Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination
Secondary 4 (O-Level Programme)

A

CHEMISTRY

6092/02

Paper 2

22 August 2023
1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions in the spaces provided.

The number of marks is given in brackets [ ] at the end of each question or part question.

The use of an approved scientific calculator is expected, where appropriate.

For examiner's use only:	Section A	/ 50

This document consists of **12** printed pages.

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Section A

Answer **all** questions in this section in the spaces provided.
The total mark for this section is 50.

A1 The table consists of four different experimental procedures.

(a) Put a tick (✓) if a redox reaction had occurred.

		Put a tick (✓) if a redox reaction had occurred.
(i)	a copper strip added to lead(II) nitrate solution	
(ii)	aqueous chlorine added to potassium iodide solution	
(iii)	hydrogen gas passed over heated copper(II) oxide	
(iv)	potassium nitrate solution warmed with sodium hydroxide solution	

[3]

(b) A student repeated **(a)(ii)** by replacing aqueous chlorine with aqueous bromine.

Describe a difference in the rates of the two reactions and explain your answer.

……

……

……

…… [2]

[Total: 5]

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A2 The boiling points of ethane and some chlorine-containing organic compounds are given in Table 2.1.

Table 2.1

formula of compound	C_2H_6	C_2H_5Cl	$C_2H_4Cl_2$	$C_2H_3Cl_3$	$C_2H_2Cl_4$
boiling point / °C	−89	12	84	114	147

(a) Describe the general trend shown by the data in Table 2.1.

……..…….

……..… [1]

(b) Use the formulae of the compounds to answer the following questions.

Each formula may be used once, more than once, or not at all.

(i) Which compound is a hydrocarbon?

…….…….…… [1]

(ii) Which compound belongs to the same homologous series as $C_4H_8Cl_2$?

…….…….…… [1]

(c) State the total number of compounds in Table 2.1 which are soluble in organic solvents.

……..… [1]

(d) Draw the displayed formulae of **two** isomers of $C_2H_4Cl_2$.

[2]

[Total: 6]

[Turn over

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A3 Some physical properties of five different substances are given in Table 3.1.

Table 3.1

substance	melting point / °C	conducts electricity in the solid state?
A	1410	no
B	340	no
C	–56	no
D	70 – 80	no
E	2595	yes

Figs. 3.1 and 3.2 show the structure of a molecule of carbon dioxide and phosphorus pentoxide respectively.

O=C=O

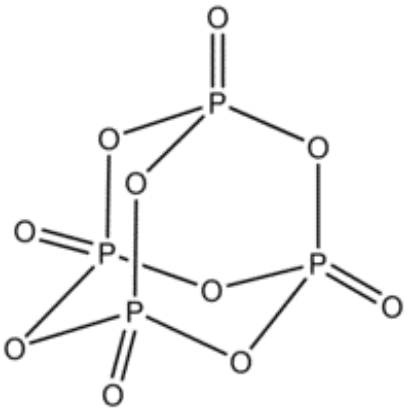


Fig. 3.1 **Fig. 3.2**

(a) Which substance (A to E) would be carbon dioxide and phosphorus pentoxide respectively?

Use ideas about structure and bonding to explain your choice.

carbon dioxide ……

phosphorus pentoxide ……

……

……

……

……

…… [5]

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(b) Silicon is a semiconductor. When adequately heated, silicon can conduct electricity.

Figs. 3.3 and 3.4 show the structure of silicon and graphite.

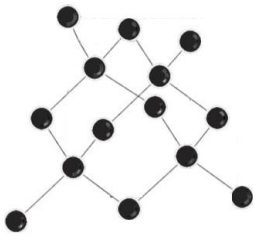


Fig. 3.3 Structure of silicon

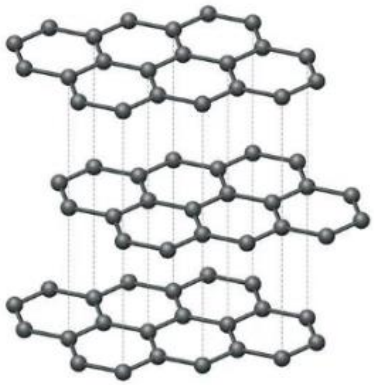


Fig. 3.4 Structure of graphite

(i) Compare the structure and bonding of silicon and graphite.

……...

……...

……...

……...

……...

……..…… [2]

(ii) Explain if Fig. 3.3 shows that silicon can act as a semiconductor.

……...

……...

……...

