Class:	Register No:	Name:

CRESCENT GIRLS' SCHOOL
SECONDARY FOUR
PRELIMINARY EXAMINATION

6092/03
CHEMISTRY

PAPER 3 Practical

14 AUGUST 2024

1 hour 50 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class in the spaces provided at the top of this page.
Give details of the practical shift and laboratory where appropriate, in the boxes provided.
Write in dark blue or black pen.
You may use a 2B pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in the spaces provided on the Question paper.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show working or if you do not use appropriate units.
Qualitative Analysis Notes are printed on page 12.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Shift
Laboratory

For Examiner's Use	
Q1	**/17**
Q2	**/15**
Q3	**/8**
Total	**/40**

This document consists of 12 printed papers.

1 You are to determine the enthalpy change of neutralisation of sodium hydroxide with an acid and the concentration of hydrogen ions in the acid.

These can be found by measuring the temperature change when solutions of the acid and alkali are mixed.

Read all the instructions below carefully before starting the experiments in Question 1.

Instructions
You are going to carry out seven experiments.

P is 1.50 mol/dm^3 sodium hydroxide, NaOH.
Q is an aqueous solution of a strong acid.

(a) *Experiment 1*

Place a Styrofoam cup into a 250 cm^3 glass beaker.

Put **P** into a burette and measure 40.00 cm^3 of **P** into the Styrofoam cup. Measure the temperature of **P** and record the value in the table.

Use a measuring cylinder to measure 10.0 cm^3 of **Q**. Pour this volume of **Q** into the Styrofoam cup containing **P**. Stir gently, using the thermometer, and measure the highest temperature reached.
Record this temperature in the table.

Empty the Styrofoam cup and rinse it with deionised water.

Experiments 2 to 7

Repeat Experiment 1 but use different volumes of **P** and **Q** for each experiment given in the table.

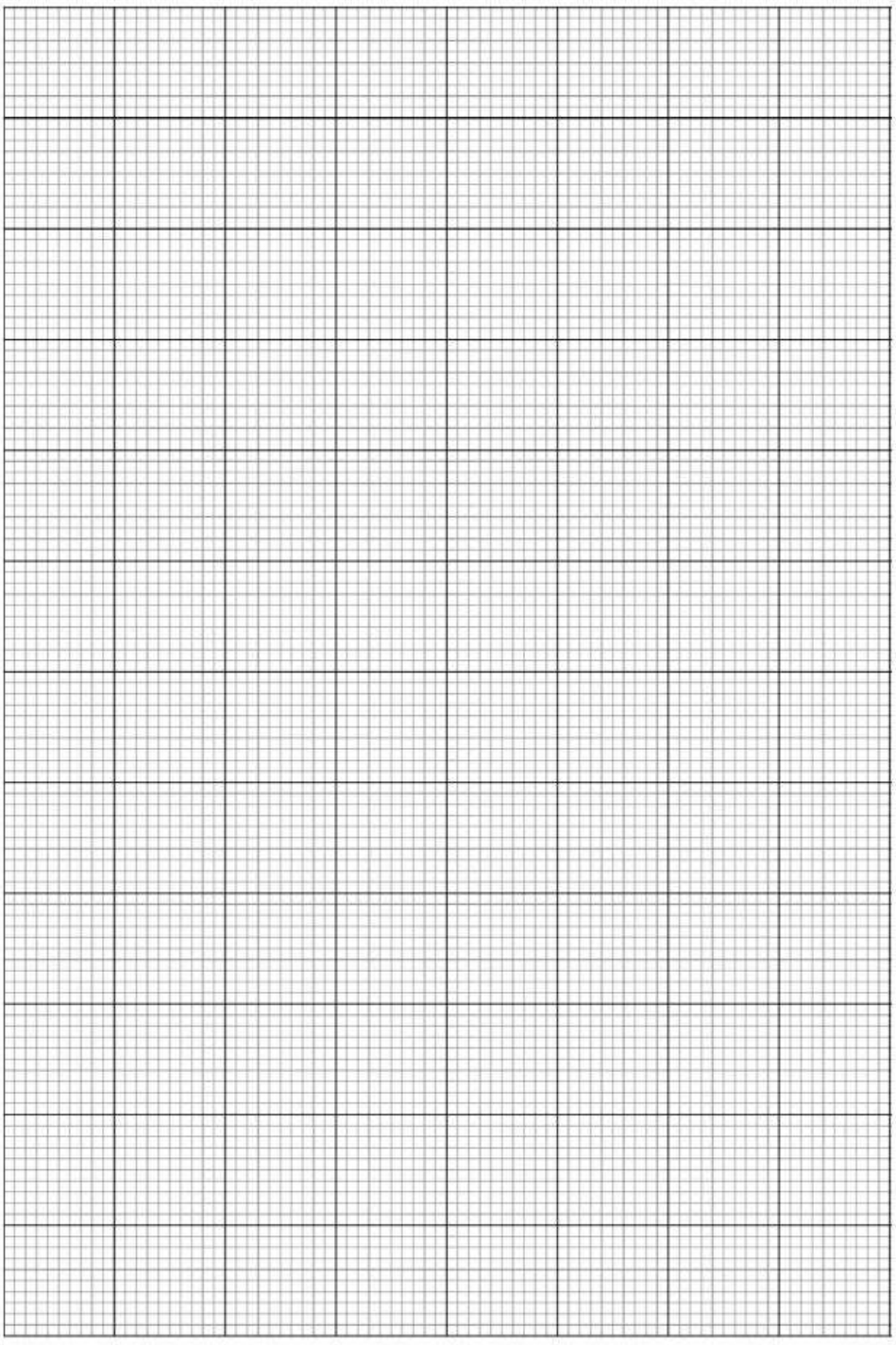
Complete the table by calculating the temperature rise for each experiment.

