$
$$= 91\tfrac{208}{176} - 61\tfrac{165}{176} = 85\tfrac{43}{176}.$$

Since we cannot subtract $\frac{165}{176}$ from $\frac{32}{176}$, we take 1 from the minuend, and considering it as $\frac{176}{176}$, add it to $\frac{32}{176}$. $92\frac{32}{176} = 91\frac{208}{176}$.

23. In two days a boy rode $65\frac{3}{10}$ mi. on his bicycle. On the first day he rode $31\frac{7}{8}$ mi. How many miles did he ride the second day?

24. Mr. Smith is building a fence. In two days he builds $21\frac{1}{3}$ rd. On the first day he builds $15\frac{5}{8}$ rd. How many rods does he build the second day?

MULTIPLICATION OF FRACTIONS

1. Multiply $\frac{3}{19}$ by 4. This means, repeat $\frac{3}{19}$ four times. $\frac{3}{19}+\frac{3}{19}+\frac{3}{19}+\frac{3}{19}=\frac{12}{19}$. $\frac{3}{19}\times 4=\frac{12}{19}$.

2. Multiply $\frac{3}{8}$ by 6. $\frac{3}{8}\times 6=\frac{3}{\cancel{8}_{4}}\times\overset{3}{\cancel{6}}=\frac{9}{4}=2\frac{1}{4}$.

First cancel the factors common to denominator and multiplier. Then multiply. Reduce the resulting fraction to a mixed number.

3. Multiply $\frac{5}{6}$ by 12.

$$\frac{5}{\cancel{6}_{1}}\times\overset{2}{\cancel{12}}=10.$$

4. Multiply $\frac{9}{12}$ by 8.

$$\frac{\overset{3}{\cancel{9}}}{\cancel{12}_{4}}\times\overset{2}{\cancel{8}}=6.$$

Multiply:

5. $\frac{9}{16}\times 10$. **8.** $\frac{36}{74}\times 49$. **11.** $\frac{151}{180}\times 4$.

6. $\frac{18}{21}\times 9$. **9.** $\frac{72}{96}\times 18$. **12.** $\frac{42}{169}\times 39$.

7. $\frac{13}{22}\times 11$. **10.** $\frac{85}{198}\times 36$. **13.** $\frac{23}{148}\times 74$.

14. Multiply $\frac{4}{5}$ by $\frac{3}{7}$.

$$\frac{4}{5}\times\frac{3}{7}=\frac{12}{35}.$$

15. Multiply $\frac{8}{9}$ by $\frac{3}{4}$.

$$\frac{\overset{2}{\cancel{8}}}{\cancel{9}_{3}}\times\frac{\overset{1}{\cancel{3}}}{\cancel{4}_{1}}=\frac{2}{3}.$$

To multiply one fraction by another, first cancel if possible. Then find the product of the numerators for the new numerator and of the denominators for the new denominator.

Multiply:

16. $\frac{4}{5}\times\frac{10}{16}$. **19.** $\frac{2}{3}\times\frac{4}{5}\times\frac{10}{16}$. **22.** $\frac{13}{14}\times\frac{28}{120}$.

17. $\frac{7}{8}\times\frac{2}{21}$. **20.** $\frac{27}{64}\times\frac{56}{81}$. **23.** $\frac{68}{74}\times\frac{15}{90}$.

18. $\frac{13}{86}\times\frac{9}{39}$. **21.** $\frac{40}{108}\times\frac{18}{72}$. **24.** $\frac{5}{12}\times\frac{9}{20}\times\frac{18}{27}$.

DIVISION OF FRACTIONS

$\frac{1}{6} \div 2 = \frac{1}{12}$.
$\frac{1}{3} \div 4 = \frac{1}{12}$.
$\frac{4}{5} \div 4 = \frac{1}{5}$.
$\frac{8}{9} \div 2 = \frac{4}{9}$.

To divide a fraction by a whole number, multiply the denominator by that number, or divide the numerator by that number.

Divide:

1. $\frac{1}{7}$ by 3.
2. $\frac{3}{25}$ by 5.
3. $\frac{9}{20}$ by 2.
4. $\frac{14}{21}$ by 7.
5. $\frac{2}{9}$ by 7.
6. $\frac{6}{11}$ by 3.
7. $\frac{7}{13}$ by 2.
8. $\frac{15}{21}$ by 5.
9. $\frac{3}{10}$ by 4.
10. $\frac{18}{38}$ by 9.
11. $\frac{9}{14}$ by 3.
12. $\frac{16}{31}$ by 8.

To divide a fraction by a fraction, invert the divisor and multiply.

13. Divide $\frac{7}{12}$ by $\frac{9}{10}$.

$$\frac{7}{12} \div \frac{9}{10} = \frac{7}{\cancel{12}_{6}} \times \frac{\cancel{10}^{5}}{9} = \frac{35}{54}.$$

14. Divide $\frac{4}{10}$ by $\frac{8}{30}$.

$$\frac{4}{10} \div \frac{8}{30} = \frac{\cancel{4}^{1}}{\cancel{10}_{1}} \times \frac{\cancel{30}^{3}}{\cancel{8}_{2}} = \frac{3}{2} = 1\tfrac{1}{2}.$$

Divide:

15. $\frac{9}{36}$ by $\frac{3}{4}$.
16. $\frac{1}{9}$ by $\frac{3}{10}$.
17. $\frac{8}{15}$ by $\frac{12}{20}$.
18. $\frac{7}{18}$ by $\frac{21}{72}$.
19. $\frac{9}{49}$ by $\frac{108}{112}$.
20. $\frac{18}{64}$ by $\frac{15}{22}$.
21. $\frac{9}{20}$ by $\frac{12}{13}$.
22. $\frac{9}{10}$ by $\frac{2}{7}$.
23. $\frac{2}{3}$ by $\frac{27}{28}$.
24. $\frac{5}{6}$ by $\frac{6}{7}$.
25. $\frac{14}{39}$ by $\frac{2}{26}$.
26. $\frac{81}{144}$ by $\frac{9}{12}$.
27. $\frac{5}{9}$ by $\frac{18}{30}$.
28. $\frac{8}{9}$ by $\frac{1}{3}$.
29. $\frac{9}{16}$ by $\frac{4}{32}$.
30. $\frac{24}{51}$ by $\frac{2}{17}$.
31. $\frac{19}{32}$ by $\frac{3}{8}$.
32. $\frac{1}{2}$ by $\frac{39}{42}$.
33. $\frac{42}{75}$ by $\frac{2}{5}$.
34. $\frac{20}{64}$ by $\frac{5}{8}$.
35. $\frac{96}{99}$ by $\frac{2}{3}$.
36. $\frac{49}{96}$ by $\frac{7}{9}$.
37. $\frac{16}{27}$ by $\frac{4}{10}$.
38. $\frac{9}{50}$ by $\frac{2}{5}$.

39. What will be the cost of 9460 sq. ft. of land at $\$\frac{8}{10}$ per square foot?

40. How much will 246 yd. of cloth cost at $\$\frac{5}{6}$ per yard?

REVIEW OF FRACTIONS

1. A money box contains 47 half-dollars, 36 quarters, 25 twenty-cent pieces, 49 dimes, and 17 nickels. How much money is there in all?

2. When 25 laborers earn each $\$\frac{1}{3}$ per hour, how much do they all earn in 12 da. and 12 hr., reckoning 8 hr. to the day?

3. A grocer bought two tubs of butter, weighing together $75\frac{11}{12}$ lb. One tub when empty weighed $8\frac{1}{4}$ lb., and the other $9\frac{1}{3}$ lb. How much butter did he buy?

4. A clerk has a monthly income of \$70, and spends $\$ 48\frac{2}{5}$ per month. How much does he save in a year?

5. What number multiplied by $5\frac{1}{3}$ will give 292 for the product?

6. At $\$9\frac{3}{8}$ a cord, how many cords of wood can be bought for $\$277\frac{1}{2}$?

7. John spent $\$6\frac{4}{8}$ in 7 da. How much did he spend in one day at that rate?

8. When one yard of percale costs $\$\frac{3}{5}$, how many yards can be bought for $\$\frac{16}{25}$?

9. If 8 yd. of cloth cost $\$8\frac{21}{25}$, what is the price per yard?

10. How much will 584 lb. of tea cost at $\$\frac{5}{8}$ per pound?

11. How many pieces of cloth, each piece $2\frac{4}{9}$ yd. long, can be cut from a bolt of cloth containing 66 yd.?

12. When $\frac{5}{6}$ of a barrel of flour costs $\$5\frac{1}{3}$, what is the price per barrel?

REVIEW OF FRACTIONS

1. A child spilled first $\frac{1}{10}$ of a quart of milk and then $\frac{5}{6}$ of a quart. What part did she bring home?

2. A garden contains $185\frac{3}{8}$ sq. rd. in potatoes, $145\frac{4}{21}$ sq. rd. in cabbage plants, and $65\frac{4}{35}$ sq. rd. in onions. What is the area of the garden?

3. Mr. Johnson contracted to dig $3518\frac{1}{4}$ cu. yd. of earth. How much of his contract remained after digging $1660\frac{5}{12}$ cu. yd.?

4. A merchant sold 86 lb. of butter at $25\frac{3}{5}¢$ a pound, 98 doz. eggs at $17\frac{2}{3}¢$ per dozen, and $63\frac{5}{16}$ gal. of milk at $24\frac{1}{2}¢$ per gallon. What was the total amount of sales?

5. A factory was worth $18464. Mr. Williams owned $\frac{3}{10}$ of it, but sold $\frac{5}{8}$ of his share at its full value. What sum did he receive for it?

6. A farmer exchanged with a grocer $\frac{15}{16}$ of a bushel of corn worth $64¢$ per bushel for $6\frac{2}{3}$ lb. of bacon. How much did the grocer charge per pound for the bacon?

7. I bought $13\frac{1}{2}$ A. of land and divided it into building lots of $\frac{3}{8}$ of an acre each. How many building lots did I get?

8. Mr. Swan owes Mr. Davis $35.28, and pays part of it in 33 yd. of dress goods at $82\frac{1}{2}¢$ per yard, and the remainder in calico at $4\frac{1}{2}¢$ per yard. How many yards of calico does Mr. Davis get?

9. How many acres does a farm contain, when $\frac{3}{18}$ of it is grass, $\frac{5}{36}$ is corn, $\frac{2}{9}$ is wheat, and the remaining 34 A. is oats?

UNITED STATES MONEY

10 mills = 1 cent. 100 cents = 1 dollar.
10 cents = 1 dime. 10 dimes = 1 dollar.

We write nine dollars seventy-eight cents, \$9.78; twenty-five dollars eighteen cents, \$25.18; four dollars forty cents, \$4.40. A mill is $\frac{1}{10}$ of a cent. Mills are written at the right of cents. We write four cents six mills \$.046; one dollar seventeen cents eight mills, \$1.178.

1. What three coins together make \$.25?

2. What coins together make 12¢? 18¢? 28¢? 35¢? 49¢? 54¢? 67¢? 75¢? 91¢? 84¢? \$1.29?

3. How many dimes should you give for $\$\frac{4}{5}$? For $\$\frac{1}{2}$?

4. How many mills are there in three quarters of a dollar?

5. What is the largest silver coin? The smallest?

6. $\$\frac{1}{2}$ expressed decimally is \$.50; $\$\frac{3}{4} = \$.75$.

7. Write decimally $\$\frac{1}{5}$, $\$\frac{1}{10}$, $\$\frac{1}{25}$, $\$\frac{1}{8}$, $\$\frac{1}{3}$, $\$\frac{1}{4}$, $\$\frac{1}{6}$, $\$\frac{7}{8}$, $\$\frac{4}{25}$, $\$\frac{7}{10}$, $\$\frac{4}{5}$, $\$\frac{3}{4}$, $\$\frac{9}{25}$, $\$\frac{3}{8}$, $\$\frac{2}{3}$.

Read and add:

8.	9.	10.	11.
\$ 2.27	\$ 28.11	\$ 99.81	\$ .86
4.00	17.43	20.14	1.14
56.00	493.19	936.08	.09
300.00	60.04	257.348	200.246
12.18	182.632	85.513	46.00

12. What is the difference between $\$1\frac{3}{4}$ and \$1.75?

13. What is the difference between $\$\frac{1}{20}$ and a nickel?

UNITED STATES MONEY

1. How many dollars and cents are there in: 420¢? 328¢? 112¢? 249¢? 104¢? 297¢? 333¢? 219¢? 738¢?

Write decimally:

2. 7 dollars 3 dimes 4 cents 2 mills.
3. 2 dollars 0 dimes 8 cents 6 mills.
4. 316 dollars 4 dimes 9 cents 4 mills.

Add:

5.	6.	7.	8.
$936.21	$ 1.00	$4028.24	$ 91.80
41.00	408.25	900.07	121.46
3.08	72.69	36.43	.37
709.56	38.41	7300.90	2081.51
$1689.85			

Subtract:

9.	10.	11.	12.	13.
$800.00	$928.31	$5000.00	$638.11	$436.25
629.46	244.93	4999.99	391.56	211.44
$170.54				

Multiply:

14.	15.	16.	17.	18.
$480.25	$975.36	$475.28	$526.15	$944.75
8	9	21	36	56
$3842.00				

Divide:

19.	20.	21.
8)$78.48	9)$5691.69	$68,168.23 ÷ 13 = ?
$9.81		

22. $78,656.25 ÷ 25 = ?

23. $15,417 ÷ 36 = ?

NUMERATION AND NOTATION OF DECIMALS

DECIMAL TABLE

Hundred millions	Ten millions	Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Units	Decimal point	Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths	Millionths	Ten-millionths	Hundred-millionths
7	8	9	4	6	0	2	4	4	.	1	4	5	1	8	7	1	2
Whole Number										Decimal							

The above number is read seven hundred eighty-nine million four hundred sixty thousand two hundred forty-four, and fourteen million five hundred eighteen thousand seven hundred twelve hundred-millionths.

Read the following:

1. 2567.89434	4. 3974691.25	7. 993.462809	10. 27.4972
2. 7.498397	5. 4396	8. 47.00001	11. .008092
3. 678.4728	6. 67.900021	9. .789501	12. 289.04

Read each decimal as if it were a whole number, giving it the name of its right-hand figure.

Write in figures:

13. Four hundred twenty-five, and four tenths.
14. Ten thousand nine hundred, and three hundredths.
15. Eighty, and seven hundred eighteen thousandths.
16. Four hundred thirty-five, and ninety-two millionths
17. Three thousand six hundred ten ten-thousandths.
18. Thirty-six, and fifteen thousandths.
19. Seven ten-millionths.

ADDITION OF DECIMALS

1. Add 4.0271, 320.16, .096, 23, and 80.006.

4.0271
320.16
.096
23.
80.006
427.2891

In adding decimals, set the figures for units of the same order in a column, as in adding numbers without decimals.

See that the decimal points are placed in a vertical line.

Add by columns and by rows:

	a.	*b.*	*c.*
2.	4.036	45.207	600.
3.	89.234	7894.	.789672
4.	257.428	.27963	3478.90008
5.	793.698	428.055	4120.
6.	79.028	9246.8	800.01725
7.	87.	.728	28.084
8.	9.21	49.2	39.
9.	100.009	.9578	8.18
10.	76.21134	.935	97.256
11.	9270.008	8.95	131.0258

Add the following:

12. $408.67 + 21.5 + 2008.0085 + .980489 + 6897.2 + 56.3.$
13. $99.172 + 2895.25 + 3.14508 + 1234.008 + .724608.$
14. $75.67 + 125 + .00725 + 78 + 29.35 + 86 + 1857.09.$
15. $51.416 + 99.0005 + 6437.45 + .000425 + .2178. + .0974.$
16. $79.836 + 107.0485 + .89504 + 3.6 + 989.707 + 68 + 9.27.$
17. $308.906 + 27.8 + 74.609 + 8.009701 + .98405 + 7.56.$
18. $79.575 + 103.4 + 4.0289 + 73.2 + 12690.$

SUBTRACTION OF DECIMALS

1. Subtract 8.4725 from 115.021.

$$\begin{array}{r} 115.021 \\ 8.4725 \\ \hline 106.5485 \end{array}$$

In subtracting decimals, set the figures for units of the same order in a column.

2. Subtract 3.46125 from 12.

$$\begin{array}{r} 12. \\ 3.46125 \\ \hline 8.53875 \end{array}$$

See that the decimal points are placed in a vertical line.

Subtract:

3. 4.2859 from 13.008.

4. .5047 from 2.4.

5. 17.9167 from 100.002.

6. 736.917 from 923.405.

7. 28.4008 from 57.3.

8. 999.9021 from 1000.

9. 37.4 from 206.0097.

10. 2.6894 from 93.1.

11. 23.4 from 32.9693.

12. 8.92463 from 11.209

13. .000904 from 5.

14. 467.924 from 538.42.

15. 46.95 from 92.8.

16. 234.607 from 2384.54.

17. .0709 from 1.3.

18. 4.697 from 8.75.

Find the value of:

19. 91.58 − 46.61.

20. .00097 − .000089.

21. 98.41 − 7.781469.

22. 2.00007 − .871436.

23. 86 − .0068.

24. 3.002 − .486.

25. Mr. Jones had $1000 in cash and paid as taxes on three pieces of property $351.728, $607.341, and $19.413. How much did he have left?

26. Mr. Smith had $2500 in the bank. He took out $1728.78. How much was left in the bank?

MULTIPLICATION OF DECIMALS

1. Multiply 68.4 by 2.13.

$$\begin{array}{r} 68.4 \\ 2.13 \\ \hline 2052 \\ 684 \\ 1368 \\ \hline 145.692 \end{array}$$

In multiplying decimals point off in the product as many decimal places as the sum of the decimal places in both multiplier and multiplicand.

Find the products:

2. $.012 \times .6$.
3. $.208 \times .009$.
4. 17.41×8.4.
5. $216.48 \times .24$.
6. $.256 \times .58$.
7. $.9601 \times 3.41$.
8. 20.43×4.6.
9. 7.5×6.8.
10. $48.03 \times .587$.
11. $.625 \times .005$.
12. $250 \times .08$.
13. $.825 \times 3.8$.
14. $.76 \times 1.009$.
15. $2.1 \times .1$.
16. $100 \times .65$.
17. 700×2.693.
18. $658 \times .625$.
19. $1.25689 \times .37$.
20. $.257 \times .07$.
21. $.019 \times 28.9$.
22. 27.5×24.
23. $250.05 \times .002$.
24. $.0036 \times 4.61$.
25. $.73 \times 91$.
26. 9.6831×50.
27. $.0037 \times 1560$.
28. 200.002×202.2.
29. 4.3089×4.8712.
30. $39.473 \times .00089$.
31. 24.51×2.5.

32. What is the price of 426.56 A. of land at $36.48 per acre?

33. In 1 sq. rd. there are 272.25 sq. ft. What is the value of 1 sq. rd. of land at $.87 per square foot?

34. In 1 sq. rd. there are 30.25 sq. yd. How many square yards are there in 57.08 sq. rd.?

35. In a barrel there are 31.5 gal. How many gallons are there in 78.25 bbl.? In 125 bbl.?

DIVISION OF DECIMALS

1. Divide .525 by 2.5.

$$\begin{array}{r} 2.5).525(.21 \\ \underline{50} \\ 25 \\ \underline{25} \end{array}$$

Since the dividend is the product of the quotient and the divisor, the number of decimal places in the quotient must equal the excess of the number of decimal places in the dividend over the number of places in the divisor.

In this problem there are two more decimal places in the dividend than in the divisor. Hence, there are two decimal places in the quotient.

Divide:

2. 338.75 by 8.5.

3. 2.0942 by 250.42.

4. .4366 by .0034.

5. .00012 by 506.

6. 3.428 by 16.

7. 8.1225 by 5.4.

8. .0625 by 1.75.

9. 3.1 by .0125.

10. .0088 by .675.

11. 32.5 by .126.

12. 2316 by .0625.

13. 5.36368 by 71.34.

14. .638924 by 39.64.

15. 11.6 by .0011.

16. 4432.1 by .679.

17. 3.1416 by .7854.

18. .00456 by .1276.

19. 22.65 by .01006.

20. 4.2232 by .032.

21. .0594 by .04666.

22. 7.2135 by 165.

