

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

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Candidate number

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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 (*).

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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.

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

(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.

☐

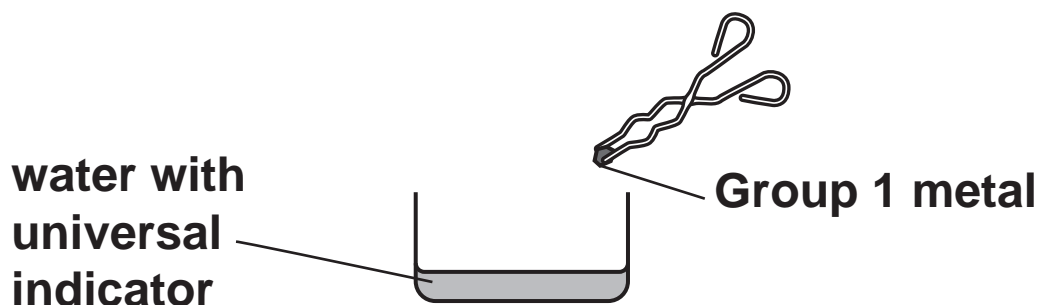
They lose electrons easily.

☐

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.

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

- (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

Presence of water

Indicator turns blue

Presence of hydroxide ions

- 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					
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- (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.

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

- (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 cm³.

Calculate the density of PVC.

Density = _____ g/cm³ [2]

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4 Mia adds magnesium to dilute hydrochloric acid.

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

magnesium + $\begin{matrix} \text{hydrochloric} \\ \text{acid} \end{matrix}$ \rightarrow $\begin{matrix} \text{_____} \\ \text{_____} \end{matrix}$ + hydrogen

_____ + _____ HCl \rightarrow MgCl_2 + _____

(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

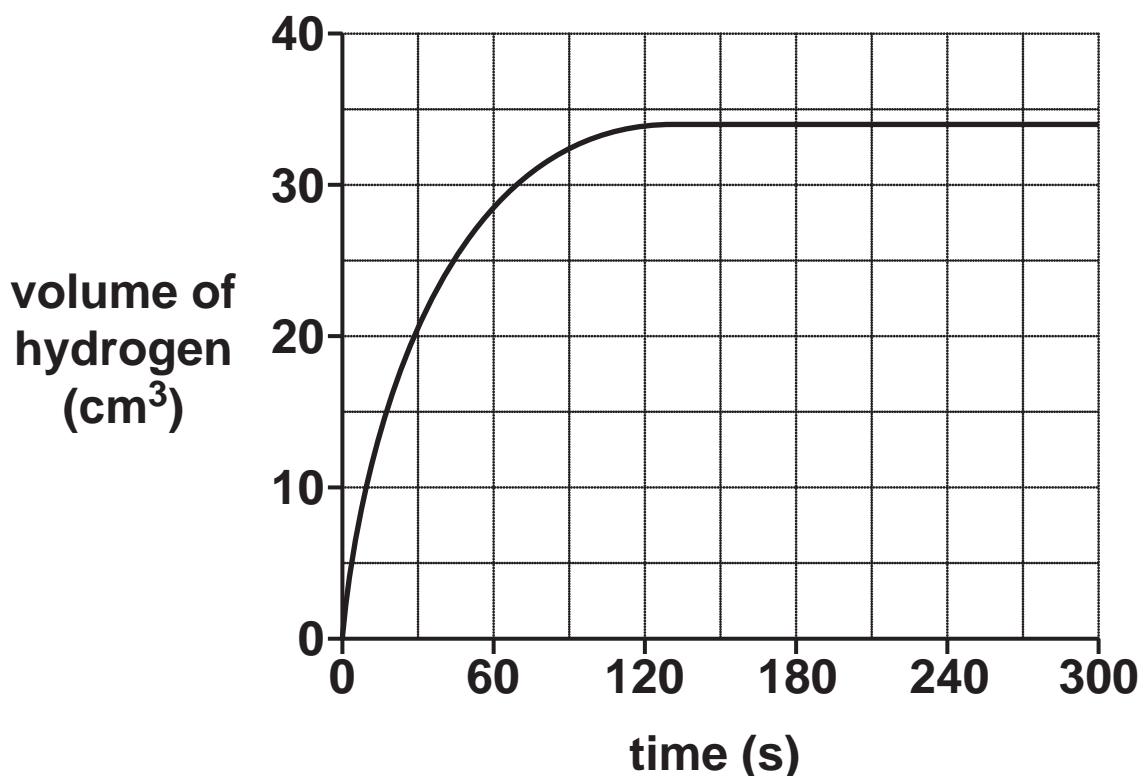
gas syringe

pipette

thermometer

(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 12s 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 cm³ of hydrogen?

