OCR
Oxford Cambridge and RSA

Monday 19 May 2025 – Morning

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

J260/02 Chemistry (Foundation Tier)

Time allowed: 1 hour 45 minutes

F

You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Combined Science (Chemistry) B (inside this document)

You can use:
- an HB pencil
- a scientific or graphical calculator

J260/02

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

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1 Many everyday products are based on the chemistry of acid reactions.

(a) Complete the sentences to describe how to show that a solution is acidic.

Put a (ring) around each correct option.

Add a few drops of **alkali / universal indicator / water** to a small amount of the solution.

If the solution is acidic, the solution will turn **blue / green / red**.

[2]

(b) Acids react with some metals to form a salt and hydrogen.

The table shows some information about the reactions between some metals and acids.

(i) Complete the table.

Metal	Acid	Salt formed
Calcium	Nitric acid	.....
Iron	.....	Iron sulfate

[2]

(ii) Pieces of zinc metal react with dilute sulfuric acid to form a solution of zinc sulfate and hydrogen gas.

Complete the **state symbols** in the balanced symbol equation.

$$Zn(.....) + H_2SO_4(.....) \rightarrow ZnSO_4(.....) + H_2(.....)$$

[2]

(c) Acids react with alkalis to form a salt and water, for example:

$$\underset{\text{Acid}}{HCl} + \underset{\text{Alkali}}{NaOH} \rightarrow \underset{\text{Salt}}{NaCl} + \underset{\text{Water}}{H_2O}$$

Complete the sentences to describe this type of reaction.

Put a (ring) around each correct option.

When an acid reacts with an alkali it is called **evaporation / neutralisation / precipitation**.

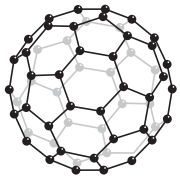
During the reaction, **H^+ / Na^+ / Cl^-** ions from the acid react with **H^+ / Na^+ / OH^-** ions from the alkali.

[3]

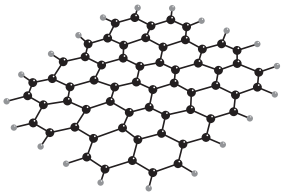
2 Nanoparticles are very small particles. They have many important uses.

(a) Fullerene and graphene are nanoparticles made from carbon.

The diagrams show their structures.



Fullerene



Graphene

(i) Complete the table to show which statements are true for fullerenes only, graphene only, both or neither.

Tick (✓) **one** box in each row.

	True for fullerene only	**True for graphene only**	**True for both**	**True for neither**
Each carbon atom is bonded to 5 other carbon atoms.				
The carbon atoms in each structure are covalently bonded.				
The structure is a molecule.				
The structure is a sheet of rings.				

[4]

(ii) Graphene is a very good conductor of electricity.

Complete the sentence to explain why.

Put a (ring) around each correct option.

Graphene is a good conductor of electricity because the **atoms / electrons / ions**

within graphene can **evaporate / move / vibrate**.

[2]

(iii) Fullerene can be used to carry drugs into the body.

Which **two** properties of the structure makes this possible?

Tick (✓) **two** boxes.

It is hollow. ☐

It is made up of carbon atoms. ☐

It is made up of rings. ☐

It is very small. ☐

[2]

(b) Some scientists are worried about the use of fullerenes to carry drugs into the body.

State **one benefit** and **one risk** of using **fullerenes** in this way.

Benefit .....

.....

Risk .....

.....

[2]

3 The elements in Group **7** of the periodic table are called the halogens.

(a) Draw lines to connect each **element** with its **colour at room temperature**.

Element	Colour at room temperature
Chlorine	Grey
Bromine	Brown-red
Iodine	Yellow-green

[2]

(b) The table shows some properties of different halogens.

	Formula	Boiling point (°C)	Reaction with hydrogen
Fluorine	F_2	–188	Explodes when cold and in the absence of light.
Chlorine	Cl_2	–35	Explodes with flame or when placed in direct sunlight.
Bromine	Br_2	59	Vigorous reaction with burning hydrogen.
Iodine	I_2	184	Slow reaction when heated strongly.

Which statements about the properties of halogens are **true**, and which are **false**?

Tick (✓) **one** box in each row.

	True	False
The boiling points increase down the group.		
They consist of molecules containing two identical atoms.		
They get more reactive down the group.		

[2]

(c) The halogens also react with metals to form metal halides.