23. 2.4 by .0064.

24. 5.69327 by 21.8.

25. 8.2 by .42.

26. .09436 by 2250.

27. 15.4546 by .019.

28. 4127.08 by .063.

29. .025339 by .000745

30. Divide 1 by 13; by 17; by 19.

PROBLEMS IN DECIMALS

1. A regiment of 1200 men has .04 of its number on the sick list. How many men are there in active service?

2. The difference between two numbers is 29.25. The greater number is 38.125. What is the smaller number?

3. If I walk 3.761 mi. an hour, at the same rate, how many miles can I walk in 6.5 hr.?

4. If one yard of calico costs $.09, how many yards may be bought with $8.19? With $1.08?

5. After selling 45.28 A. of land, Mr. Smith had 34.5 A. left. How many had he at first?

6. Mr. Davis has $5000 in cash. After paying four debts of $1246.38, $25.97, $136.49, and $3296.21, how much has he left?

7. A grocer bought two tubs of butter, one tub containing 27.48 lb., the other 35.76 lb. How much did he receive for the butter at $.23 per pound?

8. Mr. Swan has 765 A. of land. He divides it up into lots of 42.5 A. each. How many lots are there?

9. A mechanic earns $3.65 a day. He worked 299 da. last year. How much did he earn that year? If he spent $15.38 per week on his family, how much did he save?

10. When a cord of wood costs $8.90, how much will $\frac{4}{5}$ of a cord cost?

11. When 235 A. of land cost $8577.50, how much will 396.75 A. cost at the same price?

12. How many rails, each 12.6 ft. long, will it take to make a fence 4536 ft. long, there being two rails in each section of the fence?

BILLS

A **bill** is a statement of merchandise sold or services rendered.

Foot and receipt the following bills:

BILL

CHICAGO, ILL., June 12, 1902.

1. MR. CHARLES ADAMS,

200 Wabash Av., Chicago.

Bought of JONES & CO.

TERMS, CASH.

10 lb. Java Coffee,	28¢	2	80		
6 lb. Sugar,	7¢		42		
12 lb. Rice,	$8\frac{1}{3}$¢	1	00		
1 doz. cans Tomatoes, for	$2	2	00		
$6\frac{1}{2}$ lb. Butter,	32¢	2	08	8	30

Received Payment,

JONES & CO.

2. A. E. Arnold bought of C. D. Phelps of Montclair, N.J., 10 lb. Rice @ $8\frac{1}{3}$¢; 16 lb. Sugar @ $7\frac{1}{2}$¢; 6 lb. Lard @ 8¢; 20 lb. Cheese @ $12\frac{1}{2}$¢. Make out the bill in proper form and receipt it.

3. Herbert E. Johnston bought of Charles Wright, on account, 100 bbl. Mess Pork @ $8.40; 100 bbl. St. Louis Flour @ $6.30; 20 firkins Butter (56 lb. to the firkin) @ 20¢ per pound; 100 lb. Rice @ 10¢. Make out the bill in proper form and receipt it.

BILLS

Foot and receipt the following bills:

1. C. W. Hammond bought of R. C. Mills,

100 lb. Prime Butter	@	20¢.
50 lb. Cheese	@	12½¢.
5 bbl. St. Louis Flour	@	$6.30.
25 bbl. Loaf Sugar (5746 lb.) . .	@	6¢.
20 bales Cloves (2820 lb.) . . .	@	25¢.
50 bags Rio Coffee (7900 lb.) . .	@	25¢.

2. C. E. Farrand sold A. D. Haines, on account,

50 bbl. St. Louis Flour	@	$6.30.
25 bbl. Mess Pork	@	$8.20.
10 bbl. Coffee Sugar (2120 lb.) .	@	7¢.
20 chests Y. H. Tea (1360 lb.) .	@	45¢.
10 bags Rio Coffee (1580 lb.) . .	@	26¢.

3. Frank Small bought of M. R. Johnson, on account,

10,000 Envelopes	@	$1.60 per M.
1½ gross Penholders . . .	@	$3.60 per gross.
10,000 sheets of Paper . .	@	$2.80 per ream.
6 gross Pens	@	$1.00 per gross.
10 half-pint bottles Ink . .	@	75¢ per pint.

4. Samuel Acre bought of M. E. Miller, for cash,

10 bbl. C. Sugar (2120 lb.)	@	7¢.
25 boxes S. G. Starch (1000 lb.) . .	@	5¢.
5 cases Indigo (250 lb.)	@	36¢.
10 chests Y. H. Tea (680 lb.) . . .	@	45¢.

5. Hiram Jones bought of Anderson Hill,

2000 lb. Farm Cheese	@	11¢.
50 firkins Prime Butter (2800 lb.) .	@	22¢.
50 bbl. N. O. Molasses (31½ gal. each)	@	50¢.
20 chests Japan Tea (1220 lb.) . .	@	55¢.

BILLS

1. Render Account Sales:

ALBANY, N.Y., April 15, 1904.

Sold for account of A. D. JONES,

By H. M. CLARK & CO.

Oct.	1	75 bbl.	Greening Apples	@	$3.20
"	2	20 "	Russets	@	$2.80
"	3	120 "	Baldwins	@	$3.50
"	4	100 "	Surprise	@	$4.00
"	5	25 "	Ben Davis	@	$8.60
			Charges		
		Freight,	340 bbl.	@	12¢ each
		Drayage,	340 "	@	6¢ "
		Inspection,	340 "	@	2¢ "
		Storage,	340 "	@	4¢ "
		Net Proceeds remitted			

2.

SAN FRANCISCO, CAL., May 18, 1904.

Sold for account of THE ST. LOUIS TRADING CO.,

By ELLOR & HALL.

May	1	25 coats		@	$4.50
		48 vests		@	$1.50
		7 doz. felt hats		@	$27.00
		8 doz. pr. suspenders		@	$4.25
		½ gr. pr. gloves		@	$ .80 per pr.
			Charges		
		Expressage			$12.00

DENOMINATE NUMBERS

Linear Measure

TABLE

12	inches (in.)	= 1 foot . . .	ft.
3	feet	= 1 yard . . .	yd.
$5\frac{1}{2}$	yards or $16\frac{1}{2}$ feet	= 1 rod . . .	rd.
320	rods	= 1 mile . . .	mi.

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

Square Measure

TABLE

144	square inches	= 1 square foot . . .	sq. ft.
9	square feet	= 1 square yard . . .	sq. yd.
$30\frac{1}{4}$	square yards	= 1 square rod . . .	sq. rd.
160	square rods	= 1 acre	A.
640	acres	= 1 square mile . . .	sq. mi.

1 sq. mi. = 1 section = 640 A. = 102,400 sq. rd.

Plastering is estimated by the square yard; stonecutting, paving, and glazing are estimated by the square of ten feet (100 sq. ft.).

Cubic Measure

TABLE

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

A pile of wood or stone 8 ft. long, 4 ft. wide, and 4 ft. high is one cord.

A perch of stone or masonry contains $24\frac{3}{4}$ cu. ft.

A cubic yard of earth is considered a load.

A cubic foot of distilled water weighs $62\frac{1}{2}$ lb. or 1000 oz.

DENOMINATE NUMBERS

Liquid Measure

TABLE

4 gills (gi.)	= 1 pint	pt.
2 pints	= 1 quart . . .	qt.
4 quarts	= 1 gallon . . .	gal.

1 gal. = 4 qt. = 8 pt. = 32 gi. = 231 cu. in.

The capacities of reservoirs, cisterns, etc., are often estimated in barrels of $31\frac{1}{2}$ gal.

Dry Measure

TABLE

2 pints (pt.)	= 1 quart . . .	qt.
8 quarts	= 1 peck	pk.
4 pecks	= 1 bushel . . .	bu.

1 bu. = 4 pk. = 32 qt. = 2150.42 cu. in.

The gallon, quart, and pint of dry measure are about $\frac{1}{7}$ more than the gallon, quart, and pint of liquid measure.

Avoirdupois Weight

TABLE

16 ounces (oz.)	= 1 pound	lb.
100 pounds	= 1 hundredweight . . .	cwt.
2000 pounds (20 cwt.)	= 1 ton	T.

1 T. = 20 cwt. = 2000 lb. = 32,000 oz.

The long ton of 2240 lb. is used in weighing coal at the mines and goods at the United States custom houses 196 lb. of flour equal 1 bbl.; 200 lb. of beef equal 1 bbl.

DENOMINATE NUMBERS

Time Measure

TABLE

60 seconds (sec.)	= 1 minute	min.
60 minutes	= 1 hour	hr.
24 hours	= 1 day.	da.
7 days	= 1 week	wk.
365 days	= 1 year (common) . . .	yr.
366 days	= 1 leap year	yr.
100 years	= 1 century	cen.

Centennial years exactly divisible by 400, and all other years exactly divisible by 4, except other centennials, are leap years.

Circular Measure

TABLE

60 seconds (″)	= 1 minute	′
60 minutes	= 1 degree	°
360 degrees	= 1 circumference . . .	cir.

Table showing the weight of a bushel of the principal grains, etc., as established by law in most of the States in the year 1903:

Wheat, 60 lb. in all States except Conn., 56 lb. in Conn.

Corn, 56 lb. in all except Cal. and Mo., 52 lb., N.C., 54 lb., and N.Y., 58 lb.

Oats, 32 lb., Cal., Ill., La., Mich., Minn., N.Y., O., Pa., Vt., Wis.; 36 lb., Me., Mass., N.C., N.H., N.J.; 35 lb., Ia. and Mo.; 28 lb., Conn.; 100 lb. to 3 bu., Ky.

Rye, 56 lb. in all except Cal., 54 lb., and La., 52 lb.

Barley, 48 lb., Ill., Ind., Ia., Ky., O., N.J. Mich., Minn., Wis., Mo., Mont., and N.C.; 46 lb., Or., Vt., Mass.; 50 lb., Cal.; 47 lb., La.

Beans, peas, and potatoes usually 60 lb.

In the great wheat, corn, and oats markets these grains are now measured by tons and hundredweight, and then computed in bushels.

EXERCISES IN LINEAR MEASURE

1. How many inches are there in 2 ft.? In 1 yd.? In 1 rd.?

2. How many rods are there in $\frac{1}{4}$ mi.? In $\frac{3}{4}$ mi.? In 66 ft.? In $1\frac{1}{2}$ mi.?

3. How many yards are there in 1 rd.? In 12 ft.? In $\frac{1}{4}$ mi.? In 144 in.?

4. What part of a yard is 1 ft.? $1\frac{1}{2}$ ft.? 9 in.?

5. How many kite strings 40 yd. long can be cut from a mile of string?

6. When a person walked 80 rd. and back, what part of a mile did he walk?

7. How many 6-ft. posts can be cut from a pole 30 yd. long?

8. How many leaps 4 yd. long will a fox take in running 1 mi.?

9. Since the ratio of 5 to 7 is $5 \div 7 = \frac{5}{7}$, what is the ratio of 3 to 5? Of 1 ft. to 1 yd.? Of 2 ft. to 1 yd.? Of 18 in. to 1 yd.?

10. What is the ratio of 10 rd. to $\frac{1}{8}$ of a mile?

11. A and B start from the same place and travel in opposite directions, A at the rate of 40 rd. in 3 min., B at the rate of $\frac{1}{4}$ mi. in 5 min. How many miles apart are they in 1 hr.?

12. If A and B had traveled in the same direction on conditions named in problem **11**, how far would they have been apart in 1 hr.?

13. How many boards 15 ft. long, 1 ft. wide will be required to build a 4-ft. tight board fence around a lot 30 yd. long and 20 yd. wide?

SQUARE MEASURE

Square measure is used in measuring surfaces.

A surface having four straight sides and four equal angles is a **rectangle**.

Figures *A* and *B* are rectangles; *B* is also called a square.

The measuring unit of surface is a square, and the **area** of a surface is the number of squares it contains.

The square inch (sq. in.) is the measuring unit for small surfaces.

The square foot (sq. ft.) is used in measuring lumber; the square yard is used in estimating areas of floors, walks, etc.

The square rod (sq. rd.) and the acre (160 sq. rd.) are used as the measuring units for States, countries, etc.

Figure 1 represents a rectangular surface 2 ft. wide and 3 ft. long. It contains 1 sq. ft. 6 times; hence, its area equals 6 sq. ft., but the number 6 is the product of the numbers expressing the length and the width of the rectangle. Hence,

FIG. 1.

The area of a rectangle is equal to the product expressed in square measure of the numbers representing its length and its width expressed in corresponding units of linear measure.

The dimensions, that is the length and width, must be of the same denomination.

A **scale** is a device for representing large dimensions by units of smaller dimensions, as, for example, 1 ft. by 1 in., 1 yd. by $\frac{1}{2}$ in. Draw to a suitable scale a rectangle 5 ft. $\times$ $3\frac{1}{2}$ ft.

EXERCISES IN SQUARE MEASURE

1. How many square inches (sq. in.) are there in $\frac{3}{4}$ sq. ft.? In $\frac{2}{3}$ of a square foot? In a square yard?

2. How many square inches are there in a piece of cardboard 1 ft. long and 8 in. wide? In one a yard long and 9 in. wide?

3. How many square feet of oilcloth are there in a piece 3 yd. square? In a piece 18 in. wide and 2 yd. long?

4. How many square yards are there in a floor 12 × 15 ft.? In one 18 × 21 ft.?

5. How much will it cost to pave a street 60 ft. wide and $\frac{1}{4}$ mi. long at 50¢ a square yard?

6. What is the difference between a square yard and 3 sq. ft.? Between a 6-in. square and 6 sq. in.?

7. How many acres are there in a lot 40 rd. long and 20 rd. wide?

8. How many square yards are there in a square lot, the distance around it being 176 yd.?

9. A lot containing 63 sq. rd. is 9 rd. long. How wide is it?

10. A field containing 10 A. is 20 rd. wide. How long is the field?

11. How much will it cost to fence a 5-A. field whose width is 16 rd. at 75¢ a rod?

12. Find the cost of a brick pavement 30 ft. long and 6 ft. wide at 75¢ a square yard.

13. How many square feet are there in a piece of oilcloth 6 ft. long and 10 in. ($\frac{10}{12}$ or $\frac{5}{6}$ ft.) wide? In one 20 ft. long and 9 in. ($\frac{3}{4}$ ft.) wide?

14. How many square yards are there in a walk 30 yd long and 4 ft. ($1\frac{1}{3}$ yd.) wide?

DRY MEASURE

Dry measure is used in measuring all kinds of seeds, grains, vegetables, and fruits.

1. How many pints are there in 2 qt.? In $\frac{1}{4}$ gal.? In 2 gal.?

2. How many quarts are there in $\frac{1}{2}$ pk.? In 2 pk.? In 6 pt.?

3. How many 1-pt. paper sacks will be needed to hold 1 pk. of peanuts?

4. How much will 7 bu. of potatoes cost at 35¢ a peck?

5. What amount of money was made by selling 10 bbl. of apples ($2\frac{1}{2}$ bu. each) at 45¢ a peck, the cost being $3 per barrel?

6. If $3\frac{1}{2}$ bu. of clover seed is to be divided equally among 16 men, how many quarts should each receive?

7. 4 qt. are what part of a peck? Of 1 bu.?

8. 1 pk. is what part of 64 pt.? Of $2\frac{1}{2}$ bu.?

9. When clover seed sells at $8 per bushel, how much should you measure out to a customer for $3?

10. How many 3-pk. sacks will be needed to sack 21 bu. of seed?

11. When wheat is worth 80¢ a bushel, how much should be received for 50¢?

12. If a man paid $2 a bushel for apples, how much should he charge a peck so as to make $1 per bushel?

13. What will be the cost of paper sacks, 1 qt. each, at 5¢ a dozen, to sack 15 bu. of peanuts?

14. What part of 3 pk. is 6 qt.? 6 in. is what part of $\frac{2}{3}$ yd.?

LIQUID MEASURE

Liquid measure is used in measuring most liquids.

1. In 2 qt. there are how many pints? How many half pints?

2. How many quarts are there in 12 pt.? In 3 gal.? In $2\frac{1}{2}$ gal.?

3. Find the cost of 10 gal. of cream at 20¢ a pint.

4. How many pint bottles will $1\frac{1}{2}$ gal. fill?

5. How many 2-qt. cans will be needed to hold $3\frac{1}{2}$ gal. of jam?

6. How many half-gallon jugs will it take to hold the contents of 20 quart cans of vinegar?

7. If you paid 20¢ for a gallon of milk, for how much must you sell it per pint, to double your money?

8. How many 2-qt. bottles will be required to hold the contents of 120 half-pint bottles?

9. How much should you pay for $1\frac{1}{2}$ gal. of milk that sells at 8¢ a quart?

10. How much should you charge a customer for 3 qt. of sirup that sells at 60¢ a gallon?

11. 5 pt. are what part of a gallon? Of $\frac{3}{4}$ gal.?

12. What should you charge for 3 qt. and 1 pt. of sirup worth 80¢ per gal.?

13. How much sirup worth 60¢ a gallon should you give a customer for 75¢?

14. If from a 5-gal. can you had sold 1 gal. to Mr. A., $1\frac{1}{2}$ gal. to Mr. B., and two $\frac{1}{2}$-gal. jugsful to Mr. C., how many pints would remain in the can?

15. Compare the bulk of 63 qt. of flour with that of 35 qt. of water.

AVOIRDUPOIS WEIGHT

Avoirdupois weight is used in weighing groceries and all kinds of coarse, heavy articles, such as coal, hay, grains, iron, lead, etc.

1. What part of a pound are 8 oz.? 4 oz.? 10 oz.? 12 oz.?

2. How much will 8 oz. of butter cost at 30¢ a pound? How much will 12 oz. cost?

3. How many hundredweight are there in 2 T.? Ir $1\frac{1}{2}$ T.? In $\frac{1}{4}$ T.? In $\frac{4}{5}$ T.? In 600 lb.?

4. Find the cost of 1700 lb. of coal at $5 a ton.

5. When the strength of a wagon is 2.94 T., how many barrels of flour could you haul at a load?

6. When wheat sells at 75¢ a bushel, at what mark should you set the scales to give a customer $9 worth?

7. How much should you charge for 3 lb. 8 oz. of butter worth 32¢ a pound?

8. When hams sell at 8¢ a pound, how much should you charge for one weighing 9 lb. 12 oz.?

9. How much should you pay for 12 cwt. of hay at $15 per ton?

10. How should you set the scales to weigh out a dollar's worth of 40¢ tea?

11. What weight is on the floor of a bin containing 100 bu. of wheat?

12. What is the weight of 20 bbl. of flour? Of 10 bbl. of beef?

13. When a bushel of wheat makes 50 lb. of flour, how many barrels of flour can be made from 98 bu. of wheat?

DENOMINATE NUMBERS — PROBLEMS

1. How many yards of ribbon will it take to make 18 hair ribbons 18 in. long?

2. How many belts 4 ft. long can be made from 3 bolts of braid of 8 yd. each?

3. How many yards of ribbon must be used for 18 hat ribbons 40 in. long?

4. How many square feet of flooring are there in a room 6 yd. long and 15 ft. wide?

5. How many square yards are there in a floor 12 ft. wide and 15 ft. long?

6. At 15¢ a square yard, what will be the expense of plastering the ceiling of a room 30 ft. long and 18 ft. wide?

7. How many square yards of plastering are there in the walls and ceiling of a room 24 ft. long, 18 ft. wide, and 12 ft. high?

8. What is the total value of 2 doz. sacks, each containing $\frac{3}{4}$ bu. of beans, and of 1 doz. baskets, each containing 6 qt. of beans at $1.50 a bushel?

9. If from a sack containing 2 bu. of wheat there were sold to Mr. A. 20 lb., to Mr. B. 30 lb., and to Mr. C. 40 lb., how much is the remainder worth at 20¢ a peck?

10. When a bushel of wheat yields 40 lb. of flour, how many barrels of flour can be made from 490 bu. of wheat?

11. What is the equal number of each, pint and quart cans, that will contain 9 gal.?

12. If a "pint's a pound," how many 2-oz. bottles will a gallon of oil fill?

DENOMINATE NUMBERS — PROBLEMS

1. At 60¢ a dozen for the bottles and 10¢ a dozen for the work, how much will it cost to bottle up 1 bbl. ($31\frac{1}{2}$ gal.) of molasses in quart bottles?

