

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

Total Marks
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**Time: 1 hour 10 minutes plus your additional time allowance**

**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 – 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.**

**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.**

## **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 ☐.**

**(continued on the next page)**

- 1 Magnesium reacts with dilute sulfuric acid to form magnesium sulfate and hydrogen gas.**

**A student wants to find out the effect of temperature on the rate of this reaction.**

**The student used the following method.**

**STEP 1 pour 25cm<sup>3</sup> of dilute sulfuric acid into a conical flask**

**STEP 2 warm the acid until its temperature is 30°C**

**STEP 3 add a piece of magnesium to the acid**

**STEP 4 start a stopwatch**

**STEP 5 wait until the reaction has finished**

**STEP 6 stop the stopwatch**

**STEP 7 repeat steps 1–6 but at 50°C.**

- (a) The student kept the volume of sulfuric acid the same when they repeated the method at 50°C.**

**State two other variables that should be kept the same.**

**(2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**1 continued.**

**(b) Which piece of equipment can be used to find the volume of  $25\text{ cm}^3$  of sulfuric acid?**  
**(1 mark)**

- ☐ **A balance**
- ☐ **B measuring cylinder**
- ☐ **C ruler**
- ☐ **D thermometer**

**(c) State how the student will know that the reaction has finished.**  
**(1 mark)**

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**(continued on the next page)**

**1 continued.**

**(d) The reaction at 50 °C was faster than the reaction at 30 °C.**

**Give ONE reason, in terms of particles, why the reaction at 50 °C was faster than the reaction at 30 °C.**

**(1 mark)**

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**(continued on the next page)**

1 continued.

- (e) At 50 °C, 15.0 cm<sup>3</sup> of gas was produced during the first 60 seconds of the reaction.

Calculate the average rate of reaction, in cm<sup>3</sup> s<sup>-1</sup>, for the first 60 seconds of the reaction.

(2 marks)

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average rate of reaction =

\_\_\_\_\_ cm<sup>3</sup> s<sup>-1</sup>

(Total for Question 1 = 7 marks)

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**2 This question is about the noble gases.**

- (a) (i) State, in terms of outer shell electrons, why the noble gases are unreactive.  
(1 mark)**
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- (ii) Look at Figure 1 for Question 2(a)(ii) in the Diagram Booklet. It shows an airship, filled with helium, floating above the ground.**

**Helium, hydrogen and krypton are gases.**

**Figure 2 shows the reactivity and density, at room temperature and pressure, of helium, hydrogen and krypton.**

**Figure 2**

<b>gas</b>	<b>reactivity</b>	<b>density in g cm<sup>-3</sup></b>
<b>helium</b>	<b>unreactive</b>	<b>0·00018</b>
<b>hydrogen</b>	<b>very reactive</b>	<b>0·00009</b>
<b>krypton</b>	<b>unreactive</b>	<b>0·00380</b>

**The density of air is 0·001225 g cm<sup>-3</sup>.**

**Helium is used in airships.**

**(continued on the next page)**

**Turn over**

**2 continued.**

**Explain why hydrogen and why krypton are NOT used in airships.  
(3 marks)**

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**(b) Mendeleev produced one of the earliest periodic tables.**

**State why he could NOT include any of the noble gases in his periodic table.  
(1 mark)**

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**(continued on the next page)**

**Turn over**

2 continued.

- (c) Figure 3 shows the boiling points of some of the noble gases.

Figure 3

noble gas	boiling point in °C
helium	−270
neon	−250
argon	−190
krypton	−150
xenon	

- (i) Look at the bar chart for Question 2(c)(i) in the Diagram Booklet. Complete the bar chart to show the boiling points of neon and argon.  
(2 marks)
- (ii) Predict the boiling point of xenon.  
(1 mark)

boiling point of xenon= \_\_\_\_\_ °C

(Total for Question 2 = 8 marks)

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**3 Fluorine, chlorine, bromine and iodine are elements in group 7 of the periodic table.**

**(a) (i) State the name given to the group 7 elements.  
(1 mark)**

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**(ii) Name one other element that is in group 7.  
Use the periodic table provided to help you.  
(1 mark)**

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**(iii) Which element is liquid at room temperature  
and pressure?  
(1 mark)**

☐ **A**    fluorine

☐ **B**    chlorine

☐ **C**    bromine

☐ **D**    iodine

**(continued on the next page)**

**Turn over**

**3 continued.**

**(iv) Which element is dark grey in colour at room temperature and pressure?  
(1 mark)**

☐ **A**    **fluorine**

☐ **B**    **chlorine**

☐ **C**    **bromine**

☐ **D**    **iodine**

**(continued on the next page)**

**3 continued.**

**(b) Tin reacts with chlorine to form tin chloride.**

**A sample of tin chloride contains 1.19 g of tin and 1.42 g of chlorine.**

**Calculate the empirical formula of this tin chloride.**

**(relative atomic masses: Cl = 35.5, Sn = 119.0)**

**You must show your working.**

**(3 marks)**

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**empirical formula of this tin chloride =**

\_\_\_\_\_

**(continued on the next page)**

**Turn over**

**3 continued.**

**(c) Tin also reacts with fluorine.**

**The reaction between fluorine and tin is much more vigorous than the reaction between chlorine and tin.**

**Look at Figure 4 for Question 3(c) in the Diagram Booklet. It shows the electronic configurations of fluorine and chlorine.**

**Explain, in terms of their electronic configurations, why fluorine reacts with tin more vigorously than chlorine reacts with tin.**

**(2 marks)**

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

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- 4 Look at Figure 5 for Question 4 in the Diagram Booklet. It shows a sample of hydrogen peroxide solution decomposing to form water and oxygen gas.

