

Chemistry
Science (Double Award) 4SD0
PAPER 1C

Total Marks

Time: 2 hours plus your additional time allowance

In the boxes below, write your name, centre number and candidate number.

Surname										
Other names										
Centre Number										
Candidate Number										

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet

Periodic Table

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided – there may be more space than you need.

Show all the steps in any calculations and state the units.

Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

INFORMATION

The total mark for this paper is 110.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

A Periodic Table is provided.

ADVICE

Read each question carefully before you start to answer it.

Write your answers neatly and in good English.

Try to answer every question.

Check your answers if you have time at the end.

Good luck with your examination.

Answer ALL questions.

1 The list below shows the names of some substances.

bromine

carbon dioxide

copper

iodine

methane

nitrogen

sulfur dioxide

water

(a) Look at the table for Question 1(a) in the Diagram Booklet. Complete the table by choosing substances from the list above that match the description.

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

(5 marks)

(continued on the next page)

1 continued.

**(b) Describe a test for carbon dioxide.
(2 marks)**

(Total for Question 1 = 7 marks)

2 (a) Look at Table 1 for Question 2(a) in the Diagram Booklet. It gives some information about three subatomic particles.

(i) Complete Table 1 by giving the missing information.

(3 marks)

(ii) Give the name of the part of the atom containing protons and neutrons.

(1 mark)

(continued on the next page)

2 continued.

- (b) Look at Table 2 for Question 2(b) in the Diagram Booklet. It shows the numbers of protons, neutrons and electrons in the species U, V, W, X, Y and Z.**

Use the information in Table 2 to answer these questions.

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

- (i) Give the letter of the species that has six electrons in its outer shell.
(1 mark)**

-
- (ii) Give the mass number of Z.
(1 mark)**
-

(continued on the next page)

2 continued.

**(iii) Give the letter of the species that is a positive ion.
(1 mark)**

**(iv) Give the letters of the two species that are isotopes of the same element.
(1 mark)**

(continued on the next page)

2 continued.

- (c) A sample of neon contains two isotopes,
 ^{20}Ne and ^{22}Ne**

**The relative abundances of the two isotopes in the
sample are**

^{20}Ne 91.2% ^{22}Ne 8.80%

**Calculate the relative atomic mass of this sample
of neon.**

**Give your answer to one decimal place.
(3 marks)**

relative atomic mass = _____

(Total for Question 2 = 11 marks)

Turn over

3 Some sugar is added to cold water in a beaker.

After some time, all the sugar dissolves and spreads throughout the water.

**(a) (i) Name the process that occurs which causes the sugar to spread throughout the water.
(1 mark)**

**(ii) State two ways to make the sugar dissolve more quickly.
(2 marks)**

1

2

(continued on the next page)

3 continued.

(b) Look at the apparatus for Question 3(b) in the Diagram Booklet. Pure water can be obtained from the sugar solution using this apparatus.

**(i) Name the process used to obtain pure water from the sugar solution.
(1 mark)**

(continued on the next page)

3 continued.

- (ii) Explain the purpose of the piece of apparatus labelled X.
(2 marks)**

(Total for Question 3 = 6 marks)

- 4 A student uses paper chromatography in an experiment to separate the dyes in four different food colourings, E, F, G and H.**

Look at the diagram for Question 4 in the Diagram Booklet. It shows the appearance of the paper before and after the experiment.

- (a) (i) Describe how the student should complete the experiment after putting a spot of each food colouring on the paper.
(3 marks)**

(continued on the next page)

Turn over

4 continued.

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4 continued.

- (ii) Deduce the number of dyes in food colouring H.
(1 mark)**

- (iii) Suggest why food colouring F does not move during the experiment.
(1 mark)**

(continued on the next page)

4 continued.

- (iv) Explain which two food colourings contain the dye that is likely to be the most soluble in the solvent.
(2 marks)**

(continued on the next page)

4 continued.

(b) Determine which food colouring contains a dye with R_f value closest to 0.67

**Show your working.
(3 marks)**

(Total for Question 4 = 10 marks)

5 This question is about alkanes and alkenes.

(a) (i) Look at the table for Question 5(a)(i) in the Diagram Booklet. Complete the table by giving the missing information about the alkane with the molecular formula C_2H_6 (3 marks)

(ii) Complete the chemical equation for the complete combustion of the alkane C_2H_6 (1 mark)



(iii) Incomplete combustion occurs when the air supply is limited.

Give the names of two products of incomplete combustion. (2 marks)

1 _____

2 _____

(continued on the next page)

Turn over

5 continued.

(b) An alkene with molecular formula C_4H_8 reacts with bromine to form a compound with molecular formula $C_4H_8Br_2$

**(i) What is the name of this type of reaction?
(1 mark)**

- ☐ **A addition**
- ☐ **B decomposition**
- ☐ **C precipitation**
- ☐ **D substitution**

**(ii) Look at the table for Question 5(b)(ii) in the Diagram Booklet. Draw displayed formulae for two different alkenes with the molecular formula C_4H_8
(2 marks)**

(continued on the next page)

5 continued.

