

**Modified Enlarged 36pt**  
**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Thursday 16 May 2019 – Morning**

**GCSE (9–1) Combined Science B**  
**(Twenty First Century Science)**

**J260/02 Chemistry (Foundation Tier)**

**Time allowed: 1 hour 45 minutes**  
**plus your additional time allowance**

**YOU MUST HAVE:**

**the Data Sheet (for GCSE Chemistry B)**  
**a ruler (cm/mm)**

**YOU MAY USE:**

**a scientific or graphical calculator**  
**an HB pencil**

**Please write clearly in black ink.**

**Centre number**

--	--	--	--	--

**Candidate number**

--	--	--	--

**First name(s)** \_\_\_\_\_

**Last name** \_\_\_\_\_

**READ INSTRUCTIONS OVERLEAF**



# **INSTRUCTIONS**

**The Data Sheet will be found with this document.**

**Use black ink. You may use an HB pencil for graphs and diagrams.**

**Answer ALL the questions.**

**Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.**

**Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.**

# **INFORMATION**

**The total mark for this paper is 95.**

**The marks for each question are shown in brackets [ ].**

**Quality of extended responses will be assessed in the question marked with an asterisk (\*).**

**BLANK PAGE**

**Answer ALL the questions.**

- 1 Lithium metal is a group 1 element.  
Lithium atoms have the electron  
arrangement 2.1.**

**(a) Which of the following statements  
about the atoms of ALL group 1  
elements are TRUE and which are  
FALSE? [2]**

**Tick (✓) ONE box in each row.**

<b>Statement</b>	<b>True</b>	<b>False</b>
<b>They all have 2 electrons in their first shell.</b>		
<b>They all have 1 electron in their outer shell.</b>		
<b>They all have the same number of electrons.</b>		
<b>They all have the same number of electron shells.</b>		

**(b) The elements on the left of the periodic table are all metals.**

**Which two statements about atoms of these elements are TRUE? [2]**

**Tick (✓) TWO boxes.**

**They have a small number of electrons in their outer shell.**

☐

**They do not contain electrons.**

☐

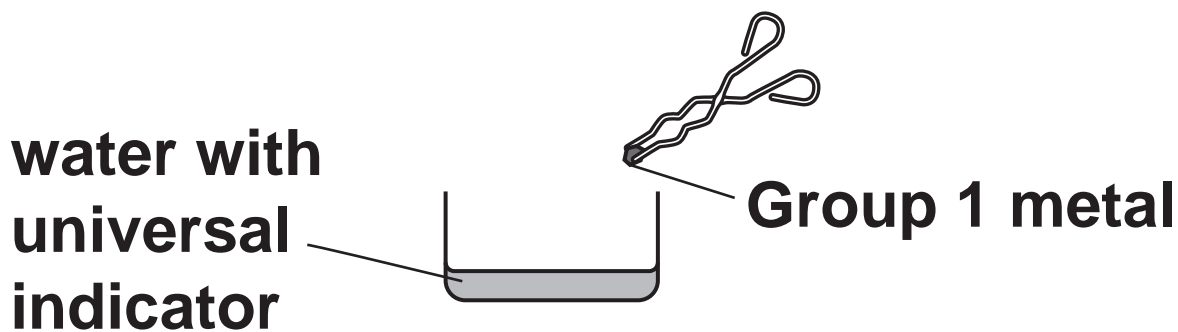
**They lose electrons easily.**

☐

**They form covalent bonds by gaining electrons.**

☐

**(c) Beth is a chemistry teacher. She does experiments to show the reactivity of the Group 1 metals with water.**



**She places a small piece of lithium into the water with universal indicator and records her observations. She repeats this method with sodium and then potassium.**

**Beth's observations are shown in the table.**

<b>Metal</b>	<b>Observations</b>
<b>Lithium</b>	<b>Fizzes slowly. Indicator turns blue.</b>
<b>Sodium</b>	<b>Fizzes quickly. Sodium melts and moves quickly on surface of water. Indicator turns blue.</b>
<b>Potassium</b>	<b>Fizzes quickly. Potassium melts and purple flame formed. Indicator turns blue.</b>

**(i) How do the observations show the trend in reactivity going down Group 1 of the Periodic Table?**

---

---

---

**[2]**

- (ii) All the metals fizz when added to water and the universal indicator turns blue.

