Chem1403 Worksheet
Concentration Problems Key

1. **5.8900g of NaCl was added into 100.00mL volumetric flask. The flask was then filled up with water to the mark. What is the molarity of the solution?**

$$mol\ of\ NaCl = \frac{5.8900g}{58.443\ g/mol} = .10079\ mol$$

$$M = \frac{mol\ of\ solute}{L\ of\ solution} = \frac{.10079\ mol\ NaCl}{.10000L} = 1.0079M$$

2. **Calculate the mass of solid H_3PO_4 is needed to prepare a solution of 2.5M solution in 500.0mL of water**

$$M = \frac{mol\ of\ solute}{L\ of\ solution} \rightarrow mol\ of\ solute = M(L\ of\ solution) = 2.5(.5000) = 1.25mol$$

$$mass\ of\ H_3PO_4 = 1.25\ (97.995) = 122.49gH_3PO_4$$

3. **How much water is needed to prepare a solution of 0.80M of KOH if 3.8909g is used?**

$$mol\ of\ KOH = \frac{3.8909g}{56.106\ g/mol} = 0.06935\ mol$$

$$M = \frac{mol\ of\ solute}{L\ of\ solution} \rightarrow L\ of\ solution = \frac{mol\ of\ solute}{M} = \frac{.06935\ mol}{.80M}$$

$$= .08668L\ or\ 86.68mL$$

4. **20.00mL of 0.00500M solution of H_2SO_4 is transferred to 100.00mL volumetric flask and diluted to the mark. What is the final concentration of that weak acid solution?**

$$M_1V_1 = M_2V_2$$

$$M_2 = \frac{M_1V_1}{V_2} = \frac{(.00500M)(20.00mL)}{(100.00mL)} = .00100M$$

5. **5.8900g of NaCl was added into 250.00mL of water. What is the molality of the solution?**

$$mol\ of\ NaCl = \frac{5.8900g}{58.443\ g/mol} = .10079\ mol$$

$$m = \frac{mol\ of\ solute}{kg\ of\ solvent} = \frac{.10079\ mol\ NaCl}{.25000\ kg} = 0.40316m$$

*Notes: as density of water is 1.0 g/mL. Therefore, 250.00mL of water = 250.00g of water

6. **Calculate the molality of the Na^{2+} ion by adding 2.5000g of Na_2SO_4 into 150.00mL of water.**

$$Na_2SO_4 \ \rightarrow 2Na^{2+} + SO_4^{2-}$$

$$mol\ of\ Na_2SO_4 \ = \frac{2.5000g}{142.042\ g/mol} = \ .017600\ mol$$

$$m = \frac{mol\ of\ solute}{kg\ of\ solvent} = \frac{.17600\ mol\ Na_2SO_4}{.15000\ kg} = 1.1733m\ or\ 1.1733\frac{mol\ Na_2SO_4}{kg}$$

$$1.1733\frac{mol\ Na_2SO_4}{kg}\left(\frac{2\ mol\ Na^{2+}}{1\ mol\ Na_2SO_4}\right) = \ 2.3466\frac{mol\ Na^{2+}}{kg}\ or\ 2.3466m\ Na^{2+}$$

7. **A solution contained 28.9909g of water (H_2O), 5.4900g of hydrochloric acid (HCl) and 0.4599g of cisplatin. What is mass percent of cisplatin?**

$$Mass\ \%\ of\ A = \left(\frac{mass_A}{mass_A +\ mass_B + mass_C}\right) \times\ 100$$

$$Mass\ \%\ of\ cisplatin = \left(\frac{mass_{cisplatin}}{mass_{cisplatin} +\ mass_{H_2O} + mass_{HCl}}\right) \times\ 100$$

$$Mass\ \%\ of\ cisplatin = \left(\frac{0.4599}{0.4599 +\ 28.9909 + 5.4900}\right) \times\ 100 = 1.316\%$$

8. **A solution of ethyl acetate is 72% water. If the density of pure ethyl acetate is .902 g/mL and the molecular weight is 88.11 g/mol, calculate the molarity of the solution.**

Assume we have 100mL of solution = 100% solution

$$\%\ water + \%\ ethyl\ acetate = 100\%$$

$$\%\ ethyl\ acetate = 100\% - \%\ water = \ \ 100 - 72 = 28\%$$

Therefore, volume of ethyl acetate is 28mL

$$28mL\ ethyl\ acetate\ \left(\frac{.902\ g}{mL}\right)\left(\frac{1\ mol}{88.11g}\right)\left(\frac{1}{100mL\ solution}\right)\left(\frac{1000mL}{1L}\right) = \ 2.866M$$

9. **A 2.7M solution is found to be composed of 2.3% by mass of an unknown organic compound. The density of the solution was experimentally determined to be 1.48g/mL. In order for Dr. Belford to identify the compound, he must know the molecular mass. Calculate the molecular mass of the unknown compound.**

Assume we have 100g of solution = 100% solution

Therefore, we have 2.3g of unknown organic compound

$$\frac{2.3g\ of\ unknown}{100\ g\ of\ solution}\left(\frac{1.48g\ solution}{1\ mL\ solution}\right)\left(\frac{1000mL}{1L}\right)\left(\frac{1L\ solution}{2.7\ mol\ unknown}\right) = 12.60\ g/mol$$

10. **Calculate the parts per million of 3.00L solution of 1.79 x 10^{-3} M Rb_2SO_3. The molecular weight of Rb_2SO_3 is 250.999g/mol**

$$ppm = \frac{g\ of\ solute}{10^6 g\ solution}\ or\ \frac{mg\ solute}{L\ solution}$$

$$mass\ of\ solute = \frac{1.79\ \times\ 10^{-3}\ mol\ Rb_2SO_3}{1L\ solution}\left(\frac{3.00L\ solution}{1}\right)\left(\frac{250.999g\ Rb_2SO_3}{mol}\right)\left(\frac{1000mg}{1g}\right) = 1347.86\ mg$$

$$ppm = \frac{1347.86\ mg}{3.00\ L\ solution} = 449.29\ ppm$$

11. **Calculate the parts per billion of 6.20L of a 2.77 x 10^{-6}M solution of $Zn(NO_3)_2$. The molecular weight of $Zn(NO_3)_2$is 189.390g/mol.**

$$ppb = \frac{g\ of\ solute}{10^9 g\ solution}\ or\ \frac{\mu g\ solute}{L\ solution}$$

$$mass\ of\ solute = \frac{2.77\ \times\ 10^{-6}\ mol\ Zn(NO_3)_2}{1L\ solution}\left(\frac{6.20L\ solution}{1}\right)\left(\frac{189.390g\ Zn(NO_3)_2}{mol}\right)\left(\frac{10^6 \mu g}{1g}\right) = 3252.58\ \mu g$$

$$ppb = \frac{3252.58\ \mu g}{6.20\ L\ solution} = 524.61\ ppb$$