- (iii) State the term used for compounds with the same molecular formula but different structural formulae.
(1 mark)**
-
-

(continued on the next page)

5 continued.

(c) The alkene C_3H_6 can be polymerised to form the polymer poly(propene).

**(i) Look at the equation for Question 5(c)(i) in the Diagram Booklet. Complete the equation for this polymerisation reaction.
(2 marks)**

(ii) Two ways of disposing of polymers such as poly(propene) are

- burying them in landfill sites**
- burning them to release heat energy**

**Discuss the environmental problems caused by these two methods of disposal.
(3 marks)**

(continued on the next page)

5 continued.

(Total for Question 5 = 15 marks)

6 This question is about some of the Group 1 elements and their compounds.

(a) A teacher adds a small piece of lithium to water in a trough.

**(i) Give three observations that are made when lithium reacts with water.
(3 marks)**

1 _____

2 _____

3 _____

(continued on the next page)

6 continued.

- (ii) After the reaction has finished, the teacher adds a few drops of universal indicator to the solution in the trough.**

**Explain the colour of the universal indicator after it is added to the solution.
(2 marks)**

- (iii) Write a chemical equation for the reaction of lithium with water.
(2 marks)**

(continued on the next page)

Turn over

6 continued.

(b) A student does a flame test to see if a white solid contains sodium ions.

She cleans a platinum wire before using it for the flame test.

**(i) Explain why the student needs to clean the platinum wire.
(2 marks)**

(continued on the next page)

Turn over

6 continued.

**(ii) Which of these is the colour of the flame if the solid contains sodium ions?
(1 mark)**

☐ **A green**

☐ **B lilac**

☐ **C red**

☐ **D yellow**

(c) Potassium sulfate (K_2SO_4) is an ionic compound.

**(i) Give the formula of each ion in potassium sulfate.
(1 mark)**

potassium ion _____

sulfate ion _____

(continued on the next page)

6 continued.

- (ii) The melting point of potassium sulfate is 1069 °C.**

Explain why potassium sulfate has a high melting point.

**Refer to structure and bonding in your answer.
(4 marks)**

(continued on the next page)

Turn over

6 continued.

(Total for Question 6 = 15 marks)

- 7 A student investigates the reaction between magnesium and hydrochloric acid.

He uses this method.

Step 1 add 25 cm³ of dilute hydrochloric acid to a polystyrene cup

Step 2 record the temperature of the acid

Step 3 find the mass of a 10 cm strip of magnesium ribbon

Step 4 add the magnesium ribbon to the hydrochloric acid

Step 5 when all the magnesium has reacted, record the highest temperature reached

- (a) Complete the word equation for the reaction.
(1 mark)

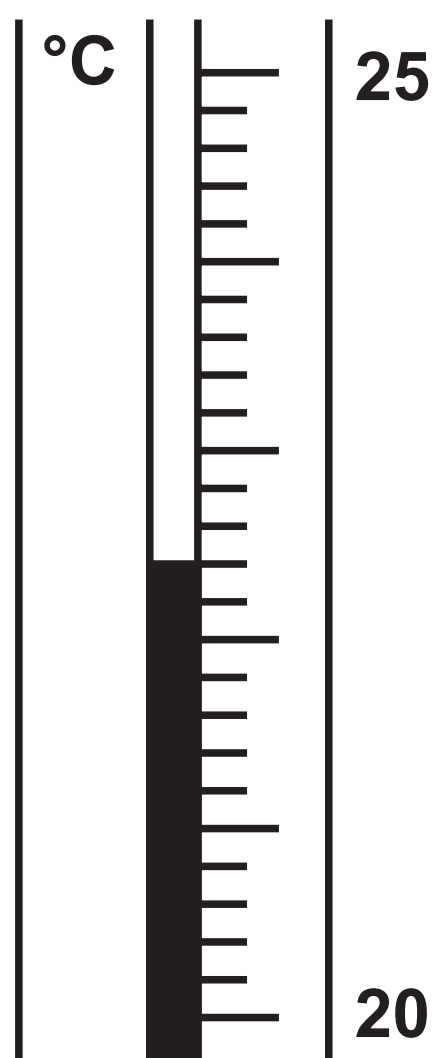
magnesium + hydrochloric acid →

_____ +

(continued on the next page)

7 continued.

(b) The thermometer shows the temperature of the acid at the start of the experiment.



**(i) Look at the table for Question 7(b)(i) in the Diagram Booklet. Complete the table by giving the temperatures to the nearest 0.1 °C.
(2 marks)**

(continued on the next page)

7 continued.

(ii) Show that the heat energy change (Q) for this reaction is about 2200 J.

