



Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

**GCSE
CHEMISTRY**

F

Foundation Tier Paper 1

8462/1F

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]



JUN 21 84621F01

For this paper you must have:

- a ruler
- a scientific calculator
- the periodic table (enclosed).

INSTRUCTIONS

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Answer ALL questions in the spaces provided. Do not write on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.



INFORMATION

- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO



| | |
|---|---|
| 0 | 1 |
|---|---|

This question is about elements, compounds and mixtures.

| | | | |
|---|---|---|---|
| 0 | 1 | . | 1 |
|---|---|---|---|

Substance A contains only one type of atom.

Substance A does NOT conduct electricity.

Which type of substance is A? [1 mark]

Tick (✓) ONE box.

Compound

Metallic element

Mixture

Non-metallic element



01.2

Substance B contains two types of atoms.

The atoms are chemically combined together in fixed proportions.

Which type of substance is B? [1 mark]

Tick (✓) ONE box.

Compound

Metallic element

Mixture

Non-metallic element

[Turn over]



01.3

What is the name of the elements in Group 0 of the periodic table? [1 mark]

Tick (✓) ONE box.

Alkali metals

Halogens

Noble gases

Transition metals



0 1 . 4

Which statement about the elements in Group 0 is correct? [1 mark]

Tick (✓) ONE box.

All elements in the group are very reactive.

All elements in the group form negative ions.

The boiling points increase down the group.

The relative atomic masses (A_r) decrease down the group.

[Turn over]



| | | | |
|---|---|---|---|
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|---|---|---|---|

Neon is in Group 0.

What type of particles are in a sample of neon?
[1 mark]

Tick (✓) ONE box.

Atoms

Ions

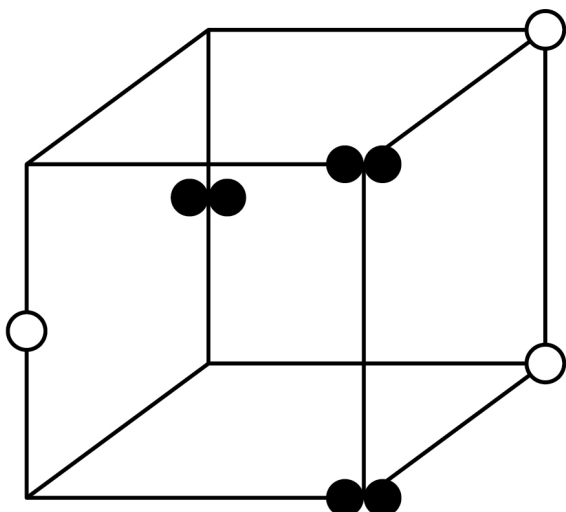
Molecules



01.6

FIGURE 1 represents part of the structure of an oxide of a metal.

FIGURE 1



KEY

○ Metal (X)

● Oxygen (O)

Determine the empirical formula of this oxide. [1 mark]

Empirical formula = XO _____

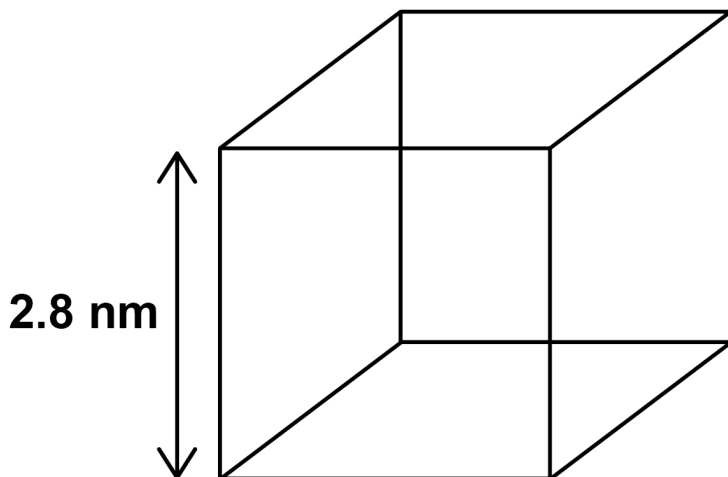
[Turn over]



A nanoparticle of a metallic element is a cube.