(i) Complete the **balanced symbol equation** for the reaction between sodium and bromine to form sodium bromide.

$$2Na + Br_2 \rightarrow \text{.....}NaBr$$

[1]

(ii) Complete the table to show the ions present and the formulae of other metal halides.

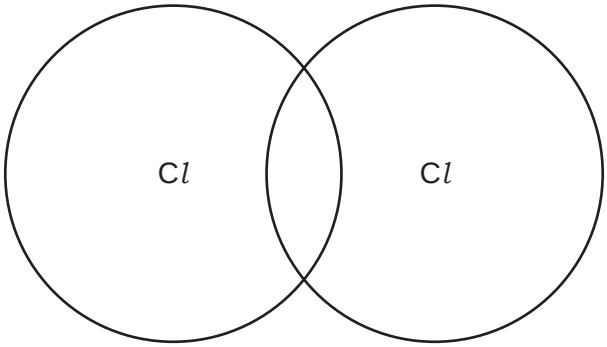
Metal halide	**Ions present**	**Formula**
Sodium iodide	Na^+ and I^-	NaI
Magnesium chloride	..... and	$MgCl_2$
Iron(III) bromide	Fe^{3+} and Br^-	.....

[3]

(d) Chlorine has the electron arrangement 2.8.7.

Complete the dot and cross diagram for a chlorine molecule, Cl_2.

Show the outer shell electrons only.



[2]

4 Energy is transferred when reactants change into products in a chemical reaction.

(a) When solid ammonium chloride dissolves in water, energy is transferred from the surroundings to the reaction mixture.

(i) Suggest a simple experiment to show that this reaction is **endothermic**, and describe the results expected.

Experiment .....

.....

Results .....

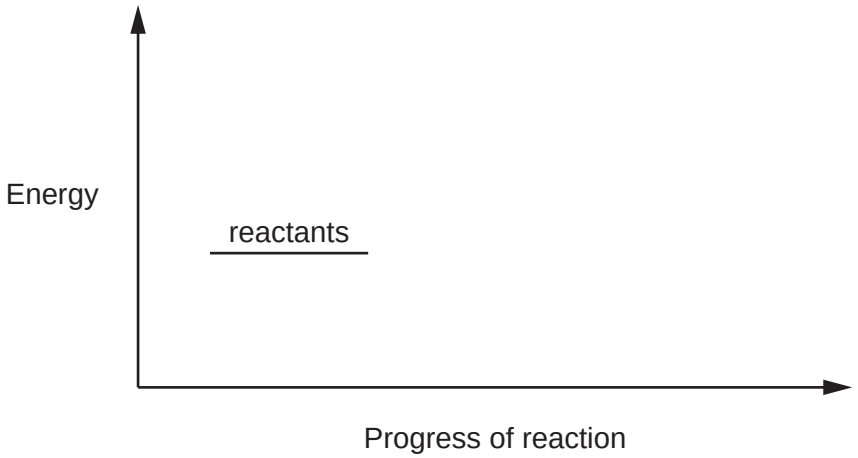
.....

[2]

(ii) Complete the reaction profile for an endothermic reaction.

Include labels for:

- the products
- the activation energy.



[3]

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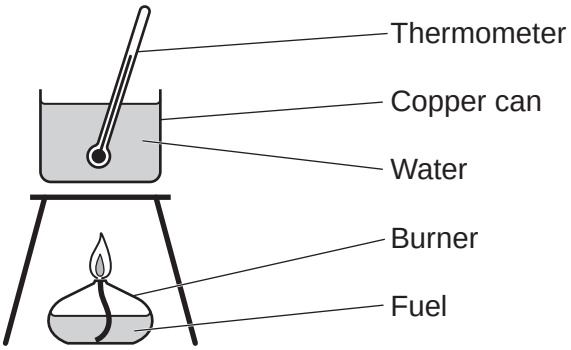
(b) A student does an experiment to find out the change in thermal energy when a fuel burns.

They use this apparatus.



They burn the fuel to heat some water.

The table shows their results.

Mass of fuel burned (g)	4.6
Temperature of water before experiment (°C)	18
Temperature of water after experiment (°C)	25
Mass of water (g)	200

(i) Describe how the mass of fuel burned is measured.

.....

.....

.....

..... **[2]**

(ii) Calculate the change in the thermal energy of the water.

