

SECTION A

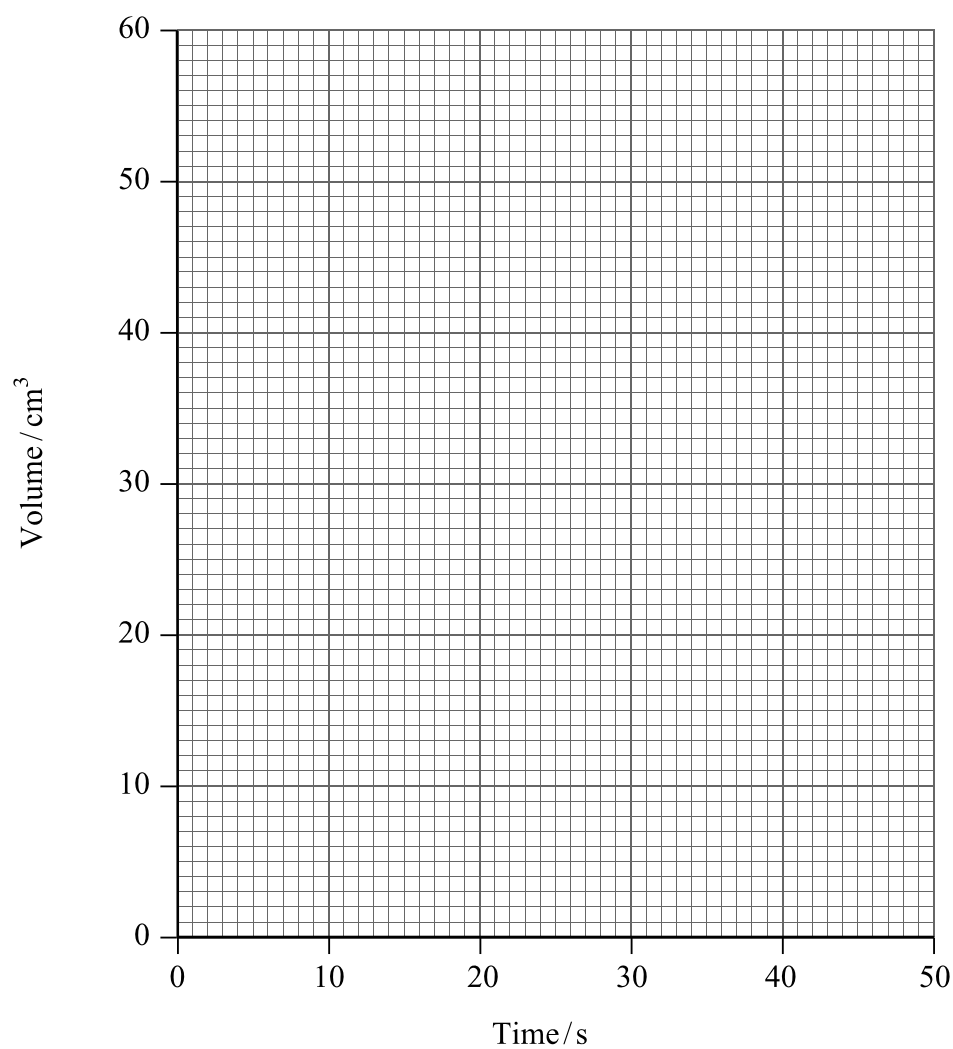
Answer ALL questions in this section.

There is useful data on the front cover and a Periodic Table is printed on the back of this booklet.

1. In order to investigate the rate of reaction between magnesium and dilute sulphuric acid, excess acid was added to a strip of magnesium ribbon and the volume of gas evolved was recorded every 5 seconds. The results are given in the following table.

Volume / cm ³	0	18	30	38	45	50	54	57	59	60	60
Time /s	0	5	10	15	20	25	30	35	40	45	50

- (a) Use the grid to plot a graph of volume of gas produced against time.



(3)



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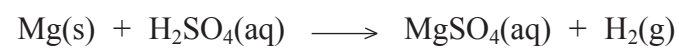
(b) (i) How long did it take for half of the magnesium to react?

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(1)

(ii) What fraction of magnesium remained after 20 seconds?

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(1)

(c) Here is the equation for this reaction.



Calculate the mass of magnesium ribbon used.

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(2)

(d) State the effect, if any, on the rate of reaction if the same mass of magnesium powder was used in place of magnesium ribbon. Explain your answer in terms of collision theory.