FIGURE 2 shows a diagram of the nanoparticle.

FIGURE 2



0 1 . 7

The surface area of a cube is given by the equation:

$$\text{surface area} = (\text{length of side})^2 \times 6$$

Calculate the surface area of the cube in FIGURE 2.

Give your answer to 2 significant figures. [3 marks]



Surface area (2 significant figures) = _____ nm²

[Turn over]



0 1 . 8

Fine and coarse particles of the metallic element are also cubes.

The length of a fine particle cube is 10 times smaller than the length of a coarse particle cube.

How does the surface area to volume ratio of the fine particle cube compare with that of the coarse particle cube? [1 mark]

Tick (✓) ONE box.

Both surface area to volume ratios are the same.

The surface area to volume ratio of the fine particle is 10 times greater.

The surface area to volume ratio of the fine particle is 10 times smaller.

| |
|-----------|
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| 10 |



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[Turn over]



0 2

This question is about chemical cells and batteries.

0 2 . 1

Three different types of battery can be used to power a TV remote control.

TABLE 1 gives information about these batteries.

TABLE 1

| | Zinc-carbon battery | Alkaline battery | Nickel-metal hydride battery |
|-------------------------------------------------------------|----------------------------|-------------------------|-------------------------------------|
| Cost of battery in £ (pounds) | 0.17 | 0.50 | 1.50 |
| Rechargeable? | No | No | Yes |
| Time before needing to replace or recharge in months | 5 | 12 | 8 |



Give ONE advantage of each type of battery. [3 marks]

Zinc-carbon _____

Alkaline _____

Nickel-metal hydride _____

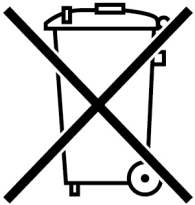
[Turn over]



02.2

FIGURE 3 shows a symbol printed on batteries.

FIGURE 3



This symbol shows that batteries should not be put in household waste.

Suggest why batteries should NOT be put in household waste. [1 mark]

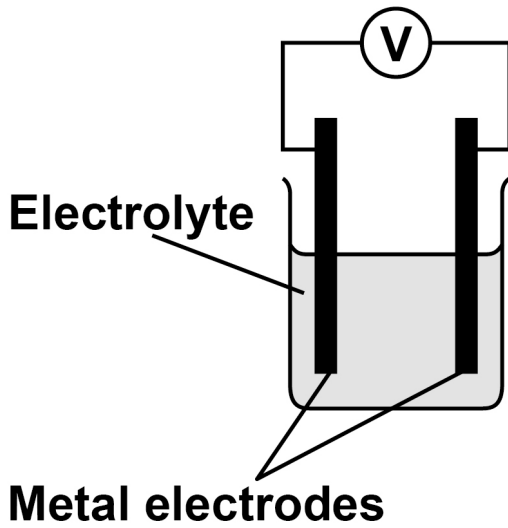
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[Turn over]



FIGURE 4 shows a chemical cell.

FIGURE 4



0 2 . 3

The order of reactivity of three metals is shown below.

Iron (Most reactive)

Tin ↑

Copper (Least reactive)



Which combination of metal electrodes would give the highest voltage in the chemical cell in FIGURE 4?

[1 mark]

Tick (✓) ONE box.

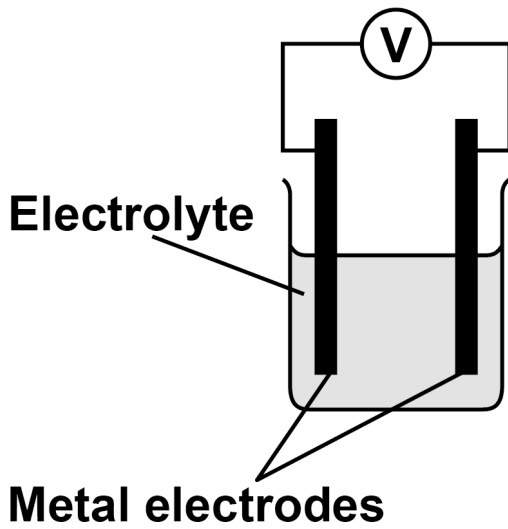
Copper and iron

Iron and tin

Tin and copper

[Turn over]



REPEAT OF FIGURE 4**0 2 . 4**

The voltage produced by the cell in FIGURE 4 depends on the type of electrodes and the type of electrolyte.