2. When kerosene is bought at 14¢ a gallon and sold at 3¢ a pint, how many gallons must be handled to make a profit of $200?

3. How many square rods are there in a lot 40 rd. long and 20 rd. wide? How many acres are there in the lot?

4. Where land is worth $125 per acre, what is the value of a farm 80 rd. long and 60 rd. wide?

5. At 50¢ per square foot, find the cost of a lot 55 yd. deep and 2 rd. frontage.

6. How much is a load of wheat weighing 2760 lb. (60 lb. to the bushel) worth, at 75¢ a bushel?

7. What is the value of 1280 lb. of oats (32 lb. to the bushel), at 30¢ a bushel?

8. I paid $3 for a bushel of timothy seed, and sold it at 50¢ a gallon. Did I gain or lose, and how much?

9. When a 150-lb. bale of hay lasts a horse 1 wk., how much will it cost to feed a horse 1 yr., at $20 a ton for the hay?

10. A car containing 30 T. of coal will make how many loads of 15 cwt. each?

11. How many 12-oz. rolls can be made from 480 lb. of butter?

12. How many horseshoes weighing $1\frac{3}{4}$ lb. each can be made from 1120 oz. of bar iron?

13. How many 125-lb. bales of hay can be made from $1\frac{1}{2}$ T. of hay?

DENOMINATE NUMBERS — PROBLEMS

1. How many square feet of lumber are there in a board 18 in. wide and 16 ft. long?

2. How much lumber is there in a board 9 in. ($\frac{3}{4}$ ft.) wide and 4 yd. long?

3. How many pieces of zinc $1\frac{1}{4}$ ft. square can be cut from a piece 45 in. wide and 15 ft. long?

4. How much lumber 1 in. thick will be needed for a board walk $1\frac{1}{3}$ yd. wide and 20 yd. long? How much will it cost at \$20 per M (thousand)?

5. A board containing 96 sq. in. is 1 ft. long. How wide is it?

6. I paid \$2 for a bushel of nuts and sold them at the rate of 10¢ a quart. How much did I gain?

7. Having paid \$5 for $\frac{1}{2}$ mi. of string, I cut it into fish lines 5 yd. long and sold them at 5¢ each. Did I gain or lose, and how much?

8. Find the cost of fencing in a one-acre lot whose width is 10 rd., at 50¢ a rod for the fencing and 20¢ a rod for the work.

9. How many cows, each giving 4 gal. of milk daily, must be kept to supply 8 families with 1 pt. a day, 12 families with $\frac{1}{2}$ gal. per day, and 5 families with 1 gal. per day?

10. How much should you charge a customer for a ham weighing 15 lb. 10 oz., at 8¢ a pound?

11. Find the cost of $\frac{3}{5}$ of a ton of coal at 25¢ per hundredweight.

12. At what mark should the scales be set to weigh out 50¢ worth of 40¢ tea?

DENOMINATE NUMBERS

Fundamental Operations

To add or to subtract compound denominate numbers, first change them to numbers of the same denomination, and then proceed as in ordinary addition or subtraction.

1. Find the sum of 1 yd. 1 ft. 10 in.; and 3 yd. 2 ft. 8 in.

1 yd. 1 ft. and 10 in. = 58 in.
3 yd. 2 ft. and 8 in. = 140 in.
198 in.

198 in. changed to higher denominations = 5 yd. 1 ft. 6 in.

2. Find the sum of 3 bu. 2 pk. 5 qt. 1 pt.; 2 bu. 3 pk. 6 qt. 1 pt.; and 4 bu. 3 pk. 2 qt. 1 pt.

3. In one bin was placed 5 T. 16 cwt. 35 lb. 12 oz. In another there was 3 T. 12 cwt. 70 lb. 10 oz. How much was there in both bins?

To multiply or to divide a compound denominate number by any quantity, first change it to a number of one denomination, and then proceed as in ordinary multiplication or division.

4. Multiply 3 pk. 3 qt. 1 pt. by 3.

3 pk.	24 qt.	27 qt.
8	3 qt.	2
24 qt.	27 qt.	54 pt.
		1 pt.
		55 pt.

3 pk. 3 qt. and 1 pt. equal 55 pt. Multiply the 55 pt. by 3. This gives 165 pt. Change the 165 pt. to higher denominations. 165 pt. equal 2 bu. 2 pk. 2 qt. and 1 pt.

5. Multiply 3 gal. 2 qt. 1 pt. by 9.

6. Divide 376 gal. 3 qt. 1 pt. by 9.

7. Divide 328 yd. 1 ft. 3 in. by 21.

8. Multiply 5 yd. 2 ft. 10 in. by 5.

DENOMINATE NUMBERS—PROBLEMS

1. At 65¢ a square yard, find the cost of paving a street 500 ft. long and 43 ft. wide.

2. At $2.50 an acre, find the cost of plowing a field 60 rd. long and 35 rd. wide.

3. Find the number of square feet in the walls of a room 25 ft. long, 18 ft. wide, and 19 ft. 6 in. high.

4. How much will it cost, at $3.15 a square yard, to plaster a room 48 ft. long, 30 ft. wide, and 20 ft. high?

5. Find the cost of a farm $\frac{1}{2}$ mi. long and 120 rd. wide, at $37 per acre.

6. At 75¢ a yard, how much will it cost to carpet a room 25 ft. long, 22 ft. wide, with carpet $\frac{3}{4}$ of a yard wide?

7. At $1.12 a yard, find the cost of carpeting a room 32 ft. long and 25 ft. wide with carpet $\frac{5}{8}$ of a yard wide.

8. How much will it cost, at 65¢ per square yard, to concrete a walk 250 ft. long and 15 ft. 3 in. wide?

9. How much will it cost, at 6¢ a sq. ft., to build a walk 9 ft. wide around the outside of a block 190 ft. square?

10. How much will it cost, at 15¢ a square yard, to paper the walls and ceiling of a room 18 ft. long, 15 ft. wide, and 7 ft. high?

11. How much will it cost to plaster the sides and ceiling of a room 36 ft. 9 in. long, 23 ft. 4 in. wide, and 7 ft. high, at 23¢ a square yard, if 28 sq. yd. are allowed for doors and windows?

12. How much would it cost to build an iron fence around a park a mile square, at $4.75 a rod?

13. How many hours are there in the month of July?

DENOMINATE NUMBERS—PROBLEMS

1. A dairyman sold buttermilk at 4¢ a pint and paid for it at 25¢ a gallon. How much would he gain in one week if he sold 15 qt. a day?

2. A skating rink 104 ft. by 196½ ft. was floored with 2-in. plank at $22.50 per M. What was the cost of the lumber?

3. How many sheets of tin 18 in. by 14 in. will be required to cover a roof 65½ ft. wide and 158¼ ft. long?

4. How much will it cost, at $1.25 a yard, to carpet a flight of stairs 12 ft. high, when the tread of each stair is 9 in. and the riser is 8 in.?

5. How many shingles averaging 4 in. wide and laid 4 in. to the weather will cover the roof of a barn, when one side of the roof is 34 ft. wide and the other 42 ft. wide, and when the length of the barn is 65 ft.?

6. How many granite blocks 8 in. by 12 in. will be required to pave a mile of roadway 40 ft. in width?

7. I wish to floor and ceil a room 37½ yd. long and 12 yd. 2 ft. wide, with matched pine. What will be the cost of the material at $25.25 per M?

8. Change 57,364 cu. ft. to cubic yards.

9. How many cubic inches are there in 170 cu. ft.?

10. How much is a pile of wood 20 ft. long, 4 ft. wide, and 6 ft. 6 in. high worth at $6.75 a cord?

11. When a pile of wood is 40 ft. long and 8 ft. wide, how high must it be to contain 20 C.? At $5.75 per C., what is its value?

DENOMINATE NUMBERS — PROBLEMS

1. A farmer gathered a wagonload of apples from his orchard and sold them to a greengrocer at 85¢ a bushel. The grocer sold them at retail at 25¢ a half peck. If the farmer's wagon held 16 bu., what was the grocer's net profit?

2. A peach grower had 67 bu. of peaches on his trees. He paid 6¢ a peck to have them gathered and packed. The express charges to the nearest market were 20¢ a bushel. He sold them at 7¢ a quart. What profit did he make?

3. A party of 7 boys collected 28 qt. of blueberries and sold them at 26¢ a half peck. What was each boy's share of the money?

4. A peddler bought apples at 60¢ per bushel. How much did he gain in a day's sale of 5 bu. 2 pk. of apples at 13¢ a half peck?

5. A peanut vender sold peanuts at 5¢ a half pint. He had bought them for $3 a bushel. What was his gain on $2\frac{1}{2}$ bu.?

6. A peddler bought potatoes at 70¢ a bushel. How much did he gain in a day's sale of 6 bu. 3 pk. at 14¢ a half peck?

7. How much did a confectioner make on a sale of $327\frac{1}{2}$ boxes of salted almonds at 15¢ a box, when the almonds cost him $15 a bushel, shelled and salted, and the boxes held half a pint?

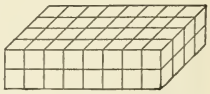
8. It required 12 yr. and 6 mo. to build the Brooklyn Bridge. It was completed Jan. 3, 1890. When was its construction begun?

CUBIC MEASURE

Cubic measure is used in measuring solid bodies of three dimensions — length, breadth, and thickness.

The quantity of matter or space such bodies contain is called **contents** or **volume.**

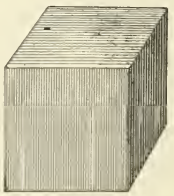
Rectangular bodies have six rectangular sides called faces. Most boxes, bricks, rooms, etc., are rectangular bodies.



RECTANGULAR SOLID

A rectangular solid having all its faces equal is called a **cube.**

The measuring units of solids are cubes of different dimensions, such as cubic inch, cubic foot, cubic yard, etc.



A CUBE

The number of cubic inches, cubic feet, cubic yards, etc., that a solid body contains expresses its contents or volume.

The rectangular figure above represents a solid 8 in. long, 4 in. wide, and 2 in. thick, and the number of cubic inches it contains (64) equals the continued product of the numbers expressing its three dimensions. $8 \times 4 \times 2 = 64$. The volume is 64 cu. in.

In calculating the volume of solids, etc., it is necessary to express all the dimensions in the same denominations.

1. How many cubic inches are there in a brick 8 in. long, 4 in. wide, and 2 in. thick?

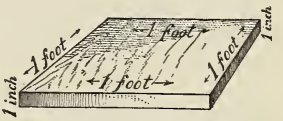
2. How many cubic feet are there in a block of marble 4 ft. long, 3 ft. wide, and 2 ft. thick?

3. How many cubic yards are there in a cellar 5 yd. long, 4 yd. wide, and 6 ft. deep?

BOARD MEASURE

Board measure is used in measuring all kinds of sawed lumber—boards, planks, joists, studding, scantling, and timber. Pieces 4 in. wide and 2 in. thick, called 2 × 4's (two by fours), are used for studding in walls of frame buildings, upon which the lath and siding are nailed. Pieces 6, 8, 10, or more inches wide and 2 in. thick are called **planks**; they are called **joists** when used in buildings for the purpose of nailing flooring upon them. The term **board** is generally understood to mean inch lumber. Pieces 4 in. wide, 3 in. thick (3 × 4's, three by fours), and 8, 10, 12 ft. long, or more, and 4 × 4's, etc., are called **scantling**.

The unit of measure is the **board foot**, which is a board 1 ft. long, 1 ft. wide, and 1 in. thick, containing 1 sq. ft. of lumber, as shown in the adjacent cut. Such a board when 9 in. wide contains $\frac{9}{12}$ or $\frac{3}{4}$ of a square foot of lumber. Since each foot of length represents 1 sq. ft. of lumber, 4 ft. of length would represent 1 sq. ft. multiplied by 4, or 4 sq. ft. of lumber. If the board were 9 in. ($\frac{3}{4}$ ft.) wide, the four feet of length would represent $\frac{3}{4}$ sq. ft. × 4, or 3 sq. ft. of lumber.



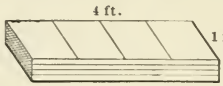
1 Board Foot

Therefore, the number of square feet of lumber in an inch board equals the product of the numbers expressing its length and width in feet by the number expressing its thickness in inches.

The drawing upon this page represents a board in **perspective**. When you measure the rear edge of the board, you see that it is not really as wide as the front edge. Measure and determine to what scale the picture is drawn.

BOARD MEASURE

A stick of timber may be regarded as being made up of as many inch boards as there are inches in its thickness.

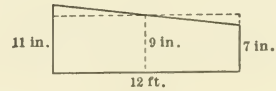


This figure represents a stick of timber 4 ft. long, 1 ft. wide, and 4 in. thick. The top section represents 4 sq. ft. Since the stick is 4 in. thick, there are four sections; hence, the stick contains 4 sq. ft. × 4, or 16 sq. ft. of lumber.

A stick 12 ft. long, 9 in. ($\frac{3}{4}$ ft.) wide, and 8 in. thick contains 8 times the product of the length (12 ft.) and width ($\frac{3}{4}$ ft.), or $12 \times \frac{3}{4} \times 8$, which equals 72 sq. ft.

Observe that of the three dimensions two (width and length) are in feet, while the other (thickness) is in inches; the product of these three dimensions thus expressed equals the number of square board feet of lumber.

Lumber less than 1 in. thick is regarded in trade just as though it were an inch thick; thus, a board 4 ft. long, 1 ft. wide, and $\frac{1}{2}$ in. thick sells as 4 sq. ft. of lumber. But such a board $1\frac{1}{2}$ in. thick sells for all there is in it, viz. 6 sq. ft.



This figure represents a board 12 ft. long, 11 in. wide at one end, 7 in. wide at the other. The average width is one half the sum of 11 in. and 7 in., which is 9 in., or $\frac{3}{4}$ ft. Hence, 12 sq. ft. × $\frac{3}{4}$ = the number of square feet in the board, which is 9.

EXERCISES IN BOARD MEASURE

1. What is the amount of lumber in a board 18 ft. long and 16 in. ($1\frac{1}{3}$ ft.) wide?

2. How much lumber is there in a load containing 30 boards, each 16 ft. long and 9 in. wide?

3. Find the cost of 10 planks, each 12 ft. long, 1 ft. wide, and 2 in. thick @ 3¢ per board foot.

4. How many boards 12 ft. long and 4 in. wide are required for a floor 24 ft. long and 21 ft. wide? How much lumber is there in all?

5. How much should you charge for a stick of timber 8 by 10 in., 12 ft. long, when lumber is worth $30 per M (thousand)?

6. How many feet of lumber are there in a board 16 ft. long and 19 in. wide at one end, and 11 in. at the other?

7. How much lumber will be required for a tight board fence 6 ft. high around a lot 50 × 100 ft.?

8. In the fence (prob. **7**) the lumber is worth $20 per M, the posts, 10 ft. apart (30 in all), cost 10¢ each, and the railing, upper and lower, is of 2 × 4's, the work costing 25¢ a yard. Find the cost of the fence.

9. How much lumber is there in a 3-in. plank 12 ft. long and 10 in. wide?

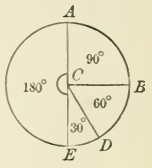
10. How much lumber is there in a board 18 in. wide at one end, and tapering to a point, when the length is 16 ft.?

11. How much lumber can be cut from a stick of timber 10 in. square and 12 ft. long, when $\frac{1}{8}$ in. is allowed for each saw cut?

CIRCULAR OR ANGULAR MEASURE

A circle is a plane surface bounded by a curved line, every part of which is equally distant from a point within called the **center.** The curved line is called the **circumference.** Any part of the circumference is called an **arc.**

Circular measure is used in measuring arcs of circles. The measuring unit is one of the 360 equal parts of a circumference. It is called a **degree,** and is marked thus °. The entire circumference contains 360 degrees (360°). The arc $AB = \frac{1}{4}$ of 360,° or 90°. The angle ACB is a right angle, and is measured by the arc AB; therefore, a right angle contains 90°. BCE is also a right angle. BCD is $\frac{2}{3}$ of BCE, hence, it contains $\frac{2}{3}$ of 90,° or 60°. The lines AC, BC, CD, CE are **radii** of the circle. The straight line AE is the **diameter** of the circle. A radius is one half the diameter. The degrees, marked °, of a circle are subdivided into 60 equal parts called minutes, marked ′, and these are again subdivided into 60 equal parts called seconds, marked ″. Thus, 60 min. (60′) equal 1° and 60 sec. (60″) equal 1′.



The real length of a degree of a circle depends upon the size of the circle.

1. How many degrees are there in a semi- (half) circle? In $\frac{1}{3}$ of a circle?

2. If an angle contains 40°, what part of a circle is it?

3. How many minutes are there in 3°? In $\frac{1}{2}$°? In 1° and 20′?

4. How many seconds (″) are there in 1°? In 1° 10′ and 15″?

5. When an angle contains 60°, what part of a circle is it?

DATES

There are seven days in every week, at least four weeks or twenty-eight days in every month, twelve months in every year, and a hundred years in a century. We are living in the twentieth century. It is more than 1900 years since Jesus Christ was born. When we write letters, we put three facts at the top, called the date. We tell the year, the month, and the day of the month; sometimes we tell also the day of the week. We may write the date, November 1, 1904, or Tuesday, Nov. 1, 1904. The **calendar** tells us the year, the month, the day of the month, and the day of the week.

This calendar is true for any month when the first day of the month falls on Sunday, and when the month has 31 days. This calendar represents May, 1904, January, 1905, and October, 1905.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

The names of the months are: January, February, March, April, May, June, July, August, September, October, November, December.

The year has 365 days, except "leap year," which has 366 days. In leap year, which comes every four years, February gains another day.

Thirty days hath September,
April, June and November;
All the rest have thirty-one,
Excepting February alone.
Twenty-eight are all its store,
Till leap year gives it one day more.

Until the year 2100, every year we can divide by 4 will be leap year. We usually call thirty days a month, unless we know the exact month in question.

TIME MEASURE

The ordinary divisions of **time** are centuries, years, seasons, months, weeks, days, hours, minutes, and seconds.

The standard unit for measuring time is the solar day of twenty-four hours, from midnight to midnight.

In business affairs thirty days are considered a month, and fifty-two weeks are considered a year.

The spring months are March, April, and May; the summer months are June, July, and August; the fall months are September, October, and November; and for winter we have December, January, and February.

Day and night are caused by the revolution of the earth upon its axis once in every twenty-four hours. The seasons are caused by the revolution of the earth around the sun once in a year, and by the inclination of the earth's axis to the plane of the earth's orbit.

The revolution of the earth upon its axis from west to east once in every twenty-four hours causes every point upon the earth's surface (except the poles) to describe a circle (360°) in twenty-four hours, causing the sun to appear to move from east to west $\frac{1}{24}$ of 360°, or 15° every hour; hence, 15° of longitude equal one hour of time. Therefore, when it is noon at any point, it is eleven o'clock 15° west of that point, and one o'clock 15° east of that point.

1. How many minutes are there in a day? How many are there from 10 A.M. to 1 P.M.?

2. How many hours are there from Monday noon till 6 A.M. Tuesday?

3. When the sun rises at 5 A.M., about what time does it set?

4. How many days longer is summer than fall?

DENOMINATE NUMBERS — PROBLEMS

1. How many acres are there in a street 66 ft. wide and 1 mi. long?

2. Find the amount of lumber in a 2-ft. board walk around a flower bed 12 ft. long and 10 ft. wide.

3. How many bushels of oats (32 lb. to the bu.) are there in a load weighing 900 lb.?

4. A grocer bought 3 bbl. of flour at $6 a barrel, and sold it at 4¢ a pound. How much did he gain?

5. In a block of marble 6 ft. long and 3 ft. square, how many cubic feet are there?

6. In a pile of wood 26 ft. long, 6 ft. high, and 4 ft. wide, how many cubic feet are there? How many cords?

7. How much will 3 mi. of cable cost at 12¢ a foot?

8. How many cubic feet are there in a stick of timber 32 ft. long, 2 ft. wide, and $1\frac{1}{2}$ ft. thick?

9. In 352 yd., how many rods are there?

10. At 6¢ a pint, how much molasses can be bought for $4.26?

11. What will be the cost of 2 bu. 1 pk. 6 qt. of timothy seed, at 10¢ a quart?

12. How much will it cost to dig a cellar 24 ft. long, 18 ft. wide, and 6 ft. deep, at 27¢ a load?

13. How many boxes, each having a capacity of 12 lb., can be filled from a hogshead of sugar weighing 9 cwt.?

14. When 1 bu. of wheat makes 45 lb. of flour, how many 50-lb. sacks of flour can be made from 500 bu. of wheat?

15. How many acres are there in a field 90 rd. by 75 rd.?

16. How many minutes more were there in the year 1600 than in 1700?

DENOMINATE NUMBERS — PROBLEMS

1. A farmer raised 24 T. 17 cwt. of hay. He sold 5 loads, each weighing 1 T. 8 cwt. 21 lb. How much had he remaining?

2. Mr. A., who had bought 2 A. 140 sq. rd. of land, reserved $\frac{1}{2}$ an acre for himself, and then divided the remainder into 4 equal lots. How much land did each lot contain?