Use the formula:

Change in thermal energy (J) = mass of water (g) × 4.2 × temperature change (°C)

Change in thermal energy = ... J **[3]**

(iii) Calculate the change in thermal energy of the water if only 1 g of fuel was burned.

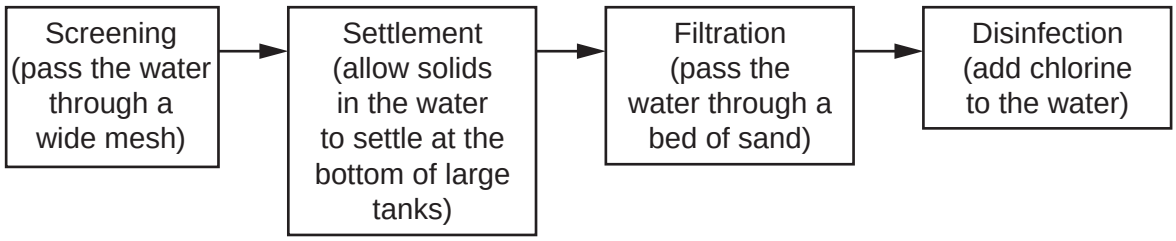
Use your answer to **(b)(ii)**.

Give your answer to **2** significant figures.

Change in thermal energy = ... J **[3]**

5 Drinking water in the UK can be obtained from rivers. Rivers are a type of surface water.

(a)* The diagram shows some stages of the treatment to make surface water more suitable for drinking.



Surface water contains impurities including:

- large objects such as branches or leaves
- other insoluble items such as grit, sand and soil
- harmful microorganisms
- dissolved minerals
- other pollutants.

Explain which impurities are removed at each stage of the process shown **and** why the treated water is now more suitable for drinking but is still **not** considered scientifically pure.

.....

.....

.....

.....

.....

.....

.....

.....

.....

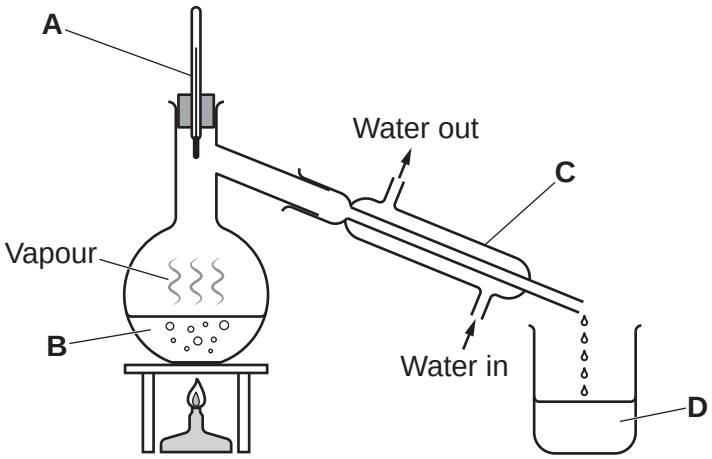
.....

.....

..... **[6]**

(b) Some countries get their drinking water from seawater. Seawater contains dissolved salts such as sodium chloride.

A student plans to use distillation to separate the salt from the water, using this apparatus:



(i) Complete the table by identifying the labels, **A**, **B**, **C**, and **D** on the diagram.

Use words from the list.

Burette	**Burner**	**Condenser**	**Funnel**
Pipette	**Seawater**	**Thermometer**	**Water**

	Label
A	
B	
C	
D	

[4]

(ii) Complete the sentences to explain how distillation separates the salt from the water.

Put a (ring) around each correct option.

The separation occurs because the salt and water have different **boiling / freezing / melting** points. The **salt / solution / water** evaporates and the vapour passes through the condenser where it is **cooled / heated / stirred**. The **salt / solution / water** condenses and is collected in the beaker.

[4]

6 The compounds found in crude oil are mostly in the alkane homologous series.

(a) State **one** way in which modern life is dependent upon hydrocarbons.

.....

..... **[1]**

(b) The alkanes are all hydrocarbons with a general formula C_nH_{2n+2}.

What is the molecular formula of the alkane with **8** carbon atoms?

..... **[2]**

(c) The table shows some information about some alkanes.

Number of carbon atoms	Melting point (°C)	Boiling point (°C)
5	–130	36
6	–95	69
7	–91	98
9	–54	151
10	–30	174

(i) Describe the trend in melting points shown in the table.