Time = _____ s [1]

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

Total volume = _____ cm³ [1]

5 Zinc is made by heating zinc oxide with carbon.

zinc oxide + carbon → 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.

☐

The zinc oxide reacts with air.

☐

Zinc oxide loses energy.

☐

Zinc oxide loses oxygen.

☐

- (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.

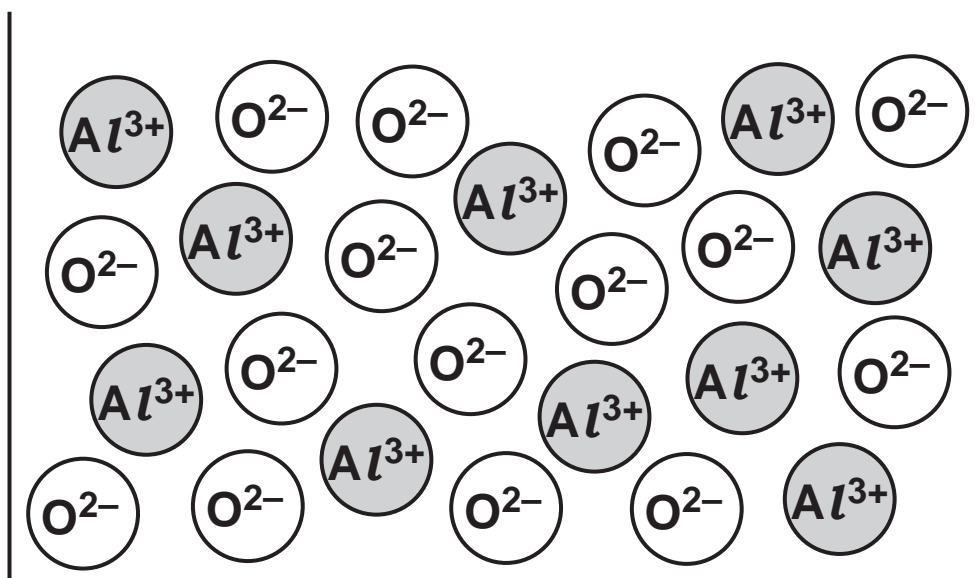
(i) What state is molten aluminium oxide in? [1]

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
	Aluminium
Negative	Aluminium oxide
	Water
Positive	Hydrogen
	Oxygen

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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.

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

(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 = _____

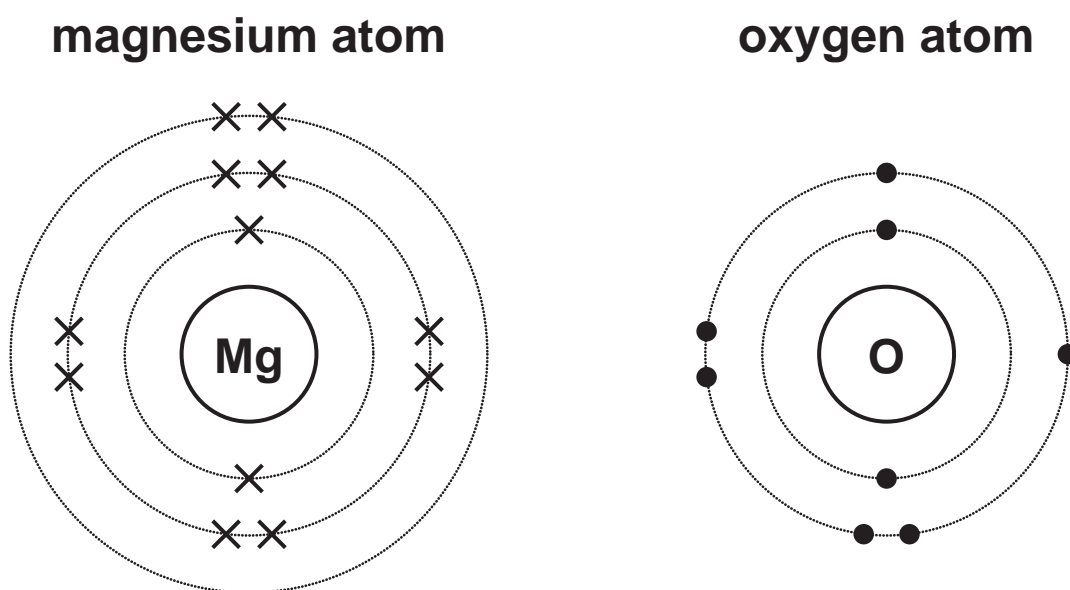
Neutrons = _____

- (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.