3. How many steps of 30 in. each will a person take in walking 12 mi.?

4. How many revolutions will a wheel 13 ft. 4 in. make in running 12 mi.?

5. How much sugar at 9¢ a pound must be given for 2 cwt. 43 lb. of pork at 6¢ a pound?

6. How many cubic feet of air are there in a room 6 yd. long, 16 ft. wide, and 10 ft. high?

7. When 720 bu. of potatoes are put into 192 bbl., how many bushels are there in each barrel?

8. How many rods of fence will be required to inclose a section of land?

9. When a cubic foot of granite rock weighs 175 lb., how many tons will a cubic yard weigh?

10. When $\frac{7}{8}$ of an acre of land costs $126, how wide a strip can be purchased from a tract 120 rd. deep, for $8640?

11. When a man travels 3 mi. 80 rd. an hour, how many days will it take him to go 234 mi., traveling 12 hr. a day?

12. How many fence pickets 2 ft. 4 in. long and 3 in. wide can be cut from a board 14 ft. long, $1\frac{1}{4}$ ft. wide when cuts are not considered?

DENOMINATE NUMBERS — PROBLEMS

1. When a man sleeps from 10 P.M. till 6 A.M. daily until he is 75 yr. old, how many years has he spent in sleep?

2. How many hours are there in $1\frac{2}{7}$ wk.?

3. When a wheel with a diameter of 2 ft. 4 in. revolves 3 times in 2 sec., how far will it travel in 2 hr.? (For practical purposes, the circumference of a circle equals $3\frac{1}{7}$ times the diameter.)

4. When wages are \$9 a week, how much is due a person who worked $\frac{1}{2}$ da. on Monday, all day on Wednesday, $5\frac{1}{2}$ hr. on Thursday, and $3\frac{1}{2}$ hr. on Friday? (9 hr. day system.)

5. When your wages are \$10 a week, what should you receive for 4 days' work?

6. How much is a 3-lb. 6-oz. steak worth at 24¢ a pound?

7. How many acres are there in a field 80 rd. long, 50 rd. wide at one end, and 30 rd. wide at the other?

8. How many cubic feet of space are there in a tank 3 yd. long, 2 yd. wide, and 4 ft. deep?

9. What is the value of a stick of ship timber 60 ft. long, 2 ft. 6 in. wide, and 1 ft. 8 in. thick, at \$30 per thousand (M) square feet? How much would it cost at 36¢ a cubic foot?

10. Since a cubic foot of ice weighs 60 lb., how many tons of ice can be taken from a pond 100 ft. wide and 200 ft. long, when the ice is 6 in. thick?

11. How many cans, holding 5 gal. 1 qt. each, can be filled from a 63-gal. hogshead of kerosene?

FORMS OF CHECK, NOTE, AND DRAFT

REDUCED IN SIZE

No. *329.* Date, *x/1, '04.* Name, *G. Thompson.* For *Mdse.* Amount, *$400.* Deposit, Balance, *$785.*	*No. 329.* *New York, Oct. 1, 1904.* National Exchange Bank *Pay to the Order of George Thompson* *Four hundred* ~~~~ $\frac{no}{100}$ *Dollars.* *$400.* *William S. Forbes.*
STUB	CHECK

No. *27.* Date, *xii/5, '04.* Name, *Smith & Willcox.* For *200 bu. Wheat.* Amount, *$180.* Interest, *6%.* Date due, *Jan. 4, '04.*	*No. 27.* *St. Louis, Mo., Dec. 5, 1904.* *Thirty days after date I promise to pay to the order of Smith & Willcox One hundred eighty* ~~~~ $\frac{no}{100}$ *Dollars at the* ~~~~ *Farmers' National Bank, with interest at Six per cent.* *Value received, Jas. T. Martin.* *Due Jan. 4, '04.*
STUB	PROMISSORY NOTE

No. *378.* Date, *vii/1, '04.* For *Hastings & Brooks.* To *Phillips & Co.* Amount, *$1000.* Exchange, *25¢.* Interest, *None.* Time, *Sight.*	*No. 378.* *Chicago, Ill., July 1, 1904.* *At Sight pay to the order of Hastings & Brooks* *One thousand* ~~~~ $\frac{no}{100}$ *Dollars, and charge to account of To Phillips & Co.* *Howard Bros.* *New Orleans, La.* *Phillips & Co. July 3, 1904 First National Bank*
STUB	SIGHT DRAFT ACCEPTED

RELATION OF NUMBERS TO 100

Before taking up the subject of percentage, it will be of advantage to study the relations of certain numbers to 100.

All numbers may be regarded as parts of 100 or as a certain number of times 100.

Thus: 20 is $\frac{1}{5}$ of 100, 200 is 2 times 100.

ANALYSIS. — 50 is $\frac{50}{100}$, $\frac{5}{10}$, or $\frac{1}{2}$ of 100; 80 is $\frac{80}{100}$, $\frac{8}{10}$, or $\frac{4}{5}$ of 100. 150 is $\frac{150}{100}$, $\frac{15}{10}$, $\frac{3}{2}$, or $1\frac{1}{2}$ times 100, etc.

The relation, therefore, that a number sustains to 100 is the quotient obtained by dividing the number by 100 and reducing it to its simplest form.

The following numbers and their separate relations to 100 are useful in shortening operations and in simplifying computations in percentage. They should be memorized.

TABLE

$6\frac{1}{4} = \frac{1}{16}$ of 100.	$33\frac{1}{3} = \frac{1}{3}$ of 100.	$20 = \frac{1}{5}$ of 100.
$8\frac{1}{3} = \frac{1}{12}$ of 100.	$37\frac{1}{2} = \frac{3}{8}$ of 100.	$30 = \frac{3}{10}$ of 100.
$10 = \frac{1}{10}$ of 100.	$62\frac{1}{2} = \frac{5}{8}$ of 100.	$40 = \frac{4}{10}$ of 100.
$12\frac{1}{2} = \frac{1}{8}$ of 100.	$66\frac{2}{3} = \frac{2}{3}$ of 100.	$35 = \frac{7}{20}$ of 100.
$16\frac{2}{3} = \frac{1}{6}$ of 100.	$75 = \frac{3}{4}$ of 100.	$55 = \frac{11}{20}$ of 100.
$25 = \frac{1}{4}$ of 100.	$87\frac{1}{2} = \frac{7}{8}$ of 100.	$65 = \frac{13}{20}$ of 100.

1. $\$\frac{3}{8}$ equals how many cents?

2. When oranges sell for $2.50 a hundred, how much should you pay for 5 doz.?

3. How much is $\frac{7}{8}$ of a dollar? $\frac{5}{8}$? $\frac{3}{8}$? $\frac{1}{8}$?

4. How does $\frac{1}{4}$ of 100 compare with $\frac{1}{12}$ of 100?

5. 85 is what part of 100? 15 is what part of 100?

6. 125 is how many times 100? 250 is how many times 100?

PERCENTAGE

The term **per cent** means per hundred, or **hundredths.**

When a person invests 100¢ in a bushel of apples and sells them for 120¢, he gains 20¢; but when he sells them for 80¢, he loses 20¢. In either case the 20¢ is $\frac{20}{100}$ of the cost price, 100¢; and the gain or loss is 20% of the cost price: the 20% is called the **rate** of gain or loss.

Rate per cent of gain or loss may be expressed in each of the following three ways:

By the sign %, thus: 20%;

By the common fraction: $\frac{20}{100}$ or $\frac{1}{5}$;

By the decimal: .20.

Thus, 20% of 75 equals $\frac{1}{5}$ of 75, or $75 \times .20 = 15$.

1 per cent is written	1%, $\frac{1}{100}$, or	.01.
6 per cent is written	6%, $\frac{6}{100}$, or	.06.
8 per cent is written	8%, $\frac{8}{100}$, or	.08.
12 per cent is written	12%, $\frac{12}{100}$, or	.12.
25 per cent is written	25%, $\frac{25}{100}$, or	.25.
125 per cent is written	125%, $\frac{125}{100}$, or	1.25.
$\frac{1}{2}$ per cent is written	$\frac{1}{2}$%, $\frac{1}{200}$, or	$.00\frac{1}{2} = .005$.
$\frac{1}{5}$ per cent is written	$\frac{1}{5}$%, $\frac{1}{500}$, or	$.00\frac{1}{5} = .002$.

In computing percentage, the rate per cent must be expressed decimally, or in the form of a fraction, and be used as a multiplier.

Thus: 25% of 80 equals $80 \times \frac{1}{4}$, or $80 \times .25 = 20$; the 25% is called the **rate**, 80 the **base**, and 20 the **percentage.**

1. Write as common fractions:

$$5\%;\ 7\%;\ 15\%;\ 33\%;\ 100\%.$$

2. Write as decimals:

$$2\%;\ \tfrac{1}{4}\%;\ \tfrac{1}{8}\%;\ \tfrac{2}{3}\%;\ \tfrac{3}{5}\%.$$

PERCENTAGE

a. Product = multiplicand × multiplier.

b. Multiplicand = product ÷ multiplier.

c. Multiplier = product ÷ multiplicand.

The **base** in percentage corresponds to the **multiplicand.**

The **rate** in percentage corresponds to the **multiplier.**

The **percentage** in percentage corresponds to the **product.**

Hence, all computations in percentage may be performed by applying the principles of multiplication and division.

1. Given the *base* (multiplicand) 80, and the *rate* (multiplier) .25, to find the *percentage* (product).

$$\begin{array}{rl} 80 & \text{base (multiplicand)} \\ .25 & \text{rate (multiplier)} \\ \hline 20.00 & \text{percentage (product)} \end{array} \qquad (a)$$

2. Given the *percentage* (product) 20, and the *rate* (multiplier) 25% (.25), to find the *base* (multiplicand).

Rate Percentage

$$.25\overline{)20} \qquad (b)$$

80 base

3. Given the *percentage* (product) 20, and the *base* (multiplicand) 80, to find the *rate* (multiplier).

Base Percentage

$$80\overline{)20} \qquad (c)$$

$.25 = 25\%$ rate

4. Find 14% of 250.

5. 35 is 14% of what number?

6. What per cent of 250 is 35?

7. Show that 20% of 80 = $\frac{1}{5}$ of 80; that 20% of anything = $\frac{1}{5}$ of it.

20% of 80 = 80 × .20 = 16; $\frac{1}{5}$ of 80 = 16.

20% of anything = .20 of it = $\frac{1}{5}$ of it.

PERCENTAGE

Express each of the following in the three forms (thus, 5 per cent $= 5\% = .05 = \frac{5}{100}$ or $\frac{1}{20}$):

2 per cent, 25 per cent, 8 per cent, 15 per cent, 20 per cent, 30 per cent, 45 per cent, 75 per cent, 100 per cent, 125 per cent, 175 per cent, 200 per cent, $\frac{1}{2}$ per cent, $\frac{3}{4}$ per cent, $\frac{2}{5}$ per cent, $\frac{3}{10}$ per cent, $66\frac{2}{3}$ per cent, $12\frac{1}{2}$ per cent, $87\frac{1}{2}$ per cent.

When the rate is an aliquot part of 100, it is often more convenient to use the equivalent fraction. 20% of $75 = \frac{1}{5}$ of $75 = 15$. (See p. 61.)

1. What is 25% of 200?
2. What is $37\frac{1}{2}\%$ of 240?
3. What is $12\frac{1}{2}\%$ of 800?
4. What is $16\frac{2}{3}\%$ of 600?
5. What is 5% of 200?
6. What is 20% of 500?

Divide in the quickest way:

7. 25 by $12\frac{1}{2}\%$.
8. 40 by $16\frac{2}{3}\%$.
9. 30 by $33\frac{1}{3}\%$.
10. 300 by 75%.
11. 700 by $87\frac{1}{2}\%$.
12. 200 by $66\frac{2}{3}\%$.
13. 560 by 20%.
14. 330 by $37\frac{1}{2}\%$.
15. 150 by $8\frac{1}{3}\%$.
16. 200 by $6\frac{1}{4}\%$.
17. 550 by $62\frac{1}{2}\%$.
18. 740 by $16\frac{2}{3}\%$.
19. Find $87\frac{1}{2}\%$ of 1600.
20. What per cent of 1600 is 1400?
21. 1400 is $87\frac{1}{2}\%$ of what number?
22. What is $16\frac{2}{3}\%$ of 540?
23. 150 is $33\frac{1}{3}\%$ of what number?
24. What per cent of 800 is 300?
25. What per cent of 160 is 100?

PERCENTAGE

1. 6% of 500 acres = how many acres?

2. A farmer, who had 300 sheep, sold 20% of them. How many had he left?

3. In a schoolroom of 50 pupils, $\frac{3}{5}$ are girls. What per cent are girls?

4. 20 is what part of 50? What per cent of 50 is 20?

5. $6\frac{2}{3}$% of 60 = what? $\frac{3}{5}$% of \$1000 = how much?

6. 20 is what per cent of 25? 25 is what per cent of 20?

7. In an orchard of 120 trees, 20% of the trees bore 5 bu. of apples each, and 30% bore 10 bu. each. How many bushels of apples were there in the orchard?

8. $\frac{1}{2}$ of anything is what per cent of it? $\frac{3}{8}$ is what per cent of $\frac{3}{4}$?

9. When mutton loses 20% in dressing, how much marketable meat can be secured from a sheep weighing 150 lb.?

10. When wheat loses $2\frac{1}{2}$% in storage, what is the loss on 500 bu. at 75¢ a bushel?

11. When a man's salary is \$50 a month, how much can he save in a year, after paying 40% for board and 15% for clothing?

12. When the C.P. (cost price) of an article is \$8, and the S.P. (selling price) \$10, what is the rate of gain? When the C.P. is \$10 and the S.P. is \$8, what is the rate of loss?

13. What per cent of 300 is 60? 5 is what per cent of 10?

14. 5 is what per cent of 1?

SOLUTION. — 1 is 100% of itself. 5 is 1×5; hence 5 is 100% × 5 of 1, or 500%.

15. 3 is what per cent of 1? $1\frac{1}{2}$ is what per cent of $\frac{1}{2}$?

16. 4 qt. is what per cent of a bushel?

PROFIT AND LOSS

Profit and loss treats of gains and losses in business transactions. In business the amount of gain or the amount of loss is always compared in quantity with the **cost price**, and is estimated as a part or a per cent of the cost. Thus: If the cost of an article was \$10 and the selling price \$12, the gain, \$2, is compared with the cost price, \$10; hence, the gain was $\frac{1}{5}$ or 20% of the cost.

(100% represents the cost price; 100% + or − the rate represents the selling price.)

1. If \$60 was paid for a harness, for what must it be sold to gain 20%? (20 is an aliquot part of 100.)

2. What was the rate of gain in selling at 25¢, butter that cost 20¢?

3. What must be the selling price per quart of nuts costing \$2.56 a bushel, so that a profit of 25% may be realized?

4. When flour costing \$4.90 per barrel is sold at 4¢ a pound, what is the gain per cent?

5. What price must goods costing \$3.50 be marked to gain 20%?

6. When goods costing \$4 are sold at \$6, what will be the gain per hundred dollars?

7. When cloth shrinks 5% in sponging, how much loss will there be in a piece 80 yd. long?

8. When 40% of ore is pure metal, how many hundredweight of pure metal can be secured from 10 T. of ore?

9. Find the net gain in the following transaction: — X bought a house for \$2500, and sold it at 10% advance, bought it back at 5% advance, and then sold it for $12\frac{1}{2}$% advance.

TRADE DISCOUNT

Trade discount or **commercial discount** is a reduction made in the price of goods.

Business houses issue price lists of their goods; and as the market price changes from time to time, the rate of discount is changed instead of the list price.

Trade discount is calculated on the list price.

The **selling price** equals the list price less the discount, unless there is a further discount for cash.

1. On a bill of goods amounting to $75 there was a discount of 20%, with 10% off for cash. What was the net price?

SOLUTION:

20% or $\frac{1}{5}$ of $75 = $15. $75 − $15 = $60.

10% or $\frac{1}{10}$ of $60 = $6. $60 − $6 = $54, net price.

2. On a bill amounting to $250, there was a discount of 30%, and 10% off for cash. What was the net price?

3. Which is the better and how much, to settle an account of $875 at a discount of 40%, or at a discount of 30% and 10%?

4. If the selling price is to be $8, what must be the marked price, so that a discount of 20% therefrom will yield the $8?

5. What number less 30% of itself leaves as a remainder 105?

6. How much must goods costing $8 be marked so that a discount of 20% may be allowed from the marked price, and a profit of 20% still be realized?

7. What single per cent of 50 equals 20% and 10%?

8. When goods marked $12 are sold at $9, what is the rate of discount?

INSURANCE

Insurance is an agreement whereby one party, in return for a fixed consideration, undertakes to make good certain specified losses sustained by the other contracting party.

Fire insurance covers losses caused by fire or water.

Marine insurance covers losses of ships, cargoes, etc., in navigation.

Accident insurance provides for the payment of a certain amount to the insured when injured by accident.

Life insurance provides for the payment of money to some person named in the agreement, at a certain time or at the death of the insured.

The written contract is called a **policy**. It is usually a printed blank form issued by the company. In it is set forth the rate of premium, the amount of insurance, and the person to whom the money is to be paid, called the beneficiary.

Life insurance policies are of different kinds; the more prominent are as follows, viz.:

The ordinary life policy provides for annual premiums until the death of the insured.

The limited payment life policy requires annual premiums for 10, 20, 30 or other term of years, and provides for the payment of the insurance at death.

The endowment policy requires annual premiums for a term of years and provides for the payment of a certain sum of money at the close of the term or at death, should that event occur before the term ends.

All insurance companies usually accept semi-annual or quarterly, instead of annual, payments, charging interest upon the delayed payments.

INSURANCE

Fire and **marine insurance** estimates the premium at a certain rate per cent, or at so much per $100. **Life insurance** estimates the premium at a certain number of dollars per $1000 insurance, varying according to the age of the insured at the time of writing the policy.

1. What is the premium for insuring a store worth $10000 for $\frac{4}{5}$ its value at $1\frac{1}{2}\%$, and what is the loss in case of total destruction by fire?

SOLUTION. — $\frac{4}{5}$ of $10000 = $8000, amount of insurance. $1\frac{1}{2}\%$ of $8000 = $120, premium cost of insurance. Loss is $2000 (that is, $10000 − $8000) + $120 = $2120.

2. A store, valued at $6000, contents $3000, and insured for $\frac{2}{3}$ the value at $1\frac{1}{4}\%$ premium, was destroyed by fire. What was the total net loss?

3. Find the amount of premiums that will be paid in 20 yr. on a life policy of $5000 at the rate of $16.50 per $1000 annually.

4. Had the person insured as above lived 20 yr. more, what would have been the difference between the insurance money and the total premiums?

5. What was the total amount of all premiums on a 20 yr. endowment $10000 policy at the rate of $48.50 per $1000? (Party insured was 30 yr. old.)

6. In problem 5, what two benefits were derived, and what was the age of the insured when the insurance was paid?

7. The cargo of a ship, valued at $80000, was insured at 6% for $75000. The ship was lost. What was the total loss to the owner of the cargo? (Include premium. The real loss includes also interest upon the money invested in the cargo.)

TAXES

Taxes are sums of money assessed upon persons and property to meet the expenses of the government of the State, county, town, and district.

