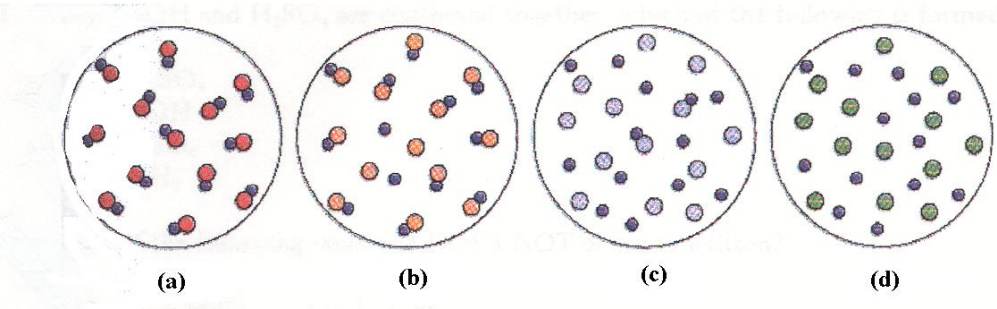
REVIEW QUESTIONS

Chapter 8

1. Identify each of the diagrams below as strong electrolyte, weak electrolyte or non-electrolyte:



(a) Non-electrolyte (no ions present)
(b) Weak electrolyte (few ions present)
(c) Strong electrolyte (mostly ions present)
(d) Strong electrolyte (only ions present)

2. Identify the predominant particles in each of the following solutions and write the equation for the formation of the solution:

a) Li_2CO_3 **Ions (strong electrolyte)**

Li_2CO_3 (s) → 2 Li^+ (aq) + CO_3^{2-} (aq)

b) CCl_4 **Molecules (non-electrolyte)**

CCl_4 (l) → CCl_4 (aq)

c) H_2S **Molecules (weak electrolyte)**

$H_2S \rightleftharpoons H^+$ (aq) + HS^- (aq)

3. How many equivalents are present in 5.0 g of Al^{3+}?

$$\mathbf{5.0\ g\ Al^{3+}\ x\ \frac{1\ mol}{27.0\ g}\ x\ \frac{3\ Eq}{1\ mol} = 0.56\ Eq}$$

4. An intravenous replacement solution contains 4.0 mEq/L of Ca^{2+} ions. How many grams of Ca^{2+} are in 3.0 L of the solution?

$$\mathbf{3.0\ L\ soln \times \frac{4\ mEq}{1\ L\ soln} \times \frac{1\ Eq}{10^3\ mEq} \times \frac{1\ mol\ Ca^{2+}}{2\ Eq} \times \frac{40.1\ g}{1\ mol} = 0.24\ g\ Ca^{2+}}$$

5. Calculate the mass percent (m/m or m/v)) for each of the following solutions:

   a) 25 g of KCl in 125 g H_2O

$$\mathbf{mass\ of\ solution = 25\ g + 125\ g = 150\ g}$$

$$\mathbf{mass\ \% = \frac{25\ g}{150\ g} \times 100 = 17\%\ (m/m)}$$

   b) 75 g of NaOH in 325 mL of solution

$$\mathbf{mass\ \% = \frac{75\ g}{325\ mL} \times 100 = 23\%\ (m/v)}$$

6. Calculate the molarity of the following solutions:

   a) 0.50 mol sugar in 270 mL of solution.

$$\mathbf{Volume\ of\ solution = 270\ mL = 0.27\ L}$$

$$\mathbf{molarity = \frac{0.50\ mol}{0.27\ L} = 1.9\ M}$$

   b) 17.0 g of $AgNO_3$ in 0.500 L of solution.

$$\mathbf{moles\ of\ solute = 17.0\ \cancel{g} \times \frac{1\ mol}{169.9\ \cancel{g}} = 0.100\ mol}$$

$$\mathbf{molarity = \frac{0.100\ mol}{0.500\ L} = 0.200\ M}$$

7. Calculate the moles of solute needed to prepare each of the following solutions:

   a) 450 mL of 0.20 M KBr solution.

$$0.45\ \text{L} \times \frac{0.20\ \text{mol}}{1\ \text{L}} = 0.090\ \text{mol}$$

   b) 2.0 L of 1.5 M NaOH solution.

