

Ratios, Rates, Proportions, and Percent

A **ratio** is a comparison of two quantities. It can be written in words, with a colon separating the numbers, or as a fraction.

Example of Ratios:

- 3 cups flour to 2 cups sugar in a cake recipe
 - Ratio Form: 3:2
 - Fraction Form: $\frac{3}{2}$
- 17 men to 19 women in a class
 - Ratio Form: 17:19
 - Fraction Form: $\frac{17}{19}$
- 30 cm height to 52 cm width on a computer monitor
 - Ratio Form: 30:52
 - Fraction Form: $\frac{30}{52}$
- \$120 for 8 hours of work
 - Ratio Form: 120:8
 - Fraction Form: $\frac{120}{8}$

In the last two examples, we have fractions that can be reduced to simplest form. In particular,

$$\frac{\$120}{8 \text{ hours}} = \frac{\$15}{1 \text{ hour}}$$

This reduced ratio is called a “**rate**,” since the denominator is equal to 1, and we state it as “\$15 per hour”.

Example of Rates

- **Rate of Speed:** 65 miles per hour

- Fraction Form: $\frac{65 \text{ miles}}{1 \text{ hour}}$
- **Drainage rate:** 32 gallons per minute
 - Fraction Form: $\frac{32 \text{ gallons}}{1 \text{ minute}}$
- **Per capita income:** \$10,500 per person
 - Fraction Form: $\frac{\$10,500}{1 \text{ person}}$
- **Fuel efficiency:** 29 miles per gallon
 - Fraction Form: $\frac{29 \text{ miles}}{1 \text{ gallon}}$

A **proportion** is an equation that has just one ratio on each side: $\frac{a}{b} = \frac{c}{d}$.

If three of the four numbers in a proportion are known, the fourth value can be found using the Multiplication Property of Equality. For practice, see [Solve Proportions](#).

A **percent** is another way of writing the ratio of a portion (of something) to the whole (of that thing). The word “percent” means “out of 100,” so we can always write a percent as a fraction with 100 in the denominator.

Examples of Percent:

- 75% of the questions on a test are correct
 - Fractions Form: $\frac{75}{100} = \frac{3}{4}$
 - Decimal Form: 0.75
- 20.8% of the population smokes tobacco
 - Fractions Form: $\frac{20.8}{100}$
 - Decimal Form: 0.208
- A certain surgery has a 98% success rate
 - Fraction Form: $\frac{98}{100}$

- Decimal Form: 0.98
- There is a 40% chance of rain
 - Fraction Form: $\frac{40}{100} = \frac{2}{5}$
 - Decimal Form: $0.40 = 0.4$

In basic percent problems, we must determine one of three quantities—the percent, P , the “base” (whole thing), B , or the “amount” (a portion of the base), A . These three quantities are related by the formula:

$$A = P \cdot B$$

In this formula, write P in fraction or decimal form.

To practice using this formula, go to [Solve Percent Problems](#). Then complete these problems.

Solve for n : $\frac{25}{n} = \frac{40}{48}$

15 is what percent of 120?

You bike 35 miles in 2 hours. What is your rate of speed?

Sam spends 24% of his salary of \$30,000 on housing. What is his housing cost?

The links included here will take the reader to OpenStax [Elementary Algebra](#), which is published under a Creative Commons Attribution License 4.0. Download for free at <http://cnx.org/contents/0889907c-f0ef-496a-bcb8-2a5bb121717f@8.17>.

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