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(3)

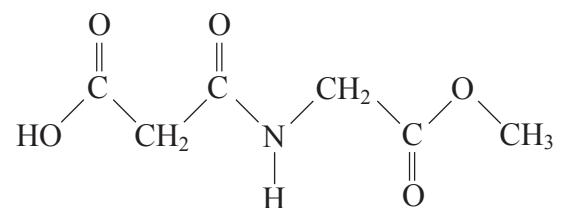
(Total 10 marks)

Q1

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2. The following diagram shows the structure of an artificial sweetener called Sweetex.



- (a) On the diagram draw circles around and label
- (i) a carboxylic acid group
 - (ii) an ester group.
- (2)**

- (b) (i) Write down the molecular formula of Sweetex.
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- (1)**

- (ii) The relative molecular mass of Sweetex is 175. Calculate the percentage by mass of carbon in Sweetex.
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- (2)**

- (c) (i) Suggest what you would observe if Sweetex was added to sodium carbonate solution.
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- (ii) Write an ionic equation to represent this reaction using H^+ for the acidic species.
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- (3)**



(d) A small pill of Sweetener is placed in the bottom of a cup of coffee. After standing for a few minutes without stirring, all of the coffee tastes sweet. Explain what happens to the Sweetener molecules.

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(2)

(Total 10 marks)

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Q2



3. The following table shows some information about the first four compounds in the homologous series of alkenes.

Name	Structural formula	Relative molecular mass	Boiling point / °C
ethene	$\text{CH}_2=\text{CH}_2$	28	-104
propene		42	-48
	$\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_3$	56	-6
pentene	$\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_3$		20

(a) Complete the table by adding the missing information.

(3)

(b) Describe the pattern between the length of the carbon chain and the boiling point in this homologous series.

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(1)

(c) Ethene is the starting material in the manufacture of ethanol.

(i) Give the name of the type of reaction involved.

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(1)

(ii) Draw the displayed formula of ethanol.

(1)



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(d) Ethanol can be converted into ethanoic acid by atmospheric oxygen.

(i) Write an equation to represent this reaction.

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(1)

(ii) What type of reaction is involved?

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(1)

(e) Name the organic product formed when ethanol is reacted with:

(i) sodium

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(1)

(ii) phosphorus pentachloride.

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(1)

(Total 10 marks)

Q3

7

Turn over



4. Chlorine exists as two isotopes $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$.

(a) Complete the following table.

Isotope	Number of protons	Number of neutrons
$^{35}_{17}\text{Cl}$		
$^{37}_{17}\text{Cl}$		

(2)

(b) The relative atomic mass of chlorine is 35.5. What is the ratio of $^{35}_{17}\text{Cl}$ to $^{37}_{17}\text{Cl}$ in a sample of naturally-occurring chlorine?

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(1)

(c) Starting from iron, give an equation for the formation of iron(II) chloride and iron(III) chloride.

(i) Formation of iron(II) chloride

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(2)

(ii) Formation of iron(III) chloride

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(2)

(d) Describe a chemical test, including its result, that could be carried out to determine the oxidation state of iron in a solution of an iron compound.

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(3)

(Total 10 marks)

Q4

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5. (a) Draw a diagram to show the arrangement of carbon atoms in graphite.

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(b) Explain, in terms of its structure, why graphite can conduct electricity.

