

FACTOR-LABEL METHOD

also known as *Dimensional Analysis*

The **factor-label method** is a problem solving technique using units (labels) and conversion factors. **Units** tell us the type of measurement being made; for example, "5.2 cm" has a unit (cm) which tells us the measurement to be made is length. **Conversion factors** (also known as "equalities") are fractions that relate two kinds of units; for example, "6.0 cm / s" tells us that for every 1 second that passes (time), 6.0 cm are covered (length). Notice that "6.0 cm s⁻¹" is the same as "6.0 cm / s" in unit notation.

Most problems ask a question whose answer is a number with its unit. Problems also give information that contains numbers with their units. Multiply the information by conversion factors so that all units cancel *except* the units needed in the answer. (A unit in the numerator may be cancelled by placing the same unit in the denominator of the neighboring conversion factor. Conversely, a unit in the denominator may be cancelled by placing the same unit in the numerator of the neighboring conversion factor.)

- Numbers and units are considered separately.
- Multiply by as many conversion factors as necessary.
- Common conversion factors may or may not be supplied with the problem.

Examples:

1. How many hours are in 6 days?

$$6 \text{ days} * \frac{24 \text{ hours}}{1 \text{ day}} = 144 \text{ hours}$$

2. How many seconds are in 5 hours?

$$5 \text{ hours} * \frac{60 \text{ minutes}}{1 \text{ hour}} * \frac{60 \text{ seconds}}{1 \text{ minute}} = 18,000 \text{ seconds}$$

3. How many feet per second is 5 miles per hour?

$$\frac{5 \text{ miles}}{1 \text{ hour}} * \frac{1 \text{ hours}}{60 \text{ minutes}} * \frac{1 \text{ minute}}{60 \text{ seconds}} * \frac{5280 \text{ feet}}{1 \text{ mile}} = 7.3 \frac{\text{feet}}{\text{second}}$$

A common **variation** occurs when more than one piece of information is provided with the problem. In these cases, start with the information that contains the same type of units as the answer. (For example, if length units are needed in the numerator of the answer, use the information that contains length units and arrange it so that those length units are in the numerator.) Next, multiply by conversion factors so that unwanted units cancel.

Test Yourself:

1. How many gallons of milk does a family drink in 5 days if they drink 4 pints per day? *Answer:* 2.5 gallons
2. How many minutes will it take an automobile traveling 60 miles per hour to travel a distance of 400 miles? *Answer:* 400 minutes