

**Combined Science**  
**PAPER 5**  
**Foundation Tier**

<b>Total Marks</b>
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**Tuesday 13 June 2023 – Morning**

**Time: 1 hour 10 minutes**

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

<b>Surname</b>					
<b>Other names</b>					
<b>Centre Number</b>					
<b>Candidate Number</b>					

## **YOU MUST HAVE**

**Calculator, ruler**

## **YOU WILL BE GIVEN**

**Diagram Booklet, Periodic Table**

## **INSTRUCTIONS**

**Answer ALL questions.**

**Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.**

**Calculators may be used.**

**Any diagrams may NOT be accurately drawn, unless otherwise indicated.**

**You must show all your working out with your answer clearly identified at the end of your solution.**

## **INFORMATION**

**The total mark for this paper is 60.**

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

**(continued on the next page)**

**Turn over**

**INFORMATION** continued.

In questions marked with an **ASTERISK (\*)**, marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

A periodic table is provided as a separate insert.

There may be spare copies of some diagrams.

**ADVICE**

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

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**Answer ALL questions. Write your answers in the spaces provided.**

**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 ☐.**

- 1 Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows the structure of a molecule of each of four compounds, A, B, C and D.**

**(a) The formula of a molecule of compound A is  $\text{H}_2\text{O}$ .**

**Give the formula of a molecule of compound D.  
(1 mark)**

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**(continued on the next page)**

**1 continued.**

- (b) Look at the diagram for Question 1(b) in the Diagram Booklet. The names of two of the compounds in Figure 1 are shown.**

**Draw one straight line from each name to the structure of a molecule of that compound.  
(2 marks)**

**(continued on the next page)**

**1 continued.**

- (c) Figure 2 shows information about the number of electrons in the outer shell of each of the different atoms in a molecule of compound C.**

**FIGURE 2**

<b>Symbol of element</b>	<b>Number of electrons in outer shell of the atom</b>
<b>H</b>	<b>1</b>
<b>S</b>	<b>6</b>

**Look at the diagram for Question 1(c) in the Diagram Booklet. Use the information to complete the dot and cross diagram for a molecule of compound C.**  
**(2 marks)**

**(continued on the next page)**

**1 continued.**

**(d) The atomic number of phosphorus, P, is 15.**

**One atom of phosphorus has a relative atomic mass of 31.**

**Give the number of protons, neutrons and electrons in this atom of phosphorus.  
(3 marks)**

**number of protons = \_\_\_\_\_**

**number of neutrons = \_\_\_\_\_**

**number of electrons = \_\_\_\_\_**

**(Total for Question 1 = 8 marks)**

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- 2 A student investigated the temperature change that took place when different salts were dissolved in water.**

**The student used the following method.**

**step 1** pour  $50\text{ cm}^3$  of water into a polystyrene cup and record the temperature of the water

**step 2** find the mass of an empty boiling tube

**step 3** add 2 spatula measures of a salt to the boiling tube and find its new mass

**step 4** add the salt to the water

**step 5** stir the mixture and record the temperature after 2 minutes.

**Look at Figure 3 for Question 2 in the Diagram Booklet. It shows the apparatus used.**

**(continued on the next page)**



**2 continued.**

- (a) Look at Figure 4 for Question 2(a) in the Diagram Booklet.**

**For steps 2 and 3, the student obtained the mass measurements shown in Figure 4 for the first salt.**

**Use the mass measurements in Figure 4 to calculate the mass of salt, in grams, added to the water.**

**(1 mark)**

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**mass of salt = \_\_\_\_\_g**

**(continued on the next page)**

**2 continued.**

- (b) The student repeated the method for three different salts, A, B and C.**

**The same mass of each salt was used.**

**Look at Figure 5 for Question 2(b) in the Diagram Booklet. It shows the temperature readings obtained for the three different salts.**

- (i) Calculate the temperature change for salt C.**

**Include a sign to show if the temperature change is an increase or a decrease.  
(2 marks)**

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**temperature change = \_\_\_\_\_ °C**

**(continued on the next page)**

**2(b) continued.**

- (ii) Explain which salt produces the biggest exothermic change.  
(2 marks)**

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**(continued on the next page)**

**2 continued.**

- (c) Explain why a polystyrene cup is a better container to use for this investigation than a glass beaker.  
(2 marks)**

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**(Total for Question 2 = 7 marks)**

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**3 Look at Figure 6 for Question 3 in the Diagram Booklet. A scientist produced the information in Figure 6 about the Earth's atmosphere and the Earth's average surface temperature.**