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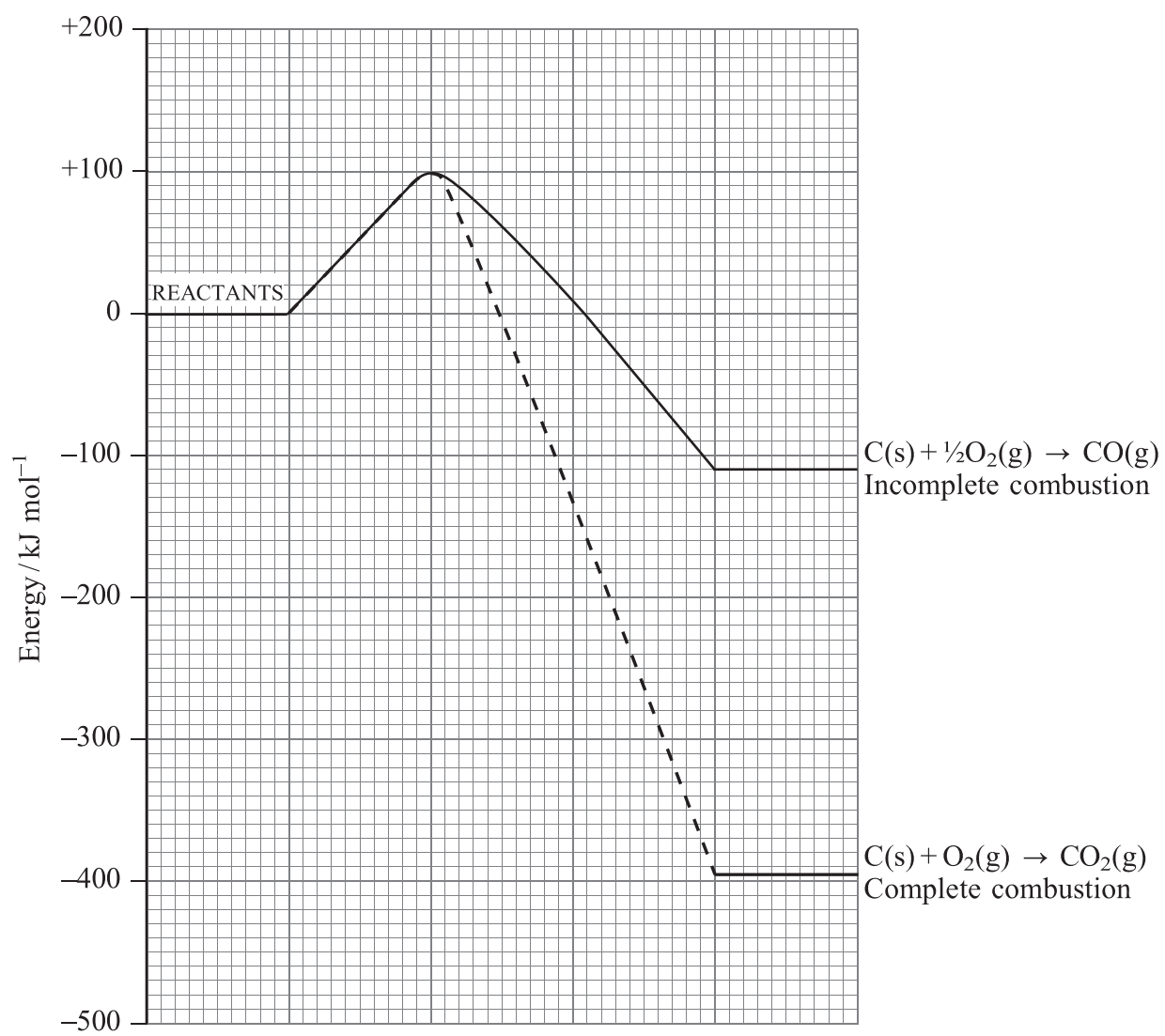
(2)

QUESTION 5 CONTINUES ON THE NEXT PAGE



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(c) The following graphs show the energy changes which occur during the incomplete and complete combustion of one mole of carbon.



(i) Are the reactions endothermic or exothermic? Explain your answer.

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(1)

(ii) Use the graphs to estimate the enthalpy change, ΔH , for each reaction.



(3)



(d) State **two** disadvantages of the incomplete combustion of carbon.

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2

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(2)

(Total 10 marks)

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Q5

TOTAL FOR SECTION A: 50 MARKS



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SECTION B

Answer TWO questions in this section.

Where appropriate, equations and diagrams should be given to clarify your answers.

If you answer question 6, put a cross in this box .

6. State the principle involved in each of the following processes and give an account of how it is used industrially to prepare the product given in brackets.

Your account should include details of starting materials and details of how the product is obtained.

(a) Electrolysis (aluminium)

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If you answer question 7 put a cross in this box ☒.

7. Describe simple experiments you would carry out in the laboratory to demonstrate that each of the following statements is correct.

(a) The blue colour of copper(II) sulphate crystals is due to water in the structure.

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(5)

(b) Iron is more reactive than copper but less reactive than zinc.

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(5)



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(c) Ammonia diffuses more quickly than hydrogen chloride.

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(5)

(d) The rate of reaction between zinc and dilute hydrochloric acid increases with temperature.

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(5)



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(c) Heating each of the following compounds produces copper(II) oxide. For each reaction, name the other product(s) and write an equation.

