Factor-Label Method for Converting Units

A very useful method of converting one unit to an equivalent unit is called the factor-label method of unit conversion. You may be given the speed of an object as 25 km/h and wish to express it in m/s. To make this conversion, you must change km to m and h to s. In algebra, you learned that if a quantity is multiplied by 1, its value does not change. But 1 is just a quantity divided by its equivalent. Since 1000 m = 1 km and 60 s = 1 min and 60 min = 1 h,

$$\frac{1000\text{ m}}{1\text{ km}} = 1 \qquad \frac{1\text{ min}}{60\text{ s}} = 1 \qquad \frac{1\text{ h}}{60\text{ min}} = 1$$

To change 25 km/h to m/s, you must multiply by a series of factors so that the units you do not want will cancel out and the units you want will remain.

$$\frac{25\ \text{km}}{1\ \text{hr}} \left| \frac{1000\text{ m}}{1\ \text{km}} \right| \frac{1\ \text{hr}}{60\ \text{min}} \left| \frac{1\ \text{min}}{60\text{ s}} \right| = 69\text{ m/s}$$

To convert 80 milliliters to liters, first choose the factor. Since 1 L = 1000 mL,

$$\frac{1\text{ L}}{1000\text{ mL}} = 1$$

Use this factor for your conversion as follows.

$$\frac{80\ \text{mL}}{} \left| \frac{1\text{ L}}{1000\ \text{mL}} \right| = 0.08\text{ L}$$

Problems

Carry out the following conversions using the factor-label method.

1. How many seconds are in a year?

   3.1558×10^7 s/yr (based on 365.25 days/year)

2. Convert 28 km to cm.

   2.8×10^6 cm

3. Convert 50 g to kg.

   .05 Kg

4. Convert 45 kg to mg.

   4.5×10^7 mg

5. Convert 450 m/s to m/h.

   1.6×10^6 m/hr

6. Convert 50 liters to mL.

   50,000 ml or 5×10^4 ml

7. Convert 85 cm/min to m/s.

   1.4×10^{-2} m/s

8. Convert the speed of light, 3.0×10^8 m/s, to km/day.

   2.6×10^{10} Km/day