Introduction to Ratios & Proportions

A ratio is a comparison of two numbers. If an automotive manufacturer had 3,000 useable parts and 150 scrap parts, the ratio for useable to scrap parts is 3,000 to 150. Ratios can be written in three forms:

- 3,000 to 150
- 3,000:150
- \( \frac{3,000}{150} \)

You should always reduce ratios to their lowest terms. The above example would be reduced to:

- 20 to 1
- 20:1
- \( \frac{20}{1} \)

Find the lowest terms for the following ratios:

1) \( \frac{12}{18} = \) _____  
2) \( \frac{8}{16} = \) _____  
3) \( \frac{15}{3} = \) _____  
4) \( \frac{18}{24} = \) _____  
5) 2 to 10 = _____  
6) 3.5:7 = _____

Write a ratio for the following:

A) as a fraction  
B) using the : symbol

1) 5 eggs out of a dozen  
2) 3 cigarettes from a pack of 20  
3) 17 minutes left in an hour  
4) 6 rolls from a bakers’ dozen (13)  
5) 1 of a pair  
6) 4 days in one week  
7) 2 students in a class of 11  
8) 7 days in a leap year February  
9) 1 foot from a yard  
10) 243 days in a year

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A proportion is two ratios that are equal to each other

Do not reduce answers

Proportions can be written in symbols in various ways:

1) as equal fractions, \( \frac{2}{16} = \frac{4}{32} \)

2) with colons and equal signs, 2:16 = 4:32

3) with colons and double colons, 2:16 :: 4:32

All of the above are read as two equal ratios connected by the word \( \text{as} \): 2 is to 16 \( \text{as} \) 4 is to 32.

Write the following

<table>
<thead>
<tr>
<th>Write the following</th>
<th>A) as two equal fractions</th>
<th>B) using : and ::</th>
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<tbody>
<tr>
<td>1) 5 is to 10 as 15 is to 30</td>
<td>( \frac{5}{10} = \frac{15}{30} )</td>
<td>(5 : 10 = 15 : 30)</td>
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<td>2) 14 is to twenty as 7 is to ten</td>
<td>( \frac{14}{20} = \frac{7}{10} )</td>
<td>(14 : 20 = 7 : 10)</td>
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<td>3) Five is to two as twenty-five is to ten</td>
<td>( \frac{5}{2} = \frac{25}{10} )</td>
<td>(5 : 2 = 25 : 10)</td>
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<td>4) Nine is to three as twelve is to four</td>
<td>( \frac{9}{3} = \frac{12}{4} )</td>
<td>(9 : 3 = 12 : 4)</td>
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<td>5) 30 is to 75 as 2 is to 5</td>
<td>( \frac{30}{75} = \frac{2}{5} )</td>
<td>(30 : 75 = 2 : 5)</td>
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<td>6) 20 is to 40 as 60 is to 120</td>
<td>( \frac{20}{40} = \frac{60}{120} )</td>
<td>(20 : 40 = 60 : 120)</td>
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<td>7) 99 is to one as 990 is to ten</td>
<td>( \frac{99}{1} = \frac{990}{10} )</td>
<td>(99 : 1 = 990 : 10)</td>
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<td>8) 12 is to 18 as 44 is to 66</td>
<td>( \frac{12}{18} = \frac{44}{66} )</td>
<td>(12 : 18 = 44 : 66)</td>
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<tr>
<td>9) One is to three as seventeen is to fifty-one</td>
<td>( \frac{1}{3} = \frac{17}{51} )</td>
<td>(1 : 3 = 17 : 51)</td>
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<tr>
<td>10) Seven is to 21 as nine is to 27</td>
<td>( \frac{7}{21} = \frac{9}{27} )</td>
<td>(7 : 21 = 9 : 27)</td>
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To test whether or not two ratios are equal, cross multiply. The products will be the same if the ratios are equal.

Example 1) \( \frac{2}{16} = \frac{4}{32} \) 2 \( \times \) 32 = 64 and 4 \( \times \) 16 = 64 Therefore these fractions form a proportion.
When written with colons, multiply the two inside numbers together and multiply the two outside numbers together. The results will be the same.

Example 2) 2:16 = 4:32 16 times 4 = 64 and 2 times 32 = 64. Therefore these form a proportion.

