

Key

CONCENTRATIONS OF SOLUTIONS

For each of the following:

- Determine the equation needed to solve the problem. Underline the key word in the problem that indicates the equation to be used.
- Write the equation (including units).
- Substitute the values and solve the problem.
- Round final answers to the appropriate number of significant figures and label with the appropriate units.

1) What is the molarity of a solution containing 6.5 moles of NaCl in 2.5 L solution?

$$M = \frac{\text{moles}}{L} \quad M = \frac{6.5 \text{ moles}}{2.5 \text{ L}} = \boxed{2.6 \text{ M NaCl}}$$

2) What is the percent by mass of NaHCO₃ in a solution containing 20.0 g of NaHCO₃ dissolved in 600.0 g of H₂O?

$$\% \text{ by mass} = \frac{\text{mass solute}}{\text{mass solution}} \times 100 = \frac{20.0 \text{ g}}{(600.0 + 20.0 \text{ g})} \times 100 = 3.2258\% \approx \boxed{3.23\%}$$

3) What is the percent by volume of ethanol in a solution that contains 35 mL of ethanol dissolved in 155 mL of water?

$$\% \text{ volume} = \frac{\text{volume solute}}{\text{volume solution}} \times 100 = \frac{35 \text{ mL}}{(155 + 35 \text{ mL})} \times 100 = 18.421\% \approx \boxed{18\%}$$

4) You have 1500.0 g of a bleach solution. The percent by mass of the solute sodium hypochlorite (NaOCl) is 3.62%. How many grams of NaOCl are in the solution?

$$\% \text{ by mass} = \frac{\text{mass solute}}{\text{mass solution}} \times 100$$

$$3.62\% = \frac{x}{1500.0 \text{ g}} \times 100$$

$\div 100$

$$0.0362 = \frac{x}{1500.0 \text{ g}}$$

$$\boxed{x = 54.3 \text{ g}}$$

5) A solution is made by dissolving 0.36 g of NaCl in 895 g of water. What is the concentration of the solution in parts per million?

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 1,000,000 = \frac{0.36 \text{ g}}{(0.36 + 895 \text{ g})} \times 1,000,000$$

solute + solvent

6) How many moles of solute are in 450 mL of a 0.58 M solution of Na₂CO₃?

$$M = \frac{\text{moles solute}}{\text{L solution}}$$

450 mL of solution = 0.450 L
 *convert mL to L, move decimal 3 places left = 0.450 L

~~$$0.58 \text{ M} = \frac{x}{0.450 \text{ L}}$$~~

$$x = 0.261 \text{ moles} = \boxed{0.26 \text{ moles}}$$

7) A solution is made by dissolving 50.0 g of CaCl₂ in water. What is the mass of the solution if it is 2.65% CaCl₂?

$$\% \text{ by mass} = \frac{\text{mass solute}}{\text{mass solution}} \times 100$$

$$2.65 = \frac{50.0 \text{ g}}{x} \times 100$$

~~$$0.0265 = \frac{50.0}{x}$$~~

$$x = 1886.79 = \boxed{1890 \text{ g}}$$

8) Determine the percent by volume of isopropyl alcohol in a solution that contains 24 mL of isopropyl alcohol in 1.1 L of water.

$$\% = \frac{\text{volume solute}}{\text{volume solution}} \times 100$$

*make sure the units for volume are the same, whether you make them both mL or both L.

$$\% = \frac{24 \text{ mL}}{(1,100 + 24 \text{ mL})} \times 100 = 2.1352 = \boxed{2.1\%}$$

9) What is the molarity of an aqueous solution containing 40.0 g of glucose (C₆H₁₂O₆) in 1.5 L solution?

$$M = \frac{\text{moles solute}}{\text{L solution}}$$

need to first convert 40.0 g to moles to plug in:

$$\text{mol} = \frac{g}{\text{gfm}} = \frac{40.0 \text{ g}}{180.0 \text{ g/mol}} = 0.22 \text{ mol}$$

$$= \frac{0.2 \text{ mol}}{1.5 \text{ L}} = \boxed{0.13 \text{ M}}$$

10) A 2.5 g sample of ground water is found to contain 5.4 x 10⁻⁶ g of Cu²⁺. What is the ion concentration in parts per million?

