Week 3 Discussion Worksheet Answers

1) Consider the following reaction

$$H_3PO_4(aq) + NaOH(aq) \rightarrow Na_3PO_4(aq) + H_2O(l)$$

a) Balance the chemical equation above.

$$1\ H_3PO_4(aq) + 3NaOH(aq) \rightarrow 1Na_3PO_4(aq) + 3H_2O(l)$$

b) How many grams of sodium phosphate will form when 50.0 mL of 0.280 M H_3PO_4 solution are added to 80.0 mL of 0.370 M NaOH solution?

$$(0.280\,M)(0.050\,L) = 0.0140 \text{ mo } H_3PO_4 \times \frac{1 \text{ mol } Na_3PO_4}{1 \text{ mol } H_3PO_4} \times \frac{163.9\text{ g } Na_3PO_4}{1 \text{ mol } Na_3PO_4}$$

$$= 2.29\text{ g } Na_3PO_4$$

$$(0.370\,M)(0.080\,L) = 0.0296 \text{ mol } NaOH \times \frac{1 \text{ mol } Na_3PO_4}{3 \text{ mol } NaOH}$$

$$\times \frac{163.9\text{ g } Na_3PO_4}{1 \text{ mol } Na_3PO_4} = 1.62\text{ g } Na_3PO_4$$

NaOH LR and H_3PO_4 is excess. Therefore only $\boxed{1.62\text{g } Na_3PO_4}$ forms

2) How many grams of lithium sulfate must be used to prepare 500.0 mL of a 0.950 M solution?

$$n = MV = (0.950\,M)(0.500\,L) = 0.475 \text{ mol } Li_2SO_4$$

$$\times \frac{109.9\text{g } Li_2SO_4}{1 \text{ mol } Li_2SO_4} = \boxed{52.2\text{ g } Li_2SO_4}$$

3) 1.2 L of water is added to 700.0 mL of a 6.0 M LiBr solution. What is the new concentration?

$$M_C V_C = M_D V_D$$

$$(6.0\,M)(0.700\,L) = M_D(1.2\,L + 0.700\,L)$$

$$\boxed{M_D = 2.2\text{ M LiBr}}$$

4) Make a 10x PBS from 1.37 M NaCl, 27 mM KCl, 100 mM Na_2HPO_4, and 18 mM KH_2PO_4.

a) How much of each compound should be weighed out to make a 1L solution of 10x PBS?

1.37 M NaCl → 1.37 mole NaCl × $\frac{58.44g}{mol}$ = $\boxed{80.1\text{ g NaCl}}$

27 mM KCl → 0.027 Mole KCl × $\frac{74.55g}{mol}$ = $\boxed{2.01\text{ g KCl}}$

100 mM Na_2HPO_4 → 0.100 mole Na_2HPO_4 × $\frac{141.96g}{mol}$ = $\boxed{14.4\text{ g } Na_2HPO_4}$

18 mM KH_2PO_4 → 0.018 mole KH_2PO_4 × $\frac{136.09g}{mol}$ = $\boxed{2.45\text{g } KH_2PO_4}$

5) a) Make 0.5 M EDTA solution using EDTA • $Na_2 \cdot 2H_2O$ (MW = 372.24)

(0.5 M)(1L) = 0.5 moles. Then $\frac{372.24g}{mole}$ × 0.5 moles =

$\boxed{186.12\text{ g EDTA}}$

b) Make 50% ; 70% Ethanol solution from a 90% stock solution.

70%: $C_1V_1 = C_2V_2$ ⇒ 90% V_1 = (0.5L)(70%)

$\boxed{V_1 = 389\text{ mL 90\% ethanol. Fill with } H_2O \text{ till 500mL}}$

50%: $C_1V_1 = C_2V_2$ ⇒ 90% V_1 = (0.5L)(50%)

⇒ $\boxed{V_1 = 278\text{ mL 90\% ethanol}}$
Fill with H_2O till 500mL mark

c) Make various buffer solutions.