Example 3) 2:16 :: 4:32 same as above

Math problems ask you to find the missing number in a proportion. To solve these problems

Step 1) Leave a space for the missing number in the proportion.

Step 2) Multiply whichever 2 numbers are available (cross multiply if a fraction or multiply either the inside or outside pair if written with colons)

Step 3) Divide by the only remaining number

Step 4) Place your answer in the empty space

Step 5) Check your answer

Example A:  \[ \frac{4}{6} = \frac{8}{x} \]

Step 1) \[ \frac{6}{8} \]

Step 2) Multiply: 6 times 4 = 24

Step 3) Divide by 8: 24 divided by 8 = 3

Step 4) Write 3 in the empty space: \[ \frac{3}{4} = \frac{6}{8} \]

Step 5) To check your answer, cross multiply: 3 x 8 = 24 4 x 6 = 24

Example B: 7:3 :: 28 : ___

Step 2) Multiply the two inner numbers: 3 times 28 = 84 (you only have one of the two outer numbers in this problem)

Step 3) Divide by 7: 84 divided by 7=12

Step 4) Write 12 in the empty space: 7 : 3 :: 28 : 12

Step 5) To check your answer, multiply the 2 inner numbers and the 2 outer numbers: 3 x 28 = 84 7 x 12 = 84
Find the missing number in the proportion exercises below

1) \( \frac{6}{7} = \frac{14}{?} \)  
2) \( \frac{3}{8} = \frac{24}{?} \)  
3) \( \frac{9}{5} = \frac{?}{15} \)  
4) \( \frac{3}{?} = \frac{24}{72} \)

5) \( \frac{9}{6} = \frac{?}{2} \)  
6) \( \frac{1}{4} = \frac{4}{12} \)  
7) \( \frac{?}{6.5} = \frac{5}{13} \)  
8) \( \frac{1.3}{2} = \frac{2.6}{?} \)

9) ____:7::3:21  
10) 6::__:16:8  
11) 7:21::__:9  
12) 14:7::__:5

13) 3:5::6:____  
14) ____:4::18:12

Use the same method to find solutions to these more difficult problems

15) \( \frac{7}{?} = \frac{17.5}{20} \)  
16) \( \frac{.7}{1.75} = \frac{?}{5.25} \)  
17) \( \frac{?}{3} = \frac{34}{51} \)

18) 108::__:27:3  
19) .2:9::1::____  
20) 2:17::__:119

Extra Challenge

21) 42::__:\( \frac{1}{2} \)::\( \frac{1}{8} \)  
22) \( \frac{1}{4} : \frac{1}{5} :: 25::____ \)  
23) 256:64::\( \frac{1}{9} ::____ \)
USING PROPORTION TO SOLVE PERCENTAGE PROBLEMS

A percentage is a part of 100. A completed percentage problem will give one number as a % of another. One way to solve % problems is to work with them in fraction form set up as a proportion. Put the number that is the part over the number that is the whole on the left of the = sign followed by the number that is given as the % over 100.

% problems contain only 2 numbers which you must put in their proper places, and ALWAYS use 100 as the last denominator or number. Then cross multiply and divide as for any proportion problem.

Hint: read a problem as: a part is what % of a whole

\[
\begin{array}{c|c}
\text{Part} & \% \\
\hline
\text{Whole} & 100
\end{array}
\]

Step 1) Determine what you’re solving for and leave it blank
Step 2) Fill in the other 2 numbers
Step 3) Cross multiply the 2 diagonal numbers
Step 4) Divide by the number you haven’t used yet
Step 5) Fill in the answer

To set up proportion problems using the : and :: follow the same procedure:

Step 1) Determine what you’re solving for and leave that space blank
Step 2) Fill in the information you have, in this order-- part : whole :: number of % : 100
Step 3) Multiply the two inner or the two outer numbers, whichever you have
Step 4) Divide by the number you haven’t used yet
Step 5) Fill in the answer

To determine which number goes where, look for these keys—the word is, the word of, and the %. In a proportion, the part is some % of the whole. (Usually the part is smaller than the whole)
Finding the Percentage One Number is of Another

You are solving for % so leave the percent space empty

May be written as 3 correct answers out of 4 problems is what %?   Or 3 is what % of 4? or what % of 4 is 3?

Choose the set up that works best for you.