Draw lines to connect each observation with the product that causes it. [2]

**OBSERVATION**

**PRODUCT**

**Fizzing**

**Hydrogen gas  
released**

**Oxygen gas  
released**

**Indicator turns  
blue**

**Presence of  
water**

**Presence of  
hydroxide ions**



**BLANK PAGE**

**2 Many countries with sunny climates get most of their salt from seawater.**

**The seawater is trapped in shallow pools and left in the sun. After some time, piles of solid salt form.**

**(a) Complete the sentences to explain how solid salt forms. [3]**

**Put a ring around each correct choice to complete the sentences.**

**The HEAT / LIGHT from the  
sun DECREASES / INCREASES  
the temperature in the shallow  
pools.**

**This causes the WATER / SALT  
to EVAPORATE / DISSOLVE.**

**(b) The piles of solid salt contain a mixture of salt and sand.**

**Sand is insoluble in water.**

**Jack plans an experiment to find the percentage of pure salt in the mixture. These are the steps he plans. They are NOT in the correct order.**

- A Add water to the mixture and stir.**
- B Collect a sample of the mixture.**
- C Filter and collect the solution.**
- D Heat the solution until all water has gone.**
- E Weigh the pure salt.**
- F Weigh the mixture.**

**(i) Put the steps in the correct order. [3]**

<b>B</b>					
----------	--	--	--	--	--

**(ii) Jack finds that his method makes very small crystals.**

**How could he change step D so that he makes larger crystals?**

---

---

---

**[2]**

**(iii) Jack used 10.0 g of the mixture for his sample.**

**He used a dish to weigh the pure salt he made.**

**Mass of empty dish = 50.0 g**

**Mass of dish with  
pure salt = 58.4 g**

**Calculate the MASS OF PURE  
SALT he made.**

**Mass of pure salt = \_\_\_\_\_ g [1]**

**(iv) The percentage of pure salt in the mixture can be calculated using the formula:**

$$\text{Percentage} = \frac{\text{mass of pure salt}}{\text{mass of mixture}} \times 100$$

**Calculate the PERCENTAGE of pure salt in the sample.**

**Percentage = \_\_\_\_\_ % [2]**

- 3 Tennis rackets used to be made of wood, but wood was not strong enough to make bigger rackets and so designers considered using other materials.**

**The table shows the properties of some materials they considered.**

<b>Material</b>	<b>Stiffness (GPa)</b>	<b>Density (g/cm<sup>3</sup>)</b>	<b>Strength (MPa)</b>
<b>Steel (iron alloy)</b>	<b>210</b>	<b>7.8</b>	<b>400</b>
<b>Aluminium alloy</b>	<b>71</b>	<b>2.7</b>	<b>300</b>
<b>Graphite</b>	<b>90</b>	<b>2.0</b>	<b>500</b>
<b>PVC</b>	<b>4</b>	<b>1.0–2.0</b>	<b>50</b>

- (a) Which TWO materials in the table contain mainly metals?**

\_\_\_\_\_ and \_\_\_\_\_  
[1]

**(b) Graphite tennis rackets are made from a polymer combined with graphite fibres.**

**What is the name for a type of material that is made from two or more substances combined together? [1]**

**Put a ring around the correct answer.**

**ceramic**

**composite**

**metal**

**plastic**



**(c) A sample of PVC has a mass of 12.0 g and a volume of 8.0 cm<sup>3</sup>.**

**Calculate the density of PVC.**

**Density = \_\_\_\_\_ g/cm<sup>3</sup> [2]**

**(d)\* A company decides to make a new tennis racket. They want the new racket to be stiff, light and strong.**

**The company considers using STEEL, ALUMINIUM ALLOY or GRAPHITE for the new racket.**

**Decide which of these three materials is the best choice for the racket by discussing their advantages and disadvantages.**

**Use data from the table on page 15 to support your answer.**

---

---

---

---

---

---

---

---

---

---

---

---

---

---

[6]

