

KEY

Molarity Review Problems

- Calculating the molarity of a solution

1. Calculate the molarity of a solution made by dissolving 20.631 g $\text{Ca}(\text{NO}_3)_2$ in enough water to make 475 mL of solution.

$$475\text{L} \quad 20.631\text{g Ca}(\text{NO}_3)_2 \left(\frac{1\text{mol Ca}(\text{NO}_3)_2}{164.1\text{g Ca}(\text{NO}_3)_2} \right) = 0.16\text{mol Ca}(\text{NO}_3)_2$$

$$M = \frac{0.16\text{mol}}{0.475\text{L}} = \boxed{0.338\text{M Ca}(\text{NO}_3)_2}$$

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

$$8.956\text{g NaCl} \left(\frac{1\text{mol NaCl}}{58.44\text{g}} \right) = 0.15325\text{mol NaCl}$$

$$M = \frac{0.15325\text{mol}}{0.200\text{L}} = \boxed{0.7663\text{M NaCl}}$$

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 ?)

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

- Using Molarity as a conversion factor.

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

$$45.00\text{mL} \left(\frac{10^{-3}\text{L}}{1\text{mL}} \right) \left(\frac{2.50\text{mol}}{1\text{L sol'n}} \right) = \boxed{0.1125\text{mol NaCl}}$$

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 $\text{Mg}(\text{NO}_3)_2$ that is contained in a 26.5mL sample of .25M $\text{Mg}(\text{NO}_3)_2$ solution?

$$\text{MM} = 148.33 \text{ g/mol}$$

$$.0265 \text{ L} \left(\frac{.25 \text{ mol Mg}(\text{NO}_3)_2}{1 \text{ L}} \right) \left(\frac{148.33 \text{ g}}{1 \text{ mol}} \right) = \boxed{.983 \text{ g Mg}(\text{NO}_3)_2}$$

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?

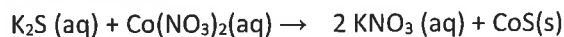
$$4.67 \text{ g CsBr} \left(\frac{1 \text{ mol CsBr}}{212.81 \text{ g}} \right) \left(\frac{1 \text{ L CsBr}}{.358 \text{ mol CsBr}} \right) = .0613 \text{ L}$$
$$= \boxed{61.3 \text{ mL}}$$

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?

$$15.00 \text{ L} \left(\frac{4.25 \text{ mol}}{1 \text{ L}} \right) \left(\frac{80.06 \text{ g}}{1 \text{ mol}} \right) = \boxed{5,104 \text{ g NH}_4\text{NO}_3}$$

- Molarity in stoichiometry.

9. Consider the reaction:



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

$$5.00\text{g CoS} \left(\frac{1\text{mol CoS}}{90.99\text{g CoS}} \right) \left(\frac{1\text{mol K}_2\text{S}}{1\text{mol CoS}} \right) \left(\frac{1\text{L}}{.750\text{mol K}_2\text{S}} \right)$$

$$= .0733\text{L}$$

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?

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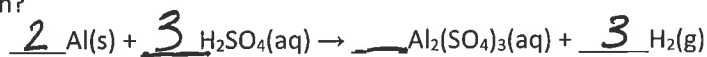
$$\frac{3.98\text{g}}{5.00\text{g}} \times 100 = 79.6\%$$

10. Use the reaction in the problem above to answer the following question. If I want to react 50.0mL of .95M $\text{Co(NO}_3)_2$ completely, what volume of .465M K_2S solution would I need?

$$.050\text{L} \left(\frac{.95\text{mol Co(NO}_3)_2}{1\text{L}} \right) \left(\frac{1\text{mol K}_2\text{S}}{1\text{mol Co(NO}_3)_2} \right) \left(\frac{1\text{L K}_2\text{S}}{.465\text{mol K}_2\text{S}} \right) =$$

$$.102\text{L K}_2\text{S}$$

11. What volume of 6.0M H₂SO₄ is needed to react with 14.20g of Aluminum in the following reaction?



$$14.20\text{g Al} \left(\frac{1 \text{ mol Al}}{26.98\text{g Al}} \right) \left(\frac{3 \text{ mol H}_2\text{SO}_4}{2 \text{ mol Al}} \right) \left(\frac{1 \text{ L H}_2\text{SO}_4}{6 \text{ mol H}_2\text{SO}_4} \right) = \boxed{.132 \text{ L H}_2\text{SO}_4}$$

12. Using the reaction above, how many grams of H₂ will I form if I combine 3.58g Al with 50mL of .450M H₂SO₄?

$$3.58\text{g Al} \left(\frac{1 \text{ mol Al}}{26.98\text{g Al}} \right) \left(\frac{3 \text{ mol H}_2}{2 \text{ mol Al}} \right) \left(\frac{2.02\text{g H}_2}{1 \text{ mol H}_2} \right) = .402\text{g H}_2$$

$$\underbrace{.050\text{L H}_2\text{SO}_4}_{\text{LR}} \left(\frac{.450 \text{ mol H}_2\text{SO}_4}{1 \text{ L H}_2\text{SO}_4} \right) \left(\frac{3 \text{ mol H}_2}{3 \text{ mol H}_2\text{SO}_4} \right) \left(\frac{2.02\text{g H}_2}{1 \text{ mol H}_2} \right) = \boxed{.0455\text{g H}_2}$$

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