**(a) Look at the bar chart for Question 3(a) in the Diagram Booklet. Complete the bar chart showing the composition of the Earth's atmosphere 3 billion years ago by adding a bar to show the percentage of carbon dioxide.**

**(1 mark)**

**(b) (i) Use words from the list to complete the following sentence.**

**(1 mark)**

**has decreased**

**has increased**

**has stayed the same**

**Over the past 3 billion years the average surface temperature of the Earth**

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**(continued on the next page)**

**3(b) continued.**

- (ii) The Earth's atmosphere 3 billion years ago contained much more water vapour than today's atmosphere.**

**Explain what happened to the water vapour.  
(2 marks)**

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**(continued on the next page)**

**3 continued.**

**(c) Scientists think that the decrease in percentage of carbon dioxide was partly due to this gas being used in the growth of primitive plants.**

**(i) Carbon dioxide was used in the growth of primitive plants and produced oxygen.**

**Give the name of the process in plants that takes in carbon dioxide and produces oxygen.  
(1 mark)**

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**(continued on the next page)**

**3(c) continued.**

**(ii) Which of the following tests would show that a gas is oxygen?  
(1 mark)**

- ☐ **A put a lighted splint into the gas and it burns with a pop**
- ☐ **B put a glowing splint into the gas and it relights**
- ☐ **C put a lighted splint into the gas and it relights**
- ☐ **D put a glowing splint into the gas and it burns with a pop**

**(continued on the next page)**



**3 continued.**

**(d) Many people are concerned by the increasing amount of carbon dioxide in the atmosphere.**

**(i) The amount of carbon dioxide in the atmosphere is measured in parts per million (ppm).**

**Look at Figure 7 for Question 3(d) in the Diagram Booklet. It shows the amount of carbon dioxide in the atmosphere in June 2001 and in June 2021.**

**(continued on the next page)**

**3(d)(i) continued.**

**Calculate the increase in the amount of carbon dioxide, in ppm, from June 2001 to June 2021.**

**Give your answer to the nearest whole number.  
(2 marks)**

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**increase in amount of carbon dioxide = \_\_\_\_\_ ppm**

**(continued on the next page)**

**3(d) continued.**

- (ii) State ONE possible effect that could be caused by the increasing amount of carbon dioxide in the atmosphere.  
(1 mark)**

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**(Total for Question 3 = 9 marks)**

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**4 Chlorine is an element in group 7 of the periodic table.**

**(a) What name is given to group 7 of the periodic table?**

**(1 mark)**

- ☐ **A alkali metals**
- ☐ **B halogens**
- ☐ **C noble gases**
- ☐ **D transition metals**

**(b) Chlorine reacts with sodium to form sodium chloride.**

**(i) Write the word equation for this reaction.**  
**(2 marks)**

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**(continued on the next page)**

**4(b) continued.**

**(ii) Chlorine,  $\text{Cl}_2$ , is made of simple molecules.**

**Describe what is meant by the  
term MOLECULE.**

**(2 marks)**

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**(continued on the next page)**

**4(b) continued.**

**(iii) Sodium, like all metals, conducts electricity.**

**Explain how sodium conducts electricity.  
(2 marks)**

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**(continued on the next page)**

**4(b) continued.**

**(iv) Sodium chloride contains sodium ions,  $\text{Na}^+$ , and chloride ions,  $\text{Cl}^-$ .**

**Use this information to state the formula of sodium chloride.**

**(1 mark)**

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**(continued on the next page)**

**4(b) continued.**

- (v) Sodium chloride is made of a giant structure of ions.**

**Look at the diagrams for Question 4(b)(v) in the Diagram Booklet.**

**Which diagram shows the arrangement of particles in sodium chloride?  
(1 mark)**

☐ **Diagram A**

☐ **Diagram B**

☐ **Diagram C**

☐ **Diagram D**

**(continues on the next page)**



**4(b) continued.**

**(vi) Look at Figure 8 for Question 4(b)(vi) in the Diagram Booklet. Sodium chloride solution conducts electricity.**

**State what can be put into the circuit in Figure 8 to show that a current is flowing.  
(1 mark)**

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**(continued on the next page)**

4 continued.

(c) Look at Figure 9 for Question 4(c) in the Diagram Booklet. It shows a flow diagram of how hydrochloric acid can be made.