**4 Mia adds magnesium to dilute hydrochloric acid.**

**(a) Complete the word and balanced symbol equations opposite for the reaction between magnesium and hydrochloric acid. [3]**

magnesium + hydrochloric acid → \_\_\_\_\_ + hydrogen

\_\_\_\_\_ + \_\_\_\_\_ HCl → MgCl<sub>2</sub> + \_\_\_\_\_

**(b) Mia measures the volume of hydrogen gas every 30 seconds.**

**Which piece of apparatus could she use to measure the volume of hydrogen collected? [1]**

**Put a ring around the correct answer.**

**balance**

**beaker**

**gas syringe**

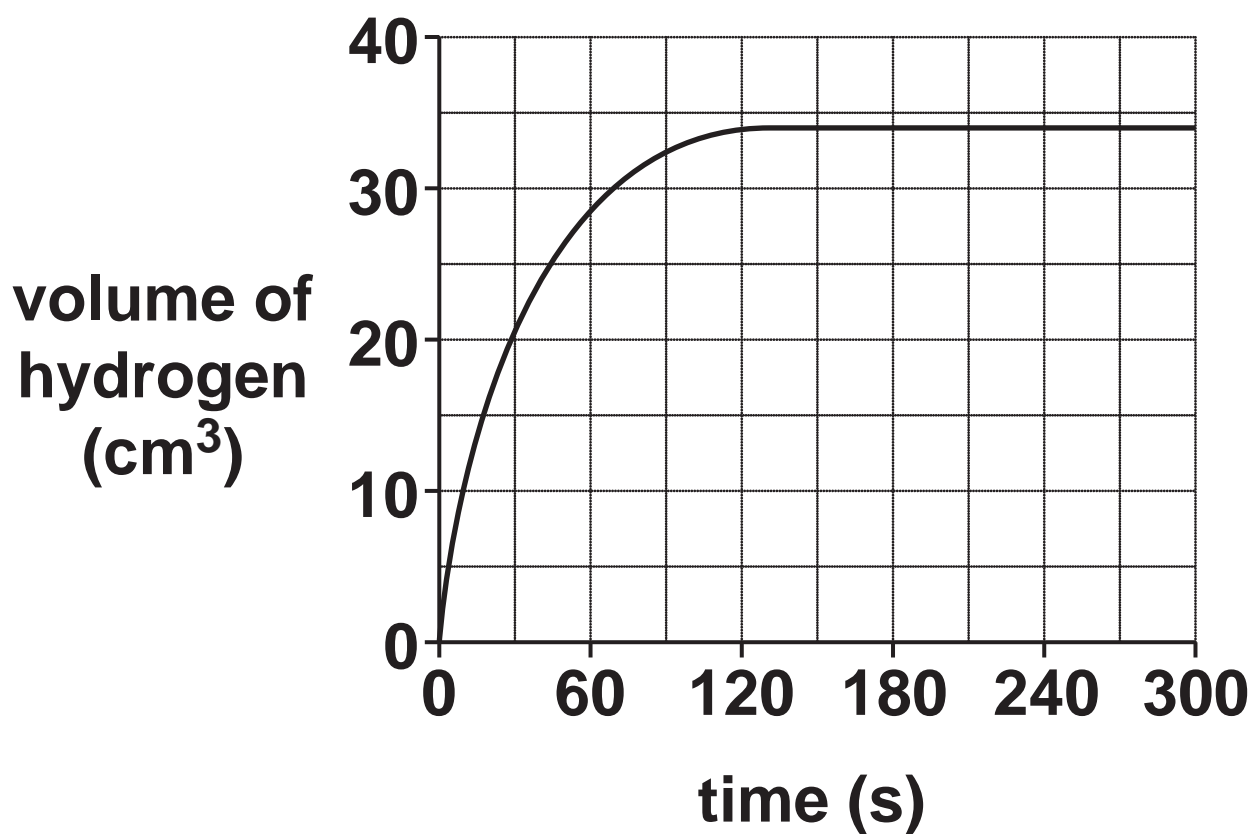
**pipette**

**thermometer**

**BLANK PAGE**

**(c) She plots her results on a graph.**

**Fig. 4.1**





**(i) Which statement is the best description of what is happening during the first 12 s of the reaction in Fig. 4.1? [1]**

