

### Problem Set 3: Unit Analysis and Problem Solving

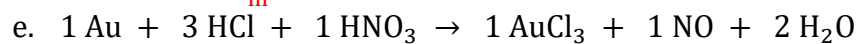
1) Match the correct conversion factor to each statement.

a.  $3.50 \text{ mols Fe(OH)}_3 \times \frac{3 \text{ mols H}}{1 \text{ mol Fe(OH)}_3} = 10.5 \text{ mols H}$

b.  $67400 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 67.4 \text{ L}$

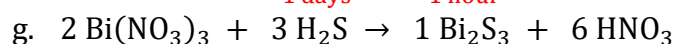
c.  $2.80 \text{ mols Bi(NO}_3)_3 \times \frac{9 \text{ mols O}}{1 \text{ mol Bi(NO}_3)_3} = 25.2 \text{ mols O}$

d.  $6.745 \text{ m} \times \frac{1000 \text{ mm}}{\text{m}} = 6745 \text{ mm}$



$1.2 \text{ mols HCl} \times \frac{2 \text{ mols H}_2\text{O}}{3 \text{ mols HCl}} = 0.8 \text{ mols H}_2\text{O}$

f.  $27.050 \text{ days} \times \frac{24 \text{ hours}}{1 \text{ days}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = 38952 \text{ minutes}$



$0.50 \text{ mols H}_2\text{S} \times \frac{1 \text{ mols Bi}_2\text{S}_3}{3 \text{ mols H}_2\text{S}} = 0.17 \text{ mols Bi}_2\text{S}_3$

h.  $0.0504 \text{ L} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 50.4 \text{ mL}$

i.  $3972 \text{ g} \times \frac{1 \text{ kg}}{1000 \text{ g}} = 3.972 \text{ kg}$

2) Calculate the volume of sulfuric acid in mL if the acid has a mass of 65.14 g and a density of 1.84 g/mL.

$$V = \frac{m}{d} = \frac{65.14 \text{ g}}{1.84 \frac{\text{g}}{\text{mL}}} = 35.4 \text{ mL sulfuric acid}$$

3) a) What volume of water is necessary to make a  $1.0 \times 10^{-3} \text{ M}$  sodium hypochlorite ( $\text{NaOCl}$ ) solution from 0.353 moles of  $\text{NaOCl}$ ?

$$M = \frac{\text{mol}}{\text{L}}$$

$$ML = \text{mol}$$

$$L = \frac{\text{mol}}{M} = \frac{0.353 \text{ mols}}{1.0 \times 10^{-3} \frac{\text{mol}}{\text{L}}} = 353 \text{ L H}_2\text{O}$$

b) What would be the new concentration if 125 mL of the  $\text{NaOCl}$  solution was diluted to 500 mL in a volumetric flask?

$$M_1 = 1.0 \times 10^{-3} \text{ M}$$

$$V_1 = 125 \text{ mL}$$

$$M_2 = ?$$

$$V_2 = 500 \text{ mL}$$

$$M_1 V_1 = M_2 V_2$$

$$\frac{M_1 V_1}{V_2} = M_2$$

$$M_2 = \frac{M_1 V_1}{V_2} = \frac{(125 \text{ mL})(1.0 \times 10^{-3} \text{ M})}{500 \text{ mL}} = 2.5 \times 10^{-4} \text{ M}$$

- 4) Gemstones are weighed in carats (ct), with 1 carat = 200 mg (exactly). What is the mass in grams of the Hope Diamond, the world's largest blue diamond at 44.4 carats?

$$44.4 \text{ ct} \times \frac{200 \text{ mg}}{1 \text{ ct}} \times \frac{1 \text{ g}}{1000 \text{ mg}} = 88.8 \text{ g}$$

- 5) a) Hydrochloric acid is sold commercially as a 12.0 M aqueous solution. How many moles of HCl are in 300.0 mL of a 12.0 M solution?

$$M = \frac{\text{mol}}{\text{L}}$$

$$ML = \text{mol}$$

$$ML = \frac{12.0 \text{ mol}}{\text{L}} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times 300.0 \text{ mL} = 3.60 \text{ mols}$$

- b) What volume of the 12.0 M HCl solution is required to make a HCl solution with a concentration of 3.0 M?

$$M_1 = 12.0 \text{ M}$$

$$V_1 = ?$$

$$M_2 = 3.0 \text{ M}$$

$$V_2 = 1 \text{ L}$$

$$M_1 V_1 = M_2 V_2$$

$$V_1 = \frac{M_2 V_2}{M_1}$$

$$V_1 = \frac{M_2 V_2}{M_1} = \frac{(1 \text{ L})(3.0 \text{ M})}{12.0 \text{ M}} = 0.25 \text{ L}$$