A **poll tax** is a tax levied upon the person of a citizen.

A **property tax** is a tax levied upon property. Property is of two kinds: real estate, such as lands, houses, factories, etc., and personal property, such as money, furniture, merchandise, horses, carriages, etc.

A person elected or appointed to estimate the value of property is called the **assessor**, and the one who receives the taxes is called the **collector**.

The **rate** of taxation is a certain percentage of the taxable property.

1. It was ascertained that the running expenses of a town for one year would be \$9270. The valuation of all the taxable property was \$250000. The number of polls was 520, \$1 each. Find the rate of taxation.

SOLUTION. — \$9270 − \$520 = \$8750, amount to be raised by tax on property. \$8750 ÷ \$250000 = .03½ = 3½%, or \$3.50 per \$100.

2. The amount of tax to be raised in a village is \$2055, and the assessed valuation of village property is \$425000. Find the rate of taxation and the amount of the tax of A, whose property is assessed at \$3500. Number of polls is 355 at \$1 each.

3. X paid \$5400 for a property taxed at ⅔ its value. What was the rate of taxation, when his tax was \$14.40?

4. Compare the taxes upon two \$10000 properties: one assessed at 100% of true value, rate \$17 per \$1000; and the other assessed at 60% of value, rate \$2.90 per \$100.

DUTIES OR CUSTOMS

Duties or **customs** (called tariffs) are taxes levied by the government upon imported goods for the support of the government and sometimes for the protection and encouragement of home industries.

When the tax is a certain per cent of the value of the goods, it is called an **ad valorem duty**. When it is a certain amount per ton, pound, yard, gallon, etc., it is called a **specific duty**.

Tare (weight of boxes, etc.), leakage, and breakage are **allowances**. Usually 5% is deducted before specific duties are computed.

1. When 100 yd. silk worth $2 a yard are imported, what will be the duty, ad valorem, at 40%?

SOLUTION. — 100 yd. at $2 = $200. 40% of $200 = $80, duty. (The total cost of the silk is $200 + $80 = $280.)

2. Mr. A. imported 200 yd. fine silk worth $3.50 per yard. The ad valorem duty was 50% of 80% of the cost. Find the selling price per yard to gain 25% on total cost.

3. Find the duty on 200 quart bottles of wine at 40¢ a gallon, breakage 5%.

SOLUTION. — 5% of 200 bottles equals 10 bottles. 200 bottles − 10 bottles = 190 bottles. 40¢ a gallon equals 10¢ a quart, or 10¢ per bottle. 10¢ × 190 = $19, duty.

4. What is the duty on 10 bbl. oil (50 gal. each) at 10¢ per gallon, leakage 5%?

5. Find the duty on 15 boxes goods, 60 lb. each, valued at 10¢ a pound, tare 10%, ad valorem duty 5%.

COMMISSION AND BROKERAGE

A person who transacts business for others is called an **agent**, a **broker**, a **commission merchant**, etc.

The sum paid the agent for his services is called a **commission**.

A broker is one who buys and sells stocks, bonds, etc. His commission is called **brokerage**.

Commission and **brokerage** are certain percentages of the sales or purchase money.

A quantity of merchandise shipped from one person to another is called a **consignment**. The person who sends the goods is called the **consignor**; the receiver of the goods is called the **consignee**.

Expenses embrace commission, freight, cartage, storage, insurance, etc.

The **net proceeds** is the balance due the consignor after all expenses have been paid.

1. An agent sold for Mr. A. 1500 bu. of wheat at 65¢, charging 2% commission. Find his commission and Mr. A.'s proceeds.

2. An agent sold for Mr. A. 150 bbl. flour at $4 per barrel, at 3% commission. He paid cartage $15, freight $10, and storage $5. How much was due Mr. A.?

3. An agent was instructed to buy $600 worth of wheat at 75¢ a bushel. How much wheat could he buy, and what was his commission at 2%?

4. A New York merchant directed his agent in Chicago to buy $1845 worth of pork at $15 per barrel. How many barrels could he buy and what was his commission at $2\frac{1}{2}$%?

MISCELLANEOUS PROBLEMS

1. When coats costing \$8 are sold for \$7, what part of the cost is lost? What is the loss per cent?

2. If 50% of a flock of sheep were sold, and 30% died, what part of the flock remained? What per cent remained?

3. $\frac{6 \times 8 \times 9 \times 20}{8 \times 12 \times 15 \times 30} =$ what? $\frac{3}{5} \times \frac{10}{12}$ of $\frac{6}{7} \times \frac{7}{9} =$ what?

4. How many rectangular solids 7 in. × 4 in. × 3 in. can be cut from a solid 42 in. × 24 in. × 12 in., not considering saw cuts?

5. Reduce 53 pt. to higher denominations.

6. Reduce 1242 in. to higher denominations.

7. How many acres are there in 25440 sq. yd.?

8. If 20% was gained by selling a horse for \$360, what was its cost?

9. What is the shortest length and width of a box into which books 3 × 4, 4 × 6, and 6 × 9 in. may be packed, utilizing the entire space with any one of the sizes named?

10. How many pounds of butter, at 27¢ a pound, will pay for 63 bu. of corn, at 57¢ a bushel?

11. When 1 bbl. of apples costs \$4.28, find the cost of 357 bbl.

12. How much are 2115 lb. of wheat worth (60 lb. to the bu.) at 80¢ a bushel?

13. The sides of a triangular lot are 144 ft., 192 ft., and 112 ft. What is the greatest length of boards that can be used in fencing the lot without cutting them?

14. Find the volume of a block of marble 6 ft. long and 3 ft. square.

MISCELLANEOUS PROBLEMS

1. I bought 5 gal. 3 qt. of berries, and sold $17\frac{1}{2}$ qt. How much is the remainder worth at 5¢ a pint?

2. Divide 26 bu. 1 pk. 1 qt. 1 pt. equally among 9 families. How many bushels, pecks, quarts, and pints will each receive?

3. At 30¢ a load, compute the cost of excavating a cellar 15 ft. × 18 ft. and 6 ft. deep.

4. What number multiplied by .25 = 200? 100 is 25% of what?

5. After losing $\frac{1}{5}$ of an article, what per cent remained?

6. After losing 25% of his trees, a nurseryman had 900 trees remaining. How many had he at first?

7. Mr. A. sold a horse for $120, thereby losing 20%. How much did the horse cost him?

8. What is the width of the Atlantic Ocean where steamers cross in 6 da. at the rate of 22 mi. an hour?

9. Reckoning 25000 mi. as the distance around the world, a point on the equator travels how many miles per hour? How many degrees (°) does it travel per hour?

10. Since water in freezing increases $6\frac{1}{4}$% in volume, how many cubic inches of ice will a cubic foot of water make?

11. If a man buys two 5¢ cigars a day, how much money will he spend in cigars during 10 yr.?

12. Two boys start from the same point at the same time, and travel in opposite directions around a half-mile race track; one at the rate of 2 yd. per second; the other at 3 yd. per second. When they meet, how far has each traveled?

13. Of what number is 40 2%? Of what is 2 40%?

GENERAL REVIEW

1. What per cent of 32 is 10% of 80?

2. If five people are to share equally a quantity of land, what per cent is each to have?

3. $\frac{1}{4}$ is what per cent of $\frac{1}{2}$? $\frac{3}{10}$ is what per cent of $\frac{3}{5}$?

4. $\frac{1}{4}$ is what per cent of 1? .25 is what per cent of $\frac{5}{6}$?

5. A dealer paid 40¢ per dozen for oranges, and sold them at 5¢ apiece. What was his per cent of profit?

6. Suits, costing \$8, and marked \$15, were sold at a discount of 20% and 10% off for cash. What was the per cent gained?

7. What must be the asking price for a house and lot worth \$6000 so that by giving 4% off for cash a gain of 20% may be realized?

8. After gaining 15% of his investment, Mr. A. had \$5750. How much had he at first?

9. If by selling a piano at a gain of 20%, I cleared \$90, what was the cost price?

10. A fruit dealer bought 175 bu. of apples at 80¢. 40% of them decayed while in storage. For how much per bushel must he sell the remainder to incur no loss?

11. Goods, costing 12¢ a yard, and marked 15¢, may be sold at what per cent discount, to incur no loss?

12. 75 is 25% less than what number? It is 25% more than what number?

13. A farmer, who had 800 sheep, placed them in 3 fields: 45% in one field, $\frac{6}{11}$ of the remainder in the second, and what then remained in the third. What per cent of the whole flock was in the second field? In the third?

RATIO AND PROPORTION

The **ratio** of one number to another of the same kind is the quotient obtained by dividing the first number by the second. 5 bu. is $\frac{5}{7}$ of 7 bu. The ratio between 5 bu. and 7 is written 5 : 7.

Proportion is an expression of equality between two ratios. The ratio of 4 to 6 equals the ratio of 8 to 12. 4 : 6 = 8 : 12. The expression of equality is called a **proportion**. Every proportion has four **terms**. The first and the last are called the **extremes**; the second and the third are called the **means**.

In any proportion the product of the means equals the product of the extremes. $4 \times 12 = 48$, and $6 \times 8 = 48$.

When one of the means is lacking, multiply the extremes together and divide by the given mean. When one of the extremes is lacking, multiply the means together and divide by the given extreme.

1. If 8 men do a piece of work in 15 da., how long will it take 10 men to do it?

SUGGESTION. — Since days are required, place days for third term. 10 men will take less time. Hence, place the less number, 8, for the second term, etc. 10 : 8 = 15 : 12.

2. When 19 yd. of goods cost \$28.50, at the same rate how much will 37 yd. cost?

3. How much will 80 bu. of grain cost, when \$75 pays for 50 bu.?

4. When 18 men can do a piece of work in 12 da., how many men will do it in 9 da.?

5. How many hats will \$27 buy, when 32 hats cost \$36?

6. If the R. R. Co. charged \$3.12 as freight on 975 lb., at the same rate how much would it charge on 575 lb.?

THE EQUATION

An **equation** is an expression of equality between two quantities. Thus,

$$a = b,\ c = 2 \times 3,\ 4x = 12,\ 3 \times 4 = 7 + 5.$$

The quantity on the left of the equality sign is called the first or left member; that on the right, the second or right member of the equation.

Both members of an equation may be (a) multiplied, (b) divided, (c) increased, or (d) diminished by the same quantity without affecting the equality.

In the following illustrations of the above principle use the equation $4x = 6a$, and let $a = 2$, then $4x = 12$.

If $4x = 12$, one x, or $x = \frac{1}{4}$ of 12, or 3; hence, if $a = 2$, $x = 3$.

Multiplication

$4x = 6a$	Original equation.
$12x = 18a$	Multiplied by 3.
$12x = 36$	Giving to a its value (2).
$x = 3$	Original value of x.

Division

$2)4x = 6a$	Original equation.
$2x = 3a$	Quotient.
$2x = 6$	Substituting value of a (2).
$x = 3$	Original value of x.

Addition

$4x = 6a$	Original equation.
$4x + 2 = 6a + 2$	Adding 2 to both members.
$(4 \times 3) + 2 = (6 \times 2) + 2$	Substituting values of x and a.
or $14 = 14$	Which is true.

Subtraction

$4x = 6a$	Original equation.
$4x - 2 = 6a - 2$	Subtracting 2.
$(4 \times 3) - 2 = (6 \times 2) - 2$	Substituting values of x and a.
or $10 = 10$	Which is self-evident.

THE EQUATION

The purpose of an **equation** is to convert the question of a problem into a statement; *i.e.* to change the interrogative sentence into a declarative sentence. To do this, the question must be answered. This can be done by letting x stand for the unknown quantity.

When \$12 is so divided between A and B that A has 5 times as much as B, what amount has each?

By letting x stand for B's amount, 5 times x, or $5x$, represents A's amount; hence, $5x + x = \$12$, but $5x + x = 6x$. Therefore, $6x = \$12$. $x = \frac{1}{6}$ of \$12, or \$2, B's share; and $5x = \$2 \times 5$, or \$10, A's share. The value of x in the equation $6x = \$12$ can be found by direct division, thus:

$$6)\underline{6x = \$12}$$
$$x = \$2.$$

To find the value of x in the equation $2x + 5 = 20 - x$, transpose the unknown quantity (x) to the left member and change its sign, and the known quantity (5) to the right member and change its sign. We then have $2x + x = 20 - 5$, $3x = 15$, $x = 5$. Transposing the x and changing its sign is a short way of adding x to both sides, to dispose of the x in the right member, and of subtracting 5, to dispose of the 5 in the left member.

One half of x, or $x \div 2 = \frac{x}{2}$; $\frac{2}{3}$ of $x = \frac{2x}{3}$; $7x \div 3 = \frac{7x}{3}$; $\frac{2x}{3} + \frac{3x}{4} = \frac{8x}{12} + \frac{9x}{12} = \frac{17x}{12}$; $\frac{3x}{5} - \frac{x}{3} = \frac{9x}{15} - \frac{5x}{15} = \frac{4x}{15}$.

If $\frac{2x}{3} = 4$, multiply both sides by 3, then $2x = 12$, $x = 6$.

If $\frac{3x}{4} = \frac{3}{10}$, reduce to common denominator, $\frac{15x}{20} = \frac{6}{20}$. or $15x = 6$. $x = \frac{6}{15} = \frac{2}{5}$

EQUATIONS AND UNKNOWN QUANTITIES

1. Divide 36 into two parts so that the first part shall be twice as large as the second part.

2. John and Mary together have 24¢; Mary has 3 times as many as John. How many has each?

3. William and Henry together have 108 marbles; William has 3 times as many as Henry. How many has each?

4. The combined weight of two men is 396 lb., and the smaller man weighs $\frac{1}{2}$ as much as the larger. What is the weight of each?

5. What number plus twice itself equals 12?

6. In a flock of 48 sheep there is 1 black sheep to every 7 white sheep. How many black sheep are there in the flock?

7. Z bought a horse and a harness for $102. The horse cost 5 times as much as the harness. Find the cost of each.

8. The sum of the ages of a father and son equals 42 yr. The age of the father is 5 times that of the son. What is the age of each?

9. James traveled 48 mi. in 3 da. The second day he traveled twice as far as on the first; the third day 3 times as far as on the first. How far did he travel each day?

SUGGESTION. — Let x = first, $2x$ = second, and $3x$ = third.

10. A lady paid $78 for a dress, a coat, and a hat. The coat cost twice as much as the hat, and the dress 3 times as much as the hat. Find the cost of each.

11. A farmer paid $84 for a horse, a cow, and a sheep. The sheep cost $\frac{1}{5}$ as much as the cow, and the horse cost 3 times as much as the cow. What was the cost of each?

EQUATIONS AND UNKNOWN QUANTITIES

1. Given $3x + 5 = 17$ to find the value of x.

(Subtract 5 from both members, $3x = 17 - 5$ or 12.)

2. Given $5x - 9 = 6$, find the value of x.

3. Given $4x - 5 = 39$, find the value of x.

Observe that in example 1 the same result will be obtained by transposing the 5 to the second member and changing its sign from + to −; and in the third example by transposing the 5 to the second member and changing its sign from − to +, thereby saving time and labor.

4. John and James together have 37 marbles; John has 7 more than James. How many has each?

SUGGESTION. — Let x = James's number, then John's number equals $x + 7$, the sum $2x + 7 = 37$, etc.

5. The sum of A's and B's ages is 43 years. A is 5 years older than B. What is the age of each?

6. A father wished to divide $2700 between his son and daughter so that the son should have $500 more than the daughter. How much should each receive?

7. Mr. A. has 50 yd. of fencing with which to fence in a lot whose length is 5 yd. more than its width. What are the length and width of the lot?

REMARKS. — $\frac{1}{2}$ of $x = \frac{x}{2}$, $\frac{2}{3}$ of $x = \frac{2x}{3}$, etc. The equation $\frac{2x}{3} = 8$ may be reduced to a simple form by multiplying both members by 3. Whence $2x = 24$, etc.

8. The combined ages of A and B equal 40 yr. B's age is $\frac{2}{3}$ of A's. Find the age of each.

SUGGESTION. — Let x = A's age, $\frac{2x}{3}$ = B's age, $\frac{2x}{3} + x = 40$. Multiplying both sides by 3, $2x + 3x = 120$, etc.

INTEREST

Money paid for the use of money is **interest.** The amount on which interest is paid is called the **principal.**

The **rate of interest** is some per cent of $1 for one year. Thus: Interest at 6% means $\frac{6}{100}$ of $1 for 1 yr. = 6 cents or $.06; the rate is 6%; the interest is $.06; the principal is $1.

Six Per Cent Method

N.B. { Interest of $1 at 6% for 1 yr. (12 mo.) = $.06
Interest of $1 at 6% for 1 mo. (30 da.) = .005
Interest of $1 at 6% for 1 da. = $.000\frac{1}{6}$

Therefore, to find interest at 6%:

Multiply $.06 *by the number of years. Take one half as many cents as there are months and one sixth as many mills as there are days. The sum equals the interest of* $1 *for the time given.*

Find the interest at 6%:

1. Of $300 for 2 yr. 5 mo. 18 da.

Interest of $1 for 2 yr. = $.12
Interest of $1 for 5 mo. = .025
Interest of $1 for 18 da. = .003
Interest of $1 whole time = $.148

Int. of $300 for 2 yr. 5 mo. 18 da. = $.148 × 300 = $44.40.

2. Of $250 for 1 yr. 9 mo. 15 da.
3. Of $725 for 3 yr. 4 mo. 9 da.

The **amount** equals the interest plus the principal.

Find the amount of:

4. $450 for 2 yr. 2 mo. 6 da.
5. $1250 for 1 yr. 11 mo. 22 da.
6. $925 for 2 yr. 9 mo. 20 da.

INTEREST

Different Rates of Interest by the 6% Method

If a 6% rate produces $18 interest, how much will a 7% rate produce? If 6% produces $18, 1% will produce $\frac{1}{6}$ of $18 or $3, and 7% will produce $3 × 7 ≡ $21. Or, 7% is $\frac{7}{6}$ of 6%, and $\frac{7}{6}$ of $18 ≡ $21.

1. What part of 6% are the following:

5%? 4%? 3%? $4\frac{1}{2}\%$? $1\frac{1}{2}\%$?

2. How many times 6% are the following:

7%? 8%? 9%? 10%?

3. Find the interest of $212 for 2 yr. 7 mo. 15 da. at 7%

To the interest at 6% add its $\frac{1}{6}$ for the interest at 7%.

4. Find the interest of $250 for 8 mo. 21 da. at 5% ($\frac{5}{6}$ of 6%).

Short Method

The interest on any sum of money for 2 mo. at 6% equals as many cents as there are dollars in the principal, or it equals the principal divided by 100.

The interest at 6% for 2 mo. (60 da.) of $37 ≡ 37¢ ≡ $.37. Of $375 ≡ 375¢ ≡ $3.75.

Again, 1 mo. ≡ $\frac{1}{2}$ of 2 mo.; 3 mo. ≡ 2 mo. × $1\frac{1}{2}$, 4 mo. ≡ 2 mo. × 2, 5 mo. ≡ 2 mo. × $2\frac{1}{2}$, 8 mo. ≡ 2 mo. × 4, etc.

Therefore, since the interest at 6%

Of $300 for 2 mo. is $3, for 3 mo. it is $3 × $1\frac{1}{2}$ ≡ $4.50.

Of $675 for 2 mo. is $6.75, for 4 mo. it is $6.75 × 2 ≡ $13.50.

Of $250 for 2 mo. is $2.50, for 5 mo. it is $2.50 × $2\frac{1}{2}$ ≡ $6.25.

Of $400 for 2 mo. is $4, for 90 da. it is $4 × $1\frac{1}{2}$ ≡ $6.

INTEREST

Find the interest at 6%; short method:

1: Of $500 for 4 mo.

2: Of $375 for 60 da. ($\frac{2}{3}$ mo.):

3: Of $250 for 90 da. ($\frac{3}{2}$ mo.):

4: Of $100 for 15 da. ($\frac{1}{4}$ of $\frac{2}{3}$ mo.):

5: Of $600 for 12 mo. ($\frac{1}{1}$ yr.):

6: Of $500 for 1 yr. 2 mo.

7: Of $1000 for 1 mo.

8: Of $800 for 45 da.