**Tick (✓) ONE box.**

**No reaction is happening.**

☐

**The reaction is at its fastest.**

☐

**The reaction is speeding up.**

☐

**The reaction is at a constant rate.**

☐

**(ii) Which statement is the best description of what is happening after 300 seconds in Fig. 4.1? [1]**

**Tick (✓) ONE box.**

**The reaction has stopped.**

☐

**The reaction is at its fastest.**

☐

**The reaction is getting faster.**

☐

**The reaction is at a constant rate.**

☐

**(iii) Using Fig. 4.1 how long did it take to collect 20 cm<sup>3</sup> of hydrogen?**

**Time = \_\_\_\_\_ s [1]**

**(iv) Using Fig. 4.1, what is the total volume of hydrogen collected in this experiment?**

**Total volume = \_\_\_\_\_ cm<sup>3</sup> [1]**

**5 Zinc is made by heating zinc oxide with carbon.**

**zinc  
oxide**    +    **carbon**     $\rightarrow$     **zinc**    +    **carbon  
dioxide**



**(a) (i) The zinc oxide is reduced by the carbon to make zinc.**

## What does REDUCED mean in this situation? [1]

**Tick (✓) ONE box.**

**The mass of zinc oxide increases.**

7

**The zinc oxide reacts with air.**

7

**Zinc oxide loses energy.**

7

## Zinc oxide loses oxygen.

7

**(ii) Zinc can be made by heating zinc oxide with carbon.**

**Aluminium CANNOT be made by heating aluminium oxide with carbon.**

**Which two statements explain why? [2]**

**Tick (✓) TWO boxes.**

**Aluminium is less reactive than zinc.**

☐

**Aluminium is more reactive than carbon.**

☐

**Aluminium oxide is very rare.**

☐

**Zinc is less reactive than carbon.**

☐

**Zinc oxide melts when it is heated.**

☐

**(b) Aluminium is made by passing electricity through molten aluminium oxide.**

**(i) What state is molten aluminium oxide in? [1]**

**Put a ring around the correct answer.**

**gas**

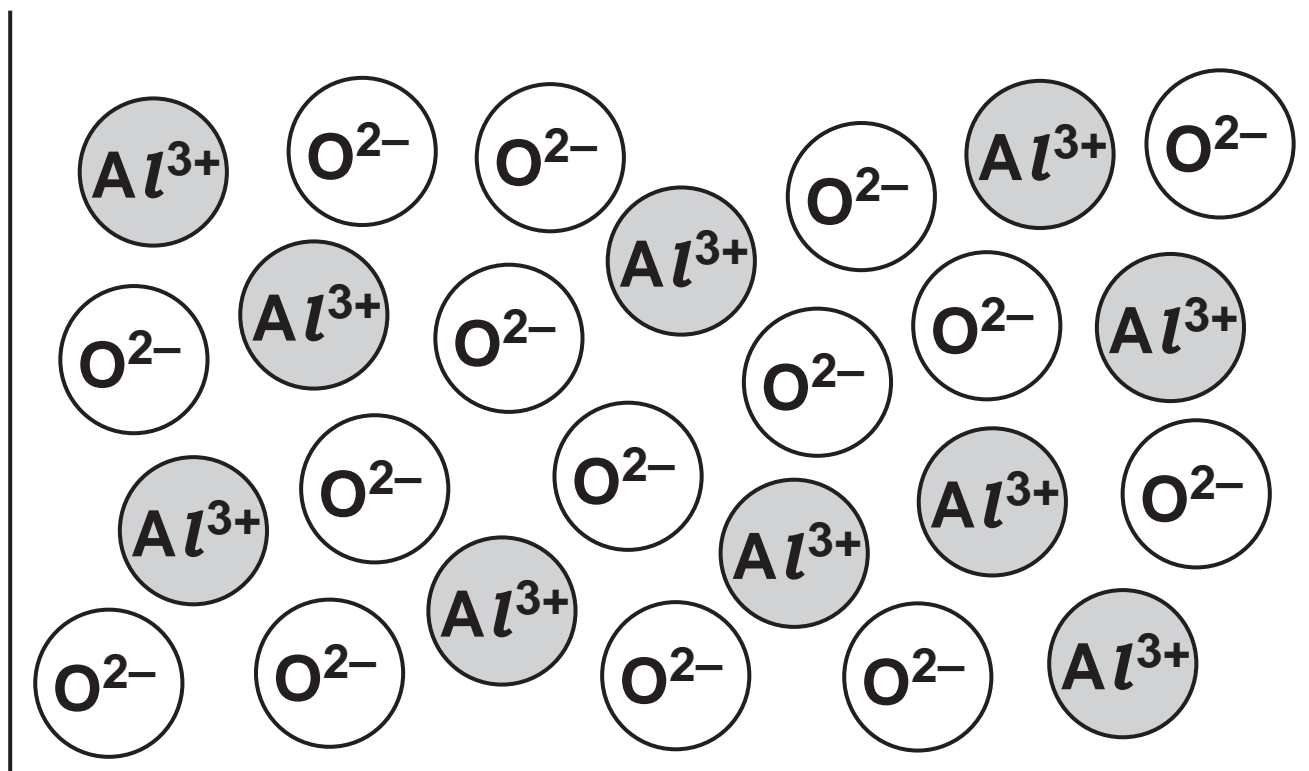