Set-up A: \( \frac{3}{4} = \frac{\_}{100} \)
\[
3 \times 100 = 300 \quad \text{and} \quad 300 \div 4 = 75 \quad \text{Answer: } 75
\]

Set-up B: \( 3:4::\_::100 \)
\[
3 \times 100 = 300 \quad \text{and} \quad 300 \div 4 = 75 \quad \text{Answer: } 75
\]

Set-up C: \( \frac{3}{4} = \frac{\_}{100} \)
\[
4 \times 25 = 100 \quad \text{and} \quad 3 \times 25 = 75 \quad \text{Answer: } 75
\]

Find the percentage for the following problems

1) 65 is what % of 100? _____ 2) ___ % of 24 is 6.

3) What % of 20 is 11? _____ 4) $21 is what % of $50.00?______

5) 4320 is what % of 9000?_______ 6) What % of 60 is 18? ______

7) What % of 540 is 135? _______ 8) 39 is what % of 75? _______

9) 3 is what % of 8? ________ 10) ___% of 10 is .5.

11) ___% of $180,000 is $2,700? 12) $4.20 is what % of $35.00? ______

13) At Dusty Mortar Concrete Company 84 of the 105 employees work in the field. What % is this?

14) One day 35 of those 105 worked overtime. What percentage worked overtime that day?

15) Of the 40 women employed by Dusty Mortar Company, 15 are white. What % is this?
For these problems, remember to include the percent sign (%) as part of your answer.

Finding a Number When a Percentage of it is Known

You are solving for the whole so leave the whole space empty

May be written as 50% of what number is 20? or 20 is 50% of what number?

Choose the set up that works best for you.

Set-up A: \[ \frac{20}{50} = \frac{x}{100} \]

Set-up B: 20:___::50:100

Set-up C: \[ \frac{20}{50} = \frac{x}{100} \]

Find the missing number for the following problems

1) 14 is 50% of what number? _____
2) 6 is 16% of what number? _____

3) 45 is 4% of what number? _____
4) 12% of what number is 3? _____

5) 27 is 75% of what number? _____
6) 30% of what number is 120? _____

7) 160 is 50% of what number? _____
8) 27% of what number is 54? _____

9) 910 is 13% of what number? _____
10) 48% of what number is 8.64? _____

11) .45 is 3% of what number? _____
12) 1.5% of what number is $3.00? _____

13) SparksALot's secretary spent $12.50 on a year's subscription to Electrical News. This was 40% of the newsstand price. What would be the yearly cost of buying the magazine at the newsstand?

14) Eight Hispanic women work for SAL. This is 25% of the total female workforce at the company. How many women does SAL employ?
15) 27 SAL employees attended a meeting. If this is 90% of the total African-Americans employed by the company, how many African-Americans work there?

Finding the number that is some % of a Given Number

You are asked to find the number that is a % of another so leave the part space empty

May be written as 10% of 50 =, 10% of 50 is, What is 10% if 50?, or Find 10% of 50.

Choose the set up that works best for you.

Set-up A: \[ \frac{50}{100} = \frac{10}{100} \]

Set-up B: \[ \frac{\text{?}}{50} = \frac{10}{100} \]

Set-up C: \[ \frac{10}{50} = \frac{10}{100} \]

Find the number that is a percent of another number

1) Find 20% of 90.______
2) 100% of 87 is _____
3) 9% of $345 = _____
4) What is 15% of $68? _____
5) Find 25% of 48.______
6) 40% of 20 = _____
7) 4% of $70 = _____
8) Find 1% of 8.______
9) What is 9.5% of $8,000? _____
10) 3.5% of 160,000 is ______
11) .5% of 8,000 is _____
12) Find 26.5% of 76._____
13) What is 2.5% of $66.00? _____
14) There are 8,100 employees at Fly By Nite Construction Company. 12% use computers daily. How many employees use computers daily?

15) Of these 8,100 employees, 25% of them are absent any given day. How many is that?

More Challenging:

Some percentage problems may be written as mixed number percentages. Solve these the same way you do any other: place the numbers in their correct spaces and do the math. You may work them as fraction problems (changing mixed numbers into improper fractions) or use decimal equivalents instead of the fractions (and round off when necessary).

Work the problems below using fractions and then using decimals and see which method is faster.