9: What is the interest of $600 for 1 yr. 5 mo. 22 da.?

SOLUTION.—1 yr. 5 mo. $\equiv$ 17 mo. $\equiv 8\frac{1}{2}$ times 2 mo.; hence
the interest of $600 for 17 mo. $\equiv 8\frac{1}{2}$ times $6 $\equiv$ $51.00
the interest of $600 for 20 da. ($\frac{20}{60} \equiv \frac{1}{3}$ of 60) $\equiv$ 3.00
the interest of $600 for 2 da. ($\frac{2}{60} \equiv \frac{1}{30}$ of 20) $\equiv$ .20
hence the interest on $600 for 1 yr. 5 mo. 22 da. $\equiv$ $53.20

10: Find the interest of $450 for 1 yr. 2 mo. 15 da.

11: What is the amount of $60 for 60 da.?

12: What is the amount of $1250 for 4 mo.?

Annual interest is interest paid annually. When not paid, it bears interest until it is paid. Thus:

13: Find the amount of $2500 for 3 yr. with interest payable annually at 6%. The interest for 1 yr. is $150; for 3 yr. it is 3 times $150 or $450. Interest on 1st yearly interest ($150 if not paid) for 2 yr. $\equiv$ 18
Interest on 2d yearly interest ($150 if not paid) for 1 yr. $\equiv$ 9
Total amount of interest $477
Principal, $2500, plus interest, $477, $\equiv$ amount, $2977.

Find the amount, with interest payable annually:

14: Of $3800 for 4 yr. 6 mo. at 6%.

15: Of $276.18 for 2 yr. 4 mo. at 5%.

REVIEW EXERCISES

1. Divide 65 into two parts having a ratio of 6 to 7.

SUGGESTION. — $6 + 7 = 13$. One part will be $\frac{6}{13}$ and the other $\frac{7}{13}$ of the whole.

2. A and B are to receive \$150 in the ratio of 2 to 3. Find the share of each.

3. A can do a piece of work in 5 da. What part can he do in 3 da.?

4. A can do a piece of work in 2 da., while B can do it in 3 da. After A and B had worked 1 da. together, A's son completed the work in 1 da. In how many days could the son have done it all?

5. Find the value of x in each of the following: (*a*) $4 : 6 = 6 : x$; (*b*) $3 : \frac{1}{2} = x : \frac{1}{12}$.

6. The product of what two equal numbers equals 4×16? With the four numbers form a proportion.

7. What are the dimensions of a square field equal in area to one 9 by 16 rd.? Form a proportion.

8. When 10 men in 6 da. of 8 hr. each can build a wall 100 ft. long, 6 ft. high, and 2 ft. thick, how many men must be employed for 6 da. of 9 hr. each to build a wall 150 ft. long, 6 ft. high, and 3 ft. thick?

9. Divide a line 35 ft. long so that one part shall be $\frac{5}{4}$ of the other.

10. The difference between two numbers is 16; their sum is 40. What are the numbers?

11. If $x \div 4 + x \div 3 = 7$, what is the value of x?

12. How far may a person ride in a carriage traveling 10 mi. an hour, so that he may return in 13 hr., walking back at the rate of 3 mi. per hour?

BANK DISCOUNT

Banks are incorporated institutions that deal in commercial paper, notes, etc., receive money for safe keeping, loan money, and issue notes or bills for general circulation.

Banks purchase notes and bills of exchange, and make loans upon bills receivable and upon other securities.

Bank discount is a deduction from the amount of a note at maturity (time due) for cashing it before it becomes due. This deduction is the simple interest of the amount of the note (principal and interest) at the time due, from the date of discounting to date of maturity, paid in advance.

The amount of the note less the bank discount is the **proceeds** of the note.

The **term of discount** is the time elapsing between the date of discount and the date of maturity.

The expression "discounting commercial paper" means buying notes at a discount.

On March 1, 1901, a bank discounted a note of $500, dated Jan. 1, 1901, and due 4 mo. from date with interest at 6%; rate of discount, 8%. What were the proceeds of the note, that is, how much did the bank pay for it?

4 mo. from Jan. 1, 1901, is May 1, 1901, date of maturity.

From March 1, 1901, to May 1 is 60 da., term of discount.

Principal, $500 + interest for 4 mo. at 6%, $10, = $510, amount at maturity.

Interest on $510 from March 1, 1901, at 8%, to May 1 = $6.80, bank discount.

Amount, $510, less the bank discount, $6.80, = $503.20, proceeds.

BANK DISCOUNT

The ordinary form of a note is as follows:

$800. NEW YORK, May 1, 1901.

Ninety days after date I promise to pay to the order of James L. Watson, Eight Hundred Dollars, with interest at 6 per cent. Value received. W. E. SMITH.

1. If the above note for Mr. Watson is discounted by bank May 15, at 6%, how much will he receive for it?

2. Find the bank discount of a note of $300 for 8 mo. 15 da., at 6%.

3. Find the time from Oct. 12, 1897, to Jan. 10, 1900.

PROCESS		
1900	1	10
1897	10	12
3	2	28

EXPLANATION.—Always place the later date for the minuend. January is the 1st month, hence 1900–1–10; October is the 10th month, hence 1897–10–12. Subtract as in compound numbers.

4. Find the interest on a $600 note dated June 11, 1900, and paid Aug. 23, 1901, at 5%.

5. Find the proceeds of a note of $250 dated Dec. 10, 1903, due in 6 mo., at 6%. Discounted March 27, 1901, at 6%.

6. When you wish to borrow $100 from the bank for 4 mo., for what amount must you give your note, the rate of discount being 6%?

SOLUTION.—The bank discount on $1 for 4 mo. at 6% ≡ $.02; the proceeds ≡ $1 − $.02 ≡ $.98. $100 ÷ .98 ≡ $102.0408+; hence, the note must be drawn for $102.04, due in 4 mo., without interest.

7. What must be the face of a note at the bank to cover a loan of $985 for 90 da., rate of discount, 6%?

NATIONAL BANKS

A **National Bank** is a chartered institution organized under the laws of the United States for the purpose of doing a general banking business.

National Banks are authorized by the National Government to issue currency; to buy and sell bullion, coin, and exchange; to discount commercial paper; to loan money on personal security; to receive deposits, etc.

A National Bank is entitled to receive from the Comptroller of Currency circulating notes of all denominations, an amount equal to 90% of the amount of registered bonds deposited by the Bank with the Treasurer of the United States.

National Bank currency is redeemable in lawful money by the issuing Bank and by the United States Treasurer.

National Banks are required to deposit in the United States Treasury at Washington sums of lawful money equal to 5% of their circulation, which are to be held for the redemption of the bank circulation.

Every National Bank is required to hold in reserve 15% to 25% of its deposits.

Stockholders of National Banks are liable for amounts equal to the par value of the stock they hold.

An annual tax of 1% of the circulation of a National Bank is paid to the United States.

Find the amount of circulation, the redemption fund, and the annual tax of a National Bank that has deposited with the United States Treasurer $300000 worth of registered bonds.

Circulation : : : : : : : :	$270000.
Redemption Fund : : : : :	$13500.
Tax : : : : : : : : :	$2700.

COMPOUND INTEREST

Compound interest is interest on interest when the latter is due, but unpaid.

Interest compounded annually is annual interest; compounded every six months it is semiannual interest.

Savings banks pay compound interest.

1. What is the compound interest of $2000 for 3 yr at 6%? How much more is it than the simple interest?

Principal	$2000.00
Interest for 1st year, $2000 × .06	120.00
Amount for 1st year or 2d principal	$2120.00
Interest for 2d year, $2120 × .06	127.20
Amount for 2d year or 3d principal	$2247.20
Interest for 3d year, $2247.20 × .06	134.83+
Amount for 3 yr.	$2382.03
Original principal subtracted	2000.00
Compound interest for 3 yr.	$382.03
Simple interest of $2000 for 3 yr. at 6%	360.00
Difference between compound and simple interest	$22.03

When there are months and days, compute interest for the months and days on the last amount, etc.

In case interest is to be compounded semiannually, find the amount for each successive six months of the entire time.

2. What is the compound interest of $5000 for 3 yr. at 5%?

3. What is the compound interest of $1500 for 1 yr. 6 mo., compounded semiannually at 6%?

4. Find the interest on $1000 for 1 yr. at 6%, compounded quarterly (every 3 mo.).

COMPOUND INTEREST TABLE

Much labor in computing compound, interest can be saved by using a table that shows at different rates, the amount of $1 at compound interest from 1 yr. to 20 yr. inclusive.

Yr.	3%	3½%	4%	5%	6%	7%
1.	1.030 000	1.035 000	1.040 000	1.050 000	1.060 000	1.070 000
2.	1.060 900	1.071 225	1.081 600	1.102 500	1.123 600	1.144 900
3.	1.092 727	1.108 718	1.124 864	1.157 625	1.191 016	1.225 043
4.	1.125 509	1.147 523	1.169 859	1.215 506	1.262 477	1.310 796
5.	1.159 274	1.187 686	1.216 653	1.276 282	1.338 226	1.402 552
6.	1.194 052	1.229 255	1.265 319	1.340 096	1.418 519	1.500 730
7.	1.229 874	1.272 279	1.315 932	1.407 100	1.503 630	1.605 781
8.	1.266 770	1.316 809	1.368 569	1.477 455	1.593 848	1.718 186
9.	1.304 773	1.362 897	1.423 312	1.551 328	1.689 479	1.838 459
10.	1.343 916	1.410 599	1.480 244	1.628 895	1.790 848	1.967 151
11.	1.384 234	1.459 970	1.539 454	1.710 339	1.898 299	2.104 852
12.	1.425 761	1.511 069	1.601 032	1.795 856	2.012 196	2.252 192
13.	1.468 534	1.563 956	1.665 074	1.885 649	2.132 928	2.409 845
14.	1.512 590	1.618 695	1.731 676	1.979 932	2.260 904	2.578 534
15.	1.557 967	1.675 349	1.800 944	2.078 928	2.396 558	2.759 031
16.	1.604 706	1.733 986	1.872 981	2.182 875	2.540 352	2.952 164
17.	1.652 848	1.794 676	1.947 900	2.292 018	2.692 773	3.158 815
18.	1.702 433	1.857 489	2.025 817	2.406 619	2.854 339	3.379 932
19.	1.753 506	1.922 501	2.106 849	2.526 950	3.025 600	3.616 527
20.	1.806 111	1.989 789	2.191 123	2.653 298	3.207 135	3.869 684

When interest is compounded semiannually, use the number corresponding to twice the number of years and half the given rate of interest.

To find the compound interest, deduct the principal.

SAVINGS BANKS

Savings banks are institutions wherein small sums of money may be deposited for safe keeping.

At certain fixed periods these banks compute interest at the rate, in most communities, of 3 % to 4 % a year on all sums deposited.

The **interest term** (the time for which interest is computed) varies in different banks. It is commonly either six months or three months, commencing Jan. 1; or Jan. 1, and July 1; or Jan. 1, Apr. 1, July 1, and Oct. 1.

Interest not withdrawn becomes an additional deposit, and as such draws interest. This is called compound interest.

In case there has been a withdrawal during an interest term, only the balance draws interest during that term. For example: If $75 were deposited Jan. 1 in a bank having a three months' interest term, and $50 were drawn out March 15, only $25 would draw interest from Jan. 1 to Apr. 1. Again, in a bank having a six months' term of interest, $50 deposited Feb. 20 will not draw interest until the next term beginning July 1.

However, many savings banks now allow interest from the first of the month following the month in which the deposit was made; also deposits made during the first ten days of January or July, and the first three days of April or October sometimes draw interest from the first of those months.

Some banks allow interest upon the average daily balance during the term for which the interest is computed. This is the common method in trust companies that pay interest upon deposits subject to check.

SAVINGS BANKS

1. Mr. A. deposited in a savings bank, having a 6 months' interest term, $240, Jan. 1, 1901, and $150, June 10, 1901. How much was due him Jan. 1, 1905, allowing interest at 4%?

Interest of $240 from Jan. 1 to July 1 (6 mo.)	$4.80
To which add the principal	240.00
Also the new deposit	150.00
Due July 1, 1901	$394.80
Interest of $394.80 from July 1 to Jan. 1, 1905	7.89
To which add the principal	394.80
Amount due Jan. 1, 1905	$402.69

2. In a savings bank having a 3 months' interest term, a deposit of $200 was made Jan. 1, $175 March 1, and $125 June 10. How much was due the depositor on Oct. 1 of the same year, at 3% interest?

Interest of $200 from Jan. 1 to Apr. 1 (3 mo.)	$1.50
To which add the principal	200.00
Also the new deposit	175.00
New principal, Apr. 1	$376.50
Interest of $376.50 from Apr. 1 to July 1	2.82
To which add the principal	376.50
Also the new deposit	125.00
New principal, July 1	$504.32
Interest of $504.32 from July 1 to Oct. 1	$3.78
To which add the principal	504.32
Amount due the depositor Oct. 1	$508.10

SAVINGS BANKS

1. Find balance of deposit when there were no withdrawals. On Jan. 1, 1902, a depositor's balance in a savings bank, whose interest term is 6 mo., was $200. He afterward made the following deposits: Feb. 6, $40; March 10, $50, May 12, $100; Sept. 1, $40; Oct. 15, $250. What was the amount due on Jan. 1, 1903, when interest at 4% was allowed on deposits from the first day of each month, on or before which they were made.

Bal. Jan. 1, 1902,	$200	× 6 =	$1200	on deposit 1 mo. int. term
Deposit Feb. 6,	40	× 4 =	160	on deposit 1 mo. int. term
Deposit March 10,	50	× 3 =	150	on deposit 1 mo. int. term
Deposit May 12,	100	× 1 =	100	on deposit 1 mo. int. term
Deposit 1st term of 6 mo.	$390	300	$1610	(Int. for 1 mo. = $\frac{1}{3}$%)
	5.36		$5.36	Int. 1st term
Bal. of Deposit July 1,	$395.36	× 6 =	$2370	on deposit 1 mo. int. term
Deposit Sept. 1,	40	× 4 =	160	on deposit 1 mo. int. term
Deposit Oct. 15,	250	× 2 =	500	on deposit 1 mo. int. term
Total Deposit 2d term	$685.36		$3030 ÷ 300 = $10.10	Int. 2d term

$685.36 + $10.10 = $695.46. Balance due depositor Jan. 1, 1903.

At the close of the first interest term, July 1, 1902, $200 had been on deposit six months, or $1200 on deposit one month. The next deposit, Feb. 6, was put in after the first of the month, and did not draw interest until March 1. $40 would be in four months, or $160 for one month. Continue with each payment until the end of the first term – July 1. The total deposits for the first term are equal to $1610 for one month. Find the interest of that amount at 4%, which equals $\frac{1}{300}$ of $1610, or $5.36. This added to amount of deposits for first term, $390 + $5.36, or $395.36 equals the balance on July 1. $395.36 remains in during the whole time of the second term, or until Jan. 1, 1903. This is six months. $395.36 × 6 = $2370 for one month. Fractions of dollars are not considered. Continue in this way with each deposit until the end of the second term, when we find the balance due depositor to be $685.36.

SAVINGS BANKS

1. Find the balance due Jan. 1, 1903, upon the following account, interest being allowed at 4% upon deposits from the first of each calendar month; interest term six months. Balance Jan. 1, 1902, $300. Deposits: Jan. 15, $200; Jan. 20, $100; Jan. 31, $400; March 15, $100; May 15, $500; Aug. 15, $200; Sept. 20, $100; Nov. 15, $200.

2. Find the balance due Jan. 1, 1903, on the following deposits, interest being allowed at 4% on deposits from the first of each calendar month; interest term six months. Balance Jan. 1, 1902, $200. Deposits: Feb. 5, $100; March 10, $200; May 15, $150; Aug. 15, $200; Oct. 15, $100; Nov. 20, $50.

3. Find the balance due Oct. 1, 1904, upon the following account, with a three months' interest term, at 3%:

Jan. 1, 1900, balance,	$105.00	Mar. 3, 1900, withdrawal,	$35.00
July 1, 1900, deposit,	60.00	Oct. 10, 1900, withdrawal,	20.00
Mar. 30, 1901, deposit,	100.00	June 12, 1901, withdrawal,	75.00
Nov. 1, 1901, deposit,	20.00	Sept. 5, 1902, withdrawal,	40.00

4. Find the balance due May 15, 1904, upon the following account, with $2\frac{1}{2}$% interest allowed upon daily balances:

Mar. 31, 1904, balance,	$2800.00	Apr. 2, 1904, checks,	$106.00
Apr. 1, 1904, deposit,	400.00	Apr. 6, 1904, checks,	640.80
May 1, 1904, deposit,	400.00	Apr. 10, 1904, checks,	1285.00

5. What is the difference in interest for 9 mo. between

$400 at 4 % compounded quarterly and
$500 at 3 % compounded monthly?

6. Get bank books and compute accounts.

PARTNERSHIP

A **partnership** is an association of several persons for the purpose of transacting business. Such an association is commonly called a **firm**, a **company**, or a **house**.

The **capital stock** is the money invested and considered as divided into equal parts, usually $100 each, called **shares**.

The **resources**, or **assets**, are: the money, the goods, the real estate, etc., belonging to the firm.

The **liabilities** are the firm's debts; the **net worth** or **net capital** is the resources less the liabilities. Should the liabilities at any time exceed the resources, the firm is said to be **insolvent**.

Each partner's share of the gain or loss is the part thereof that his investment is of the whole investment.

1. A and B form a partnership; A invests $9000, B, $6000; their net gain is $1500. What is each man's share of the gain?

SOLUTION: $9000 + $6000 = $15000 = whole investment. A's share = $\frac{9000}{15000}$, or $\frac{3}{5}$ of $1500 = $900. B's = $\frac{6000}{15000}$, or $\frac{2}{5}$ of $1500 = $600.

2. A, B, and C form a partnership; A invests $300, B, $500, and C, $700. The gain is $600. What is each man's share?

3. A and B were in partnership one year. A's investment was $3000. B's, $2000. The gain was $1500. They sold the business for $6000. How much should each receive?

4. A, M, and Z entered upon a series of joint contracts, as carpenter, mason, and plumber respectively. They invested $3000, $4000, and $1000 each, and in a year gained in all $12000. Compute the gain of each.

CORPORATIONS

A **corporation** is a company of several persons authorized under the law to transact business as a single individual.

The legal document setting forth the powers, duties, and obligations of the corporation is called its **charter**.

The **capital stock** of the corporation is represented by its shares. Shares are usually $100 each.

The owners of shares are called **stockholders**. A paper issued by the corporation to a stockholder showing the number of shares he owns is called a **certificate of stock**.

The **par value** of stock is its face value.

The **market value** of a share of stock is what it will bring in market on the stock exchange. When the market value is 5% above par, it is at a **premium**, and is quoted at 105. When its market value is 7% below par, it is at a **discount**, and is quoted at 93.

Dividends are net earnings for distribution among stockholders and are declared by the directors of the corporation at a certain rate per cent on the nominal (face) value of the stock, or so much per share. In many corporations a certain part of the capital stock has the advantage of a certain per cent of dividends before a general dividend is declared. Hence, it is called **preferred stock**. The remainder of the stock is called **common stock**.

Stock exchanges are associations organized for the purpose of buying and selling stocks, bonds, securities, etc. Stocks paying large dividends, and representing considerable permanent investments in lands, buildings, machinery, materials, patents, franchises, etc., usually sell at a premium. When the net earnings of a railroad company justify paying 8% dividends, a $100 share brings $150 or even $200.

STOCKS AND BONDS

A **bond** is a written agreement to pay a certain sum of money at a specified time, with interest at a certain rate per cent at regular intervals.

Bonds are issued by cities, counties, States, corporations, and governments.

When stocks, bonds, etc., are bought or sold through private agents, called **brokers**, or publicly on the exchange, a charge of $\frac{1}{8}\%$ is usually made on the market value: this charge is called **brokerage**.

ILLUSTRATION. — The cost to the buyer of 25 shares ($100 each) of railroad stock at 6% premium, $\frac{1}{8}\%$ brokerage, is $\$100 \times 1.06\frac{1}{8} \times 25 = \$2653.125$.