**liquid**

**solvent**

**solution**

**Fig. 5.1 shows the ions in molten aluminium oxide.**

**Fig. 5.1**



- (ii) Molten aluminium oxide conducts electricity. Solid aluminium oxide does not.**

**Explain why, using Fig. 5.1 to help you.**

---

---

[2]

- (iii) A positive and negative electrode are used to pass electricity through molten aluminium oxide. A product is made at each electrode.

Draw lines to join each **ELECTRODE** with the correct **PRODUCT** formed. [2]

Use Fig. 5.1 to help you.

**ELECTRODE**

**PRODUCT MADE**

**Negative**

**Aluminium**

**Aluminium oxide**

**Water**

**Positive**

**Hydrogen**

**Oxygen**



**BLANK PAGE**

**6 Atoms contain a nucleus surrounded by electrons.**

**(a) The nucleus contains protons and neutrons.**

**Which statements about the nucleus are TRUE and which are FALSE? [3]**

**Tick (✓) ONE box in each row.**

<b>Statement</b>	<b>True</b>	<b>False</b>
<b>Most of the mass of the atom is in the nucleus.</b>		
<b>Neutrons have a positive charge.</b>		
<b>The nucleus has an overall positive charge.</b>		
<b>The nucleus takes up most of the space of the atom.</b>		

**(b) An atom of strontium has an atomic number of 38 and a mass number of 88.**

**How many protons, electrons, and neutrons are in an atom of strontium? [2]**

**Protons = \_\_\_\_\_**

**Electrons = \_\_\_\_\_**

**Neutrons = \_\_\_\_\_**

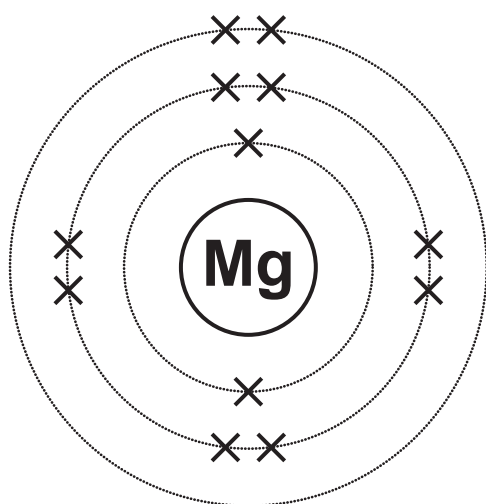
**(c) Magnesium atoms react with oxygen atoms to form magnesium oxide.**

**Magnesium oxide contains magnesium ions and oxygen ions.**

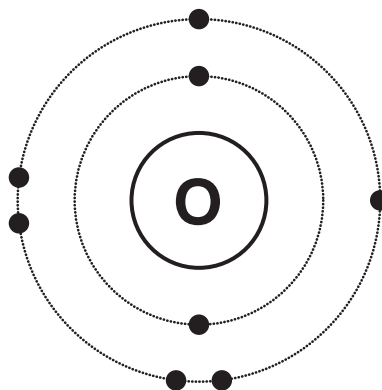
**Fig. 6.1 shows the number and arrangement of electrons in a magnesium atom and an oxygen atom.**