- (a) (i) Write the word equation for hydrogen peroxide solution decomposing.  
(1 mark)

\_\_\_\_\_ →  
\_\_\_\_\_

- (ii) In this reaction hydrogen peroxide is a solution, water is a liquid and oxygen is a gas.

Draw one straight line from each substance to its correct state symbol.  
(2 marks)

SUBSTANCE	STATE SYMBOL
hydrogen peroxide solution •	• (aq)
liquid water •	• (g)
oxygen gas •	• (l)

(continued on the next page)



**4 continued.**

- (b) Describe the test to show the gas produced is oxygen.  
(2 marks)**

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- (c) Look at Figure 6 for Question 4(c) in the Diagram Booklet. It shows the electron arrangement for an atom of hydrogen and an atom of oxygen.**

**Look at Figure 7 for Question 4(c) in the Diagram Booklet. Complete the dot and cross diagram for a molecule of water, H<sub>2</sub>O.**

**Draw outer shell electrons only.  
(2 marks)**

**(continued on the next page)**

**4 continued.**

**(d) Liver contains the enzyme catalase.**

**A piece of liver was added to another sample of hydrogen peroxide solution.**

**Look at Figure 8 for Question 4(d) in the Diagram Booklet. It shows the results.**

**Look at Figure 9 for Question 4(d) in the Diagram Booklet. It shows a graph of the volume of oxygen produced from the hydrogen peroxide with and without liver.**

- (i) Complete the missing label on the axis of the graph.**  
**(1 mark)**

**(continued on the next page)**

**4 continued.**

- (ii) Describe what the graph shows about the difference in decomposition of hydrogen peroxide with and without liver. (2 marks)**

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**4 continued.**

- (iii) Describe how the apparatus in Figure 8 could be modified to find the volume of gas produced when the liver is added to the hydrogen peroxide.  
(2 marks)**

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**(Total for Question 4 = 12 marks)**

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- 5 (a) The concentration of a solution can be calculated using the equation

$$\text{concentration of solution} = \frac{\text{mass of solid}}{\text{volume of solution}}$$

A student dissolved 9.25 g of ammonium chloride in water and made up the solution to a volume of 200 cm<sup>3</sup>.

Use the equation to calculate the concentration of this solution in g dm<sup>-3</sup>.  
(2 marks)

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concentration = \_\_\_\_\_ g dm<sup>-3</sup>

(continued on the next page)

**5 continued.**

- (b) Dissolving ammonium chloride in water is an endothermic process.**

**Look at Figure 10 for Question 5(b) in the Diagram Booklet. It shows part of the reaction profile for this process.**

- (i) Explain how Figure 10 shows that dissolving ammonium chloride in water is an endothermic process.  
(2 marks)**

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- (ii) Complete the reaction profile in Figure 10 and label the activation energy.  
(2 marks)**

**(continued on the next page)**

**Turn over**

**5 continued.**

- (c) Look at Figure 11 for Question 5(c) in the Diagram Booklet. A student used the equipment in Figure 11 to investigate whether electricity can pass through solid ammonium chloride and through ammonium chloride solution.**

**If an electrical current flows in the circuit, the lamp will light up.**

**Look at Figure 12 for Question 5(c) in the Diagram Booklet. It shows the results of the investigation.**

**Explain the results of the investigation.  
(3 marks)**

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**5 continued.**

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**(d) Ammonia gas is toxic.**

- (i) Look at the symbols for Question 5(d) in the Diagram Booklet. Which symbol should be placed on a container of a toxic gas?  
(1 mark)**

☐ **A**

☐ **B**

☐ **C**

☐ **D**

**(continued on the next page)**



**5 continued.**

- (ii) Give ONE safety precaution that should be taken when working with toxic gases in the laboratory.  
(1 mark)**

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

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**6 Diesel oil is a mixture of hydrocarbons that can be obtained from crude oil.**

**(a) State the name of the process used to separate diesel oil from crude oil.**

**(1 mark)**

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**(b) Diesel oil contains alkanes.**

**These alkanes are part of an homologous series.**

**Which statement about compounds in this homologous series is true?**

**(1 mark)**

☐ **A they have the same chemical formula**

☐ **B they have the same empirical formula**

☐ **C they have the same general formula**

☐ **D they have the same molecular formula**

**(continued on the next page)**

**6 continued.**

- (c) When fuels such as diesel oil are burned, the high temperatures produced can cause nitrogen and oxygen in the air to form the pollutant nitrogen dioxide.**

**Complete the balanced equation for the reaction.  
(2 marks)**



**(continued on the next page)**

**6 continued.**

- (d) Explain how the greenhouse effect is caused by the gases produced by the complete combustion of diesel oil.  
(3 marks)**

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**6 continued.**

- \*(e) Diesel oil can contain impurities of sulfur.  
Burning diesel oil containing impurities of sulfur  
can result in acid rain.  
Acid rain is harmful to the environment.**

**Explain how acid rain is formed and the harm it  
can do.  
(6 marks)**

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**Turn over**

**6 continued.**

[illegible]

**(continued on the next page)**

**Turn over**

**6 continued.**

[illegible]

**(continued on the next page)**

**Turn over**

**6 continued.**

[illegible]

**(continued on the next page)**

**Turn over**



**6 continued.**

[illegible]

**(continued on the next page)**

**Turn over**

**6 continued.**

[illegible]

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

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