Solutions Molarity Worksheet Name: ______KEY______

U7LM1B-WS-Key

1. When we dissolve a cube of sugar in one cup of water, we create a **homogeneous** mixture. Such mixture is called **a solution.** The sugar is the **solute** and water is the **solvent.**

2. The molarity of a solution is defined as the **moles** of solute per **liter of solution**. Molarity is abbreviated as ***M***. When the solvent is water, we have an **aqueous** solution.

3. A 3 *M* aqueous calcium nitrate solution contains **$Ca(NO_3)_2$** in **H_2O**. We can write the molarity of this solution as unit factor as follows: **moles/liter ($^{mol}/_{L}$)**.

4. One liter calcium nitrate solution contains **one** mole of calcium ions and **two** moles of nitrate ions.

5. The concentration of a solution can also be expressed in mass percent. A 5% aqueous sodium bromide solution contains **5 grams NaBr** in **100g of solution**. We can write the mass percent of a solution as a unit factor as follows: **grams/grams x 100% ($^{w}/_{w}$%).**

6. What is the number of moles of silver nitrate in a 125 mL solution that is 0.125 M? **0.0156 moles $AgNO_3$**

   You should recognize from question 2 that 0.125M is the same as 0.125mol/1L.

   Moles = 125~~mL soln~~. x $\frac{1\cancel{L}}{1000\cancel{mL}}$ x $\frac{0.125\text{mol } AgNO_3}{1\cancel{\text{L soln.}}}$ = 0.015625 moles $AgNO_3$ … 3 sig figs… 0.0156 moles

7. How many grams of calcium acetate are present in 225 mL solution that is 1.20 M? **42.7g $Ca(C_2H_3O_2)_2$**

   225~~mL soln~~. x $\frac{1\cancel{L}}{1000\cancel{mL}}$ x $\frac{1.20\ \cancel{\text{mol } Ca(C_2H_3O_2)_2}}{1\cancel{\text{L soln.}}}$ x $\frac{158.17\text{ g } Ca(C_2H_3O_2)_2}{1\ \cancel{\text{mol } Ca(C_2H_3O_2)_2}}$ = 42.7059… 3 sig figs…

8. What mass of glucose, $C_6H_{12}O_6$, is needed to prepare a 250. mL of solution that is 1.50 M glucose solution?

   Note: the decimal point indicates that the zero *is* significant. By this point you can probably convert mL to L on your own.

   0.250~~L soln~~. x $\frac{1.50\ \cancel{\text{mol } C_6H_{12}O_6}}{1\cancel{\text{L soln.}}}$ x $\frac{180.18\text{ g } C_6H_{12}O_6}{1\ \cancel{\text{mol } C_6H_{12}O_6}}$ = 67.5675… 3 sig figs… **67.6 g $C_6H_{12}O_6$**

9. What volume of a 0.150 M NaOH solution contains 2.50 g of sodium hydroxide?

   Remember that in dimensional analysis, the numerator and denominator are allowed to trade places so long as the proportion remains the same. (It's the equivalent of multiplying by 1.) You'll see here that the molar mass (g/mol) and concentration (mol/L) are 'upside down.' If you happened to perform the dimensional analysis beginning with the concentration, you will end up with 1/L or L^{-1}. To get the unit in the right place, you simply need to take invert your answer. That is $1/(^{1}/L)$ to get L.

   2.50 ~~g NaOH~~. x $\frac{1\ \cancel{\text{mol NaOH}}}{40.00\ \cancel{\text{g NaOH.}}}$ x $\frac{X\text{ L NaOH}}{0.150\ \cancel{\text{mol NaOH}}}$ = 0.41666… 3 sig figs… **0.417 L NaOH**

   You can also take the definition of molarity, M = mol/L, and the definition of molar mass, mm=g/mol... solve for mol in the latter (mol =g/mm) and plug it into the former to get M = g/(mm*L). Solving for liters gives L = g/(mm*M). It's the same!

10. What is the molarity of potassium chlorate prepared my mixing 45.0 g of $KClO_3$ to make 600. mL solution?

    45.0 ~~g $KClO_3$~~. x $\frac{1\text{ mol } KClO_3}{39.10\ \cancel{\text{g } KClO_3}.}$ x $\frac{1}{0.600\text{L soln}}$ = 1.918 $^{mol}/_{L}$… 3 sig figs… **1.92 M**

11. Given a 2.0 M ammonium sulfide, $(NH_4)_2S$:

    a. What is the molarity of ammonium ions?

    $\frac{2.0\ \cancel{\text{mol } (NH_4)_2S}}{1\text{ L soln.}}$ x $\frac{2\text{ mol } NH_4^+}{1\ \cancel{\text{mol } (NH_4)_2S}}$ = 4.0 $^{mol}/_{L}$… 2 sig figs… **4.0 M NH_4^+**

    b. What is the molarity of the sulfide ions?

    $\frac{2.0\ \cancel{\text{mol } (NH_4)_2S}}{1\text{ L soln.}}$ x $\frac{1\text{ mol } S^{2-}}{1\ \cancel{\text{mol } (NH_4)_2S}}$ = 2.0 $^{mol}/_{L}$… 2 sig figs… **2.0 M S^{2-}**

12. What is the molarity of the individual ions in a 225 mL solution that contains 12.5 g of aluminum sulfate?

$\frac{12.5 \cancel{g\ Al_2(SO_4)_3}}{0.225\ L\ soln.} \times \frac{1 \cancel{mol\ Al_2(SO_4)_3}}{342.17 \cancel{g\ Al_2(SO_4)_3}} \times \frac{5\ mol\ ions}{1 \cancel{mol\ Al_2(SO_4)_3}}$ = 0.8118 $^{mol}/_{L}$ … 3 sig figs… **0.812 M total ions**

13. If 117 g of a compound are dissolved in 500.0 mL of water to give 4.0 M solution, what is the molar mass of this compound?

See the explanation in problem 8 on how to use the definition of molar mass and molarity. The equations can be arranged to: mm = g/(L*M) or…

$\frac{117\ g\ Unknown}{0.500 \cancel{L\ soln.}} \times \frac{1 \cancel{L\ soln}}{4.0\ mol\ Unknown}$ = 58.50 $^{g}/_{mol}$ … 2 sig figs… **58 $^{g}/_{mol}$**