**Fig. 6.1**

**magnesium atom**



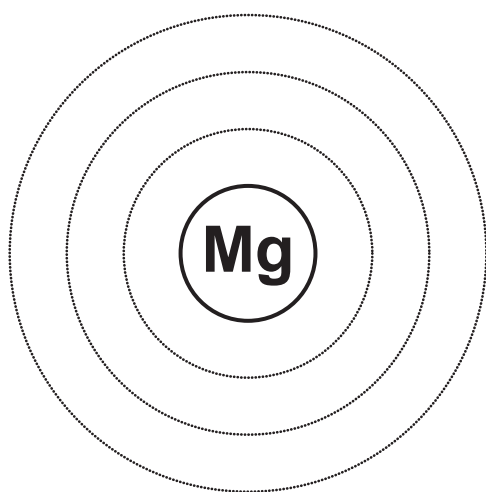
**oxygen atom**



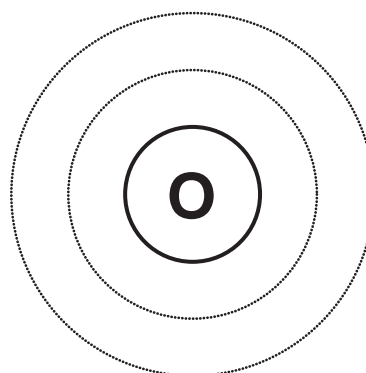
- (i) Complete Fig. 6.2 to show the number and arrangement of electrons in a magnesium ION and an oxygen ION. [2]

**Fig. 6.2**

**magnesium ion**



**oxygen ion**



**(ii) What are the charges on each ion? [2]**

**Choose from this list.**

**+1      -1      +2      -2      +3      -3**

**Charge on magnesium ion**

**= \_\_\_\_\_**

**Charge on oxygen ion**

**= \_\_\_\_\_**

**BLANK PAGE**

**7 Some metals react with bromine to form metal bromides.**

**(a) The table shows information about some metal bromides.**

**Complete the table by filling in the blank spaces. [3]**

<b>Name of bromide</b>	<b>Metal ion</b>	<b>Bromide ion</b>	<b>Formula of metal bromide</b>	<b>Relative formula mass</b>
<b>Potassium bromide</b>	<b>K<sup>+</sup></b>	<b>Br<sup>-</sup></b>	<b>KBr</b>	<b>119.0</b>
<b>Rubidium bromide</b>	<b>Rb<sup>+</sup></b>	<b>Br<sup>-</sup></b>	<b>RbBr</b>	
<b>Calcium bromide</b>	<b>Ca<sup>2+</sup></b>	<b>Br<sup>-</sup></b>		<b>199.9</b>
<b>Strontium bromide</b>	<b>Sr<sup>2+</sup></b>	<b>Br<sup>-</sup></b>	<b>SrBr<sub>2</sub></b>	



**(b) Metal bromides have high melting points.**

**Which statements about metal bromides are TRUE and which are FALSE? [2]**

**Tick (✓) ONE box in each row.**

<b>Statement</b>	<b>True</b>	<b>False</b>
<b>Bonds between metal ions and bromide ions are strong.</b>		
<b>Metal bromides have covalent bonds.</b>		
<b>When metal bromides melt they lose electrons.</b>		
<b>It takes a lot of energy to separate the ions.</b>		

**8 Hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) is made in the body.**

**An enzyme breaks down hydrogen peroxide into oxygen gas and water before it can damage cells in the body.**

**(a) Ali adds this enzyme to some hydrogen peroxide.**

**He measures the volume of oxygen gas made.**

- (i) The hydrogen peroxide does not break down to make oxygen gas until Ali adds the enzyme.**

**Which statement explains why? [1]**

**Tick (✓) ONE box.**

**The enzyme is a catalyst.**

☐

**The enzyme changes the concentration of the hydrogen peroxide.**

☐

**The enzyme causes the temperature to increase.**

☐

**The enzyme provides energy to the reaction.**

☐

**(ii) Ali then adds the enzyme to different concentrations of hydrogen peroxide.**

**He finds that the reaction is faster when the concentration of hydrogen peroxide solution is higher.**

**Explain why the reaction is faster.**

**Use ideas from the particle model in your answer.**

---

---

---

---

[2]

**(b) Ali does more experiments.**

**He makes some solutions of hydrogen peroxide with different pH values.**

**(i) Describe ONE method of measuring the pH of each solution.**

---

---

---

**[2]**

**(ii) Ali adds the enzyme to these solutions of hydrogen peroxide with different pH values.**

**He finds that the rate of reaction INCREASES when pH values increase from 1 to 6.**

**He finds that the rate of reaction DECREASES when pH values increase from 6 to 7.**

**Use ideas about enzymes to explain these results.**

---

---

---

[2]