……..…… [2]

[Total: 9]

[Turn over

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A4 **(a)** Photosynthesis is part of the carbon cycle.

(i) Explain why photosynthesis is important in the carbon cycle.

……..……...

……..…… [1]

(ii) Catalytic converters do **not** solve all environmental problems caused by car exhausts.

Explain why this is so. You should include a chemical equation in your answer.

……..……...

……..……...

……..…… [2]

Fig. 4.1 shows the apparatus set up by a student to conduct a photosynthesis experiment in the school laboratory.

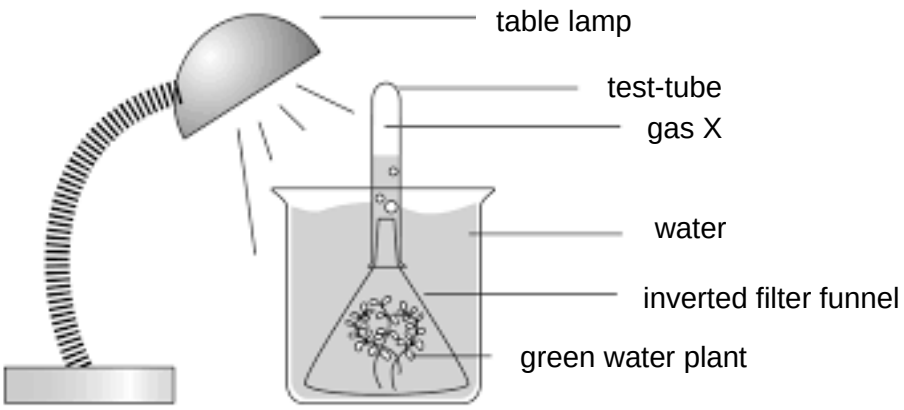


Fig. 4.1

He repeated his experiment by removing the table lamp and placing the rest of the apparatus in a dark room.

(b) **(i)** Describe a difference in the results of the two experiments.

……..……...

……..…… [1]

(ii) The student made a conclusion from his results:
'Since light energy is taken in for photosynthesis to occur, it is an endothermic reaction.'

Explain why the student's conclusion is incorrect.

……..……...

……..…… [1]

[Total: 5]

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A5 Fig. 5.1 shows some reactions starting with propanol.

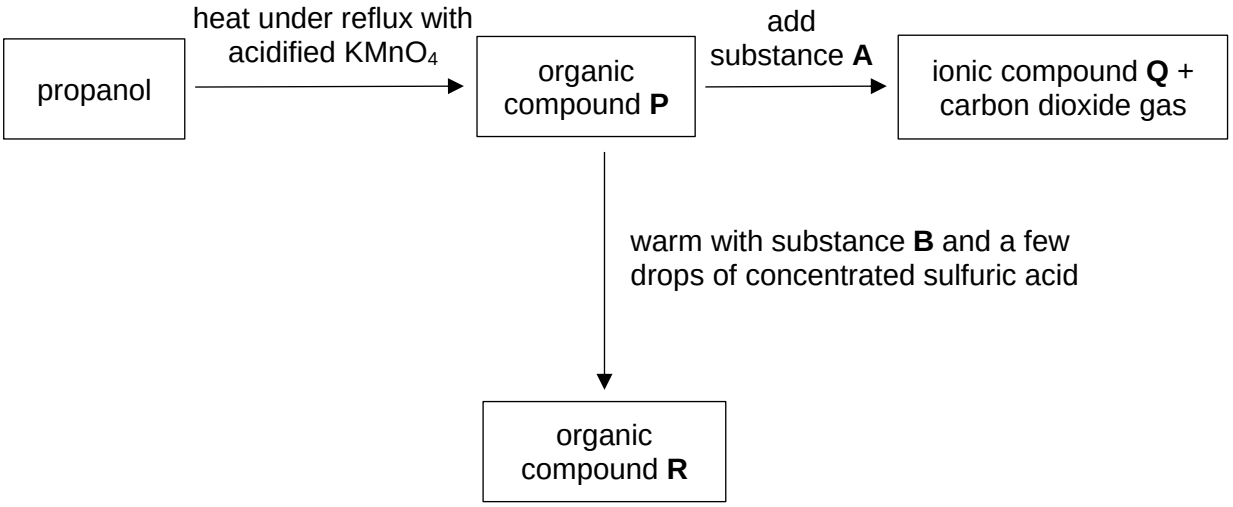


Fig. 5.1

(a) Write a balanced chemical equation for the reaction that occurs when propanol is heated under reflux with acidified $KMnO_4$ to form organic compound **P**.