1. Find the cost of 100 shares of mining stock at 3% premium, brokerage $\frac{1}{8}\%$.

2. At $3\frac{1}{2}\%$ what is the dividend on $3500 worth of stock at par?

3. What is the income of a man who owns 50 shares of railroad stock, paying an annual dividend of $6\frac{1}{2}\%$?

4. How much will 10 shares of oil stock cost on exchange at 108, brokerage $\frac{1}{8}\%$?

5. If 4% bonds (bonds paying 4% int.) were bought at 90, what is the income of Mr. A., who took 100 shares? What rate of interest does he receive?

100 shares $= \$100 \times 100 = \$10000$, worth of bonds, which pay 4% int., therefore his income is $400. $\$10000 \times .90 = \$9000$, what he paid for the bonds. $400 is what rate per cent of $9000? $\$400 \div \$9000 = .04\frac{4}{9} = 4\frac{4}{9}\%$.

6. If 10 shares of stock paying 3% dividend are bought at 75, what rate of interest will be realized?

MENSURATION

Mensuration treats of the process of measuring lines, surfaces, and solids.

Lines have length only. Parallel lines are equally distant from each other at all opposite points.

A **triangle** is a surface bounded by three straight lines.

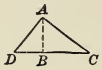
RIGHT-ANGLED TRIANGLE

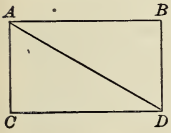
EQUILATERAL TRIANGLE

The **base** of a triangle is the side on which it is supposed to stand, or from which calculations are made.

The **vertical angle** of a triangle is the one opposite the base.

The **altitude** of a triangle is the perpendicular distance from the vertex to the base, or the base extended.

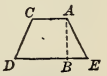




DC is the base, AB the altitude. In the adjacent figure, observe that the area of the triangle CDA is half the rectangle.

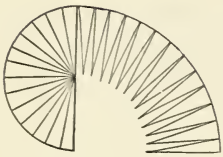
RULE. — *The area of any triangle equals half the product of the base by the altitude.*

A **trapezoid** is a quadrilateral (figure of four sides) having only two sides parallel, thus:



A **circle** is a surface bounded by a curved line, every point of which is equally distant from the center of the circle. The boundary line is the **circumference** of the circle. The **radius** of a circle is the distance from the center to the circumference, or half the diameter.

MENSURATION

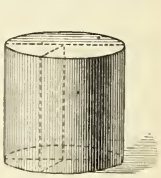


In the figure the sum of all the bases of the triangles equals the circumference of the circle. The sum of all the areas of the triangles equals the area of the circle. The altitude of each triangle equals the radius of the circle. Hence, the area of the circle equals the circumference of the circle (sum of all the bases of the triangles) multiplied by the radius (altitude of the triangles) divided by 2, or briefly:

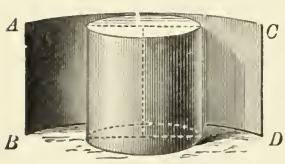
The area of a circle equals half the product of its circumference and radius.

The circumference of a circle is 3.1416 *times its diameter; or, for practical purposes,* $3\frac{1}{7}$ *times the diameter.*

A **cylinder** is a regular solid bounded by two circular ends and a curved surface.



The entire surface of a cylinder equals the sum of the two ends and the curved surface. The area of the curved surface equals that of a rectangle having one dimension equal to the altitude of the cylinder, and the other equal to its circumference; thus, AB equals the circumference of the cylinder. Therefore, the curved surface of a cylinder equals the product of its circumference and altitude. The contents of a cylinder equals the area of its base multiplied by its altitude. Cisterns, standpipes, tanks, cans, water pipes, tunnels, wells, etc., are examples of cylinders.

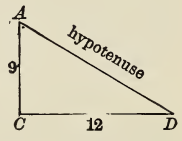


MENSURATION

The following principle is established by geometry:

The square of the hypotenuse of a right-angled triangle equals the sum of the squares of the other two sides.

1. Given the base of a right-angled triangle 12, and the perpendicular 9 to find the hypotenuse (side opposite the right angle).



SOLUTION

$\overline{CD}^2 + \overline{CA}^2 = \overline{DA}^2$.

$12^2 + 9^2 = 144 + 81 = 225$. $\sqrt{225} = 15$.

When the hypotenuse and one side are given, the other side will be the square root of the difference of their squares.

If $DA = 15$ and $CA = 9$, $CD = \sqrt{15^2 - 9^2}$ or $\sqrt{144} = 12$.

2. A boat crossing a river 40 rd. wide drifted 30 rd. down the stream. How far did the boat travel?

3. How many square feet of lumber are there in a board 18 ft. long, 30 in. wide at one end and tapering to a point at the other?

4. How many square feet are there in a gable end of a house 20 ft. wide, 18 ft. to the eaves, and 38 ft. to the point of the gable?

5. What length of rafters will be needed for the roof (prob. **4**), allowing 2 ft. projecting at the eaves?

6. How many yards of fencing will be needed to fence in a circular lot 90 ft. in diameter?

7. How many yards of plastering are on the bottom and wall of a circular cistern 8 ft. in diameter and 10 ft. deep?

8. How many revolutions will a wheel 30 in. in diameter make in running a mile?

TRADE APPLICATIONS

Plastering, **painting**, and **kalsomining** are usually estimated by the square yard.

Plastering

1. How many square yards of plastering are there on the walls and ceiling of a room 15 ft. long, 12 ft. wide, and 10 ft. high, having an 8-in. baseboard, when no allowance is made for windows and doors?

2. Find the cost, at 15¢ a square yard, of plastering the ceiling and 3 walls of a store (glass front) 60 ft. long, 30 ft. wide, and 12 ft. high, having a 3-ft. wainscoting, when no allowance is made for doors and windows.

3. How many square yards of plastering are there on the bottom and wall of a circular cistern 12 ft. deep and 8 ft. in diameter?

Papering

Wall paper is $1\frac{1}{2}$ ft. wide. A single roll contains 24 ft. of paper; a double roll contains 48 ft.

1. How many single rolls of paper will be required to paper the walls of the room named in example 1, above, allowing 6 strips for doors and windows?

Solution. — The distance around the room, 54 ft. $\div$ the width of paper, $1\frac{1}{2}$ ft. = number of strips, 36; $36 - 6 = 30$, number of strips with allowance for doors and windows. 10 ft. $- \frac{2}{3}$ ft. (baseboard) $= 9\frac{1}{3}$ ft., height to be papered. Since there are 24 ft. to a roll, $24 \div 9\frac{1}{3} = 2$ strips can be cut from a roll (the rest is waste). $30 \div 2 = 15$, the number of rolls required.

2. Find the number of single rolls required to paper

the walls and ceiling of a room 10 ft. high, 20 ft. wide, and 24 ft. long. No allowances.

3. Find how many double rolls of wall paper are required to paper the three walls of the room named in example 2 upon page 100, allowing 10 strips for doors and windows.

4. Find the number of single rolls required to paper the walls and ceiling of a room 18 ft. wide, 20 ft. long, and 10 ft. 6 in. high above the baseboard. No allowances.

Painting

Painting is estimated by the square of 10 ft. (100 sq. ft.) or by the square yard.

1. How many square yards of painting are there on the sides and ends of a house 20 ft. wide, 30 ft. long, 20 ft. to the eaves, and 37 ft. to the gable, adding $\frac{1}{10}$ for cornice?

2. How many gallon cans of paint will be required to paint a standpipe 60 ft. high and 20 ft. in diameter, allowing 2 qt. to a square (100 sq. ft.)?

Flooring

1. Find the number of linear feet of 3-in. flooring for a room 18 ft. × 20 ft.

2. How many linear feet of 4-in. flooring will be needed for a room 12 ft. × 15 ft.?

Laths

A bundle of laths contains 100 pieces 4 ft. long and 1 in. wide. It is estimated that 1 bundle will cover 5 sq. yd.

1. Find how many bundles of laths are required for a room, walls and ceiling 16 × 20 ft., 10 ft. high, allowing 104 sq. ft. for baseboard, doors, and windows.

TRADE APPLICATIONS

Roofing

Roofing is estimated by the square of 10 ft. (100 sq. ft.).

The number of shingles required to cover a square depends upon the length of shingle laid to the weather.

Laid 4 in. to the weather, 1000 shingles cover a square.

Laid $4\frac{1}{2}$ in. to the weather, 900 shingles cover a square.

Laid 6 in. to the weather, 600 shingles cover a square.

Shingles are sold by the thousand, put up in bundles of 250 shingles each.

1. How many bundles of shingles, laid 6 in. to the weather, must be purchased for a barn roof 60 ft. long and 30 ft. wide upon each side?

2. Find the cost of shingles for a roof 40 ft. long, 15 ft. wide upon each side, shingles being laid 4 in. to the weather and costing $1.50 per bundle.

Carpeting

Carpets vary in width from 27 in. to 3 ft., and are sold by the linear yard.

1. Find how many yards of 30-in. carpet are required to cover a floor 15 ft. wide, 18 ft. long, strips to run lengthwise, allowing 1 ft. waste on each strip for matching.

2. Find the cost of carpeting a room 20 ft. square, with yard wide carpet at 80¢ a yard, allowing 8 in. per strip for matching.

(Width of room ÷ width of carpet = 7 strips, and 1 ft. to turn under.)

3. Find the cost of carpeting a room 18 × 20 ft. with 27-in. carpet at $1.50 per yard, strips to run lengthwise, 9 in. per strip being wasted in matching.

TRADE APPLICATIONS

Stone and Brick Work

The unit of stonework is the **perch**, which contains $24\frac{3}{4}$ cu. ft. In brickwork, 22 common bricks are estimated to each cubic foot. When estimating the cost of masonry, the corners are usually doubled, and a deduction of one half the openings is allowed.

1. How many bricks are there in a 6-ft. wall, 30 ft. long and 1 ft. thick?

2. How many perches of stone are there in a cellar wall 2 ft. thick, 30 ft. long, 20 ft. wide (outside measurement), and 6 ft. high?

3. What will be the cost of the brick at \$6 per M for a cellar 15 ft. square inside and 6 ft. deep, the walls to be laid $1\frac{1}{2}$ ft. thick?

4. Find the cost of the bricks, at \$6 per M, for a house 40×30 ft. outside, 22 ft. high, thickness of walls $1\frac{1}{2}$ ft.

5. Find the number of bricks for a chimney 3 ft. $\times$ 4 ft. by 40 ft. high, with an opening the entire length 1 $\times$ 2 ft.

Suggestion.—Number of cubic feet $= (3 \times 4 \times 40) - (1 \times 2 \times 40)$.

6. How many perches of stone are there in the two piers of a bridge, each 20 ft. high, 15 ft. long, and 8 ft. thick?

7. How many perches of stone are there in a retaining wall 60 ft. long, 2 ft. thick, 15 ft. high at one end, and 9 ft. at the other?

8. The members of the class may invent other problems similar to these upon pages 100–103. It is profitable to find sizes of various kinds of standard brick and cut stone.

THE CASH ACCOUNT

Bookkeeping records systematically the transactions of business.

A **cash account** is a record of transactions in which money has been received or paid for things or services. **Debtor**, Dr., means that money has been received, and **Creditor**, Cr., means that money has been paid.

Prepare statements in similar form.

Cash Account

GEORGE ARNOLD, Grocer. Dr. *1904* Cr.

Dates		Items	Amts.		Totals		Dates		Items	Amts.		Totals	
1904													
Mar.	*2*	*Bal. on hand*	*43*	*59*			*Jan.*	*2*	*Id. L. T. Co.*	*25*			
"		*Sold mdse.*	*34*	*21*			"	"	" *J.W., wages*	*9*			
"		*Rec'd on acct.*					"	"	" *Dec. gas*	*3*	*45*		
"		*Geo. Bangs*	*20*		*97*	*80*	"	"	" *P. J. Smith*	*5*			
							"	"	" *A. B. & Co.*	*29*	*50*		
							"	"	" *Expressage*	*3*	*92*	*75*	*87*
									Bal. on hand			*21*	*93*
					97	*80*						*97*	*80*
Mar.	*3*	*Bal. on hand*	*21*	*93*									

BUILDING AND LOAN ASSOCIATIONS

The purposes of building and loan associations are two: to provide a use for the systematic savings of thrifty people; and to enable poor people to own their homes. The plans for carrying out these purposes vary.

The stock of an association is usually valued at $200 per share, and may be bought at the rate of $1 per month for each share. Each dollar paid in is credited annually with the interest it earns. Within a period varying from ten to thirteen years the share matures, and the shareholder receives $200. He has actually paid in from $120 to $156. The difference, $80 to $44, is interest earned during the period.

A borrower, wishing to buy or to build a house, borrows, on bond and mortgage given to the association, let us say, $1000. He takes out also five shares of $200 each. The $1000 that he borrows is the savings of other depositors. The $1000 that his stock represents will repay, ten, twelve, or thirteen years hence, the $1000 that he has borrowed. The borrower then pays $5 per month for his five shares of stock and $5 per month as interest on his loan of $1000. When his stock matures, he has paid perhaps $144 as interest for every $200 borrowed and $144 for every $200 that he gets with which to pay his debt to the association.

When an association has many borrowers and comparatively few depositors, the borrowers pay premiums for the loans, bidding against each other for the loans. These premiums are paid into the association's treasury and help to reduce the time during which it is necessary to pay $1 monthly for the stock. When the association has many depositors and comparatively few borrowers, the interest charge is usually less than $1 per month.

1. When a borrower pays $1 monthly for a loan of $200, what is the annual rate of interest?

2. What is the cost in cash of Building and Loan stock that matures in 11 yr. 4 mo.?

MISCELLANEOUS EXERCISES

1. Since sound travels 1080 ft. a second, how far away is a hill from which an echo returns in 11 sec.?

2. What should you pay for a 5-lb. 6-oz. roll of butter worth 24¢ a pound?

3. Make out a bill for 1700 lb. of coal at $5 per ton.

4. When from a board 12 in. square a board 6 in. square is cut, what part of the larger board remains?

5. If the diameter of one circle is 3 times that of another, the larger circle is how many times the smaller?

(Similar surfaces are to each other as the squares of their like dimensions.)

6. Find the cost of excavating a cellar 20 ft. square and 8 ft. deep at 80¢ a load (1 cu. yd.).

7. At 50¢ a hundredweight, find the cost of a block of ice 2 ft. square and 1 ft. thick.

8. At $1 per rod, which will cost the more, and how much, to fence in a 10-A. field in the form of a circle or in that of a square?

9. At $35 per square rod, find the cost of paving a street $\frac{1}{2}$ mi. long and 66 ft. wide.

10. How much should you pay for 5 lb. 12 oz. of 28¢ butter?

11. At what mark should you set the scales to give a customer 50¢ worth of 40¢ tea?

12. Reduce $\frac{5}{9}$ to thirds; to halves; to fourths.

13. When a boy can do a piece of work in 3 da., what part of it can he do in $\frac{3}{4}$ of a day?

14. When three girls make a dress in 2 da. for $15. how much does each girl earn per day?

MISCELLANEOUS EXERCISES

1. What amount of sirup, worth 40¢ a gallon, should you give a customer for 75¢?

2. Show that it will take a mile of fencing to go around a square 40-A. field.

3. How much waste lumber is there in cutting, into 10-in. wheels, a 15-ft. board, $\frac{5}{6}$ ft. wide? No allowances.

4. What is the circumference of a carriage wheel that makes 352 revolutions in running a mile?

5. How many cords of cord wood are there in a pile 100 ft. long and 8 ft. high?

6. How many steps 3 ft. each will a person take in walking 32 rd.?

7. At 50¢ a square foot, find the cost of a city lot 120 ft. deep, 20 yd. wide at one end, and 80 ft. at the other.

8. When a bushel of wheat makes 49 lb. of flour, how many barrels are needed to hold the flour from 600 bu. of wheat?

9. By selling apples at $3.75 per barrel, I gained 25%. What was the cost price?

10. An agent buys oil at 50¢ a gallon for Mr. A., and charges 2% commission. What is the cost of the oil per gallon to Mr. A.?

11. An agent was instructed to buy $816 worth of wheat, at 80¢ a bushel. How much wheat can he buy, and what is his commission at 2%?

12. At how much should clothing that cost $12 a suit be sold so as to gain 20%?

13. What amount of money will settle a bill of $250 at a discount of 20% and 10% off for cash?

MISCELLANEOUS EXERCISES

1. What is the weight of a piece of iron 4 ft. long, 6 in. thick, and 8 in. wide, when a piece of the same metal 6 ft. long, 4 in. thick, and 10 in. wide weighs 750 lb.?

2. With a discount of 25% and 25% off, how large a bill will $225 settle?

3. Find the proceeds of a note of $1500, due in 3 mo., at 5% interest, discounted on date of issue at 6%.

4. A depositor placed money as follows in a savings bank, having a 3-months interest term, and allowing 4% interest: Apr. 1, 1900, $250; June 10, $150; July 1, $100; Sept. 1, $100. How much was due him Jan. 1, 1901?

5. Mr. A. paid $3000 for an acre of land 10 rd. wide, through the middle of which he laid out a street 4 rd. wide and 10 rd. long. The two parts were then laid off into 5 equal lots, each of which sold for $550. His expenses were as follows: cost for surveys $50, grading $75, advertising $50, conveyances $50, contingencies $25. Find Mr. A.'s gain, and the size of each lot.

6. When a pole 10 ft. high casts a shadow 8 ft. long, how high is a tree whose shadow at the same time is 60 ft. long?

7. Find the amount of $500 at interest for 7 yr. compounded annually at 4%.

8. What rate of income is realized upon an investment of $3000 in a house and lot renting for $20 a month, out of which is paid $35 tax, $5 insurance, and $20 repairs annually?

9. How many boards, 12 ft. long, 1 ft. wide, must be bought to make 3000 pickets 3 ft. long, 2 in. wide?

MISCELLANEOUS EXERCISES

1. To run a mile, how many times must a boy run around a lot 50 yd. long and 30 yd. wide?

2. If 10 yd. of yard wide cloth make a dress, how many yards of cloth 27 in. wide will be required for the dress?

3. What are the cubical contents of a stone post 10 ft. long and 16 in. square?

4. Divide a line 184 ft. long so that one part shall be three times as long as the other.

5. The sum of A's, B's, and C's money equals $210. A's amount equals one half of B's, and one third of C's. How much money has each?

6. Mary and Anna bought a pony and cart for $125. Mary paid $75 and Anna $50. They afterwards sold both for $200. How much should each receive?

7. If factory stock is 15% below par, what is the market value of 25 shares?

8. In a village having a property valuation of $250000, there was constructed a sewer costing $6250. What was the additional tax rate?

9. How many square feet of sheet iron are there in the sides, top, and bottom of a tank 4 ft. high and 3 ft. in diameter, allowing 2 sq. ft. for seams and waste?

10. Find the cost of plastering the walls and ceiling of a room 15 ft. wide, 18 ft. long, and 10 ft. high above the baseboard, at 24¢ a square yard. No allowances.

11. How many yards of 27-in. carpet will be required for a room 18 ft. long and $15\frac{1}{2}$ ft. wide, when the strips run lengthwise? How much when they run crosswise?

MISCELLANEOUS EXERCISES

1. Find how many double rolls of paper are needed for the walls of the room named in problem **10**, p. 109, allowing 10 strips for door and windows.

2. Estimating two quarts of paint to the square rod, find how many 1-gal. cans are needed to paint the curved surface of a standpipe 65 ft. high and 15 ft. in diameter.

3. How many square feet of siding are there on a barn 60 ft. long, 40 ft. wide, 22 ft. to the eaves, and 40 ft. to the gable?

4. How much lumber is there in a plank 18 ft. long, 18 in. wide, and 2 in. thick? How much is it worth at $30 per M?

5. Find the cost of the following amounts of lumber at $27 per M:

Two 8×10 sticks, each 60 ft. long.
Four 8×10 sticks, each 40 ft. long.
Thirty 2×10 joists, each 14 ft. long.
One hundred fifty 2×4's, each 21 ft. long.