Suggest ONE other factor that could affect the voltage produced. [1 mark]



| | | | |
|---|---|---|---|
| 0 | 2 | . | 5 |
|---|---|---|---|

Water is produced in a hydrogen fuel cell.

Complete the word equation to show the reaction that produces water in a hydrogen fuel cell. [2 marks]

_____ + _____ → water

[Turn over]

| |
|---|
| |
| 8 |



03

This question is about Group 1 elements.

03.1

Complete TABLE 2 to show the electronic structure of a potassium atom. [1 mark]

TABLE 2

| Atom | Number of electrons | Electronic structure |
|-----------|---------------------|----------------------|
| Sodium | 11 | 2,8,1 |
| Potassium | 19 | |



03.2

Why do Group 1 elements have similar chemical properties? [1 mark]

Tick (✓) ONE box.

They have the same number of electron shells.

They have the same number of outer shell electrons.

They have two electrons in the first shell.

[Turn over]



03.3

What is the type of bonding in sodium? [1 mark]

Tick (✓) ONE box.

Covalent

Ionic

Metallic

03.4

Give TWO observations you could make when sodium reacts with water.

Write your answers in TABLE 3, on the opposite page.
[2 marks]



TABLE 3 shows observations made when lithium, potassium and rubidium react with water.

TABLE 3

| ELEMENT | OBSERVATIONS |
|------------------|-----------------------------------------------------------------------------------------------|
| Lithium | Bubbles slowly Floats Moves slowly |
| Sodium | 1 _____ _____ 2 _____ _____ |
| Potassium | Bubbles very quickly Melts into a ball Floats Moves very quickly Flame |
| Rubidium | Sinks Melts into a ball Explodes with a flame |

[Turn over]



03.5

How does the reactivity of the elements change going down Group 1? [1 mark]

03.6

Give TWO ways in which the observations in TABLE 3, on page 25, show the change in reactivity going down Group 1. [2 marks]

1 _____

2 _____



03.7

Which gas is produced when Group 1 elements react with water? [1 mark]

Tick (✓) ONE box.

Carbon dioxide

Hydrogen

Nitrogen

Oxygen

[Turn over]



| | | | |
|---|---|---|---|
| 0 | 3 | . | 8 |
|---|---|---|---|

Sodium fluoride is an ionic compound.

FIGURE 5, on the opposite page, shows dot and cross diagrams for a sodium atom and a fluorine atom.

Complete **FIGURE 5**, on the opposite page, to show what happens when a sodium atom and a fluorine atom react to produce sodium fluoride.

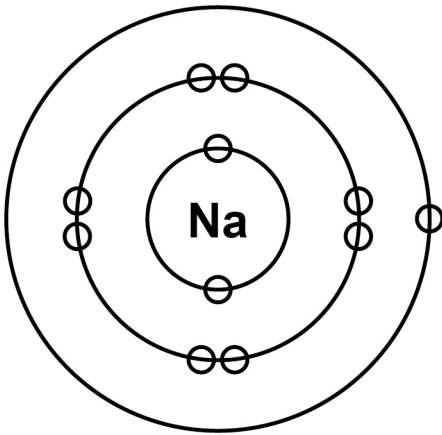
You should:

- complete the electronic structures of the sodium ion and the fluoride ion
- give the charges on the sodium ion and the fluoride ion.

