FORM FOUR CLUSTER KCSE MODEL 3

CHEMISTRY PAPER 3 QUESTIONS

1.You are required to find the percentage purity of a sample of sodium carbonate,

FA1 contains 4.50 g dm-3 of the impure sodium carbonate. FA2 is 0.50 mol dm-3 hydrochloric acid, HC1.

(a)Dilution of FA2

By using a burette, measure 34.00 cm3 of FA2 into the 250 cm3 graduated flask (volumetric flask) labeled FA3.

Make up the contents of the flask to the 250 cm3 mark with distilled water.

Place the stopper in the flask and mix the contents thoroughly by slowly inverting the flask a number of times.

Titration

Fill a second burette with FA3, the diluted solution of hydrochloric acid.

25.0 cm3 of FA1 into a conical flask. Add a few drops of methyl orange indicator and titrate with FA3.

Perform one titration and two further titrations to obtain accurate results

Record your titration results in the table below

Titration number	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of **FA3** used			

b) From your titration results obtain a suitable volume of FA3 to be used in your calculations.

Show clearly how you obtained this volume.

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Calculations

Show your working and appropriate significant figures in all of your calculations.

c) i) Calculate how many moles of HCl are contained in the FA2 run into the graduated flask(volumetric flask).

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(ii) Calculate how many moles of HCl are contained in the volume of FA3 which reacted with 25.0 cm3 of FA1 .....

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(iii) Use this answer in (c)(ii) to calculate how many moles of sodium carbonate, present in 1.00 dm3 of FA1. Na_2CO_3, are

$$Na_2CO_{3(s)} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$

(iv) Calculate the mass of sodium carbonate, Na_2CO_3

O=16.0;Na=23.0)

in 1.00 dm3 of FA1. (C=12.0;

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(v) Calculate, to 3 significant figures, the percentage purity of the sodium carbonate, Na_2CO_3, dissolved in FA1.

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2.You are provided with the following reagents.

√FB1 1 mol dm-3 sulphuric acid, Na_2CO_3

√FB2, 0.1 mol dm-3 potassium iodide, KI

√FB3, 0.1 mol dm-3 sodium thiosulphate, $Na_2S_2O_3$;

√FB4, 0.1 mol dm-3 hydrogen peroxide, ((H_2O_2) .

√ Start solution √Distilled water. In the presence of an acid, iodide ions are oxidised by hydrogen peroxide to iodine.

$$H_2O_{2(aq)} + 2H^+_{(aq)} + 2I^-_{(aq)} \rightarrow 2H_2O_{(l)} + I_{2(aq)}$$

The rate of reaction can be followed by timing the formation of a fixed amount of iodine in the solution. If sodium thiosulphate is present in the reaction mixture it reacts with the iodine formed and the solution remains colourless.

$$l_{2(aq)} + 2S_2O^{2-}_{3(aq)} \rightarrow 2l^-_{(aq)} + S_4O^{2-}_{6(aq)}$$

When all of the sodium thiosulphate present has reacted, iodine, I2, will appear in the solution producing an immediate blue colour with starch indicator. In a series of experiments where the concentration of a reagent is changed

$\frac{1}{\sqrt{time}}$

can be used as a measure of rate, √the volume of the reagent used can be taken as a measure of its concentration providing the total volume of the mixture is kept constant in each experiment. The order of reaction with respect to hydrogen peroxide can be obtained by

plotting a graph of log rate against log ((H_2O_2))

You are required to investigate the effect of concentration on the rate of reaction,

√20 cm3 of distilled water

Add to the flask from the burette 1.00 cm3 of FB3, sodium thiosulphate. Add six drops of starch indicator to the mixture in the flask.

Run 20.00 cm3 of FB4, hydrogen peroxide, from the second burette into a 100 cm3 beaker.

Use the measuring cylinder labeled B to add 20 cm3 of FB1, sulphuric acid, to the hydrogen peroxide in the beaker.

Transfer (tip) the contents of the beaker into the conical flask and immediately start a stop-clock or note the start time on a clock with a second hand. Swirl the flask to mix the reagents.

Observe the solution and stop the clock or note the time when the solution suddenly turns blue. Record the time taken to the nearest second in the table that follows.