- 9 James uses charcoal as a fuel for his barbecue.**

**Charcoal is a form of carbon. When charcoal burns in plenty of oxygen it forms carbon dioxide.**



- (a) How could you test that the gas formed is carbon dioxide?**

---

---

---

**[2]**

- (b) Explain why burning charcoal WITHOUT enough oxygen can cause a health hazard.**

---

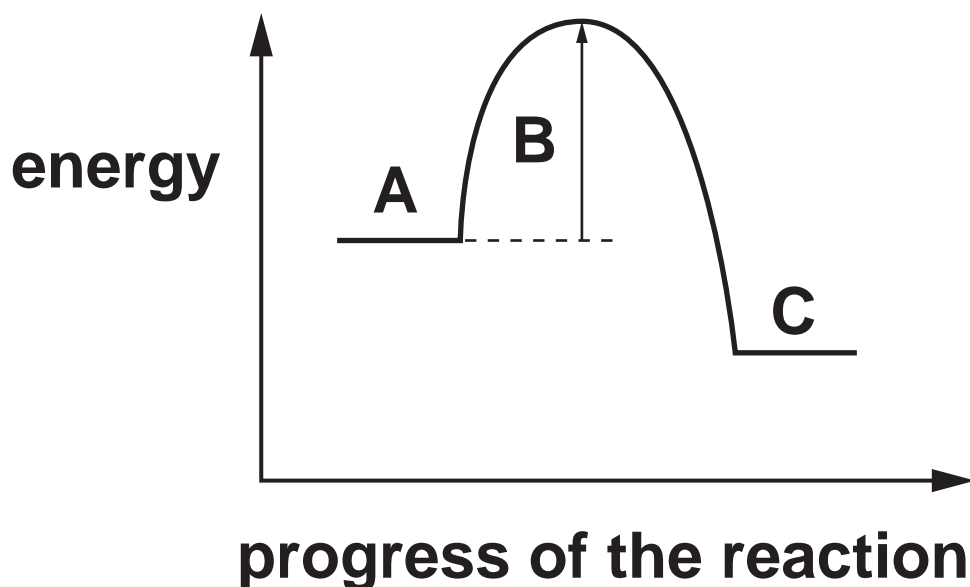
---

---

**[2]**

(c) Fig. 9.1 shows the reaction profile for charcoal burning in air.

Fig. 9.1



(i) Draw lines to connect each letter with its correct label. [2]

LETTER

LABEL

A

Reactants

B

Products

C

Energy change of reaction

Activation energy



**(ii) Complete the sentences to explain what Fig. 9.1 shows.**

**Use words from the list.**

**You may use each word once, more than once, or not at all.**

**less than                      more than**

**the same as                      given out**

**taken in                      endothermic**

**exothermic**

**The energy of the reactants is**

**\_\_\_\_\_ the energy of  
the products.**

**This means that energy is**

**\_\_\_\_\_ and so the**

**reaction is \_\_\_\_\_ [2]**

**(d) James uses a firelighter.**

**The firelighter burns with a hot flame which makes the charcoal start to burn.**

**Which two statements explain how the firelighter makes the charcoal start to burn? [2]**

**Tick (✓) TWO boxes.**

**More charcoal particles have enough energy to react.** ☐

**The activation energy decreases.** ☐

**The burning firelighter takes energy from the charcoal.** ☐

**The charcoal particles increase in energy.** ☐

**The reaction becomes more exothermic.** ☐

**BLANK PAGE**

**10 Alkanes are a family of hydrocarbons in crude oil. They all have the same general formula,  $C_nH_{2n+2}$ .**

**Table 10.1 shows some information about alkanes.**

**(a) (i) Complete the blank spaces in Table 10.1 to show the missing formulae. [3]**

**Table 10.1**

Alkane	Number of carbons	Molecular formula	Empirical formula	Structural formula	Melting point (°C)	Boiling point (°C)
Methane	1	CH <sub>4</sub>	CH <sub>4</sub>	$  \begin{array}{c}  \text{H} \\    \\  \text{H}-\text{C}-\text{H} \\    \\  \text{H}  \end{array}  $	-182	-161
Ethane	2	C <sub>2</sub> H <sub>6</sub>	CH <sub>3</sub>	$  \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  \text{H}-\text{C}-\text{C}-\text{H} \\    \quad   \\  \text{H} \quad \text{H}  \end{array}  $	-183	-88