[mass of 1.0 cm^3 of solution = 1.0 g]

**[for the solution, $c = 4.2\text{ J/g/}^\circ\text{C}$]
(2 marks)**

(continued on the next page)

7 continued.

(iii) The mass of magnesium used by the student was 0.12 g.

Calculate the value of the enthalpy change (ΔH), in kilojoules per mole of magnesium, for the reaction between magnesium and hydrochloric acid.

**Include a sign in your answer.
(4 marks)**

$\Delta H =$ _____ kJ/mol

(Total for Question 7 = 9 marks)

Turn over

8 (a) A scientist finds an unlabelled bottle on a shelf.

She thinks the bottle contains a solution of ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$

Describe tests the scientist could do to show that the solution is ammonium sulfate.

(6 marks)

(continued on the next page)

Turn over

8 continued.

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Turn over

8 continued.

(b) Ammonium sulfate is often used as a fertiliser.

It is prepared by reacting ammonia (NH_3) with sulfuric acid (H_2SO_4).

**(i) Name the type of reaction that occurs between ammonia and sulfuric acid.
(1 mark)**

**(ii) Write a chemical equation for the reaction of ammonia with sulfuric acid.
(1 mark)**

(continued on the next page)

8 continued.

(iii) Draw a dot-and-cross diagram to show the bonding in a molecule of ammonia.

**Show outer electrons only.
(2 marks)**

(Total for Question 8 = 10 marks)

- 9 Look at the apparatus for Question 9 in the Diagram Booklet. A student uses this apparatus to investigate the rate of reaction between marble chips and dilute hydrochloric acid.**

The equation for the reaction is



- (a) During the reaction the mass of the contents of the flask decreases.**

- (i) State why the mass of the contents of the flask decreases.**

(1 mark)

(continued on the next page)

9 continued.

**(ii) State the purpose of the cotton wool.
(1 mark)**

**(iii) Explain why sulfuric acid is not a suitable acid
to use in this investigation.
(2 marks)**

(continued on the next page)

Turn over

9 continued.

(b) Look at the graph for Question 9(b) in the Diagram Booklet. It shows the student's results.

(i) In the investigation the marble chips are in excess.

**Explain the shape of the graph.
(4 marks)**

(continued on the next page)

Turn over

9 continued.

(continued on the next page)

9 continued.

- (ii) The student repeats the experiment using the same volume of hydrochloric acid but of half the concentration of the original acid. All other conditions are kept the same.**

On the grid for Question 9(b) in the Diagram Booklet, draw the curve the student would obtain.

(2 marks)

(continued on the next page)

9 continued.

- (c) Explain, using particle collision theory, how increasing the temperature affects the rate of a reaction.
(4 marks)**

(continued on the next page)

Turn over

9 continued.

(Total for Question 9 = 14 marks)

- 10 (a) Look at the diagram for Question 10(a) in the Diagram Booklet. It shows the apparatus a teacher uses to determine the formula of an oxide of lead.**

This is the teacher's method.

- Step 1 find the mass of the reduction tube**
- Step 2 add some of the lead oxide to the reduction tube**
- Step 3 find the mass of the reduction tube and lead oxide**
- Step 4 pass hydrogen gas over the lead oxide and ignite the hydrogen at the hole**
- Step 5 heat the lead oxide strongly for 10 minutes**
- Step 6 keep passing hydrogen through the reduction tube until the tube and contents are cool**
- Step 7 find the new mass of the reduction tube and its contents**

(continued on the next page)

10 continued.

- (i) Give a reason why hydrogen is passed through the reduction tube until the tube and contents are cool.
(1 mark)**

- (ii) Describe what the teacher should do next to make sure all the lead oxide has been reduced to lead.
(2 marks)**

(continued on the next page)

Turn over

10 continued.

(b) The teacher completes the experiment and obtains these results.

mass of reduction tube = 23.50 g

mass of tube + lead oxide = 28.64 g

mass of tube + lead = 28.16 g

(i) Calculate the mass of lead formed.
(1 mark)

mass of lead = _____ g

(ii) Calculate the mass of oxygen removed from the lead oxide.
(1 mark)

mass of oxygen = _____ g

(continued on the next page)

10 continued.

- (iii) Determine the empirical formula of the lead oxide.
(4 marks)**

empirical formula of the lead oxide =

(continued on the next page)

10 continued.

(c) The insoluble salt lead(II) chloride (PbCl_2) can be prepared by reacting a solution of lead(II) nitrate with dilute hydrochloric acid.

**(i) Complete the equation for the reaction by adding the state symbols.
(1 mark)**



(continued on the next page)

10 continued.

- (ii) Show that the maximum mass of lead(II) chloride that can be made from 0.0370 mol of hydrochloric acid is about 5 g.

[M_r of PbCl_2 = 278]
(3 marks)

maximum mass = _____ g

(Total for Question 10 = 13 marks)

TOTAL FOR PAPER = 110 MARKS

END