experiment	volume of **P**/cm^3	volume of **Q**/cm^3	initial temperature of **P**/°C	highest temperature of mixture/ °C	temperature rise /°C
1	40.00	10.0			
2	35.00	15.0			
3	30.00	20.0			
4	25.00	25.0			
5	20.00	30.0			
6	15.00	35.0			
7	10.00	40.0			

[3]

(b) Plot a graph of temperature rise against volume of **P** on the grid below.

Use these points to draw two intersecting straight lines of best fit.



[4]

(c) Use the temperature rise obtained where the two lines intersect to calculate the maximum amount of heat energy produced during the reaction.

[Assume that 4.3 J are required to raise the temperature of 1 cm^3 of any solution by 1°C]

amount of heat produced = _____J **[1]**

(d) From your graph, read the volume of **P** where the two lines intersect. Show clearly on the graph how you obtain your answer.

volume of **P** = _____ cm^3 **[1]**

(e) Calculate the number of moles of **P** in **(d)**.

number of moles of **P** = _____ mol **[1]**

(f) The ionic equation for the reaction between **P** and **Q** is as given.

$$OH^-(aq) + H^+(aq) \rightarrow H_2O(l)$$

(i) Calculate the volume of **Q** that reacts with volume of **P** in **(d)**.

volume of **Q** = _____cm^3 **[1]**

(ii) Hence, calculate the concentration of hydrogen ions, H^+, in **Q** in mol/ dm^3.

concentration of hydrogen ions = _____ **[2]**

(g) If **Q** is sulfuric acid, state the concentration of the acid in mol/ dm^3.

Explain your reasoning.

concentration = _____

reasoning

_____

_____

_____ **[2]**

(h) A student mentioned that the experiment was not accurate because the temperature changes measured were small.

Suggest one modification to the experimental method and explain how it can give larger changes in temperature.

_____

_____

_____ **[2]**

[Total: 17]

2 You are given a hydrated salt, **M**.$6H_2O$.

On heating, hydrated **M**.$6H_2O$ loses its water of crystallisation.

$$\mathbf{M}.6H_2O\ (s) \rightarrow \mathbf{M}(s) + 6H_2O(g)$$

Read all the instructions carefully before starting the experiments.

Carry out the following tests on solid **M**.$6H_2O$, recording all of your observations in the spaces provided.

(a) Instructions

1. Use an electronic balance to measure and record mass of an empty boiling tube.
2. Add about 1.00 g of **M**.$6H_2O$ into the boiling tube.
3. Measure and record the total mass of the boiling tube and **M**.$6H_2O$.
4. Gently heat the contents for 1 minute.
5. Record your observation in **(a)(i)**.
6. Leave the boiling tube to cool to room temperature.

You may start working on Question 2c while waiting for the boiling tube to cool.

7. Reweigh the boiling tube and its contents and record the total mass.
8. Record all your results in an appropriate format in **(a)(ii)**.

(i) Observation

_____

_____ **[1]**

(ii) Results

[2]

(b) **(i)** State the mass loss and hence calculate the percentage loss in mass of **M**.$6H_2O$ on heating using the equation below.

percentage loss in mass on heating = $\frac{loss\ in\ mass\ on\ heating}{original\ mass\ of\ sample} \times 100\%$

mass loss = _____ g

percentage loss = _____ % **[2]**

(ii) In your calculations, you assume that **M**.$6H_2O$ is pure.

State how the percentage loss in mass on heating will change if an impurity of copper(II) carbonate is present in **M**.$6H_2O$ salt.
Assume same mass of sample is used as in **(a)**.

Explain your reasoning.

_____

_____

_____ **[2]**

(c) Place the remaining amount of **M**.$6H_2O$ in a boiling tube and add deionised water to dissolve the solid to produce aqueous solution of **M**.

Carry out the following tests on the aqueous solution of **M** in a test tube. Record your observations in the space provided. You should test and name any gas evolved.