…… [1]

(b) Compound **R** contains 64.6% carbon, 10.8% hydrogen and 24.6% oxygen by mass.

(i) Determine the empirical formula of **R**.

[2]

(ii) Name compound **R**.

…… [1]

(c) **(i)** Suggest an identity for substance **A**.

…… [1]

(ii) Hence, give the chemical formula of ionic compound **Q**.

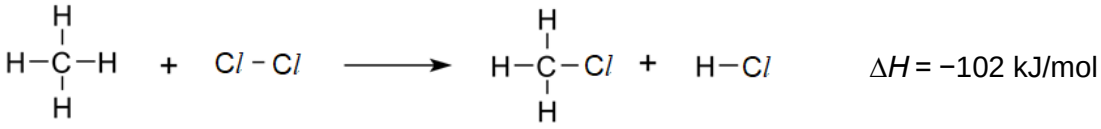
…… [1]

[Total: 6]

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A6 The substitution reaction of methane by chlorine is an exothermic process.



methane chloromethane

(a) In terms of bond breaking and bond forming, explain why the reaction is exothermic.

……

……

…… [2]

(b) Chloromethane undergoes a similar substitution reaction as methane.

(i) Write the chemical equation for this reaction, showing the displayed formulae of all organic compounds.

[1]

(ii) Suggest a value for the enthalpy change of the reaction between chloromethane and chlorine.

Explain your reasoning.

……

……

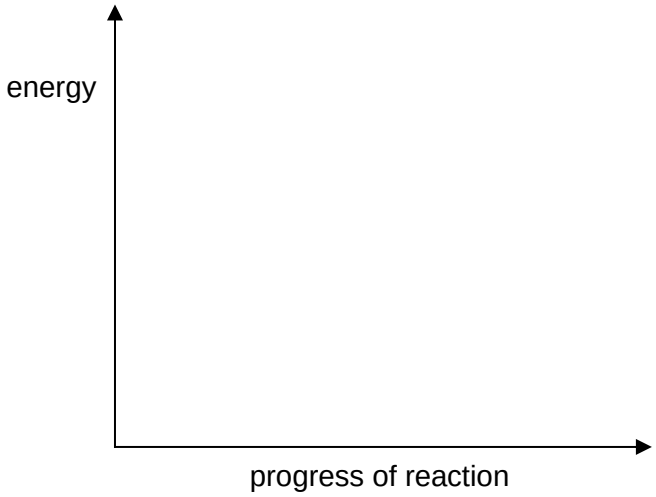
…… [2]

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(iii) Hence, draw the energy profile diagram for the reaction between chloromethane and chlorine in the axes below.

Your diagram should show:

- the reactants of the reaction
- the products of the reaction
- the energy profile and activation energy, E_a
- the enthalpy change of reaction, ΔH.



[2]

[Total: 7]

[Turn over

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A7 In the electrolysis set-up (Fig. 7.1), the filter paper is first soaked with a dilute solution containing potassium sulfate and purple litmus solution.

The circuit is then closed.

After running the electrolysis for some time, a few barium nitrate crystals are placed in the middle of the filter paper.

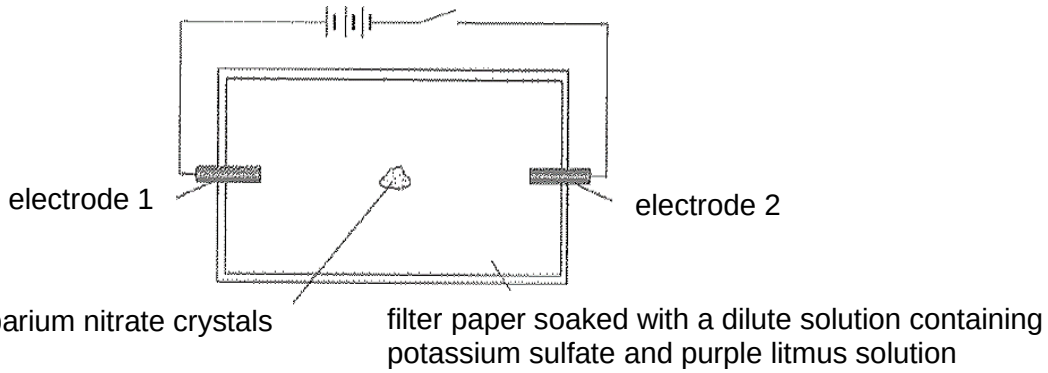


Fig. 7.1

(a) **(i)** Write the half-equations for the reactions occurring at electrodes 1 and 2 **before** the barium nitrate crystals were placed.

electrode 1 ……...

electrode 2 ..……..…… [2]

(ii) Describe and explain how the reaction occurring at **each** electrode, before the barium nitrate crystals were placed, would affect the appearance of the filter paper that is soaked with purple litmus solution.