Tris- EDTA Buffer

(0.01 M Tris)(1L) = 0.01 mole Tris × $\frac{121.14g}{mol}$ = $\boxed{1.21\text{ Tris}}$

1 mM EDTA $\rightarrow$ 0.001 M EDTA $\times \frac{372.24\,g}{mol}$ = $\boxed{0.37\,g\ \text{EDTA}}$

(0.05% Tween)(1 L) = $\boxed{0.5\,mL\ \text{Tween 20}}$

Methanol Peroxide solution

(100% MeOH) V_1 = (80% MeOH)(0.05 L)

$\Rightarrow$ $\boxed{40\,mL\ \text{of MeOH}}$

(0.6% H_2O_2)(50 mL) = 3% V_1

$\Rightarrow$ $\boxed{10\,mL\ \text{of } 3\%\ H_2O_2}$

No additional water is needed?

5% Goat Serum in 2.5% w/v BSA blocking solution

Note w/v is g/mL. Hence

2.5% w/v = $\frac{2.5\,g}{100\,mL}$ x 25 mL = $\boxed{0.625\,g\ \text{BSA}}$

(5% Goat Serum)(25 mL) = (100% Serum) V_1

$\Rightarrow$ $\boxed{1.25\,mL\ \text{Goat Serum}}$

Need 25 mL − 1.25 mL, but should add water until 25 mL mark is reached?

6) a) Write the chemical equation for $CaCl_{2(s)}$ dissolving in water.

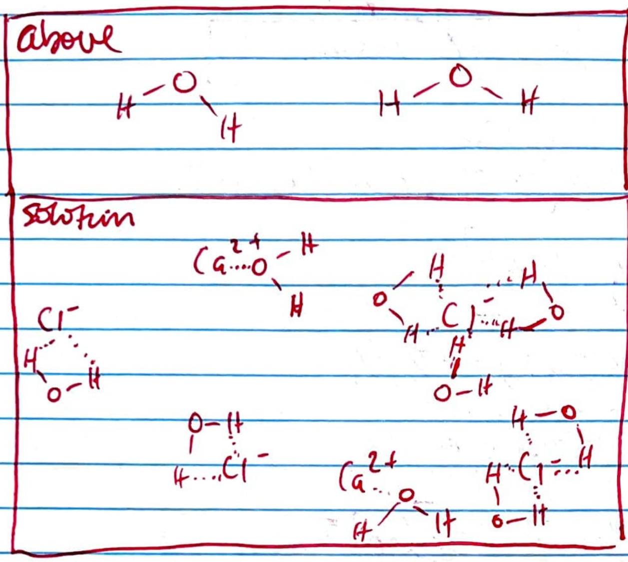
$$CaCl_{2(s)} \xrightarrow{H_2O} Ca^{2+}_{(aq)} + 2Cl^-_{(aq)}$$

b) Draw a molecular picture of $CaCl_2$ in solution.

2 molecules of $CaCl_2$: $2Ca^{2+}$, $4Cl^-$

$$X_{solute} = \frac{\text{moles solute}}{\text{moles solute} + \text{moles solvent}}$$

$\Rightarrow \frac{1}{6} = \frac{2}{2+x} \Rightarrow$ 9 molecules of water needed



c) Explain on a molecular level what happens to the vapor pressure of water when you add $CaCl_2$.

Adding solute changes IMFs present. Pure water only has H-Bonding. Adding ions ⇒ adding ionic - H-bonding interactions, which are stronger. Thus more energy required to go to the gas phase relative to pure water lowering the amount of H_2O in gas.

This is only true if your solute is nonvolatile ?

7) You discover an unlabeled organic compound (made of C & H only) in lab and decide to use freezing point depression to determine its molecular weight. You dissolve 6.45 g of the unknown in benzene (523.6 mL). The freezing point of the solution is now 5.02°C. What is the molecular weight of the compound?

$\Delta T_f = K_f m$

$\Delta T_f = 5.50 - 5.02 = 0.48°C = 0.48K$ (since $\Delta °C = \Delta K$)

$m = \frac{\Delta T_f}{K_f} = \frac{0.48K}{4.9K\ kg/mol} = 0.0980 \frac{mol\ unknown}{kg\ benzene}$

$$\frac{0.0980 \text{ moles unknown}}{\text{Kg Benzene}} \times \frac{1\text{Kg}}{1000\text{g}} \times \frac{0.08765\text{g Benzene}}{\text{ml}} \times 523.6 \text{ ml Benzene}$$

$$= 0.0450 \text{ mol Unknown.}$$

$$MW = \frac{6.45\text{g}}{0.0450} = \boxed{143 \text{ g/mol}}$$

$C_{10}H_{22}$ decane has a MW of 142 g/mol so it is likely that.