

Combined Science  
PAPER 5  
Foundation Tier

Total Marks
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Tuesday 11 June 2024 – 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, Periodic table (enclosed)**

## **YOU WILL BE GIVEN**

**Diagram Booklet**

## **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.**

**There may be spare copies of some diagrams.**

**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.

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 This question is about the metals and non-metals in period 3 of the periodic table.**

**(a) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows some data about some of the elements in period 3.**

**Use the periodic table to answer these questions.**

**(i) Give the NAME of the element in period 3 that is not shown in Figure 1.  
(1 mark)**

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**(ii) Give the relative atomic mass of silicon.  
(1 mark)**

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**(continued on the next page)**

**1(a) continued.**

- (iii) State which metal and which non-metal in Figure 1 have the lowest melting points.  
(2 marks)**

**metal with lowest melting point**

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**non-metal with lowest melting point**

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**(continued on the next page)**

**1 continued.**

- (b) Alkali metals react with water to produce an alkaline solution and hydrogen gas.**

**A test tube of gas can be tested to see if the gas is hydrogen by putting a lighted splint at the top of the test tube.**

**Look at Figure 2 for Question 1(b) in the Diagram Booklet. A student suggests the following method to show that an alkaline solution and hydrogen gas are produced in this reaction.**

**step 1** pour **150 cm<sup>3</sup>** water into the container shown in Figure 2

**step 2** add a small piece of lithium to the water in the container shown in Figure 2

**step 3** hold a lighted splint above the container

**step 4** hold some damp red litmus paper above the mixture in the container

- (i) Give the name of the container shown in Figure 2.**  
**(1 mark)**
- 

**(continued on the next page)**

**Turn over**

1(b) continued.

- (ii) A teacher says that **step 3** and **step 4** will NOT work to show that hydrogen gas and an alkaline solution are produced in the reaction.

Explain ONE change that could be made in each step to make the method work.

(3 marks)

**step 3** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**step 4** \_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_

(Total for Question 1 = 8 marks)

\_\_\_\_\_

Turn over

- 2 (a) In one reaction the temperature of the reaction mixture decreases.

Which word describes this type of reaction?  
(1 mark)

- ☐ A displacement
- ☐ B endothermic
- ☐ C exothermic
- ☐ D neutralisation

(continued on the next page)



**2 continued.**

**(b) In an experiment, a salt is dissolved in water.**

**The temperature change is measured.**

**Look at Figure 3 for Question 2(b) in the Diagram Booklet. It shows the apparatus that is used.**

- (i) State what is used to measure the temperature change in Figure 3.**  
**(1 mark)**

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- (ii) State ONE reason for using the piece of equipment **A** in Figure 3.**  
**(1 mark)**

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**(continued on the next page)**

**Turn over**

**2(b) continued.**

**(iii) A student suggests putting a lid on piece of equipment B.**

**State why this would help to give a more accurate value for the temperature change.  
(1 mark)**

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**(continued on the next page)**

2(b) continued.

- (iv) Four different salts, **P**, **Q**, **R** and **S**, are dissolved in water.

Look at Figure 4 for Question 2(b)(iv) in the Diagram Booklet. It shows the starting temperature of the water and the final temperature of the solution after the salt dissolves.

Complete the table

- to show the temperature changes when salt **R** and salt **S** dissolve
  - by placing a tick (✓) in the box, on the bottom row, for the salt that **ABSORBS** the most heat energy when it dissolves.
- (4 marks)

- (v) One of the salts dissolved is barium chloride, **BaCl<sub>2</sub>**

Barium chloride contains the chloride ion, **Cl<sup>-</sup>**

Give the **FORMULA** of the barium ion in barium chloride.

(1 mark)

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(Total for Question 2 = 9 marks)

- 3 (a) Look at Figure 5 for Question 3(a) in the Diagram Booklet. It shows the structure of one molecule of three different compounds, **X**, **Y** and **Z**.

The molecules of the compounds shown in Figure 5 all contain the same number of carbon atoms.

- (i) Give the number of carbon atoms in a molecule of compound **X**  
(1 mark)

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- (ii) Compound **X** contains carbon and one other element.

Give the NAME of the other element in compound **X**.  
(1 mark)

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(continued on the next page)

**3(a) continued.**

**(iii) Look again at Figure 5 for Question 3(a) in the Diagram Booklet. Which of the compounds in Figure 5 is a hydrocarbon?**

**(1 mark)**

- ☐ **A    X only**
- ☐ **B    Y only**
- ☐ **C    X and Y only**
- ☐ **D    X, Y and Z**

**(iv) Which of the compounds in Figure 5 have the same molecular formula?**

**(1 mark)**

- ☐ **A    none of them**
- ☐ **B    X and Y only**
- ☐ **C    X and Z only**
- ☐ **D    X, Y and Z**

**(continued on the next page)**

**3 continued.**

- (b) Look at Figure 6 for Question 3(b) in the Diagram Booklet. It shows where fractions are produced in the fractional distillation of crude oil.**

**Complete the sentences about fractions obtained from crude oil.**

**(3 marks)**

**The fraction with the smallest molecules is called**

\_\_\_\_\_.

**Compared to petrol, the boiling point of kerosene is**

\_\_\_\_\_.

**When petrol burns, one product is**

\_\_\_\_\_.