.....

..... **[1]**

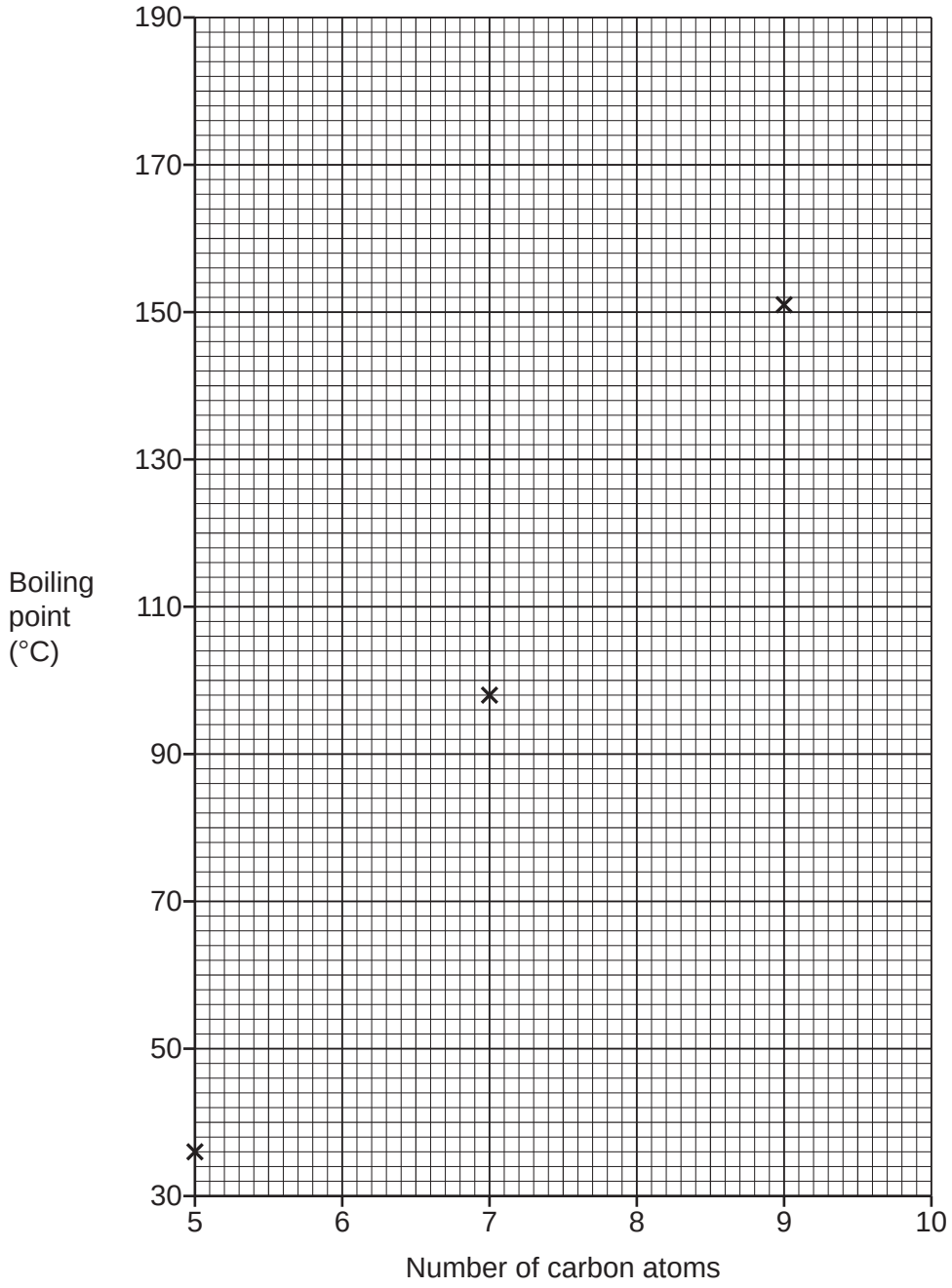
(ii) The alkane with 6 carbons has a melting point of –95 °C and a boiling point of 69 °C.

Predict the state of this alkane at 20 °C.

..... **[1]**

(iii) Plot the results from the table on the graph.

Three points have already been plotted.



[2]

(iv) Draw a **straight** line of best fit. **[1]**

(v) Use the graph to estimate the boiling point of the alkane with 8 carbon atoms.