$$2.0\ \text{L} \times \frac{1.5\ \text{mol}}{1\ \text{L}} = 3.0\ \text{mol}$$

8. Calculate the mass of solute needed to prepare each of the following solutions:

   a) 2.0 L of 1.8 M NaOH solution.

$$2.0\ \text{L} \times \frac{1.8\ \text{mol}}{1\ \text{L}} = 3.6\ \text{mol}$$

$$3.6\ \cancel{\text{mol}} \times \frac{40.0\ \text{g}}{1\ \cancel{\text{mol}}} = 140\ \text{g} \quad \text{(2 sig figs)}$$

   b) 250 mL of 1.0 M $CaCl_2$ solution.

$$0.25\ \text{L} \times \frac{1.0\ \text{mol}}{1\ \text{L}} \times \frac{111\ \text{g}}{1\ \cancel{\text{mol}}} = 28 \quad \text{(2 sig figs)}$$

   c) 750 mL of 3.5% (m/v) K_2CO_3 solution.

$$750\ \text{mL} \times \frac{3.5\ \text{g}\ K_2CO_3}{100\ \text{mL}} = 26\ \text{g} \quad \text{(2 sig figs)}$$

9. What volume (mL) of a 4.0 M solution of KCl contains 0.100 moles of solute?

$$0.100 \text{ mol} \times \frac{1 \text{ L}}{4.0 \text{ mol}} \times \frac{10^3 \text{ mL}}{1 \text{ L}} = 25 \text{ mL}$$

10. What volume (mL) of a 1.5 M solution of NaCl contains 25.0 g of solute?

$$25.0 \text{ g} \times \frac{1 \text{ mol}}{58.45 \text{ g}} = 0.428 \text{ mol}$$

$$0.428 \text{ mol} \times \frac{1 \text{ L}}{1.5 \text{ mol}} \times \frac{10^3 \text{ mL}}{1 \text{ L}} = 290 \text{ mL} \quad \text{(2 sig figs)}$$

11. How many liters of a 5.0% (m/v) glucose solution would contain 75 g of glucose?

$$75 \text{ g glucose} \times \frac{100 \text{ mL}}{5.0 \text{ g glucose}} \times \frac{1 \text{ L}}{10^3 \text{ mL}} = 1.5 \text{ L}$$

12. A patient receives an IV containing 2.5% (m/v) glucose solution at the rate of 35 mL in 1 hour. How many grams of glucose does this patient receive after 12 hours?

$$12 \text{ hr} \times \frac{35 \text{ mL}}{1 \text{ hr}} \times \frac{2.5 \text{ g glucose}}{100 \text{ mL}} = 11 \text{ g} \quad \text{(2 sig figs)}$$

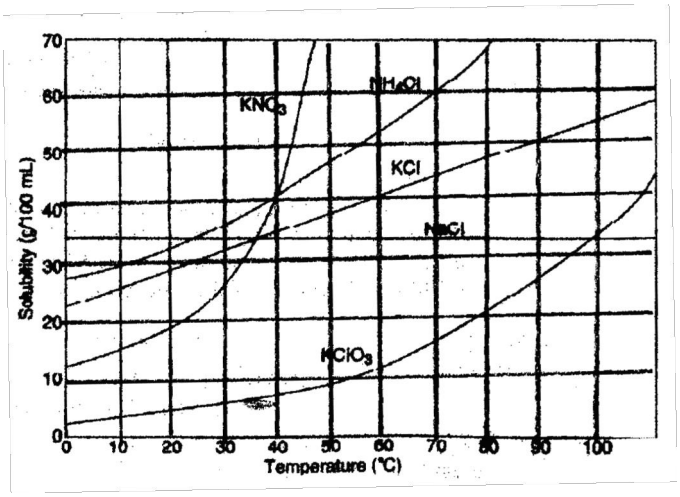
13. Use the solubility graph below to answer the following questions:

a) Which substance has the greatest solubility at 30°C?

NH_4Cl

b) What is the solubility of KCl at 60°C?

40 g/100 g H_2O (40%)



c) A sample of KNO_3 with a mass of 50.0 g is added to 150 mL of water at 40°C. Is this solution saturated or unsaturated. Give explanation or show calculations.

