PRACTICE EXAM #5

Chem20, Elementary Chemistry

1.) At 25°C, 81 g of magnesium bromide is dissolved into 100.0 g of liquid water. (18 pts)

a.) What is the concentration of $MgBr_2(aq)$ in units of mass percent?

Recall: mass percent = $\frac{\text{g solute}}{\text{total grams of solution}} \times 100\%$

$MgBr_2$ is the *solute*. (81 grams)

mass percent = $\frac{81\text{ g}}{81\text{ g}+100.0\text{ g}} \times 100\% = 44.7 \rightarrow$ **45% $MgBr_2$**

b.) What is this concentration in units of molality? (MW of $MgBr_2$ = 184.113 g/mol)

Recall: molality (m) = $\frac{\text{mols solute}}{\text{kg solvent}}$

$81\text{ g } MgBr_2 \times \frac{1\text{ mol } MgBr_2}{184.113\text{ g } MgBr_2} = 0.439\text{ mols } MgBr_2$

$100.0\text{ g } H_2O \times \frac{1\text{ kg}}{1000\text{ g}} = 0.1000\text{ kg } H_2O$

$\frac{0.439\text{ mols } MgBr_2}{0.1000\text{ kg } H_2O} = 4.39\text{ m} \rightarrow$ **4.4 molal (m)**

c.) If 81 g of magnesium bromide was diluted to 105 mL with water, what would the concentration of this solution be in units of molarity?

Recall: Molarity (M) = $\frac{\text{mols solute}}{\text{L solution}}$

$105\text{ mL} \times \frac{1\text{ L}}{1000\text{ mL}} = 0.105\text{ L}$

$\frac{0.439\text{ mols } MgBr_2}{0.105\text{ L}} = 4.18\text{ M} \rightarrow$ **4.2 M**

2.) Fill in the blanks. (15 pts)

a.) A conjugate base is the product after a(n) __**acid**__ transfers a proton.

b.) If a solution contains **more** than the equilibrium amount of solute, the solution is called __**supersaturated**__.

c.) Dispersion forces are the results of a(n) __**instantaneous**__ dipole moment created by an unequal distribution of electrons around the nucleus.

d.) If, when dissolved in aqueous solution, a compound **completely** dissociates and creates H^+ ions, it is called a(n) ____**strong acid**____.

3.) To determine the concentration of an unknown solution of hydroiodic acid, a titration was performed with a 1.3 M aqueous sodium hydroxide solution. The titration required 27.8 mL of sodium hydroxide to fully neutralize 12.9 mL of the hydroiodic acid solution. (15 pts)

a.) Write the **balanced** chemical equation for the acid-base neutralization reaction. **CIRCLE** the Arrhenius base. **BOX** the Brønsted-Lowry acid.

hydroiodic acid: HI(aq) ; sodium hydroxide: NaOH(aq)

$HI(aq) + NaOH(aq) \rightarrow H_2O(l) + NaI(aq)$ [water$^+$ salt product]

Arrhenius Base: **NaOH** (produces OH^-), Brønstead-Lowry Acid: **HI** (donates H^+)

b.) What is the concentration of the acid, in units of molarity?

Convert 27.8 mL NaOH to mols HI.

$$27.8 \text{ mL NaOH} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{1.3 \text{ mols NaOH}}{1 \text{ L}} \times \frac{1 \text{ mol HI}}{1 \text{ mol NaOH}} = 0.03614 \text{ mols HI}$$

Recall: molarity (M) = mols solute/L solution.

$$\frac{0.03614 \text{ mols HI}}{0.0129 \text{ L}} = 2.801 \rightarrow \mathbf{2.80\ M}$$

4.) An experimental procedure calls for 672 mL of a 9.1 M solution of ammonium hydroxide. The stock solution of $NH_4OH(aq)$ available is 17.8 M. What volume of the stock solution should be diluted to 672 mL to obtain the desired 9.1 M? (15 pts)

Recall: $M_1V_1 = M_2V_2$

$M_1 = 9.1$ M ; $V_1 = 672$ mL ; $M_2 = 17.8$ M ; $V_2 = ?$

$(9.1 \text{ M})(672 \text{ mL}) = (17.8 \text{ M})(V_2)$

$6595 \text{ M·mL} = (17.8 \text{ M})(V_2)$

$V_2 = 371 \text{ mL} \rightarrow \mathbf{3.7 \times 10^3\ mL}$

5.) The heat of fusion (ΔH_{fus}) for water is 6.02 kJ/mol and the specific heat capacity for liquid water is 4.184 J $\cdot g^{-1} \cdot °C^{-1}$. A sample of 112.6 g of $H_2O(l)$ was kept initially at 25.0°C. How many grams of $H_2O(s)$ would need to be added to lower the temperature to 8.0°C? (20 pts)

Recall: heat lost by the liquid water = heat absorbed by the solid ice

$H_2O(l)$ (112.6 g) is changing temperature; use $q = m\ C_s\ \Delta T$

m = 112.6 g ; C_s = 4.184 J/(g °C) ; ΔT = 8.0 °C – 25.0 °C = -17.0 °C

q = (112.6 g)(4.184 J/(g °C))(-17.0°C) = -8009 J lost by the water

- 8009 J = + 8009 J that the ice gains when melting

$H_2O(s)$ is changing phase; use ΔH fusion

m = ? ; ΔH fusion = 6.02 kJ/mol ; q = + 8009 J ; molar mass = 18.016 g/mol

$$8009\ \text{J} \times \frac{1\ \text{kJ}}{1000\ \text{J}} \times \frac{1\ \text{mol ice}}{6.02\ \text{kJ}} \times \frac{18.016\ \text{g ice}}{1\ \text{mol ice}} = 23.96 \rightarrow \textbf{24.0 g ice must melt}$$

6.) For the following compounds, list what intermolecular forces are present. (17 pts)

a.) $CH_3CH_2CH_2OH$ **dispersion, dipole-dipole, hydrogen bonding**

b.) C_{60} **dispersion**

c.) SeH_2 (polar) **dispersion, dipole-dipole**

d.) C_2H_6 (non-polar) **dispersion**

e.) Which compound will have the **highest surface tension**? **(A)** *(more IM forces)*

f.) Which compound will have the **highest vapor pressure**? **(D)** *(least IM forces, smallest)*