Boiling point = ... °C **[1]**

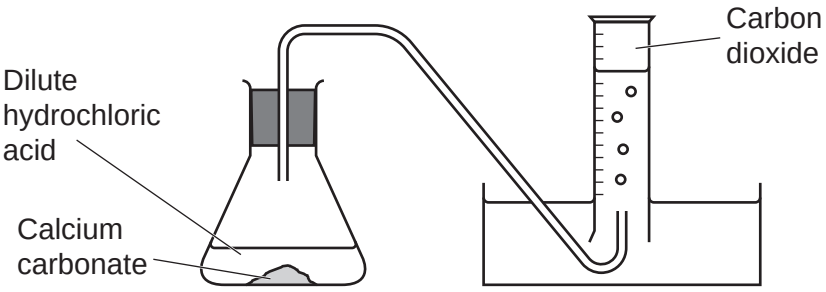
7 A student investigates the rate of reaction between calcium carbonate and dilute hydrochloric acid.

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$

(a) This is the method:

- Add powdered calcium carbonate to 50 cm^3 of 2 mol/dm^3 dilute hydrochloric acid.
- Measure the volume of carbon dioxide gas produced every 30 seconds.

The diagram shows the apparatus they use to measure the volume of carbon dioxide gas produced.



The student finds that all the gas is produced in less than a minute.

How can the student change their experiment to make it **slower**?

Tick (✓) **two** boxes.

Add a catalyst. ☐

Increase the temperature. ☐

Shake the flask. ☐

Use a lower concentration of acid. ☐

Use larger pieces of calcium carbonate. ☐

[2]

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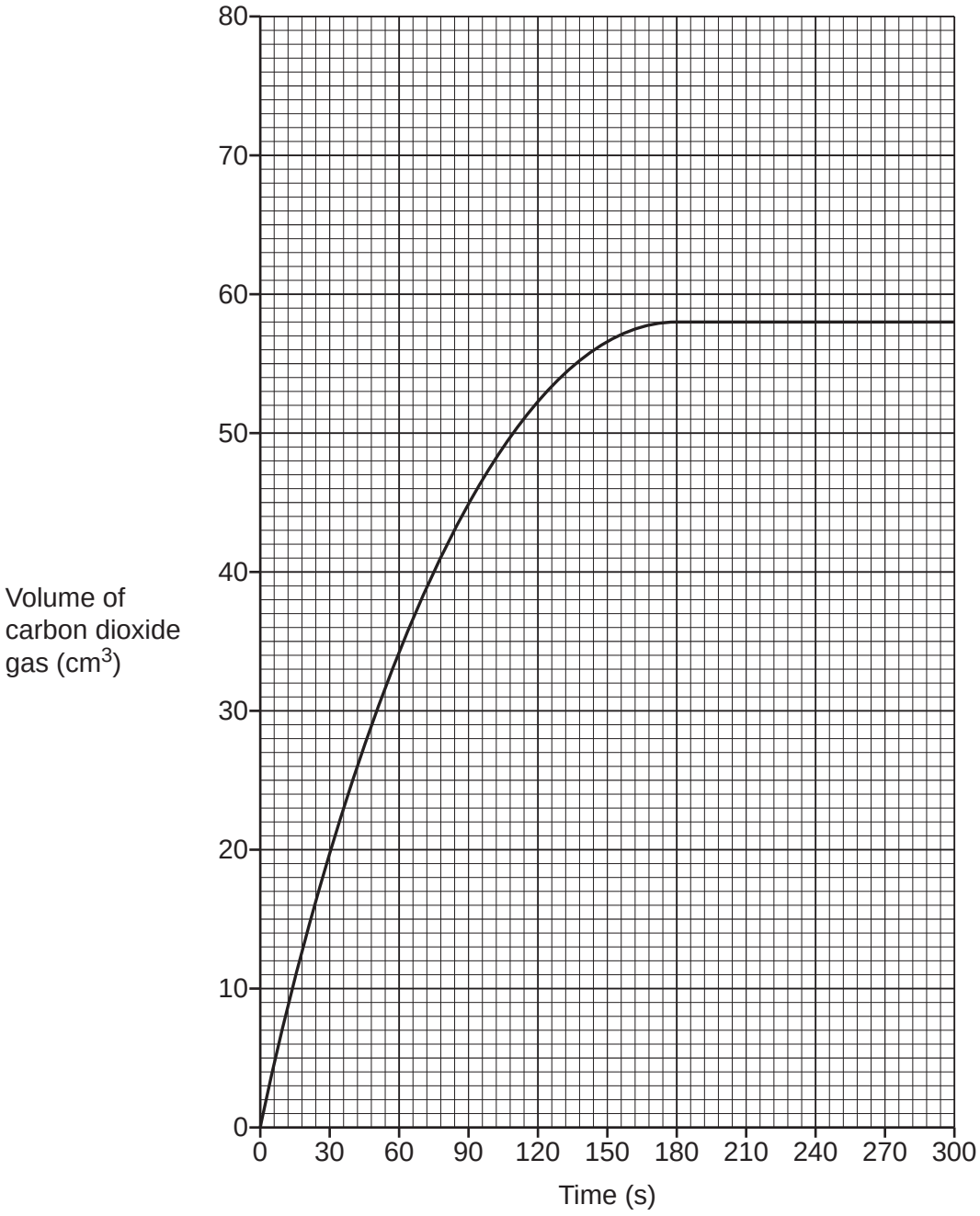
(b) The student repeats the experiment under different conditions.