(i) CuCO_3

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..... (2)

(ii) Cu(OH)_2

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..... (2)

(iii) $\text{Cu(NO}_3)_2$

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..... (3)

(Total 25 marks)

Q8



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(c) (i) State **two** differences between addition polymerisation and condensation polymerisation.

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(4)

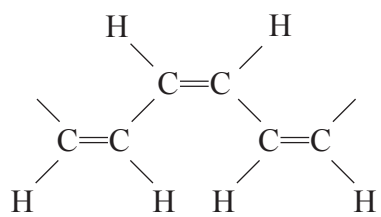
(ii) Starting from a fraction obtained from crude oil, name and describe the process used to produce ethene. Give an equation for a typical reaction that occurs during this process.

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(5)



(d) Ethyne has the structure $\text{H}-\text{C}\equiv\text{C}-\text{H}$. It polymerises in exactly the same way as ethene forming the polymer poly(ethyne).



(i) Draw a diagram to show part of a poly(ethene) molecule containing six carbon atoms.

(1)

(ii) State one difference between the structure of poly(ethyne) and poly(ethene).

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(1)

(iii) Give the empirical formula of poly(ethene) and of poly(ethyne).

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(2)

(iv) Describe a chemical test to distinguish between poly(ethene) and poly(ethyne), giving the result for each polymer.

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(3)



(v) State one reaction that would take place with both poly(ethyne) and poly(ethene) and give the products of this reaction for both polymers.

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(2)

(Total 25 marks)

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Q9

TOTAL FOR SECTION B: 50 MARKS

TOTAL FOR PAPER: 100 MARKS

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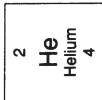
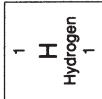


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THE PERIODIC TABLE

Period	1	2	Group										0						
1												² He Helium 4							
2	³ Li Lithium 7	⁴ Be Beryllium 9											¹⁰ Ne Neon 20						
3	¹¹ Na Sodium 23	¹² Mg Magnesium 24											¹⁸ Ar Argon 40						
4	¹⁹ K Potassium 39	²⁰ Ca Calcium 40	²¹ Sc Scandium 45	²² Ti Titanium 48	²³ V Vanadium 51	²⁴ Cr Chromium 52	²⁵ Mn Manganese 55	²⁶ Fe Iron 56	²⁷ Co Cobalt 59	²⁸ Ni Nickel 59	²⁹ Cu Copper 63.5	³⁰ Zn Zinc 65	³¹ Ga Gallium 70	³² Ge Germanium 73	³³ As Arsenic 75	³⁴ Se Selenium 79	³⁵ Br Bromine 80	³⁶ Kr Krypton 84	
5	³⁷ Rb Rubidium 85	³⁸ Sr Strontium 88	³⁹ Y Yttrium 89	⁴⁰ Zr Zirconium 91	⁴¹ Nb Niobium 93	⁴² Mo Molybdenum 96	⁴³ Tc Technetium 99	⁴⁴ Ru Ruthenium 101	⁴⁵ Rh Rhodium 103	⁴⁶ Pd Palladium 106	⁴⁷ Ag Silver 108	⁴⁸ Cd Cadmium 112	⁴⁹ In Indium 115	⁵⁰ Sn Tin 119	⁵¹ Sb Antimony 122	⁵² Te Tellurium 128	⁵³ I Iodine 127	⁵⁴ Xe Xenon 131	
6	⁵⁵ Cs Caesium 133	⁵⁶ Ba Barium 137	⁵⁷ La Lanthanum 139	⁷² Hf Hafnium 179	⁷³ Ta Tantalum 181	⁷⁴ W Tungsten 184	⁷⁵ Re Rhenium 186	⁷⁶ Os Osmium 190	⁷⁷ Ir Iridium 192	⁷⁸ Pt Platinum 195	⁷⁹ Au Gold 197	⁸⁰ Hg Mercury 201	⁸¹ Tl Thallium 204	⁸² Pb Lead 207	⁸³ Bi Bismuth 209	⁸⁴ Po Polonium 210	⁸⁵ At Astatine 210	⁸⁶ Rn Radon 222	
7	⁸⁷ Fr Francium 223	⁸⁸ Ra Radium 226	⁸⁹ Ac Actinium 227																



Key

Atomic number
Symbol
Name
Relative atomic mass

