Factor Label Method

Aim

- to convert from one unit to another by unit analysis

Notes

Creating factors from definitions

- The relationship between two units is based on a definition.
  - Examples
    - 1 km = 1,000 m
    - 1 L = 1,000 cm^3
- A factor is a number derived from the definition that is equal to 1
  - Each definition has two factors derived as follows:
    - divide both sides of the definition equation by the value on the left side of the equation causing the values on the left to cancel resulting in 1
      - Examples
        - $\frac{1km}{1{,}000m} = 1$
        - $\frac{1L}{1{,}000cm^3} = 1$
    - divide both sides of the definition equation by the value on the right side of the equation causing the values on the right to cancel resulting in 1
      - Examples
        - $1 = \frac{1{,}000m}{1km}$
        - $1 = \frac{1{,}000cm^3}{1L}$

Using factors for unit analysis

- Multiplying a value by a factor is the same as multiplying by 1
- A factor is selected such that the original units cancel and the desired unit is obtained
  - Example

How many cubic centimeters are in 0.04 *L*?

Step 1: Calculate the factors

$$\frac{1L}{1{,}000cm^3} = 1 \quad or \quad 1 = \frac{1{,}000cm^3}{1L}$$

Step 2: Multiply by the factor that causes the original unit to cancel

$$0.04\ L \times \frac{1{,}000cm^3}{1L} = 40\ cm^3$$

Answer the questions below by circling the number of the correct response

1. Which of the following conversions could be used to determine the number of μL in 1.25L?

   (1) $1.25L \times \frac{1\mu L}{0.000001L}$ (3) $1.25L \times \frac{0.000001L}{1\mu L}$

   (2) $0.000001L \times \frac{1\mu L}{1.25L}$ (4) $1\mu L \times \frac{0.000001L}{1.25L}$

2. Based on the fact that the density of water is 1 g/mL, what does the following expression show?

   $$3.0L \times \frac{1{,}000mL}{1L} \times \frac{1g}{1mL} \times \frac{1kg}{1{,}000g}$$

   (1) the number of liters in 3.0 g of water
   (2) the number of grams in 3.0 L of water
   (3) the number of liters in 3.0 kg of water
   (4) the number of kilograms in 3.0 L of water

3. Which of the following conversions could be used to determine the number of centimeters in 15 mm?

   (1) $\frac{1}{15mm} \times \frac{0.001m}{1mm} \times \frac{1cm}{0.01m}$

   (2) $15mm \times \frac{1mm}{0.001m} \times \frac{0.01m}{1cm}$

   (3) $15mm \times \frac{0.001m}{1mm} \times \frac{0.01m}{1cm}$

   (4) $15mm \times \frac{0.001m}{1mm} \times \frac{1cm}{0.01m}$

4. Which is the equivalent of 750. calories?

   (1) 0.750 kcal (3) 75. 0 kcal
   (2) 7. 30 kcal (4) 750. kcal

5. What is the numerical value of the conversion factor $\frac{1km}{1{,}000m}$?

   (1) 1 (3) 0.001
   (2) There is no way to tell (4) 1,000