**(continued on the next page)**

**3 continued.**

- (c) When some impure hydrocarbon fuels are burned, sulfur dioxide is one of the products.**

**Some sulfur dioxide gas is dissolved in water to form solution **W**.**

**When solution **W** is added to sodium hydroxide solution of **pH 12****

- the pH changes**
- the temperature increases.**

**Explain how the pH changes and why the temperature increases.  
(3 marks)**

**Answer space continues on the next page.**

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**3(c) continued.**

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**(Total for Question 3 = 10 marks)**

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**4 This question is about bromine.**

**(a) Give the colour and physical state of bromine at room temperature.**

**(2 marks)**

**colour**

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**physical state**

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**(continued on the next page)**

**4 continued.**

**(b) Bromine reacts with hydrogen to form hydrogen bromide.**

**(i) Look at the diagram for Question 4(b)(i) in the Diagram Booklet. Write the word equation for this reaction.**

**(2 marks)**

**(ii) Hydrogen bromide dissolves in water to form a solution.**

**This solution of hydrogen bromide reacts with alkalis.**

**State the type of reaction that occurs when a solution of hydrogen bromide reacts with an alkali.**

**(1 mark)**

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**(continued on the next page)**

**4 continued.**

- (c) Bromine and the other halogens react with hot iron wool.**

**Look at Figure 7 for Question 4(c) in the Diagram Booklet. It shows the relative speed of some of these reactions.**

**Fluorine also reacts with hot iron wool.**

**Use Figure 7 to predict the relative speed of this reaction.**

**(1 mark)**

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**(continued on the next page)**

4 continued.

- (d) Potassium bromide contains **32.8%** potassium by mass.

Calculate the mass of potassium and the mass of bromine in **500 g** potassium bromide.  
(3 marks)

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mass of potassium = \_\_\_\_\_ g

mass of bromine = \_\_\_\_\_ g

(Total for Question 4 = 9 marks)

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- 5 A student investigates the reaction between marble chips and dilute hydrochloric acid.**

**The student measures the total volume of carbon dioxide gas produced each minute, for 10 minutes.**

- (a) Look at Figure 8 for Question 5(a) in the Diagram Booklet. It shows part of the apparatus used in the experiment.**

**Complete Figure 8 by drawing and labelling apparatus that could be used to collect and measure the volume of the carbon dioxide gas.  
(2 marks)**

**(continued on the next page)**

**5 continued.**

- (b) Look at Figure 9 for Question 5(b) in the Diagram Booklet. It shows a graph of the results of the experiment.**

**A tangent has been drawn on the curve at a time of 3·5 minutes.**

- (i) State the total volume of carbon dioxide produced in the first 3·5 minutes.  
(1 mark)**

**volume = \_\_\_\_\_ cm<sup>3</sup>**

**(continued on the next page)**

5(b) continued.

- (ii) Using the tangent, calculate the rate of reaction at 3.5 minutes in  $\text{cm}^3$  per minute.

rate of reaction =  $\frac{\text{change in gas volume}}{\text{change in time}}$   
(3 marks)

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rate = \_\_\_\_\_  $\text{cm}^3$  per minute

(continued on the next page)

**5 continued.**

- (c) The student repeats the experiment using the same mass of smaller marble chips.**

**All other conditions remain the same.**

**Explain the effect on the rate of reaction of using smaller marble chips.**

**(2 marks)**

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**(continued on the next page)**



**5 continued.**

**(d) Which change would make the rate of reaction slower?**

**(1 mark)**

- ☐ **A using the same acid at a higher temperature**
- ☐ **B using acid of a lower concentration**
- ☐ **C using a larger flask**
- ☐ **D adding a catalyst**

**(e) In this experiment the volume of carbon dioxide gas produced is measured.**

**Give a different way that the amount of carbon dioxide produced can be measured.**

**(1 mark)**

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**(continued on the next page)**

**Turn over**

**5 continued.**

- (f) In this experiment there is an excess of dilute hydrochloric acid.**

**State what you would SEE in the conical flask at the end of the experiment.**

**(1 mark)**

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

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**6 This question is about the atmosphere.**

**(a) Describe the test to show that a gas is oxygen.  
(2 marks)**

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**(continued on the next page)**

6 continued.

(b) Copper reacts with oxygen to form copper oxide.

**2·100 g** of copper will react completely with  
**0·529 g** of oxygen.

In an experiment, **4·200 g** of copper is heated with  
**50·000 g** of oxygen until the reaction is complete.

Calculate the mass of oxygen remaining at the end  
of the experiment.

(2 marks)

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mass of oxygen = \_\_\_\_\_ g

(continued on the next page)

**6 continued.**

**(c) Helium, neon and argon are all inert.**

**(i) Explain, in terms of electrons, why these gases are inert.**

**(2 marks)**

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**(continued on the next page)**

**6(c) continued.**

- (ii) Two pieces of steel can be joined by heating the metal pieces with a very hot flame.**

**This process is often carried out in an argon atmosphere rather than in air.**

**Which property makes argon gas suitable for this use?**

**(1 mark)**

- ☐ **A argon has a low density**
- ☐ **B argon has a low melting point**
- ☐ **C argon is colourless**
- ☐ **D argon is unreactive**

**(continued on the next page)**

**6 continued.**

- \*(d) Look at Figure 10 for Question 6(d) in the Diagram Booklet. It shows how plant life and the atmosphere of Earth have changed over time.**

**Explain the effect that plant life has had on the Earth's atmosphere and the temperature of the Earth.**

**You should refer to the information in Figure 10 including**

- the plant life**
- the amounts of carbon dioxide**
- the amounts of oxygen**

**(6 marks)**

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

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**Turn over**

**6(d) continued.**

[illegible]

**Turn over**



**6(d) continued.**

[illegible]

**Turn over**

**6(d) continued.**

[illegible]

**Turn over**

6(d) continued.

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(Total for Question 6 = 13 marks)

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