

Combined Science  
PAPER 5  
Foundation Tier

Total Marks
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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.

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 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 cm<sup>3</sup> 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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**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**
- 

**(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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**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**

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

- (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 =**

**\_\_\_\_\_ cm<sup>3</sup> min<sup>-1</sup>**

**(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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**6(e) continued.**

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**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**