

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

- ★ $1 \text{ km} = 1,000 \text{ m}$

- ★ $1 \text{ L} = 1,000 \text{ cm}^3$

- ★ 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

- ★ $\frac{1\text{km}}{1,000\text{m}} = 1$

- ★ $\frac{1\text{L}}{1,000\text{cm}^3} = 1$

- ★ 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

- ★ $1 = \frac{1,000\text{m}}{1\text{km}}$

- ★ $1 = \frac{1,000\text{cm}^3}{1\text{L}}$

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

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

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

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

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) $1.25L \times \frac{1\mu\text{L}}{0.000001L}$ (3) $1.25L \times \frac{0.000001L}{1\mu\text{L}}$
 (2) $0.000001L \times \frac{1\mu\text{L}}{1.25L}$ (4) $1\mu\text{L} \times \frac{0.000001L}{1.25L}$

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