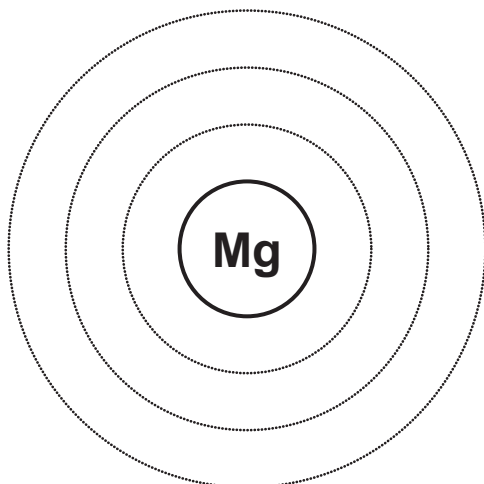
Fig. 6.1



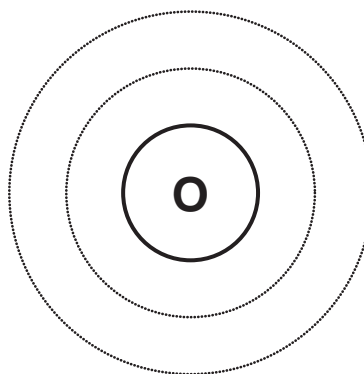
- (i) Complete Fig. 6.2 to show the number and arrangement of electrons in a magnesium ION and an oxygen ION. [2]

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 = _____

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]

Name of bromide	Metal ion	Bromide ion	Formula of metal bromide	Relative formula mass
Potassium bromide	K⁺	Br⁻	KBr	119.0
Rubidium bromide	Rb⁺	Br⁻	RbBr	
Calcium bromide	Ca²⁺	Br⁻		199.9
Strontium bromide	Sr²⁺	Br⁻	SrBr₂	

(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.

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

8 Hydrogen peroxide (H_2O_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.

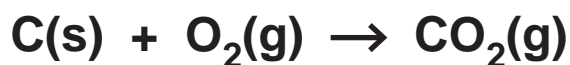
He finds that the rate of reaction DECREASES when pH values increase from 6 to 7.

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?

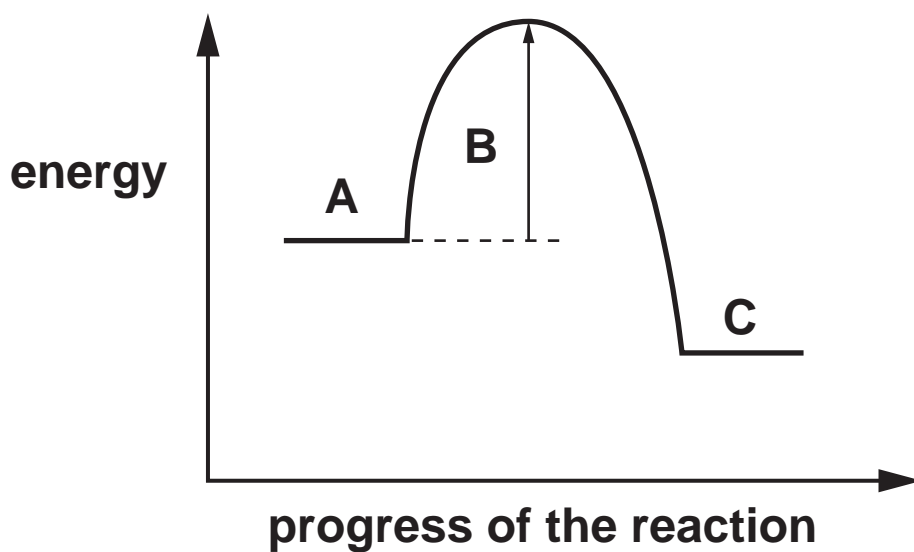
[2]

(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.

☐

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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_4	CH_4	$ \begin{array}{c} H \\ \\ H-C-H \\ \\ H \end{array} $	-182	-161
Ethane	2	C_2H_6	CH_3	$ \begin{array}{c} H & H \\ & \\ H-C & -C-H \\ & \\ H & 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.

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

- (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.

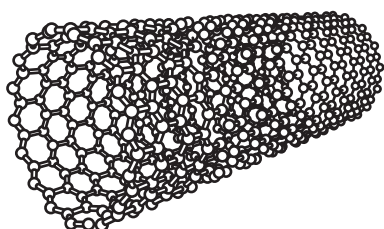
Use ideas about energy and intermolecular forces in your answer.

_____ **[2]**

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).

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