6. How many bushels of wheat can be put into a bin 8 ft. long, 4 ft. wide, and 6 ft. high? (1 bu. = 2150.42 cu. in.)

7. An oil tank 10 ft. high and 10 ft. in diameter will hold how many gallons of oil? (1 gal. = 231 cu. in.)

8. Find the simple interest of $300 for 3 yr. 3 mo. and 3 da. at 8%.

9. What is the amount of a note of $1000 for 1 yr. 5 mo. 20 da. at 5%, compounded semiannually?

10. Find the net proceeds on sale of 800 bu. of wheat at 80¢ a bushel, commission $2\frac{1}{2}$%.

MISCELLANEOUS EXERCISES

1. How many 2×4's 16 ft. long will be needed as stringers for $\frac{1}{2}$ mi. of sidewalk that has a stringer under each side and one under the middle of the walk?

2. How long a strip of carpet 1 yd. wide must be cut from a roll to cover a room 18 ft. $\times$ 20 ft., the strips to run lengthwise?

3. Since there are 640 A. in one section (1 mi. square or 1 sq. mi.) of land, how much is a quarter section worth at \$1000 per acre?

4. At 5¢ a square foot, find the cost of a piece of zinc 8 ft. long and 15 in. wide. Of a piece a yard long and 4 in. wide.

5. At 10¢ a quart, find the cost of 1 bu. 1 pk. 1 qt. 1 pt. of seed. (Find cost of each part separately, then add.)

6. If every quart of wheat sown produces 1 bu. of wheat, how much wheat will be harvested from 1 bu. of sown wheat?

7. How many gallons of paint are there in 12 half-gallon cans, 12 qt. cans, and 24 pt. cans?

8. When a 60-ft. steel rail weighs 1000 lb., how many tons of steel are necessary for each mile of railroad track?

9. How many bushels of wheat can be put into a bin 6 ft. long, 4 ft. wide, and 5 ft. deep?

10. How many yards of ribbon must be purchased for six 32-in. belts?

11. How much lumber is there in a box 6 ft. long and 2 ft. square, outside measure, made of 2-in. plank?

12. How many feet of lumber are there in a 9-in. cubical block?

MISCELLANEOUS EXERCISES

1. Since the sun appears to travel round the earth in 24 hr. (360°), how many degrees does it travel in 1 hr.?

2. Beginning with Jan. 1, by the days of the calendar months, which half of the year is the longer?

3. When telegraph poles are 66 ft. apart and a train passes one every second, what is the speed of the train?

4. Since sound travels at the rate of 1080 ft. a second, how many miles away was a cannon whose roar was heard in 15 sec. after the discharge?

5. When a horseshoe requires 16 in. of bar iron, how many can be made from 10 bars, each 16 ft. long?

6. If from 1 gal. 1 qt. there was sold $\frac{5}{8}$ gal., what part of a gallon remained?

7. The standard bushel contains 2150.42 cu. in. How many bushels of wheat will a bin hold, the dimensions being 10 ft. long, 3 ft. wide, and 5 ft. deep?

8. I wish to divide three tracts of land into fields of the same size, having the largest number of acres possible; the tracts of land contain 280 A., 315 A., and 350 A. respectively. How many acres will each field contain?

9. 2 mo. is what per cent of a year? 8 hr. is what per cent of a day?

10. By selling an article at 10% profit, I gained \$6. What were the cost price and the selling price?

11. What per cent of a man's weekly wages should he receive for 4 days' work?

12. The H. C. F. of 16, 28, and 36 divided by the L. C. M. of 4, 5, and 6 equals what?

13. Reduce $\frac{528}{880}$ to lowest terms, using only one divisor.

ANSWERS

Page 13. — **1.** 1610 A. **2.** 5632 oz. **3.** 8 yr. **4.** 1738627. **5.** 45. **6.** 235 qr.; 61 qr. **7.** 6096 hr. **8.** 759 passengers; 275 children. **9.** $13,806. **10.** $318\frac{1}{8}$ lb. **11.** 18 wk. **12.** 113,760.

Page 16. — **2.** 1728 ft. **3.** 19 pupils. **4.** 18. **5.** 24.

Page 18. — **23.** $33\frac{17}{40}$ mi. **24.** $\frac{17}{24}$ rd.

Page 21. — **1.** $43.25. **2.** $900. **3.** $58\frac{1}{3}$ lb. **4.** $259\frac{1}{5}$. **5.** $54\frac{3}{4}$. **6.** $29\frac{3}{5}$ C. **7.** $\$\frac{13}{14}$. **8.** $1\frac{1}{15}$ yd. **9.** $\$1\frac{21}{200}$. **10.** $365. **11.** 27 pieces. **12.** $6\frac{2}{5}$.

Page 22. — **1.** $\frac{1}{15}$ qt. **2.** $395\frac{173}{420}$ sq. rd. **3.** $1857\frac{5}{6}$ cu. yd. **4.** $54.84. **5.** $3462. **6.** 9¢. **7.** 36 lots. **8.** 179 yd. **9.** 72 A.

Page 30. — **1.** 1152 men. **2.** 8.875. **3.** 24.5165 mi. **4.** 91 yd.; 12 yd. **5.** 79.78 A. **6.** $294.95. **7.** $14.55. **8.** 18 lots. **9.** $1091.35; $291.59. **10.** $7.12. **11.** $14481.38. **12.** 720 rails.

Page 37. — **5.** 44 strings. **6.** $\frac{1}{2}$ mi. **7.** 15 posts. **8.** 440 leaps. **9.** $\frac{3}{5}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$. **10.** $\frac{1}{4}$. **11.** $5\frac{1}{2}$ mi. **12.** $\frac{1}{2}$ mi. **13.** 80 boards.

Page 39 — **1.** 108 sq. in.; 96 sq. in.; 1296 sq. in. **2.** 96 sq. in.; 324 sq. in. **3.** 81 sq. ft.; 9 sq. ft. **4.** 20 sq. yd.; 42 sq. yd. **5.** $4400. **6.** 6 sq. ft.; 30 sq. in. **7.** 5 A. **8.** 1936 sq. yd. **9.** 7 rd. **10.** 80 rd. **11.** $99. **12.** $15. **13.** 5 sq. ft.; 15 sq. ft. **14.** 40 sq. yd.

Page 40. — **3.** 16 sacks. **4.** $9.80. **5.** $15. **6.** 7 qt. **7.** $\frac{1}{2}$, $\frac{1}{8}$ **8.** $\frac{1}{4}$, $\frac{1}{10}$. **9.** 12 qt. **10.** 28 sacks. **11.** 2 pk. 4 qt. **12.** $.75 **13.** $2. **14.** $\frac{1}{4}$, $\frac{1}{4}$.

Page 41. — **7.** $.05. **8.** 15 bottles. **9.** $.48. **10.** $.45. **11.** $\frac{5}{8}$, $\frac{5}{6}$. **12.** $.70. **13.** 5 qt., or 1 gal. 1 qt. **14.** 12 pt.

Page 42. — **4.** $4.25. **5.** 30 bbl. **6.** 720 lb. **7.** $1.12. **8.** $.78. **9.** $9. **10.** 2 lb. 8 oz. **11.** 3 T. **12.** 3920 lb.; 1 T. **13.** 25 bbl.

Page 43. — **1.** 9 yd. **2.** 18 belts. **3.** 20 yd. **4.** 270 sq. ft. **5.** 20 sq. yd. **6.** $9. **7.** 160 sq. yd. **8.** $30.38. **9.** $.40. **10.** 100 bbl. **11.** 24 each. **12.** 64 bottles.

Page 44. —**1.** $7.35. **2.** 2000 gal. **3.** 800 sq. rd.; 5 A. **4.** $3750. **5.** $2722.50. **6.** $34.50. **7.** $12. **8.** $1.65 gain. **9.** $78. **10.** 40 loads. **11.** 640 rolls. **12.** 40 horseshoes. **13.** 24 bales.

Page 45. —**1.** 24 sq. ft. **2.** 9 board ft. **3.** 45 pieces. **4.** 240 board ft.; $4.80. **5.** 8 in. **6.** $1.20. **7.** $3.80 gain. **8.** $36.40. **9.** 3 cows. **10.** $1.25. **11.** $3. **12.** 1 lb. 4 oz.

Page 46. —**2.** 11 bu. 1 pk. 6 qt. 1 pt. **3.** 9 T. 9 cwt. 6 lb. 6 oz. **5.** 32 gal. 2 qt. 1 pt. **6.** 41 gal. 3 qt. 1 pt. **7.** 15 yd. 1 ft. 11 in. **8.** 29 yd. 2 ft. 2 in.

Page 47. —**1.** $1552.78. **2.** $32.81. **3.** 1677 sq. ft. **4.** $1596. **5.** $4440. **6.** $61.11. **7.** $159.29. **8.** $275.35. **9.** $429.84. **10.** $12.20. **11.** $36.97. **12.** $6080. **13.** 744 hr.

Page 48. —**1.** $1.84. **2.** $919.62. **3.** $5923\frac{1}{14}$ sheets. **4.** $10.63. **5.** 44,460 shingles. **6.** 316,800 blocks. **7.** $215.89. **8.** $2124\frac{8}{7}$ cu. yd. **9.** 293,760 cu. in. **10.** $27.42. **11.** 8 ft.; $115.

Page 49. —**1.** $18.40. **2.** $120.60. **3.** 26¢. **4.** $2.42. **5.** $8.50. **6.** $2.83\frac{1}{2}$. **7.** $10.75. **8.** July 3, 1877.

Page 50. —**1.** 64 cu. in. **2.** 24 cu. ft. **3.** 40 cu. yd.

Page 53. —**1.** 24 sq. ft. **2.** 360 sq. ft. **3.** $7.20. **4.** 126 boards, 504 board ft. **5.** $2.40. **6.** 20 sq. ft. **7.** 1800 sq. ft. **8.** $89. **9.** 30 sq. ft. **10.** 12 sq. ft. **11.** $88\frac{3}{4}$ sq. ft.

Page 54. —**2.** $\frac{1}{9}$. **3.** 180′; 30′; 80′. **4.** 3600″; 4215″. **5.** $\frac{1}{8}$.

Page 56. —**1.** 1440 min.; 180 min. **2.** 18 hr. **3.** 7 P.M. **4.** 1 da.

Page 57. —**1.** 8 A. **2.** 104 sq. ft. **3.** $28\frac{1}{8}$ bu. **4.** $5.52. **5.** 54 cu. ft. **6.** 624 cu. ft., $4\frac{7}{8}$ C. **7.** $1900.80. **8.** 96 cu. ft. **9.** 64 rd. **10.** 8 gal. 3 qt. 1 pt. **11.** $7.80. **12.** $25.92. **13.** 75 boxes. **14.** 450 sacks. **15.** 42 A. 30 sq. rd. **16.** 1440 min.

Page 58. —**1.** 17 T. 15 cwt. 95 lb. **2.** 95 sq. rd. **3.** 25,344 steps. **4.** 4752 revolutions. **5.** 162 lb. **6.** 2880 cu. ft. **7.** 3 bu. 3 pk. **8.** 1280 rd. **9.** 2 T. 7 cwt. 25 lb. **10.** 80 rd. **11.** 6 da. **12.** 30 fence pickets.

Page 59. —**1.** 25 yr. **2.** 216 hr. **3.** 15 mi. **4.** $3.75. **5.** $6.66\frac{2}{3}$. **6.** $.81. **7.** 20 A. **8.** 216 cu. ft. **9.** $90; $90. **10.** 300 T. **11.** 12 cans.

Page 61. —**1.** $.37\frac{1}{2}$. **2.** $1.50. **3.** $.87\frac{1}{2}$; $.62\frac{1}{2}$; $.37\frac{1}{2}$; $.12\frac{1}{2}$. **4.** 3 to 1. **5.** $\frac{17}{20}$; $\frac{3}{20}$. **6.** $1\frac{1}{4}$; $2\frac{1}{2}$.

Page 65. —**1.** 30 A. **2.** 240 sheep. **3.** 60%. **4.** $\frac{2}{5}$; 40%. **5.** 4; $6. **6.** 80%; 125%. **7.** 480 bu. **8.** 50%; 50%. **9.** 120 lb. **10.** $9.37\frac{1}{2}$. **11.** $270. **12.** 25% gain; 20% loss. **13.** 20%; 50%. **15.** 300%; 300%. **16.** $12\frac{1}{2}$%

Page 66. — **1.** \$72. **2.** 25%. **3.** \$.10. **4.** 60%. **5.** \$4.20. **6.** 50%. **7.** 4 yd. **8.** 80 cwt. **9.** \$610.94.

Page 67. — **2.** \$157.50. **3.** Former by \$26.25. **4.** \$10. **5.** 150. **6.** \$12. **7.** 28%. **8.** 25%.

Page 69. — **2** \$3075. **3.** \$1650. **4.** \$1700. **5.** \$9700. **6.** (1) 20 yr. insurance free; (2) Gain of \$300; (3) 50 yr. old. **7.** \$9500.

Page 70. — **2.** \$.004; \$14. **3.** 4 mills. **4.** \$4 difference.

Page 71. — **2.** \$6.12½. **4.** \$47.50. **5.** \$4.05.

Page 72. — **1.** \$19.50 commission; \$955.50 proceeds. **2.** \$552. **3.** 800 bu.; \$12. **4.** 123 bbl.; \$46.13.

Page 73. — **1.** ⅛; 12½%. **2.** ⅕; 20%. **3.** ⅕; ⅓. **4.** 144 solids. **5.** 6 gal. 2 qt. 1 pt. **6.** 6 rd. 1 yd. 1 ft. 6 in. **7.** $5\frac{31}{121}$ A. **8.** \$300. **9.** 36 in. by 6 in. **10.** 133 lb. **11.** \$1527.96. **12.** \$28.20. **13.** 16 ft. **14.** 54 cu. ft.

Page 74. — **1.** \$.55. **2.** 2 bu. 3 pk. 5 qt. 1 pt. **3.** \$18. **4.** 800; 400. **5.** 80%. **6.** 1200 trees. **7.** \$150. **8.** 3168 mi. **9.** 1041 mi.+ 15°. **10.** 1836 cu. in. **11.** \$365. **12.** 352 yd. and 528 yd. **13.** 2000; 5.

Page 75. — **1.** 25%. **2.** 20%. **3.** 50%; 50%. **4.** 25%; 25%. **5.** 50%. **6.** 35%. **7.** \$7500. **8.** \$5000. **9.** \$450. **10.** \$1.33⅓. **11** 20%. **12.** 100; 60. **13.** 30%; 25%.

Page 76. — **2.** \$55.50. **3.** \$120. **4.** 24 men. **5.** 24 hats. **6.** \$1.84.

Page 79. — **1.** 12; 24. **2.** 18¢; 6¢. **3.** 81 marbles; 27 marbles. **4.** 264 lb.; 132 lb. **5.** 4. **6.** 6 sheep. **7.** \$85; ¢17. **8.** 35 yr.; 7 yr. **9.** 8 mi.; 16 mi.; 24 mi. **10.** \$13; \$26; \$39. **11.** \$60; \$20; \$4.

Page 80. — **2.** 3. **3.** 11. **4.** James, 15 marbles; John, 22 marbles. **5.** A, 24 yr.; B, 19 yr. **6.** Son, \$1600; daughter, \$1100. **7.** 10 yd by 15 yd. **8.** A, 24 yr.; B, 16 yr.

Page 81. — **2.** \$26.87½. **3.** \$146.08¾. **4.** \$508.95. **5.** \$1398.33⅓. **6.** \$1080.71⅔.

Page 82. — **3.** \$38.95½. **4.** \$9.0625.

Page 83. — **1.** \$10. **2.** \$3.75. **3.** \$3.75. **4.** \$1. **5.** \$36. **6.** \$35. **7.** \$5. **8.** \$6. **10.** \$32.625. **11.** \$60.60. **12.** \$1275. **14.** \$4935.44. **15.** \$309.55.

Page 84. — **1.** 30 and 35. **2.** \$60 and \$90. **3.** ⅗. **4.** 6 da. **5.** (*a*) 9; (*b*) ½. **6.** 8 and 8; 4 : 8 = 8 : 16. **7.** 12 rd. by 12 rd **8.** 20 men. **9.** 20 ft. and 15 ft. **10.** 12 and 28. **11.** 12. **12.** 30 mi.

Page 86. — **1.** $801.71. **2.** $12.75. **4.** $126. **5.** $254.28. **7.** $1000.

Page 38. — **2.** $788.12½. **3.** $139.09. **4.** $61.36.

Page 93. — **1.** $2157.04. **2.** $1024.47. **3.** $132.82. **4.** $1573.30. **5.** $.80.

Page 94. — **2.** A, $120; B, $200; C, $280. **3.** A, $4500; B, $3000. **4.** A, $6000; M, $4800; Z, $1200.

Page 96. — **1.** $10312.50. **2.** $122.50. **3.** $325. **4.** $1081.25. **6.** 4%.

Page 99. — **2.** 50 rd. **3.** 22½ sq. ft. **4.** 560 sq. ft. **5.** 24.3 ft. **6.** 94.248 yd. **7.** 33.51 + yd. **8.** 672 + revolutions.

Page 100. — **1.** 76 sq. yd. **2.** $52.50. **3.** 39.09 + sq. yd.

Page 101. — **2.** 44 rolls. **3.** 18 rolls. **4.** 38 rolls. PAINTING: **1.** 286 sq. yd. **2.** 19 gal. cans. FLOORING: **1.** 1440 linear ft. **2.** 540 linear ft. LATHS: **1.** 21 bundles.

Page 102. — **1.** 87 bundles. **2.** $72. CARPETING: **1.** 38 yd. **2.** $38.58. **3.** $83.

Page 103. — **1.** 3960 bricks. **2.** 48.48 + perches. **3.** $85.54. **4.** $609.84. **5.** 8800 bricks. **6.** 193.93 + perches. **7.** 58.18 + perches.

Page 105. — **1.** 6%. **2.** $136.

Page 106. — **1.** 5940 ft. **2.** $1.29. **3.** $4.25. **4.** ¾. **5.** 9. **6.** $94.81. **7.** $1.25. **8.** $18.21. **9.** $22400. **10.** $1.61. **11.** 1 lb. 4 oz. **12.** $\frac{2}{3}$, $\frac{1}{2}$, $\frac{2}{4}$. **13.** ¼. **14.** $2.50.

Page 107. — **1.** 1 gal. 3 qt. 1 pt. **3.** 2.68 ft. **4.** 15 ft. **5.** 25 C. **6.** 176 steps. **7.** $4200. **8.** 150 bbl. **9.** $3. **10.** $.51. **11.** 1020 bu.; $16.32 commission. **12.** $14.40. **13.** $180.

Page 108. — **1.** 600 lb. **2.** $400. **3.** $1495.97. **4.** $613.60. **5.** $2250; 33 ft. by 99 ft. **6.** 75 ft. **7.** $657.96. **8.** 6%. **9.** 125 boards.

Page 109. — **1.** 11 times. **2.** 13¾ yd. **3.** 17.77 cu. ft. **4.** 46 ft. and 138 ft. **5.** A's, $35; B's, $70; C's, $105. **6.** Mary, $120; Anna, $80. **7.** $2125. **8.** 2½%. **9.** 53.836 sq. ft. **10.** $24.80 **11.** 42 yd. lengthwise; 41⅓ yd. crosswise.

Page 110. — **1.** 8 double rolls, 1 single roll. **2.** 6 cans. **3.** 5120 sq. ft. **4.** 54 ft.; $1.62. **5.** $126. **6.** 154.28 bu. **7.** 5875.2 gal. **8.** $78.20. **9.** $1075.43. **10.** $624.

Page 111. — **1.** 495. **2.** 120 ft. **3.** $160,000. **4.** $.50; $.05. **5.** $4.15. **6.** 32 bu. **7.** 12 gal. **8.** 88 T. **9.** 96.42 bu. **10.** $5\frac{1}{8}$ yd. **11.** $99\frac{1}{9}$ ft. **12.** $5\frac{1}{16}$ ft.

Page 112. — **1.** 15°. **2.** Latter. **3.** 45 mi. per hour. **4.** $3\frac{3}{4}\frac{3}{4}$ mi. **5.** 120 horseshoes. **6.** $\frac{5}{8}$ gal. **7.** 120.5 bu. **8.** 35 A. **9.** $16\frac{2}{3}\%$; $33\frac{1}{3}\%$. **10.** $60 C. P.; $66 S. P. **11.** $66\frac{2}{3}\%$. **12.** $\frac{1}{15}$. **13.** $\frac{3}{5}$.