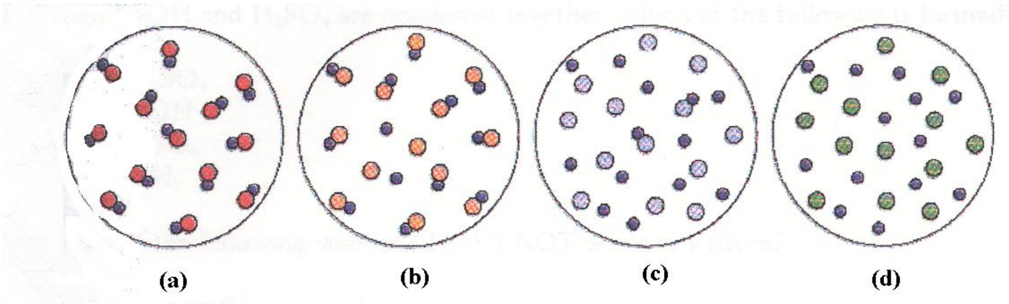
REVIEW QUESTIONS

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)**

$$Li_2CO_3\,(s) \rightarrow 2\,Li^{+}\,(aq) + CO_3^{2-}\,(aq)$$

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

$$CCl_4\,(l) \rightarrow CCl_4\,(aq)$$

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+}?

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

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?

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

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

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

$$\textbf{mass \%} = \frac{\textbf{25 g}}{\textbf{150 g}} \textbf{x100 = 17\% (m/m)}$$

   b) 75 g of NaOH in 325 mL of solution

$$\textbf{mass \%} = \frac{\textbf{75 g}}{\textbf{325 mL}} \textbf{x100 = 23\% (m/v)}$$

6. Calculate the molarity of the following solutions:

   a) 0.50 mol sugar in 270 mL of solution.

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

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

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

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

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

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

a) 450 mL of 0.20 M KBr solution.

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

b) 2.0 L of 1.5 M NaOH solution.

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

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

a) 2.0 L of 1.8 M NaOH solution.

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

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

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

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

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

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

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?

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

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

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

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

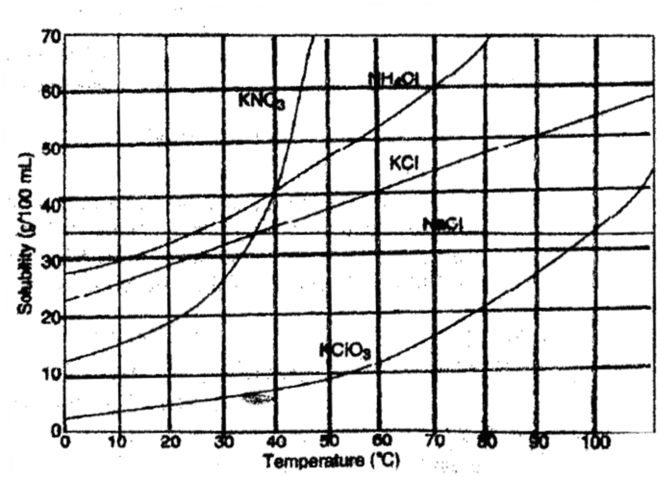
12. A patient receives an IV containing 2.5% (m/v) glucose solution at the rate of 35 mL in 1 hour. How many grams of glucose does this patient receive after 12 hours?

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

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

$$\frac{50.0\text{ g } KNO_3}{150\text{ g water}} = 33.3\%$$

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) → **PbI_2 (s) + 2 $NaNO_3$ (aq)**

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

Net Ionic Equation **Pb^{2+} + 2 I^- → PbI_2 (s)**

b) NaCl (aq) + $(NH_4)_2SO_4$ (aq) → **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) → **$Ca_3(PO_4)_2$ (s) + 6 NaCl (aq)**

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

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

d) $Ca(NO_3)_2$ (aq) + Na_2S (aq) → **CaS (s) + 2 $NaNO_3$ (aq)**

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

Net Ionic Equation **Ca^{2+} + S^{2-} → CaS (s)**

16. Complete and balance the following chemical equations:

a) **2** HCl (aq) + $Ca(OH)_2$ (aq) → **$CaCl_2$ (aq) + 2 H_2O (l)**

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

c) H_2SO_4 (aq) + **2** LiOH (aq) → **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?

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

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

$$V_2 = 250\ \text{mL} + 150\ \text{mL} = 400\ \text{mL}$$

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

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

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

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

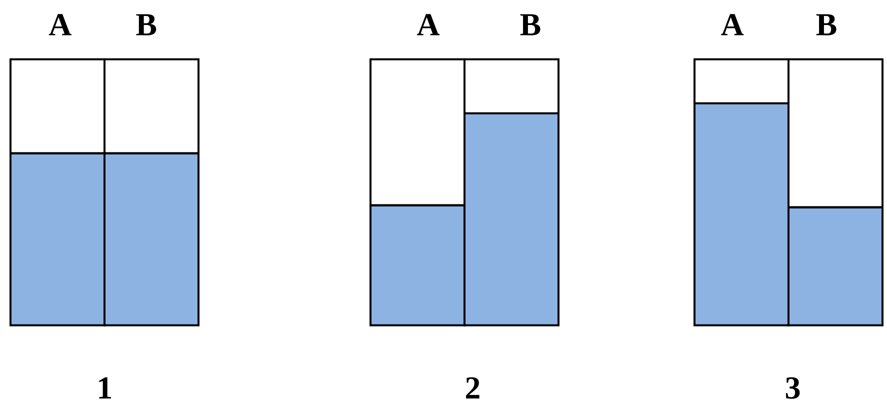
a) 0.15 M KCl **(i = 2)** **0.30 osmol (isotonic)**

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)**

21. A semipermeable membrane separates two compartments A and B. If the levels of A and B are equal initially, select the diagram that illustrates the final levels for each of the following solutions:



	Solution in A	**Solution in B**
a)	2% (m/v) starch	8% (m/v) starch
b)	1% (m/v) starch	1% (m/v) glucose
c)	0.1M NaCl **(0.2 osmol)**	0.1M glucose **(0.1 osmol)**
d)	0.15 M $CaCl_2$ **(0.45 osmol)**	0.2M NaCl **(0.4 osmol)**

The solutions will flow from the lower concentration of particles towards the greater concentration of particles, to equalize the concentrations. Therefore:

a) Diagram 2 (solution A has lower concentration than solution B)

b) Diagram 1 (both solutions have the same concentration)

c) Diagram 3 (solution B has lower concentration than solution A)

d) Diagram 3 (solution B has lower concentration than solution A)