1) \(33 \frac{1}{3}\)% of what number is 50? ______ 2) $18 is \(66 \frac{2}{3}\)% of what number? ______

3) What is \(83 \frac{1}{3}\)% of 180? ______ 4) \(16 \frac{2}{3}\)% of what number is 300? ______

5) \(8 \frac{1}{2}\)% of what number is 119? ______ 6) What is \(8 \frac{1}{2}\)% of 1200? ______

7) $210 is \(87 \frac{1}{2}\)% of what number? ______ 8) \(33 \frac{1}{3}\)% of what number is 320? ______

9) What is \(12 \frac{1}{2}\)% of 640? ______ 10) $876 is \(83 \frac{1}{3}\)% of what number? ______

11) 320 is \(12 \frac{1}{2}\)% of what number? ______ 12) What is \(37 \frac{1}{2}\)% of 64? ______

You can answer these questions more easily if you have memorized decimal equivalents of common fractions:

13) What % of 16 is 1? ______ 14) $7 is ____% of $16

15) 7 out of 8 is ____%? 16) What % of 16 is 5? ______

17) $15 is what % of $16? ______ 18) 1 is what % of 8? ______
19) What % of 16 is 9? _____

20) ____% of 8 is 5? _____

21) $6 is ____% of $8?

22) 13 out of 26 is ____%?

23) There are 16 students in shop class, three are female. What is the % of females in class?

24) In a hallway containing 6 doors, 5 doors open outward. What percentage open outward?

PRACTICE IDENTIFYING WHAT YOU ARE SOLVING FOR: WHOLE, PART OR %

Write your answer as W (whole), P (part), or % (percent)

1) What is ABC % of XYZ? ________

2) ZQP is IEO % of what? ________

3) AEI is what percent of RST? ________

4) What is MLH % of JLV? ________

5) MLV% of what is HRV? ________

6) TTT is what percent of SSS? ______

7) What is GCS % of MBB? ________

8) BBB% of what is WWB? _______

9) OUY is what % of EFG? ________

10) What is LMN% of OPQ? _______

11) CDE% of what is FGH? ________

12) MRV is what percent of SHB? _______

13) BBM% of BMW is what? ________

14) VWB% of what is TMZ? _______

15) UPN is what percent of MTV? ________

16) TCM% of what is HBO? _______

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RATIO, PROPORTION AND PERCENTAGE REVIEW PROBLEMS

Write as a ratio

A. using fraction form  B. using : form

1) 1 inch on a map to 25 miles
2) Reading 4 pages in 5 minutes
3) 2 quarts of cleaner to 5 quarts of water
4) 25 miles per gallon

Solve these problems

5) \( \frac{108}{12} = \frac{27}{9} \)  
6) \( \frac{2}{51} = \frac{34}{58} \)  
7) \( \frac{24}{6} = \frac{4}{1} \)

8) \( \frac{27}{54} = \frac{90}{180} \)  
9) \( \frac{162}{27} = \frac{58}{18} \)  
10) \( \frac{7}{1500} = \frac{21}{4500} \)

11) If a plane flies 932 miles in 2 hours, how long will it take to fly 3262 miles?

12) Joyce used 33 gallons of gas to drive 1000 miles. How much would she use to drive 250 miles?

13) How much would it have snowed in 18 days if it snowed 44 inches in 66 days?

14) 16:____::40:200  
15) 17:51::____:3  
16) 26:____::390:15

17) 65% of $850 is _____
18) 45 is 15% of _____
19) 32 is _____% of 96

20) 28 is 25% of _____
21) _____% of 600 is 426
22) 12% of $81 is _____

23) 8% of ____ is 40
24) 30 is ____% of 75
25) Find 82% of 45 _____

26) Find 20% of 4 _____
27) $24 is ____% of $40
28) 15% of _____ is 75

29) .3% of 500 is _____
30) 7.7 is 14% of _____
31) _____% of 75 is .375
32) Brenda made a down payment of $440 on a used truck that cost $3,520. What % is this?

33) 160 employees eat lunch from the catering truck daily. If this is 80% of the employees, how many people work there?

34) Alice earns $2,500 a month. If she gets an 8% raise, how much more would she make?

35) What would Alice’s new income be?

