KEY

Molarity Review Problems

- **Calculating the molarity of a solution**

1. Calculate the molarity of a solution made by dissolving 20.631 g $Ca(NO_3)_2$ in enough water to make 475mL of solution.

.475L $2.631\text{g } Ca(NO_3)_2 \left(\frac{1\text{mol } Ca(NO_3)_2}{164.1\text{g } Ca(NO_3)_2}\right) = .016\text{ mol } Ca(NO_3)_2$

$M = \frac{.016\text{mol}}{.475\text{L}} = \boxed{.0338\text{ M } Ca(NO_3)_2}$

2. Calculate the molarity of a solution made when 8.956 g NaCl is dissolved in enough water to make 200mL of solution.

$8.956\text{g NaCl} \left(\frac{1\text{mol NaCl}}{58.44\text{g}}\right) = .15325\text{mol NaCl}$

$M = \frac{.15325\text{mol}}{.200\text{L}} = \boxed{.7663\text{M NaCl}}$

3. If a K_2CO_3 solution has a molarity of 3.00, what is the molarity of the K^+ in the solution? (Remember that the K_2CO_3 dissociates in solution, how many K^+ are there for each K_2CO_3?)

$2 \times 3.00 = \boxed{6.00\text{ M } K^+}$

- **Using Molarity as a conversion factor.**

4. How many moles of NaCl are there in a 45.00mL sample of 2.50M NaCl solution?

$45.00\text{mL} \left(\frac{10^{-3}\text{ L}}{1\text{ mL}}\right)\left(\frac{2.50\text{mol}}{1\text{ L soln}}\right) = \boxed{.1125\text{mol NaCl}}$

5. What volume (liters is fine) of a 3.59M solution of LiCl contains 5.00 moles of LiCl?

$$5.00 \text{ mol LiCl} \left(\frac{1 \text{ L LiCl}}{3.59 \text{ mol LiCl}}\right) = \boxed{1.39 \text{ L LiCl}}$$

6. What is the mass of $Mg(NO_3)_2$ that is contained in a 26.5mL sample of .25M $Mg(NO_3)_2$ solution?

MM = 148.33 g/mol

$$.0265 \text{ L} \left(\frac{.25 \text{ mol } Mg(NO_3)_2}{1 \text{ L}}\right)\left(\frac{148.33 \text{ g}}{1 \text{ mol}}\right) = \boxed{.983 \text{ g } Mg(NO_3)_2}$$

7. I need 4.67 g of CsBr for a reaction. I found a bottle of CsBr solution in the stock room that has a concentration of 0.358M. How many mL of the solution do I need?

$$4.67 \text{ g CsBr} \left(\frac{1 \text{ mol CsBr}}{212.81 \text{ g}}\right)\left(\frac{1 \text{ L CsBr}}{.358 \text{ mol CsBr}}\right) = .0613 \text{ L}$$

$$= \boxed{61.3 \text{ mL}}$$

8. An industry wants 15.00 L of a 4.25M solution of NH_4NO_3. How many grams of NH_4NO_3 are needed to make the solution?

$$15.00 \text{ L} \left(\frac{4.25 \text{ mol}}{1 \text{ L}}\right)\left(\frac{80.06 \text{ g}}{1 \text{ mol}}\right) = \boxed{5,104 \text{ g } NH_4NO_3}$$

- **Molarity in stoichiometry.**

9. Consider the reaction:

$K_2S\ (aq) + Co(NO_3)_2(aq) \rightarrow 2\ KNO_3\ (aq) + CoS(s)$

What volume of .750M K_2S is needed to form 5.00g of CoS?

$$5.00g\ CoS\left(\frac{1mol\ CoS}{90.99g\ CoS}\right)\left(\frac{1mol\ K_2S}{1mol\ CoS}\right)\left(\frac{1L}{.750mol\ K_2S}\right)$$

$$= .0733L$$

If you used the amount of K_2S you calculated above, but only recovered 3.98g of CoS instead of the 5.00 g you thought you would make, what is the percent yield of the reaction?

AY

TY

$$\frac{3.98g}{5.00g} \times 100 = 79.6\%$$

10. Use the reaction in the problem above to answer the following question. If I want to react 50.0mL of .95M $Co(NO_3)_2$ completely, what volume of .465M K_2S solution would I need?

$$.050L\left(\frac{.95mol\ Co(NO_3)_2}{1L}\right)\left(\frac{1mol\ K_2S}{1mol\ Co(NO_3)_2}\right)\left(\frac{1L\ K_2S}{.465mol\ K_2S}\right) =$$

$$.102L\ K_2S$$

11. What volume of 6.0M H_2SO_4 is needed to react with 14.20g of Aluminum in the following reaction?

$\underline{2}\ Al(s) + \underline{3}\ H_2SO_4(aq) \rightarrow \underline{\quad}\ Al_2(SO_4)_3(aq) + \underline{3}\ H_2(g)$

$$14.20g\ Al \left(\frac{1\ mol\ Al}{26.98g\ Al}\right)\left(\frac{3\ mol\ H_2SO_4}{2\ mol\ Al}\right)\left(\frac{1L\ H_2SO_4}{6\ mol\ H_2SO_4}\right)$$

$$= \boxed{.132L\ H_2SO_4}$$

12. Using the reaction above, how many grams of H_2 will I form if I combine 3.58g Al with 50mL of .450M H_2SO_4?

$$3.58g\ Al \left(\frac{1\ mol\ Al}{26.98g\ Al}\right)\left(\frac{3\ mol\ H_2}{2\ mol\ Al}\right)\left(\frac{2.02g\ H_2}{1\ mol\ H_2}\right) = .402g\ H_2$$

$$.050L\ H_2SO_4 \left(\frac{.450\ mol\ H_2SO_4}{1L\ H_2SO_4}\right)\left(\frac{3\ mol\ H_2}{3\ mol\ H_2SO_4}\right)\left(\frac{2.02g\ H_2}{1\ mol\ H_2}\right)$$

LR

$$= \boxed{.0455g\ H_2}$$

↑

TY