Workshop: Conversion of Units and Transposing Equations – Answers and Solutions

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Conversion of units

1. Convert each of the following into grams, writing each answer in standard form:
   a. 1 kg $= 1 \times 10^3$ g
   b. 1 mg $= 1 \times 10^{-3}$ g
   c. 1 mcg $= 1 \times 10^{-6}$ g
   d. 5 kg $= 5 \times 10^3$ g
   e. 250 kg $= 250 \times 10^3 = 2.5 \times 10^2 \times 10^3 = 2.5 \times 10^5$ g
   f. 3500 mg $= 3500 \times 10^{-3} = 3.5 \times 10^3 \times 10^{-3} = 3.5 \times 10^0$

2. Convert each of the following into the given unit, writing each answer in standard form:
   a. 120 ml into mcl $= 120 \times 10^3 = 1.2 \times 10^2 \times 10^3 = 1.2 \times 10^5$ mcl
   b. 4500 mcg into nanograms $= 4500 \times 10^3 = 4.5 \times 10^3 \times 10^3 = 4.5 \times 10^6$ ng
   c. 2.2 l into ml $= 2.2 \times 10^3$ ml
   d. 0.56 g into mg $= 0.56 \times 10^3 = 5.6 \times 10^{-1} \times 10^3 = 5.6 \times 10^2$ mg
   e. 0.000235 g into mcg $= 2.35 \times 10^{-4} \times 10^6 = 2.35 \times 10^2$ mcg

3. Convert each of the following into the given unit, writing each answer in standard form:
   a. 54000 mg into g $= 5.4 \times 10^4 \times 10^{-3} = 5.4 \times 10^1$ g
   b. 250000 mg into kg $= 2.5 \times 10^5 \times 10^{-6} = 2.5 \times 10^{-1}$ kg
   c. 0.25 ml into l $= 2.5 \times 10^{-1} \times 10^{-3} = 2.5 \times 10^{-4}$ l
   d. 6250000 nanograms into mg $= 6.25 \times 10^6 \times 10^{-6} = 6.25 \times 10^0$ mg

4. Convert each of the following into the given unit, writing each answer in standard form:
   a. 1.25×10^{14} mg into g $1.25 \times 10^{14} \times 10^{-3} = 1.25 \times 10^{11}$ g
   b. 9.5×10^{20} kW into W $9.5 \times 10^{20} \times 10^{3} = 9.5 \times 10^{23}$ W
   c. 650×10^{15} mcg into kg $6.5 \times 10^{2} \times 10^{15} \times 10^{-9} = 6.5 \times 10^{8}$ kg
   d. 1.224×10^{-12} ml into l $1.224 \times 10^{-12} \times 10^{-3} = 1.224 \times 10^{-15}$ l
   e. 1.5×10^{-6} MJ into mJ $1.5 \times 10^{-6} \times 10^{9} = 1.5 \times 10^{3}$ mJ
   f. 56×10^{4} cm into km $5.6 \times 10^{1} \times 10^{4} \times 10^{-5} = 5.6 \times 10^{0}$ km

Transposing equations

5. Make x the subject of each of the following:
   a. $5x = b$

      $\frac{5x}{5} = \frac{b}{5} \quad \rightarrow \quad x = \frac{b}{5}$

   b. $z = a + x$

      $z - a = a + x - a \quad \rightarrow \quad z - a = x \quad \rightarrow \quad x = z - a$

   c. $y = mx + c$

      $y - c = mx + c - c$

      $y - c = mx$

      $\frac{y - c}{m} = \frac{mx}{m}$

      $x = \frac{y - c}{m}$

   d. $y - 10 = 3(x - 2)$

      $y - 10 = 3x - 6$

      $y - 10 + 6 = 3x$

      $\frac{y - 4}{3} = x$

      $x = \frac{y - 4}{3}$

   e. $\frac{x+5}{p} = q$

      $x + 5 = pq$

$$x = pq - 5$$

6. In each of the following, make the give variable [in brackets] the subject:

a. $C_1V_1 = C_2V_2 \qquad [V_1]$

$$\frac{C_1V_1}{C_1} = \frac{C_2V_2}{C_1}$$

$$V_1 = \frac{C_2V_2}{C_1}$$

b. $E = h\frac{c}{\lambda} \qquad [h]$

$$E\lambda = hc$$

$$\frac{E\lambda}{c} = h$$

c. $I = \frac{m}{h^2} \qquad [h]$

$$Ih^2 = m$$

$$h^2 = \frac{m}{I}$$

$$h = \sqrt{\frac{m}{I}}$$

d. $A = \frac{\sqrt{HM}}{60} \qquad [M]$

$$60A = \sqrt{HM}$$

$$(60A)^2 = HM$$

$$\frac{3600A^2}{H} = M$$

Mixed Questions

7. The body mass index (BMI) of a person is calculated as:

$$\text{BMI} = \frac{\text{Mass (Kg)}}{(\text{Height (m)})^2}$$

Find the height of a person in centimetres, given that they have a body mass index of 22.5 and a mass of 90000 g.

$$22.5 = \frac{90}{h^2}$$

$$22.5h^2 = 90$$
$$h^2 = \frac{90}{22.5}$$
$$h = \sqrt{4} = 2\ \text{m} = 200\ \text{cm}$$

8. The wavelength of a light wave (λ), in m, can be calculated using the speed of light (c) and the frequency (ν):

$$\lambda = \frac{c}{\nu}$$

It is found that a light wave has a wavelength of 1.5×10^{-5} mm. The speed of light is $3 \times 10^{8}\ \text{ms}^{-1}$

a. Convert the wavelength into metres

$$1.5 \times 10^{-5} \times 10^{-3} = 1.5 \times 10^{-8}\ \text{m}$$

b. By rearranging the equation, and using your answer to part a, find the frequency of the light wave.

$$\lambda\nu = c$$
$$\nu = \frac{c}{\lambda}$$

$$\nu = \frac{3 \times 10^{8}\ \text{ms}^{-1}}{1.5 \times 10^{-8}\ \text{m}}$$
$$\nu = \frac{3}{1.5} \times \frac{10^{8}}{10^{-8}}\ \text{s}^{-1} = 2 \times 10^{16}\ \text{s}^{-1}$$