The student plots a graph with their results.



(i) What is the time taken for the reaction to finish?

Time taken = ... s **[1]**

(ii) What is the volume of carbon dioxide collected when the reaction has finished?

Volume of carbon dioxide collected = ... cm^3 **[1]**

(iii) Calculate the average rate of reaction from the start to the end of the reaction.

Use the equation: average rate of reaction (cm^3/s) = $\frac{\text{volume of carbon dioxide collected } (cm^3)}{\text{time taken (s)}}$

Give your answer to **2** decimal places.

Average rate of reaction = ... cm^3/s **[3]**

(iv) Describe the changes in the gradient of the graph and the rate of reaction shown in the graph.

Gradient .....

.....

.....

.....

Rate .....

.....

.....

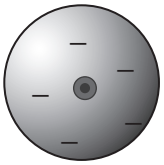
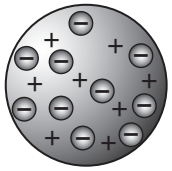
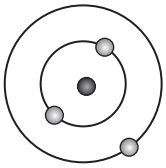
.....

[4]

8 In the 1800s, Dalton did experiments to help produce a model for the atom.

(a) Later discoveries led to scientists suggesting new models for the atom.

Draw lines to connect each **discovery** with the **model** it led to.

Discovery	**Model**
Electrons are discovered.	
Electrons are in shells.	
Nucleus is discovered.	

[2]

(b) The modern model of the atom consists of electrons, neutrons and protons.

Which statements about the modern model of the atom are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	**False**
Neutrons have a charge of 0.		
Protons and electrons are in the nucleus.		
Protons and electrons have a relative charge of –1.		
Protons and neutrons have a relative mass of 1.		

[3]

(c) The diameter of an atom is 1×10^{-10} m and the diameter of a nucleus is 1.7×10^{-15} m.

Estimate how many times bigger the atom is compared to the nucleus.

Number of times bigger = ... **[2]**

(d) The atomic number and mass number can be used to find the number of protons, neutrons and electrons in an atom.

The table shows information about an argon atom and a potassium atom.

Complete the table.

	Argon atom	**Potassium atom**
Atomic number	18	.....
Mass number	40	.....
Number of electrons	.....	19
Number of neutrons	.....	20
Number of protons	.....	19

[4]

9 Zinc is extracted from its ore by separating the zinc compounds from the waste rock and then converting the zinc compounds into zinc.

(a) A company wants to extract 5.5 kg of zinc from an ore which contains 8.5% zinc.

Calculate the mass of ore needed.

Use the equation: percentage of zinc in ore = $\frac{\text{mass of zinc} \times 100}{\text{mass of ore}}$

Give your answer to **3** significant figures.

Mass of ore = ... kg **[4]**

(b) The zinc compounds are heated strongly to produce zinc oxide.
The zinc oxide is then heated with carbon to produce zinc and carbon monoxide.

$ZnO + C \rightarrow Zn + CO$

Explain which substance is oxidised and which is reduced in this reaction.

Oxidised .....

.....

Reduced .....

.....

[2]

(c) Many metals cannot be extracted using carbon.

Explain why zinc can be extracted using carbon but aluminium **cannot**.

Zinc .....

.....

Aluminium .....

.....

[2]

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.