IB/Diff Chem: Solutions Wkst 2 Name: Answer Key

Be sure to include all your work. This includes any and all equations used, conversions and units.

1. A 32.0% by weight solution of propanol, C_3H_7OH, in water has a density at 20 °C of 0.945 g/mL. What are the molarity and molality of the solution?

$$\frac{mol}{L}: \frac{32.0\ g\ C_3H_7OH}{100\ g\ C_3H_7OH(aq)} \left| \frac{1\ mol\ C_3H_7OH}{60.11\ g\ C_3H_7OH} \right| \frac{0.945\ g\ C_3H_7OH(aq)}{1\ mL\ C_3H_7OH(aq)} \left| \frac{1000\ mL}{1\ L} \right. = 5.03\ M\ C_3H_7OH$$

$$\frac{mol}{kg}: \frac{32.0\ g\ C_3H_7OH}{68.0\ g\ H_2O} \left| \frac{1\ mol\ C_3H_7OH}{60.11\ g\ C_3H_7OH} \right| \frac{1000\ g}{1\ kg} = 7.83\ m\ C_3H_7OH$$

2. How many liters of ammonia at 25.0 °C and 1.46 atm are required to prepare 3.00 L of a 2.50 M solution of NH_3?

$$NH_3 + H_2O \rightarrow NH_4OH \quad ; \quad 1\ mol\ NH_3 : 1\ mol\ NH_4OH$$

$$\frac{3.00\ L\ NH_3(aq)}{} \left| \frac{2.50\ mol\ NH_3}{1\ L\ NH_3(aq)} \right| \frac{0.0821\ L \cdot atm}{mol \cdot K} \left| \frac{(25.0+273.15)\ K}{1} \right| \frac{}{1.46\ atm} = 126\ L\ NH_3$$

3. Calculate the percent by mass and the molality in terms of $CuSO_4$ for a solution prepared by dissolving 11.5 g of $CuSO_4.5H_2O$ in 1.00 x 10^2 mL of water.

$$\frac{11.5\ g\ CuSO_4 \cdot 5H_2O}{} \left| \frac{1\ mol\ CuSO_4 \cdot 5H_2O}{249.72\ g\ CuSO_4 \cdot 5H_2O} \right| \frac{5\ mol\ H_2O}{1\ mol\ CuSO_4 \cdot 5H_2O} \left| \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} \right. = 4.15\ g\ H_2O$$

$$\%\ mass = \frac{(11.5-4.15)\ g\ CuSO_4}{(11.5+100)\ g\ CuSO_4(aq)} = 6.60\%$$

$$\frac{(11.5-4.15)\ g\ CuSO_4}{} \left| \frac{1\ mol\ CuSO_4}{159.62\ g\ CuSO_4} \right| \frac{}{104.15\ g\ H_2O} \left| \frac{1000\ g}{1\ kg} \right. = 0.442\ m\ CuSO_4$$

4. What is the molarity of H_3PO_4 in a solution that is prepared by dissolving 10.0 g of P_4O_{10} in sufficient water to make 0.500 L of solution?

$$P_4O_{10(s)} + 6H_2O_{(l)} \rightarrow 4H_3PO_{4(aq)}$$

$$\frac{10.0\ g\ P_4O_{10}}{} \left| \frac{1\ mol\ P_4O_{10}}{283.88\ g\ P_4O_{10}} \right| \frac{4\ mol\ H_3PO_4}{1\ mol\ P_4O_{10}} \left| \frac{}{0.500\ L} \right. = 0.282\ M\ H_3PO_4$$

5. A sample of $HgCl_2$ weighing 9.41 g is dissolved in 32.75 g of ethanol, C_2H_5OH (K_b=1.20 °C/m). The boiling point elevation of the solution is 1.27 °C. Is $HgCl_2$ an electrolyte in ethanol? Show your calculations.

$$\Delta T_b = i K_b m \qquad i = \frac{\Delta T_b}{K_b m}$$

$$\frac{1.27\ °C}{} \left| \frac{mol\ HgCl_2}{1.20\ °C\ kg\ EtOH} \right| \frac{}{9.41\ g\ HgCl_2} \left| \frac{271.49\ g\ HgCl_2}{1\ mol\ HgCl_2} \right| \frac{32.75\ g\ EtOH}{} \left| \frac{1\ kg}{1000\ g} \right. = 1$$

if $i = 1$ Then there is 1 particle in solution = nonelectrolyte

6. The sugar fructose contains 40.0% C, 6.7% H, and 53.3% O by mass. A solution of 11.7 g of fructose in 325 g of ethanol has a boiling point of 78.59 °C. The boiling point of ethanol is 78.35 °C and the K_b is 1.20 °C/m. What is the molecular formula of fructose?

EF:

$$\frac{40.0\ g\ C}{} \left| \frac{1\ mol\ C}{12.01\ g} \right. = \frac{3.33\ mol\ C}{3.33} = 1\ CH_2O$$

$$\frac{6.7\ g\ H}{} \left| \frac{1\ mol\ H}{1.01\ g} \right. = \frac{6.63\ mol\ H}{3.33} = 2$$

$$\frac{53.3\ g\ O}{} \left| \frac{1\ mol\ O}{16.00\ g} \right. = \frac{3.33\ mol\ O}{3.33} = 1$$

$$\Delta T_b = i K_b \frac{mol}{kg} \qquad mol = \frac{\Delta T_b \cdot kg}{i \cdot K_b}$$

$$\frac{(78.59-78.35)\ °C}{} \left| \frac{mol}{1.20\ °C\ kg} \right| \frac{0.325\ kg\ EtOH}{1} = 0.065\ mol$$

$$m.m. = \frac{11.7\ g\ Fru}{0.065\ mol\ Fru} = \frac{180\ g/mol}{30\ g/mol} = 6$$

$(CH_2O) \cdot 6 = C_6H_{12}O_6$