

## Quantitative Analysis ----- Practice Review Quiz

(always give answers to correct number of significant figures)

1. An object has mass 14.45 g and volume 10.0 cm<sup>3</sup>. Calculate the object's density.

$$D = \text{mass/volume} = 14.45 \text{ g}/10.0 \text{ cm}^3 = 1.45 \text{ g/cm}^3$$

2. Name the following compounds

- a. FeO    iron(II) oxide                      b. Mg<sub>3</sub>N<sub>2</sub>    magnesium nitride  
c. CCl<sub>4</sub>    carbon tetrachloride                      d. CoPO<sub>4</sub>    cobalt phosphate

3. Calculate the number of moles of AgNO<sub>3</sub> in 15.0 g of AgNO<sub>3</sub>

$$\text{Moles} = \text{mass in grams/molar mass}$$

$$\text{Molar mass AgNO}_3 = 169.87 \text{ g/mol (use periodic table)}$$

$$\text{Moles} = 15.0 \text{ g} / 169.87 \text{ g/mol} = 0.0883 \text{ g}$$

4. Calculate the mass in grams of 2.00 moles of N<sub>2</sub>O<sub>3</sub>

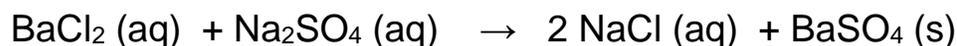
$$\text{Moles} = \text{mass in grams/molar mass}$$

$$\text{Rearranging: mass in grams} = \text{moles} \times \text{molar mass}$$

$$\text{Molar mass N}_2\text{O}_3 = 76.01 \text{ g/mol}$$

$$\text{Mass in grams} = 2.00 \text{ mol} \times 76.01 \text{ g/mol} = 152 \text{ g}$$

5. Calculate the mass of barium sulfate that will form when 10.0 g of barium chloride reacts completely according to the following reaction:



Convert 10.0 g  $\text{BaCl}_2$  to moles (as in Q3)

Molar mass  $\text{BaCl}_2 = 208.23 \text{ g/mol}$

Moles  $\text{BaCl}_2 = 10 \text{ g}/208.23 \text{ g/mol} = 0.0480 \text{ mol BaCl}_2$

Since 1 mole  $\text{BaCl}_2$  yields 1 mole  $\text{BaSO}_4$  from equation:

Moles  $\text{BaSO}_4$  formed = 0.0480 mol

Convert moles  $\text{BaSO}_4$  to grams (as in Q4)

Molar mass  $\text{BaSO}_4 = 233.38 \text{ g/mol}$

Mass  $\text{BaSO}_4$  formed =  $0.048 \text{ mol} \times 233.38 \text{ g/mol} = 11.2 \text{ g BaSO}_4$

6. 15.0 g of  $\text{Fe}(\text{NO}_3)_3$  reacts with 15.0 g  $\text{KOH}$  according to the following equation:



a. Calculate the limiting reactant

Convert masses to moles as in above questions.

Molar masses:  $\text{Fe}(\text{NO}_3)_3 = 241.86 \text{ g/mol}$      $\text{KOH} = 56.11 \text{ g/mol}$

Moles  $\text{Fe}(\text{NO}_3)_3 = 0.0620 \text{ mol}$     Moles  $\text{KOH} = 0.257 \text{ mol}$

So which is limiting (will be all used up) and which is in excess?

From equations, reactant ratio is 1:3

This means 0.0620 mol of  $\text{Fe}(\text{NO}_3)_3$  would require  $3 \times 0.0620 \text{ mol} (= 0.186 \text{ mol})$   $\text{KOH}$  to react completely

Since there are 0.257 mol of  $\text{KOH}$  (in the 15 g), the  $\text{KOH}$  is in excess and all the  $\text{Fe}(\text{NO}_3)_3$  will be used up – it is the limiting reactant since it will determine the mass of products that form, not the  $\text{KOH}$

b. Calculate the theoretical yield of  $\text{Fe}(\text{OH})_3$

Use the 15 g (0.0620 mol) of  $\text{Fe}(\text{NO}_3)_3$  (the limiting reactant) to calculate the mass of  $\text{Fe}(\text{OH})_3$  that forms (which is the theoretical yield)

Mole ratio is 1:1

That is, 0.0620 mol of  $\text{Fe}(\text{NO}_3)_3$  will form 0.0620 mol of  $\text{Fe}(\text{OH})_3$

Convert 0.0620 mol of  $\text{Fe}(\text{OH})_3$  to mass (as in above questions)

Molar mass of  $\text{Fe}(\text{OH})_3 = 106.866 \text{ g/mol}$

Recall: mass in grams = moles x molar mass

Mass of  $\text{Fe}(\text{OH})_3 = 0.062 \text{ mol} \times 106.866 \text{ g/mol} = 6.66 \text{ g Fe}(\text{OH})_3$

7. Calculate the molarity of 31.35 g of NaCl in 1.50 L of aqueous solution

Molarity = moles of solute (NaCl)/volume of solution

Convert 31.35 g NaCl to mol as in above questions - gives 0.536 mol NaCl

Molarity =  $0.536 \text{ mol}/1.50 \text{ L} = 0.357 \text{ M NaCl}$

8. Calculate the final concentration of a HCl solution prepared by diluting 100.0 mL of 12.1 M HCl to 250.0 mL.

For dilutions use  $M_1V_1 = M_2V_2$

Where  $M_1$  and  $V_1$  refer to initial molarity and volumes (the more concentrated solution) and  $M_2$  and  $V_2$  refer to final molarity and volumes (the diluted solution)

$$M_1 = 12.1 \text{ M}$$

$$V_1 = 100 \text{ mL}$$

$$M_2 = \text{unknown}$$

$$V_2 = 250 \text{ mL}$$

$$\text{Therefore, } M_2 = 4.84 \text{ M}$$

(You can leave volumes in mL since those units will cancel)