……...

……...

……...

……..… [3]

(b) After the barium nitrate crystals were placed in the middle of the filter paper, a student observed that the crystals dissolved.

(i) Explain his observation.

……...

……..… [1]

(ii) Describe **another** observation that could be made.

……...

……..… [1]

[Total: 7]

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A8 A student added powdered manganese(IV) oxide into two separate solutions, dilute hydrochloric acid and aqueous hydrogen peroxide.

The chemical equations for both reactions are given below.

Reaction A: $MnO_2(s) + 4HCl(aq) \longrightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$

Reaction B: $2H_2O_2(aq) \xrightarrow{MnO_2(s)} 2H_2O(l) + O_2(g)$

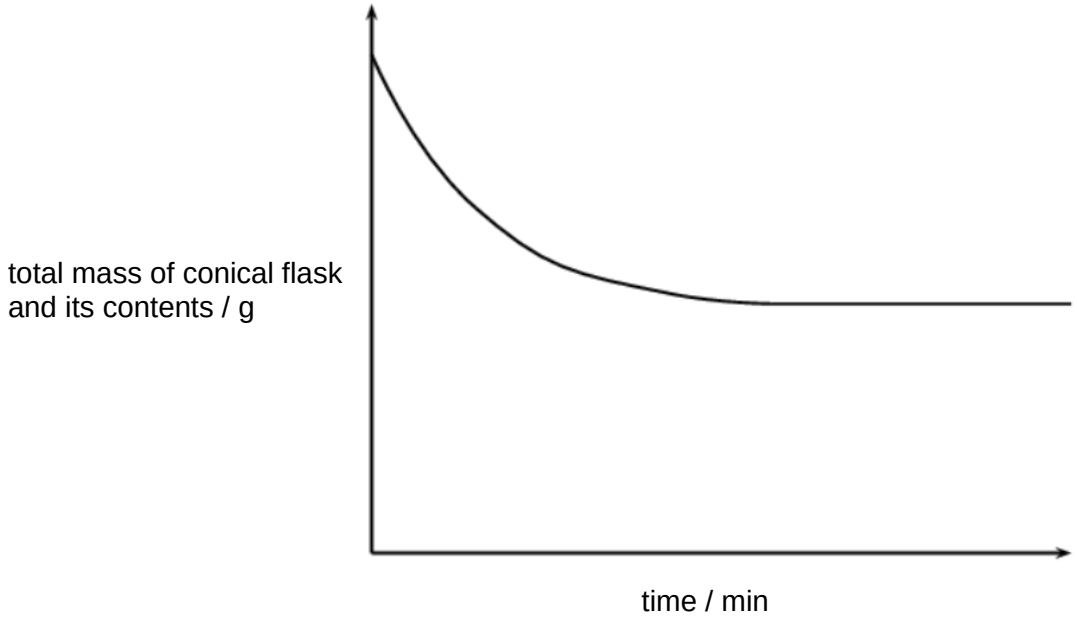
(a) The student followed the rate of reaction B by measuring the total mass of the conical flask and its contents over time.

Table 8.1 shows his results.

Table 8.1

time / min	0	5	10	15	20	25
mass / g	550.00	549.84	549.76	549.71	549.69	549.69

(i) He plotted his results and obtained the graph below.



He repeated the experiment at a **lower** temperature.

On the axes above, sketch the graph of his **repeated** experiment. [1]

[Turn over

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(ii) The student used the same method to follow the rate of reaction A.

Suggest a reason to explain why this method is **not** accurate in investigating the rate of reaction A.

……..……...

……..…… [1]

(iii) The time taken for the reaction to be half-complete is **not** determined by halving the total time taken for the reaction to reach completion.

Using the graph given, explain why this is so.

……..……..……

……..…… [1]

(b) The student modified his experiments such that he was able to accurately determine the rate of both reactions.

He then repeated the experiment for each reaction using a larger mass of powdered manganese(IV) oxide and made the following conclusions from his results.

Conclusion 1: The rate of reaction for A was significantly higher than the previous experiment.

Conclusion 2: The total volume of oxygen gas collected in B remained unchanged.

Explain why both his conclusions are correct.

……..…….

……..…….

……..…….

……..… [2]

[Total: 5]

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