QUANTITATIVE EQ BOOKLET

Leave blank

1. At a high temperature, calcium oxide reacts with carbon to form calcium carbide, CaC_2.

$$CaO(s) + 3C(s) \rightarrow CaC_2(s) + CO(g)$$

(a) Calcium oxide reacts with carbon to make 128 g of calcium carbide. Calculate

(i) the relative formula mass of calcium carbide.

(1)

(ii) the amount, in moles, of calcium carbide made in the reaction.

(1)

(iii) the minimum amount, in moles, of carbon that is required to make this amount of calcium carbide.

(1)

(iv) the minimum mass, in g, of carbon required.

(1)

(b) Calcium carbide reacts with water to make the gas ethyne, C_2H_2, and a compound of calcium.

(DATA INTERP/ APPLICATION OF KNOWLEDGE)

(i) Complete the chemical equation for this reaction:

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + \ldots\ldots\ldots\ldots\ldots\ldots$$

(1)

(ii) Ethyne, C_2H_2, is highly flammable.

(ORGANIC)

Predict the products of the complete combustion of ethyne.

.....

(2)

Leave blank

2. (a) Copper(II) carbonate reacts with dilute hydrochloric acid.
The equation for the reaction is

$$CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$$

An excess of copper(II) carbonate was added to a solution containing 0.200 mol of hydrochloric acid.

(i) Calculate the amount, in moles, of copper(II) carbonate that will react with 0.200 mol of hydrochloric acid.

(1)

(ii) Calculate the mass, in grams, of this amount of copper(II) carbonate.

(2)

(iii) Calculate the volume of carbon dioxide gas at room temperature and atmospheric pressure that will be formed in this reaction.
(The volume of 1 mol of any gas at room temperature and atmospheric pressure is 24 dm^3).

(2)

3

(a) A 5.55 g sample of calcium chloride ($M_r = 111$) is dissolved in water to make a solution.

(i) Calculate the amount, in moles, in the sample of calcium chloride.

.....

.....

.....

(2)

(ii) What amount, in moles, of sulphuric acid is needed to react completely with the calcium chloride solution?

CaCl2 + H2SO4 = CaSO4 + 2HCl

.....

.....

(1)

(iii) Calculate the relative formula mass of calcium sulphate. Use data from the Periodic Table on page 2.

.....

.....

(1)

(iv) Calculate the mass, in grams, of calcium sulphate formed.

.....

.....

.....

(2)

Leave blank

(b) The following equation represents a reaction used to prepare the salt lead(II) nitrate.

$$PbCO_3(s) + 2HNO_3(aq) \rightarrow Pb(NO_3)_2(aq) + H_2O(l) + CO_2(g)$$

In this experiment the amount of nitric acid used was 0.0400 mol.

(i) The concentration of the dilute nitric acid used was 0.500 mol dm^{-3}. Calculate the volume, in cm^3, of dilute nitric acid used.

(3)

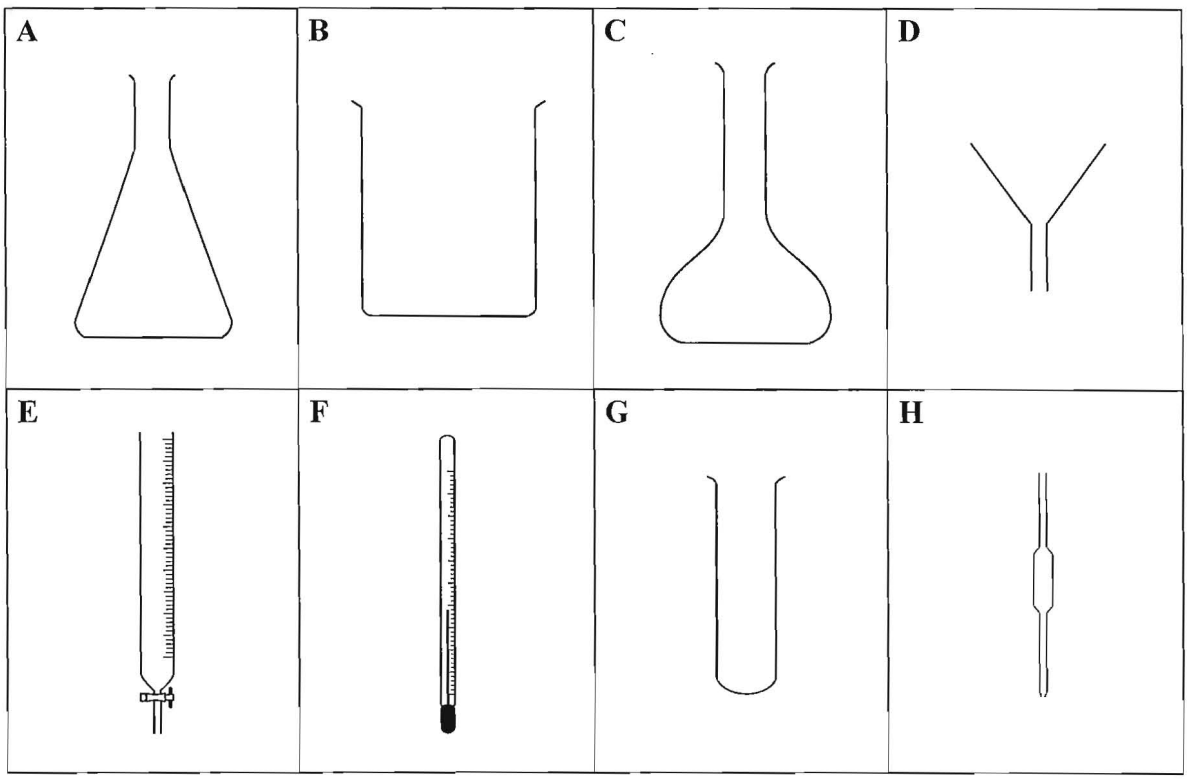
(ii) In this experiment, 0.0200 mol of carbon dioxide gas was produced. Calculate the volume, in cm^3, that this amount of carbon dioxide occupies at room temperature and pressure (rtp).
(molar volume of any gas = 24 000 cm^3 at rtp)