Solubility of KNO_3 at 40°C = 40 g KNO_3 /100 g water (40%)

150 mL of water = 150 g since density of water is 1.0 g/mL

$$\frac{\textbf{50.0 g } KNO_3}{\textbf{150 g water}} = \textbf{33.3\%}$$ **Therefore, solution is unsaturated**

14. Indicate whether each of the following is soluble or insoluble in water:

a) $MgSO_4$ **soluble**

b) KCl **soluble**

c) $(NH_4)_2 CO_3$ **soluble**

d) PbS **insoluble**

e) $Ca(OH)_2$ **soluble**

f) Na_3PO_4 **soluble**

15. For each reaction below, write the net ionic equation to show the formation of a precipitate. If no precipitate occurs, write "No Reaction" after the arrow.

a) $Pb(NO_3)_2\ (aq) + 2\ NaI\ (aq) \rightarrow PbI_2\ (s) + 2\ NaNO_3\ (aq)$

$Pb^{2+} + \cancel{2\ NO_3^-} + \cancel{2\ Na^+} + 2\ I^- \rightarrow PbI_2\ (s) + \cancel{2\ Na^+} + \cancel{2\ NO_3^-}$

Net Ionic Equation $Pb^{2+} + 2\ I^- \rightarrow PbI_2\ (s)$

b) $NaCl\ (aq) + (NH_4)_2SO_4\ (aq) \rightarrow$ **No Reaction**

No precipitate forms since the two possible products formed (Na_2SO_4 and NH_4Cl) are both soluble

c) $3\ CaCl_2\ (aq) + 2\ Na_3PO_4\ (aq) \rightarrow Ca_3(PO_4)_2\ (s) + 6\ NaCl\ (aq)$

$3\ Ca^{2+} + \cancel{6\ Cl^-} + \cancel{6\ Na^+} + 2\ PO_4^{3-} \rightarrow Ca_3(PO_4)_2\ (s) + \cancel{6\ Na^+} + \cancel{6\ Cl^-}$

Net Ionic Equation $3\ Ca^{2+} + 2\ PO_4^{3-} \rightarrow Ca_3(PO_4)_2\ (s)$

d) $Ca(NO_3)_2\ (aq) + Na_2S\ (aq) \rightarrow CaS\ (s) + 2\ NaNO_3\ (aq)$

$Ca^{2+} + \cancel{2\ NO_3^-} + \cancel{2\ Na^+} + S^{2-} \rightarrow CaS\ (s) + \cancel{2\ Na^+} + \cancel{2\ NO_3^-}$

Net Ionic Equation $Ca^{2+} + S^{2-} \rightarrow CaS\ (s)$

16. Complete and balance the following chemical equations:

a) $2\ HCl\ (aq) + Ca(OH)_2\ (aq) \rightarrow CaCl_2\ (aq) + 2\ H_2O\ (l)$

b) $CaCO_3\ (s) + 2\ HNO_3\ (aq) \rightarrow Ca(NO_3)_2\ (aq) + CO_2\ (g) + H_2O\ (l)$

c) $H_2SO_4\ (aq) + 2\ LiOH\ (aq) \rightarrow Li_2SO_4\ (aq) + 2\ H_2O\ (l)$

17. How many mL of a 15 M NH_3 solution is needed to prepare 50. mL of a 6.0 M NH_3 solution?

$$V_2 = \frac{M_1 V_1}{M_2} = \frac{(6.0\ M)(50.\ mL)}{15\ M} = 20.\ mL$$

18. Calculate the molarity of a solution prepared by mixing 250 mL of 0.75 M H_2SO_4 with 150 mL of water.

$$V_2 = 250\ mL + 150\ mL = 400\ mL$$

$$M_2 = \frac{M_1 V_1}{V_2} = \frac{(0.75\ M)(250\ mL)}{400\ mL} = 0.47\ M$$

19. What is the final volume, in mL, when 5.00 mL of 12.0 M NaOH is diluted to 0.600 M?

$$V_2 = \frac{M_1 V_1}{M_2} = \frac{(12.0\ M)(5.00\ mL)}{0.600\ M} = 100.\ mL$$

20. Determine the osmolarity and tonicity of each of the following solutions:

a) 0.15 M KCl **(i = 2) 0.30 osmol (isotonic)**

b) 0.12 M sucrose **(i = 1) 0.12 osmol (hypotonic)**

c) 0.080 M $FeCl_3$ **(i = 4) 0.32 osmol (hypertonic)**

d) 0.10 M $Ca(NO_3)_2$ **(i = 3) 0.30 osmol (isotonic)**