Solution Concentrations Worksheet (Section 12.3)

Name _____ **Period:** _____

Measuring Concentration: There are several different ways to measure and express the concentration of a solution. Molarity (Section 12.3) the term we learned earlier, refers to the concentration of a solution expressed in moles of solute per liter of solution. We also use several other units, including the following:

1. Percent by Mass $\frac{\text{mass of solute (g)}}{\text{mass of solution (g)}} \text{x}100\%$
2. Percent by Volume $\frac{\text{volume of solute (mL)}}{\text{volume of solution (mL)}} \text{x}100\%$
3. Mass/Volume Percent $\frac{\text{mass of solute (mg)}}{\text{volume of solution (dL)}}$ x100% (units are used in medicine)
4. Parts per million $\frac{1\text{ g of solute}}{1 \text{ x } 10^6 \text{ g of solution}}$

   For this type of unit, these equivalents work for water solutions:

   1 ppm = 1 mg/L 1 ppb = 1μg/L 1 ppt = 1 ng/L

   ppm = parts per million ppb = billion ppt = trillion
5. Molality $\frac{\text{amount of solute (mol)}}{\text{mass of solvent (kg)}}$ this unit is independent of temperature

Problems – Do work on Separate Paper. Show Dimensional Analysis.

1. Glucose is a sugar that is found abundantly in nature. What is the percent by mass of a solution made by dissolving 163 g of glucose in 755 g of water? Do you need to know the formula of glucose? Why or why not?
2. What is the mass percent sucrose in a solution obtained by mixing 225 g of an aqueous solution that is 6.25% sucrose by mass with 135 g of an aqueous solution that is 8.20% sucrose by mass?
3. Determine the volume percent of toluene in a solution made by mixing 40.0 mL toluene with 75.0 mL of benzene.
4. What is the concentration of Na^+, in parts per million by mass, in 0.00152 M Na_2SO_4?
5. What is the molality of a solution prepared by dissolving 225 mg of glucose ($C_6H_{12}O_6$) in 5.00 mL of ethanol (density = 0.789 g/mL)
6. How many milliliters of water (density = 0.998 g/mL) are required to dissolve 25.0 g of urea ($CO(NH_2)_2$) in order to produce a solution that is 1.65 *m*? (*m* is the abbreviation for molality)
7. Describe the process you would use in order to prepare 5.00 kg of an aqueous solution that is 8.00% NaCl by mass.
8. What is the mass percent of solute when 4.12 g is dissolved in 100.0 g of water?
9. What is the volume percent of 10.00 g of acetone (d = 0.789 g/mL) in 1.55 L of an acetone-water solution?
10. On average, glucose makes up about 0.10% of human blood, by mass. What is the approximation concentration of glucose in blood in milligrams per deciliter? (You have to assume something about blood).
11. Convert 0.0035% NaCl by mass into parts per million of NaCl.
12. Convert 2.4 ppm F^- into molarity of fluoride ion.
13. Calculate the molality of a solution prepared by dissolving 125 mL of pure methanol (density = 0.791 g/mL) into 275 g of ethanol.

Concentrations Worksheet KEY

1. 163 g glucose/918 g soln x 100% = 17.8% glucose

2.

$$\frac{[(6.25\% \text{ x } 225\text{mL}) \ + \ (8.20\% \text{ x } 135\text{mL})] \text{ g sucrose}}{(225 \ + \ 135)\text{g solution}} \text{ x } 100\% \ = \ 6.98\%$$

3. 40.0 mL/115 mL x 100 % = 34.8%

4. $$\frac{0.00152 \text{ mol } Na_2SO_4}{L} \text{ x } \frac{2 \text{ mol } Na^+}{1 \text{ mol } Na_2SO_4} \text{ x } \frac{22.9898 \text{ g}}{\text{mol } Na^+} \text{ x } \frac{1000 \text{ mg}}{\text{g}} = 69.9 \text{ mg/L or ppm}$$

5. $$\frac{225 \text{ mg } \frac{1 \text{ g}}{1000 \text{ mg}} \text{ x } \frac{1 \text{ mol glucose}}{180.158 \text{ g}}}{5.00 \text{ mL } \frac{0.789 \text{ g}}{\text{mL}} \text{ x } \frac{1 \text{ kg}}{1000 \text{ g}}} = 0.317 \, m$$

6. $$\frac{1 \text{ kg water}}{1.65 \text{ mol urea}} \text{ x } \frac{1 \text{ mol urea}}{60.055 \text{ g}} \text{ x } 25.0 \text{ g urea x } \frac{1000 \text{ g}}{\text{kg}} \text{ x } \frac{1 \text{ mL}}{0.998 \text{ g}} = 253 \text{ mL water}$$

7. 5.00 kg x 8.00% = 400. g NaCl, so dissolve 400. g NaCl in 4.60 kg of water to make solution

8. 4.12 g solute/104.12 g solution x 100% = 3.96 %

9. $$\frac{10.00\text{ g x }\dfrac{1\text{ mL}}{0.789\text{ g}}}{1.55\text{ L x }\dfrac{1000\text{ mL}}{\text{L}}}\text{ x }100\% = 0.818\%$$

10. $$\frac{0.10\text{ g glucose}}{100\text{ g blood}}\text{ x }\frac{1\text{ g}}{1\text{ mL}}\text{ x }\frac{1000\text{ mg}}{\text{g}}\text{ x }\frac{100\text{ mL}}{\text{dL}} = 1.0\text{ x }10^{2}\text{ mg/dL}$$

11. $$\frac{0.0035\text{ g NaCl}}{100\text{ g solution}}\text{ x }\frac{1\text{ g}}{1\text{ mL}}\text{ x }\frac{1000\text{ mL}}{\text{L}}\text{ x }\frac{1000\text{ mg}}{\text{g}} = 35\text{ mg/L or ppm}$$

12. $$\frac{2.4\text{ mg F}^{-}}{\text{L}}\text{ x }\frac{1\text{ g}}{1000\text{ mg}}\text{ x }\frac{1\text{ mol F}^{-}}{18.9984\text{ g}} = 1.3\text{ x }10^{-4}\text{ M F}^{-}$$

$$\frac{125\text{ mL}\,\dfrac{0.791\text{ g}}{\text{mL}}\text{ x }\dfrac{1\text{ mol CH}_3\text{OH}}{32.042\text{ g}}}{275\text{ g x }\dfrac{1\text{ kg}}{1000\text{ g}}} = 11.2\ m$$