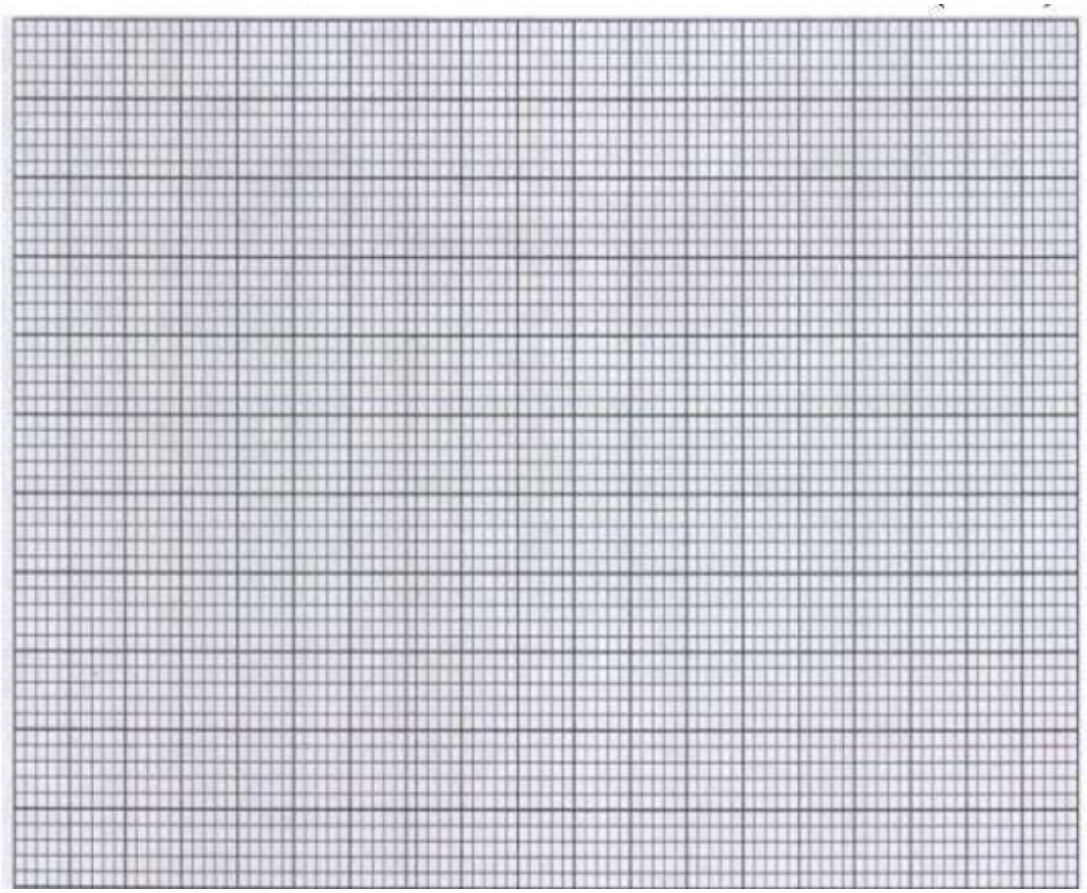
Empty, thoroughly rinse and drain the conical flask used in experiment 1.

Repeat the entire procedure for each of the experiments 2 through to 4, each time emptying rinsing and draining the conical flask;

b) Table

Expt	Contents in flask				Contents in beaker		Time (s)	1/t(s^{-1})
	Water (cm^3)	FB2(cm^3)	FB3(cm^3)	Starch (drops)	FB4(cm^3)	FBI (cm^3)		
1	20	20	1	6	20	20		
2	25	20	1	6	15	20		
3	30	20	1	6	10	20		
4	35	20	1	6	5	20		

c) Use your recorded results to plot a graph of (1/time) against (volume of FB4).



d)Calculate the gradient of the line drawn, which is the rate of reaction with respect to hydrogenperoxide.

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e)The experimental method can be modified to enable the rate of reaction with respect to iodide ions,

procedure 1.

, to be investigated. You will perform two further experiments using the method for

You will keep the concentration of hydrogen peroxide constant and reduce the concentration of iodide ions.

f). Procedure II

First copy your reaction time from experiment 1 in section (a) into the table below. Then complete the table below to show the volumes of FB2 and distilled water you will use in these two further experiments.

Carry out each experiment as before and record the time taken in each case.

	Volume FB1 (H_2SO_4)/cm^3	Volume FB2 (KI)/cm^3	Volume water /cm^3	Volume FB3 ($Na_2S_2O_3$)/cm^3	VolumeFB4 (H_2O_2)/cm^3	Reaction time/s
Experiment 1 in section (a)	20	20	20	1.00	20.00	
Experiment i	20			1.00	20.00	
Experiment ii	20			1.00	20.00	

(g) Use the experimental results from the three experiments to draw a conclusion as to how the rate of reaction is affected by changing the concentration of iodide ions.

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h) From your graph find the time taken for the colour to change using 12.0 cm3 of FB4 and 28 cm3 of water.

3.(I) You are provided with solution FA7. Carry out tests below. Write your observations and inferences in the spaces provided.

(a)Put exactly 5 drops of solution **FA7** in a test tube. Heat strongly while shaking until the entire solution evaporates and a solid forms. Continue heating until no further change on the solid. Allow to cool. Add 3 drops of nitric (V) acid, shake until the solid dissolves.	
OBSERVATIONS (1 mark)	**INFERENCES** (1 mark)
b) To the remaining portion of **FA7** in the boiling tube add exactly 10 ml of distilled water. Divide the solution into 5 portions. (i) To the first portion add sodium hydroxide drop wise till in excess.	
OBSERVATIONS (½ mark)	**INFERENCES** (½ mark)
(ii).To the second portion add aqueous ammonia drop wise till in excess.	
OBSERVATIONS (½ mark)	**INFERENCES** (½ mark)

(iii). To the third portion, add nitric acid followed by barium (II) chloride solution.	
OBSERVATIONS (½ mark)	**INFERENCES** (½ mark)
(iv). To the fourth portion, add lead (II) nitrate and warm.	
OBSERVATIONS (½ mark)	**INFERENCES** (½ mark)
(v)To the fifth portion add a piece of aluminium foil provided followed by drops of sodium hydroxide solution and heat	
OBSERVATIONS (½ mark)	**INFERENCES** (½ mark)

II. You are provided with solution FA8 in a boiling tube. Carry out tests below. Write your observations and inferences in the spaces provided.

(a)Pour a little of solution **FA8** in a watch glass. Burn the solution.	
OBSERVATIONS (1 mark)	**INFERENCES** (1 mark)
b) Divide the remaining solution into 4 portions. (i) To the first portion add 5 drops of bromine water.	
OBSERVATIONS (½ mark)	**INFERENCES** (½ mark)
(ii) To the second portion add 5 drops of acidified potassium manganate (VII) solution.	
OBSERVATIONS (½ mark)	**INFERENCES** (½ mark)

(iii). To a third portion, add sodium hydrogen carbonate powder.	
OBSERVATIONS (½ mark)	**INFERENCES** (½ mark)
(iv) To fourth portion, add 3 drops of universal indicator solution. Compare your results with an indicator chart.	
OBSERVATIONS (½ mark)	**INFERENCES** (½ mark