Alkane	Number of carbons	Molecular formula	Empirical formula	Structural formula	Melting point (°C)	Boiling point (°C)
Propane	3	$C_3H_8$		<pre>       H   H   H                 H — C — C — C — H                       H   H   H           </pre>	-188	-42
Butane	4	$C_4H_{10}$		<pre>       H   H   H   H                     H — C — C — C — C — H                           H   H   H   H           </pre>		0
Pentane	5	$C_5H_{12}$	$C_5H_{12}$	<pre>       H   H   H   H   H                         H — C — C — C — C — C — H                               H   H   H   H   H           </pre>	-130	36
Hexane	6		$C_3H_7$		-95	

**(ii) Which statements about a STRUCTURAL FORMULA are TRUE and which are FALSE? [2]**

**Tick (✓) ONE box in each row.**

<b>Statement</b>	<b>True</b>	<b>False</b>
<b>It shows the simplest ratio of atoms in a molecule.</b>		
<b>It shows how many atoms are in a molecule.</b>		
<b>It shows how the atoms in a molecule are arranged.</b>		
<b>It shows the molecule in 3D.</b>		

**(b) (i) Predict the BOILING POINT of hexane.**

**Use the data in Table 10.1 on the previous page to help you.**

**Boiling point = \_\_\_\_\_ °C [1]**

**(ii) Explain why it is difficult to use the data in Table 10.1 to predict the MELTING POINT of butane.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [1]

**(iii) What is the state of pentane at 25 °C?**

**Explain your answer.**

**State:** \_\_\_\_\_

**Explanation:** \_\_\_\_\_

\_\_\_\_\_ [2]

**(iv) Explain the trend in boiling points in Table 10.1.**

**Use ideas about energy and intermolecular forces in your answer.**

---

---

---

---

**[2]**

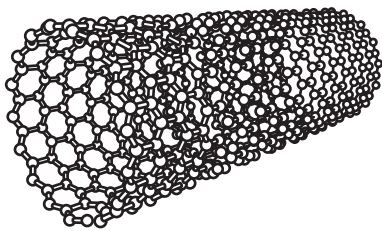


**BLANK PAGE**

# **11 Carbon nanotubes were discovered in 1991.**

**Materials made from nanotubes can be used instead of steel because nanotubes are very strong. They are a few nanometres wide and up to 1 cm long.**

**The structure of a nanotube is shown below.**



**(a) (i) Nanotubes are nanoparticles.**

**Which statement explains why nanotubes are nanoparticles? [1]**

**Tick (✓) ONE box.**

**They have covalent bonds.**

☐

**Their diameters are between 1 to 100 nm.**

☐

**They are made of carbon.**

☐

**They are hollow tubes.**

☐

**(ii) Which two statements explain why nanotubes are very strong? [2]**

**Tick (✓) TWO boxes.**

**Bonds between carbon atoms are strong.**

☐

**Lots of bonds must be broken to break the tube.**

☐

**The nanotubes have a hollow centre.**

☐

**They are very small.**

☐

**They have a large surface area.**

☐

**(iii) Nanotubes are a similar shape to a human hair but they are much smaller.**

**A human hair has a diameter of 0.001 mm.**

**A nanotube has a diameter of 2 nm and a length of 5 mm.**

**A scale model of a nanotube has the SAME diameter as a human hair.**

**What is the length of the scale model in mm?**

$$1 \text{ nm} = 1 \times 10^{-6} \text{ mm}$$

**Length = \_\_\_\_\_ mm [3]**

**(b) Short nanotubes can also be used to carry medicines into the body.**

**The medicine is put inside the tube and the tube is injected into the body.**

**Give ONE benefit and ONE risk of using nanotubes to carry medicines into the body.**

**Benefit**

---

---

**Risk**

---

---

**[2]**

**END OF QUESTION PAPER**

**ADDITIONAL ANSWER SPACE**

**If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).**





**Copyright Information**

**OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.**

**If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.**

**For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.**

**OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.**