KEY

GENERAL & ANALYTICAL CHEMISTRY I
CHMG-141
With Dr. Bailey

Name_____

Recitation
Week 10
(Ch.6, Solutions, Solution Stoichiometry, Solubility)

PART A (Solution Concentration, Molarity)

1) 2.8 liters of LiCl contains 4.3 moles. What is the molarity?

$M = \frac{\#\ moles\ (solute)}{V(L)\ (solut.)}$

$M = \frac{4.3\ mol}{2.8\ L} = \boxed{1.5\ \frac{mol}{L}}$ or $1.5\ M$

2) A 556 milliliter sample of 2.3 M KCl contains how many moles?

$\#\ moles = M \times V = 2.3\ \frac{mol}{L} \times \left(556\ mL \times \frac{1\ L}{1000\ mL}\right) = \boxed{1.3\ mol}$

3) How many liters of a 0.200 M solution of CH_3CH_2OH contain 0.45 moles?

$V = \frac{\#\ mol}{M} = \frac{0.45\ mol}{0.200\ \frac{mol}{L}} = \boxed{2.3\ L}$

4) 5.50 liters of a .500 M solution of $CaCl_2$ contains how many grams?

$\#\ mol = M \cdot V = 0.500\ \frac{mol}{L} \times 5.50\ L = 2.75\ mol$

$2.75\ mol_{CaCl_2} \times \frac{111\ g}{1\ mol} = \boxed{3.03 \times 10^2\ g_{CaCl_2}}$

5) If 22.6 g of $C_6H_{12}O_6$ are dissolved in water to a volume of 1087 mL what is the molarity of the solution?

$\#\ mol = 22.6\ g \times \frac{1\ mol}{180\ g} = 0.125\ mol$

$M = \frac{0.125\ mol}{1087\ mL \times \frac{1\ L}{1000\ mL}} = \boxed{0.116\ \frac{mol}{L}}$

6) How many milliliters of a 2.25 M solution of NaOH contain 75 grams of NaOH?

$75\ g_{NaOH} \times \frac{1\ mol}{40\ g_{NaOH}} = 1.9\ mol$

$V = \frac{1.9\ mol}{2.25\ mol/L} = \boxed{0.833\ L = 8.3 \times 10^2\ mL}$

7) 400 mL of a 1.1 M solution of $NaNO_3$ contains how many grams of $NaNO_3$?

$400\ mL \times \frac{1\ L}{1000\ mL} = 0.400\ L$

$\#\ mol_{NaNO_3} = M \times V = 1.1\ \frac{mol}{L} \times 0.400\ L = 0.44\ mol$

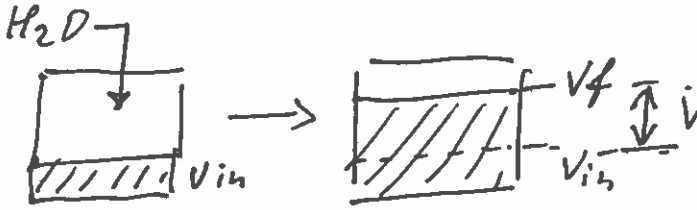
$0.44\ mol_{NaNO_3} \times \frac{85\ g}{1\ mol_{NaNO_3}} = \boxed{37\ g_{NaNO_3}}$

PART B (Dilution)

1) You have 150.0 mL of 0.215 mol/L NaOH water solution. The solution is used to prepare NaOH solution of 0.100 mol/L concentration by dilution. **How many mL of water do you need to add to prepare this solution?**

Your strategy:

a) What is volume of final solution?



$150.0\ mL \times \frac{1\ L}{1000\ mL} = 0.150\ L$

$\boxed{M_{in} \times V_{in} = M_f \times V_f}$ $V_f = \frac{M_{in} \times V_{in}}{M_f} = \frac{0.215 \times 0.150\ L}{0.100\ \frac{mol}{L}} = 0.323\ L = 323\ mL$

$V_{add} = 323\ mL - 150\ mL = \boxed{173\ mL}$

b) How many mL of water do you need to add to 150.0 mL of initial solution to make the final solution?

$V_{add} = V_f - V_{in} = 323\ mL - 150\ mL = 173\ mL$

PART C (Solution Stoichiometry)

1) Consider the reaction of neutralization of sodium hydroxide with hydrochloric acid:

$$KOH(aq) + HCl(aq) \rightarrow KCl(aq) + H_2O(l)$$

You use 100.0 mL of 0.250 M KOH.

a) How many moles of KOH are there in 100.0 mL of the solution?

$$\#moles_{HCl} = M \times V = 0.250 \frac{mol}{L} \times \left(100.0 mL \times \frac{1 L}{1000 mL}\right) = 0.0250 \text{ mol KOH}$$

b) How many moles of HCl are required for the reaction?

$$0.0250 \text{ mol KOH} \times \frac{1 \text{ mol HCl}}{1 \text{ mol KOH}} = 0.0250 \text{ mol HCl}$$

c) What is the concentration (Molarity) of HCl water solution if the volume of a solution of HCl you use is 20.0 mL?

$$20.0 mL \times \frac{1 L}{1000 mL} = 0.0200 L$$

$$M_{HCl} = \frac{0.0250 \text{ mol HCl}}{0.0200 L} = 1.25 \frac{mol}{L}$$

2) I mix 100.0 mL of $NiCl_2$ 1.00 M with 150.0 mL of 0.215 M K_2CO_3.

a) What mass of solid product do I expect to recover?

$$K_2CO_3(aq) + NiCl_2(aq) \rightarrow 2\ KCl(aq) + NiCO_3(s)$$

150.0 mL = 0.150 L, M = 0.215 mol/L

100.0 mL = 0.100 L, M = 1.00 mol/L

? g

$0.100\,L \times \frac{1.00\ mol\ NiCl_2}{1\ L} \times \frac{1\ mol\ NiCO_3}{1\ mol\ NiCl_2} = 0.100\ mol\ NiCO_3$

$0.150\,L\ K_2CO_3 \times \frac{0.215\ mol\ K_2CO_3}{1\ L} \times \frac{1\ mol\ NiCO_3}{1\ mol\ K_2CO_3} = 0.0323\ mol\ NiCO_3$

K_2CO_3 - Limiting reagent.

b) I actually collected 1.50g of product. What was the percent yield of my reaction?

Theoret. yield $= 0.0323\ mol\ NiCO_3 \times \frac{(58.69+12.01+48.00)}{1\ mol\ NiCO_3} = 0.0323 \times 118.7 = 3.83\ g$

$\frac{1.50\ g}{3.83\ g} \times 100\% = 39.2\%$

Part D (Solubility)

1) Determine whether each of the following compounds is soluble or insoluble.

For soluble compounds, write the ions present in solution: ***show reactions of dissociation***

a. AgI (s) Insoluble

b. $Cu_3(PO_4)_2$ (s) Insoluble

c. $CoCO_3$ (s) Insoluble

d. $K_3PO_4(aq) \rightarrow 3\,K^+(aq) + PO_4^{-3}(aq)$

e. $NH_4NO_3(aq) \rightarrow NH_4^+(aq) + NO_3^-(aq)$