- (i) Balance the equation for the reaction between hydrogen and chlorine to form hydrogen chloride.  
(1 mark)



- (ii) State how hydrogen chloride can be converted into hydrochloric acid.  
(1 mark)

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(Total for Question 4 = 12 marks)

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- 5 Look at Figure 10 for Question 5 in the Diagram Booklet. A student used the apparatus shown to investigate the reaction between marble chips and dilute hydrochloric acid.

The student recorded the volume of gas every minute.

**FIGURE 11**

<b>time in minutes</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>volume of gas in cm<sup>3</sup></b>	<b>0</b>	<b>52</b>	<b>78</b>	<b>91</b>	<b>97</b>	<b>100</b>	<b>100</b>

- (a) Look at the grid for Question 5(a) in the Diagram Booklet. On the grid, plot the results shown in Figure 11.

**Draw a curve of best fit.**  
**(3 marks)**

**(continued on the next page)**

5 continued.

(b) Rate of reaction can be calculated using

$$\text{rate of reaction} = \frac{\text{volume of gas produced in 1 minute}}{1 \text{ minute}}$$

Look at Figure 12 for Question 5(b) in the Diagram Booklet. It shows the rates of reaction calculated from the results of this experiment.

The rate of reaction for the time interval 2 to 3 minutes is missing.

- (i) Calculate the rate of reaction for the time interval 2 to 3 minutes.  
(1 mark)

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rate of reaction =

\_\_\_\_\_  $\text{cm}^3 \text{min}^{-1}$

(continued on the next page)

**5(b) continued.**

- (ii) State and explain what happens to the rate of reaction as the acid reacts with the marble chips in this experiment.  
(3 marks)**

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**(continued on the next page)**

**5 continued.**

- (c) The student repeated the experiment using the same volume of acid and the same mass of marble chips but used smaller marble chips.**

**All other conditions remained the same.**

**The student found that the reaction with the smaller marble chips was faster to start with but produced the same volume of gas.**

**Look again at the grid for Question 5(a) in the Diagram Booklet. Using this information, draw a line on the grid to show the results for the reaction with the smaller marble chips.**

**Label this line 'C'.**

**(2 marks)**

**(continued on the next page)**

**5 continued.**

**(d) Which of the following changes would make the reaction faster?**

**(1 mark)**

- ☐ use a larger boiling tube
- ☐ use a larger volume of the dilute acid
- ☐ use a more concentrated acid
- ☐ use a smaller boiling tube

**(e) State what could be used to measure time in the investigation.**

**(1 mark)**

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**(Total for Question 5 = 11 marks)**

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**6 Look at Figure 13 for Question 6(a) in the Diagram Booklet. It shows some information about some group 1 metals.**

**(a) Explain, in terms of their electronic configurations, why these metals are placed in group 1 of the periodic table.**

**(2 marks)**

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**(continued on the next page)**



6 continued.

- (b) Which row shows two correct properties of group 1 metals?  
(1 mark)

properties of group 1 metals		
<input type="checkbox"/> A	compounds are white in colour	high density
<input type="checkbox"/> B	low melting points	compounds are blue in colour
<input type="checkbox"/> C	soft enough to be cut by a knife	low melting points
<input type="checkbox"/> D	high density	conduct electricity

(continued on the next page)

6 continued.

- (c) The word equation for the reaction of potassium with bromine is

potassium + bromine  $\longrightarrow$  potassium bromide

Add the missing state symbol and balance the equation for this reaction.

(2 marks)



(continued on the next page)

**6 continued.**

- (d) A sample of potassium contains three isotopes, potassium-39, potassium-40 and potassium-41.**

**Explain the meaning of the term ISOTOPES.  
(2 marks)**

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**(continued on the next page)**

**6 continued.**

**\*(e)The reactivity of the group 1 metals increases from lithium to caesium.**

**Often, teachers demonstrate the reactions of lithium, sodium and potassium with water.**

**These reactions can be used to predict the behaviour and reactions of rubidium and caesium with water.**

**Describe the reactions of each of the group 1 metals with water including the predicted behaviour and reactions of rubidium and caesium.**

**You may use word equations in your answer.  
(6 marks)**

**Answer space continues on the next 4 pages.**

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**Turn over**

**6(e) continued.**

[illegible]

**Turn over**

**6(e) continued.**

[illegible]

**Turn over**

**6(e) continued.**

[illegible]

**Turn over**

**6(e) continued.**

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**(Total for Question 6 = 13 marks)**

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**TOTAL FOR PAPER = 60 MARKS**  
**END OF PAPER**