(i) To about 1 cm depth of the solution of **M**, add a few drops of aqueous sodium hydroxide until in excess.

_____

_____ **[1]**

(ii) To about 1 cm depth of the solution of **M**, add a few drops of aqueous barium nitrate.

_____ **[1]**

(iii) To about 1 cm depth of the solution of **M**, add a few drops of aqueous silver nitrate.

_____ **[1]**

(iv) To about 1 cm depth of the solution of **M**, add a few drops of aqueous potassium iodide.

_____

_____ **[1]**

(d) **(i)** Identify the salt, **M**.

_____ **[1]**

(ii) State one chemical property of **M**. Explaining your reasoning by stating evidence using one of the tests in **(c)**.

chemical property

_____

reasoning

_____

_____

_____ **[3]**

[Total: 15]

3 A student investigates the effect of concentration on rate of reaction between aqueous solutions **G** and **H**.

G is a mixture of potassium iodide and another substance.
H is an aqueous solution of ammonium peroxodisulfate, $(NH_4)_2S_2O_8$.

Solutions **G** and **H** react to produce iodine, I_2.

The student investigates the rate of reaction by using the following method at room temperature condition.

1. Put **G** into a burette and measure 10.00 cm^3 of **G** into a conical flask. To **G** in the conical flask, add 2 cm^3 of starch solution.

2. Transfer 25.0 cm^3 of **H** into the mixture of **G** and starch in the conical flask.

3. Start the stopwatch immediately and swirl the contents of the flask. Then leave the mixture to stand. When the mixture turns blue-black, stop the stopwatch. Record time taken to the nearest second in the table.

4. Empty the conical flask and rinse it with distilled water.

5. Repeat the steps 1 to 4, using different volumes of **H** and water.

(a) The results which the student obtained are shown.

experiment	volume of **G**/cm^3	volume of **H**/cm^3	volume of water/cm^3	time taken for blue-black colour to appear/s
1	10.00	25.0	0	4
2	10.00	20.0	5	6
3	10.00	15.0	10	10
4	10.00	10.0	15	15
5	10.00	5.0	20	22

(i) How does the concentration of **H** in experiment 2 compare with its concentration in experiment 4?

_____ **[1]**

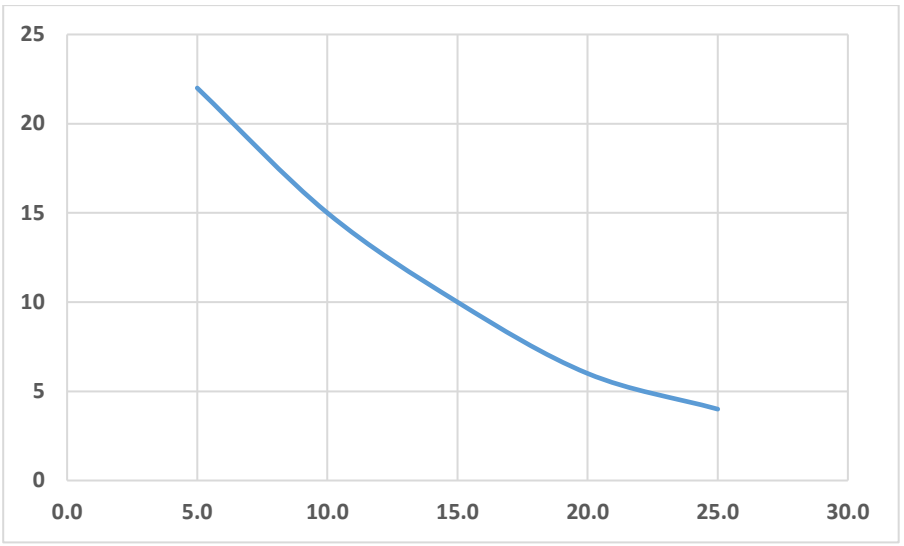
(ii) Explain why water is added to each reaction mixture for experiments 2 to 5.

_____

_____

_____ **[2]**

(b) The results are then plotted on a graph as shown.



Describe the relationship between concentration of **H** and rate of reaction.

Explain your answer using the graph.

_____

_____

_____ **[2]**

(c) A statement states that the rate of reaction doubles for every 10°C rise in temperature.

Given the same solutions of **G** and **H**, describe how you would investigate this statement by experiment.

You can assume that all the apparatus and reagents normally found in a school laboratory are available. You should include the measurements you would take and explain how you would use your results to confirm this statement.

[3]

[Total: 8]

NOTES FOR QUALITATIVE ANALYSIS

Test for anions

anion	test	test result
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil, warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Test for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt. insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	-
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt.
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
lead(II) (Pb^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

[Lead(II) ions can be distinguished from aluminium ions by the insolubility of lead(II) chloride]

Tests for gases

gas	test and test result
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	gives white ppt. with limewater (ppt. dissolves with excess CO_2)
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns acidified potassium manganate(VII) from purple to colourless