

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 cm³. 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. Mg₃N₂ magnesium nitride
c. CCl₄ carbon tetrachloride d. CoPO₄ cobalt phosphate

3. Calculate the number of moles of AgNO₃ in 15.0 g of AgNO₃

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

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

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

4. Calculate the mass in grams of 2.00 moles of N₂O₃

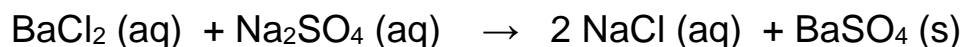
$$\text{Moles} = \text{mass in grams/molar mass}$$

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

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

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

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 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 BaCl_2 yields 1 mole BaSO_4 from equation:

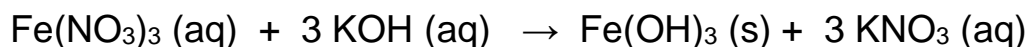
Moles BaSO_4 formed = 0.0480 mol

Convert moles BaSO_4 to grams (as in Q4)

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

Mass 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 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 $3 \times 0.0620 \text{ mol} (= 0.186 \text{ mol})$ KOH to react completely

Since there are 0.257 mol of KOH (in the 15 g), the 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 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)