(1) **Q10**

Leave blank

4 An oven cleaner contains the alkali sodium hydroxide.

(a) A solution of the oven cleaner in distilled water is titrated with hydrochloric acid. Some of the following pieces of apparatus are used in this experiment.



Choose from the letters **A** to **G** to identify the pieces of apparatus in the table below.

Name of apparatus	Letter
Beaker	
Burette	
Conical flask	
Funnel	
Pipette	

(5)

(b) It is important to wear eye protection when using an alkali.
What property of alkalis makes this safety precaution necessary?

.....

(1)

Leave blank

(c) The diagrams show the readings on the burette before and after a student added the hydrochloric acid in one titration.

before

after

Use the diagrams to help you complete the table.

Burette reading after adding acid (cm^3)	
Burette reading before adding acid (cm^3)	
Volume of acid added (cm^3)	

(3)

(d) A second student did the titration four times.
The table shows the results.

Burette reading after adding acid (cm^3)	21.10	20.90	21.80	40.95
Burette reading before adding acid (cm^3)	0.30	0.80	1.45	20.50
Volume of acid added (cm^3)	20.80	20.10	20.35	20.45
Titration results to be used (✓)				

(i) Which titration results should be used to calculate the average volume of acid added? Place ticks (✓) in the table.

(1)

(ii) Use your ticked results to calculate the average volume of acid added.

(2)

Leave blank

5. A student wanted to find the concentration of a solution of nitric acid.

She placed a 25.0 cm^3 sample of the nitric acid solution in a conical flask and titrated it with 0.200 mol dm^{-3} sodium hydroxide solution, using phenolphthalein as an indicator. The phenolphthalein changed colour after she added a total of 21.05 cm^3 of the sodium hydroxide solution.

The equation for the reaction is:

$$NaOH(aq) + HNO_3(aq) \rightarrow NaNO_3(aq) + H_2O(l)$$

(a) State the colour change of the phenolphthalein.

.....

.....

(2)

(b) (i) Calculate the amount, in moles, of sodium hydroxide used in the titration.

(2)

(ii) Calculate the concentration, in mol dm^{-3}, of the nitric acid.

(2)

(c) (i) Calculate the relative formula mass of sodium nitrate.

(1)

5 (cont)

(ii) Calculate the mass of sodium nitrate formed in the titration.

(2)

6

(c) The reaction between dilute phosphoric acid and sodium hydroxide solution is represented by the equation

$$H_3PO_4 + 3NaOH \rightarrow Na_3PO_4 + 3H_2O$$

A sample of sodium hydroxide solution was titrated against dilute phosphoric acid. It was found that 25.0 cm^3 of sodium hydroxide solution was neutralised by 12.30 cm^3 of phosphoric acid of concentration 0.150 mol dm^{-3}.

(i) Calculate the amount, in moles, of phosphoric acid used in the titration.

(2)

(ii) Calculate the amount, in moles, of sodium hydroxide that would react with this amount of phosphoric acid.

(1)

(iii) Calculate the concentration, in mol dm^{-3}, of the sodium hydroxide solution.

(2)

Q9

(Total 16 marks)