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 1,000,000$$

$$= \frac{5.4 \times 10^{-6}}{2.5} \times 1,000,000$$

$$= 2.16 = \boxed{2.2 \text{ ppm}}$$

Concentration of Solutions Problems II

Answer each of the following questions using your knowledge of chemistry. For each problem write the equation used, substitute values, and solve the problem. Round final answers to the proper number of significant figures and label with the appropriate units.

11) What volume of a 3.50 M HCl solution will contain 0.875 moles HCl?

$$M = \frac{\text{moles solute}}{\text{L solution}}$$

~~$$3.50 = \frac{0.875}{x}$$~~

$$3.50x = 0.875$$

$$x = 0.25 \text{ L}$$

12) A solution is 6.9 ppm chloride ions. What mass of chloride ions is dissolved in 750 g of solution?

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 1,000,000$$

$$6.9 = \frac{x}{750} \times 1,000,000$$

$$0.0000069 = \frac{x}{750} \quad \{ \quad x = 0.0052 \text{ g} \}$$

13) What is the molarity of a solution containing 0.25 moles of MgBr_2 in 375 mL of solution?

$$M = \frac{\text{moles solute}}{\text{L solution}}$$

$$= \frac{0.25}{0.375} = 0.67 \text{ M}$$

convert to L by moving decimal 3 places left = 0.375 L

14) How many grams of calcium hydroxide, Ca(OH)_2 , are needed to produce 1.5 L of a 0.25 M solution? (* use $M = \frac{\text{moles solute}}{\text{L solution}}$ to find the moles.

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

~~$$0.25 = \frac{x}{1.5}$$~~

$$x = 0.375 \text{ moles}$$

$$\text{moles} = \frac{g}{\text{gfm}} \quad 0.375 = \frac{g}{74.1} \quad \{ \quad g = 28 \text{ g} \}$$

15) Chlorine is used as a disinfectant in swimming pools. Only about 1.0 g of chlorine per 500,000 g of water is necessary to keep the pool sanitized. What is the concentration of chlorine in ppm?

mass solvent

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 1,000,000$$

$$= \frac{1.0 \text{ g}}{(500,000 + 1.0)} \times 1,000,000$$

$$= 2.0 \text{ ppm}$$

16) How many moles of NaNO_3 are needed to prepare 250.0 mL of a 0.325 M NaNO_3 solution?

$$M = \frac{\text{moles solute}}{\text{L solution}}$$

$$0.325 \text{ M} = \frac{x}{0.250 \text{ L}}$$

$$x = 0.0813 \text{ moles}$$

17) What is the percent by mass of sodium hydroxide if 2.50 g of NaOH are added to 50.00 g of H_2O ?

$$\% \text{ by mass} = \frac{\text{mass solute}}{\text{mass solution}} \times 100 = \frac{2.50}{2.50 + 50.00} \times 100 = 4.76\%$$

18) How many grams of glucose are required to prepare 800. grams of a 45% by mass glucose solution?

$$\% \text{ by mass} = \frac{\text{mass solute}}{\text{mass solution}} \times 100$$

$$45\% = \frac{x}{800} \times 100$$

$$x = 360.0 \text{ g}$$

19) What is the percent by volume of alcohol in a solution where 75.0 mL alcohol is dissolved in 125.0 mL water?

$$\% \text{ by vol} = \frac{\text{vol solute}}{\text{vol solution}} \times 100 = \frac{75.0}{75.0 + 125.0} \times 100 = 37.5\%$$

20) What volume of a 3.5 M NaOH solution contains 20.0 g of NaOH?

$$\text{moles} = \frac{g}{\text{gfm}} = \frac{20.0 \text{ g}}{40.0 \text{ g}} = 0.5 \text{ mol}$$

first need to convert g to mol to use M formula.

$$M = \frac{\text{moles solute}}{\text{L solution}}$$

$$3.5 = \frac{0.5}{x}$$

$$3.5x = 0.5$$

$$x = 0.14 \text{ L}$$