Extra challenge

36) 150% of ____ is 105   
37) 180 is ____ % of 120?  
38) Find 300% of 125 ____

39) 120% of $30 is _____   
40) 125% of ____ is 20   
41) 27 is ____% of 18

42) 150% of $92 is ______
Answer Key Ratio and Proportion

Page 1

1) 2:3  2) 1:2  3) 5 1  4) 3 4  5) 1 to 5  6) 1:2

1A) 5 12  2A) 3 20  3A) 17 60  4A) 6 13  5A) 1 2  6A) 4 7

1B) 5:12  2B) 3:20  3B) 17:60  4B) 6:13  5B) 1:2  6B) 4:7

7A) 2 11  8A) 7 29  9A) 1 3  10A) 243 365

7B) 2:11  8B) 7:29  9B) 1:3  10B) 243:365

Page 2

1A) 5 10 = 15 30  2A) 14 20 = 7 10  3A) 5 2 = 25 10  4A) 9 3 = 12 4

1B) 5:10::15:30  2B) 14:20::7:10  3B) 5:2::25:10  4B) 9:3::12:4

5A) 30 75 = 2 5  6A) 20 40 = 60 120  7A) 99 1 = 990 10  8A) 12 18 = 44 66

5B) 30:75::2:5  6B) 20:40::60:120  7B) 99:1::990:10  8B) 12:18::44:66

9A) 1 3 = 17 51  9B) 1:3::17:51  10A) 7 21 = 9 27  10B) 7:21::9:27
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<tbody>
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<td>1</td>
<td>18</td>
<td>2</td>
<td>87</td>
<td>3</td>
<td>$31.05$</td>
<td>4</td>
<td>$10.20$</td>
<td>5</td>
<td>12</td>
<td>6</td>
<td>8</td>
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<td>7</td>
<td>$2.80$</td>
<td>8</td>
<td>.08</td>
<td>9</td>
<td>$760$</td>
<td>10</td>
<td>5,600</td>
<td>11</td>
<td>40</td>
<td>12</td>
<td>20.14</td>
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<tr>
<td>13</td>
<td>$1.65$</td>
<td>14</td>
<td>972 employees</td>
<td>15</td>
<td>2,025 employees</td>
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*Chicago Women in Trades*  
... Established in 1981  
www.CHICAGOWOMENINTRADES.org
Page 9
1) 150  2) $ 27  3) 150  4) 1,800  5) 1,400  6) 102
7) $ 240  8) 960  9) 80  10) $1,051.20  11) 2,560
12) 24  13) 6.25% or 6 $\frac{1}{4}$\%  14) 43.75% or 43 $\frac{3}{4}$\%  15) 87.5% or 87 $\frac{1}{2}$\%
16) 31.25% or 31 $\frac{1}{4}$\%  17) 93.75% or 93 $\frac{3}{4}$\%  18) 12.5% or 12 $\frac{1}{2}$\%
19) 56.25% or 56 $\frac{1}{4}$\%  20) 62.5% or 62 $\frac{1}{2}$\%  21) 75%
22) 50%  23) 18.75% or 18 $\frac{3}{4}$\%  24) 83.33% or 83 $\frac{1}{3}$\%

Page 10
1) P  2) W  3) %  4) P  5) W  6) %  7) P  8) W

Page 10 & 11 Review Problems

1) $\frac{1}{25}$ and 1:25  2) $\frac{4}{5}$ and 4:5  3) $\frac{2}{5}$ and 2:5  4) $\frac{25}{1}$ and 25:1
5) $\frac{27}{3}$  6) $\frac{2}{3}$  7) $\frac{4}{1}$  8) $\frac{45}{90}$
9) $\frac{348}{58}$  10) $\frac{7}{500}$  11) 7 hours  12) $\frac{8\frac{1}{4}}{1}$ gal. or 8.25 gal
13) 12"  14) 80  15) 1  16) 1
17) $552.50  18) 300  19) 33.33% or 33 $\frac{1}{3}$\%  20) 112
21) 71%  22) $9.72  23) 500  24) 40%
25) 36.9  26) .8  27) 60%  28) 500
29) 1.5 or 1 $\frac{1}{2}$  30) 55  31) .5% or $\frac{1}{2}$\%  32) 12.5% or 12 $\frac{1}{2}$\%
33) 200 people
34) $200
35) $2,700
36) 70

37) 150%
38) 375
39) $36
40) 16

41) 150%
42) $138