5 Worksheet: Mole concept and stoichiometric calculations

QUESTION 1

1.1 Calculate how many CO_2 molecules there are in 8,8 g gas.

1.2 Calculate what volume of a 0,3 mol.dm^{-3} oxylic acid solution contains 22,5 g oxylic acid ($(COOH)_2$).

1.3 Calculate the how many sodium atoms must react **completely** to give 33,6 dm^3 hydrogen gas at STP.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2(g)$$

1.4 What mass of $KClO_3$ must decompose **completely** to produce 3,36 dm^3 of oxygen gas at STP?

$$2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$$

1.5 Consider the following reaction:

$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

The reaction take place in a container where CONDITIONS ARE NOT STP! Calculate the volume N_2O_5 that must decompose completely to produce 9,64 dm^3 nitogen dioxide.

1.6 A standard sodium carbonate solution is prepared by dissolving 5,3 g of the crystals in 250 cm^3 water. 25 cm^3 of this solution neutralises 10 cm^3 of a hydrochloric acid solution.

a. Calculate the concentration of the sodium carbonate solution.
b. Write a balanced equation for the neutralisation reaction.
c. Calculate the concentration of the hydrochloric acid.

1.7 Eastern Cape 2015 Preperatory exam Question 7.2:

> 0,28 g of potassium hydroxide is dissolved in water and titrated against a solution of sulphuric acid. The end point is reached after adding exactly 20 cm^3 of a sulphuric acid solution.The balanced equation for this reaction is:
>
> $$2KOH\ (aq) + H_2SO_4(\ell) \longrightarrow K_2SO_4\ (aq) + 2H_2O\ (\ell)$$
>
> Calculate the concentration of the sulphuric acid solution. (5)

(The following questions focus on study material covered in Video 3)

QUESTION 2

2.1 Sodium burns in oxygen accordng to the following equation:

$$4Na + O_2 \rightarrow 2Na_2O$$

483 g sodium is placed in a container with 5,8 mol oxygen gas..

a. Determine which substance acts as limiting agent. Show all calculations
b. Calculate the mass of sodium oxide that can be produced.

2.2 Two solutions are mixed:

Solution	Volume (cm^3)	Concentration ($mol \cdot dm^{-3}$)
H_2SO_4	200	0,2
KOH	100	0,3

Calculate the pH of the solution.

(Hint: Determine the mole and concentration that is left over from the reactant that is in excess after the reaction.)

(The following questions focus on study material covered in Video 4)

QUESTION 3

3.1 $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$

97,2 g Al reacts and produce 150 g aluminium oxide. Calculate the percentage yield.

3.2 In an experiment 8 g of unpure aluminium is added to an excess of sulphuric acid. The following reaction occurs:

$$2\ Al(s) + 3\ H_2SO_4(aq) \longrightarrow Al_2(SO_4)_3(aq) + 3\ H_2(g)$$

The volume of $H_2(g)$ that is produced is 6,72 dm^3. Calculate the percentage purity of the aluminium.

3.3 An impure magnesium sample with mass 0,45 g reacts with 200 cm^3 of a 0,2 $mol.dm^{-3}$ nitric acid solution. The acids is in excess. The acid that remain is neutralised by 35 cm^3 of a 0,2 $mol.dm^{-3}$ sodium hydroxide solution. Calculate percentage purity of the magnesium sample.

$$Mg + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H_2(g)$$

$$HNO_3 + NaOH \longrightarrow NaNO_3 + H_2O$$