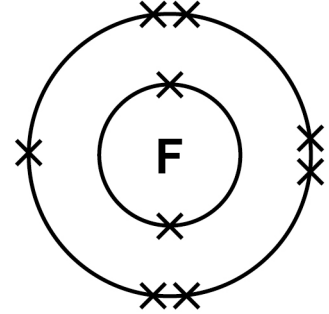
[3 marks]



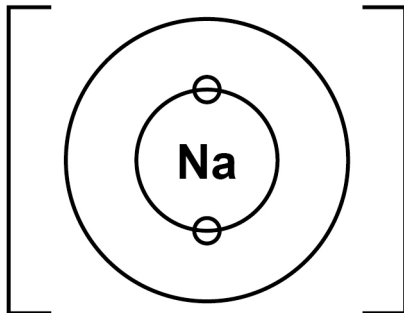
FIGURE 5



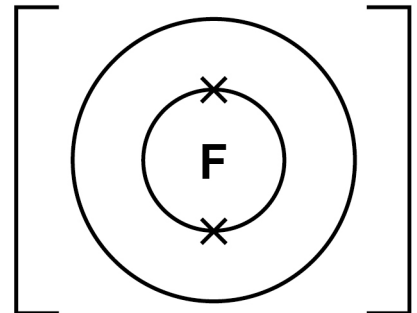
Sodium atom



Fluorine atom



Sodium ion



Fluoride ion

[Turn over]

| |
|----|
| 12 |
|----|



| | |
|---|---|
| 0 | 4 |
|---|---|

A student investigated the reactivity of metals with hydrochloric acid.

This is the method used.

- 1. Measure 50 cm³ of hydrochloric acid into a polystyrene cup.**
- 2. Measure the temperature of the hydrochloric acid.**
- 3. Add one spatula of metal powder to the hydrochloric acid and stir.**
- 4. Measure the highest temperature the mixture reaches.**
- 5. Calculate the temperature increase for the reaction.**
- 6. Repeat steps 1 to 5 three more times.**
- 7. Repeat steps 1 to 6 with different metals.**

TABLE 4, on the opposite page, shows the student's results.



TABLE 4

| Metal | Temperature increase in °C | | | | Mean temperature increase in °C |
|-----------|----------------------------|---------|---------|---------|---------------------------------|
| | Trial 1 | Trial 2 | Trial 3 | Trial 4 | |
| Cobalt | 6 | 7 | 5 | 9 | 7 |
| Magnesium | 54 | 50 | 37 | 55 | X |
| Zinc | 18 | 16 | 18 | 20 | 18 |

| | | | |
|---|---|---|---|
| 0 | 4 | . | 1 |
|---|---|---|---|

Calculate the mean temperature increase X for magnesium in TABLE 4.

Do NOT include the anomalous result in your calculation. [2 marks]

X = _____ °C

[Turn over]



REPEAT OF TABLE 4

| Metal | Temperature increase in °C | | | | Mean temperature increase in °C |
|-----------|----------------------------|---------|---------|---------|---------------------------------|
| | Trial 1 | Trial 2 | Trial 3 | Trial 4 | |
| Cobalt | 6 | 7 | 5 | 9 | 7 |
| Magnesium | 54 | 50 | 37 | 55 | X |
| Zinc | 18 | 16 | 18 | 20 | 18 |



| | | | |
|---|---|---|---|
| 0 | 4 | . | 2 |
|---|---|---|---|

Determine the order of reactivity for the metals cobalt, magnesium and zinc.

Use TABLE 4, on the opposite page. [1 mark]

Most reactive _____

Least reactive _____

| | | | |
|---|---|---|---|
| 0 | 4 | . | 3 |
|---|---|---|---|

The range of measurements either side of the mean shows the uncertainty in the mean temperature increase.

Complete the sentence.

Use TABLE 4. [1 mark]

The mean temperature increase for zinc is $18 \pm$

_____ °C

[Turn over]



04.4

What type of variable is the volume of hydrochloric acid in this investigation? [1 mark]

Tick (✓) ONE box.

Control

Dependent

Independent



| | | | |
|---|---|---|---|
| 0 | 4 | . | 5 |
|---|---|---|---|

Suggest ONE way of improving STEP 3, on page 30, in the method to give results which are more repeatable.

[1 mark]

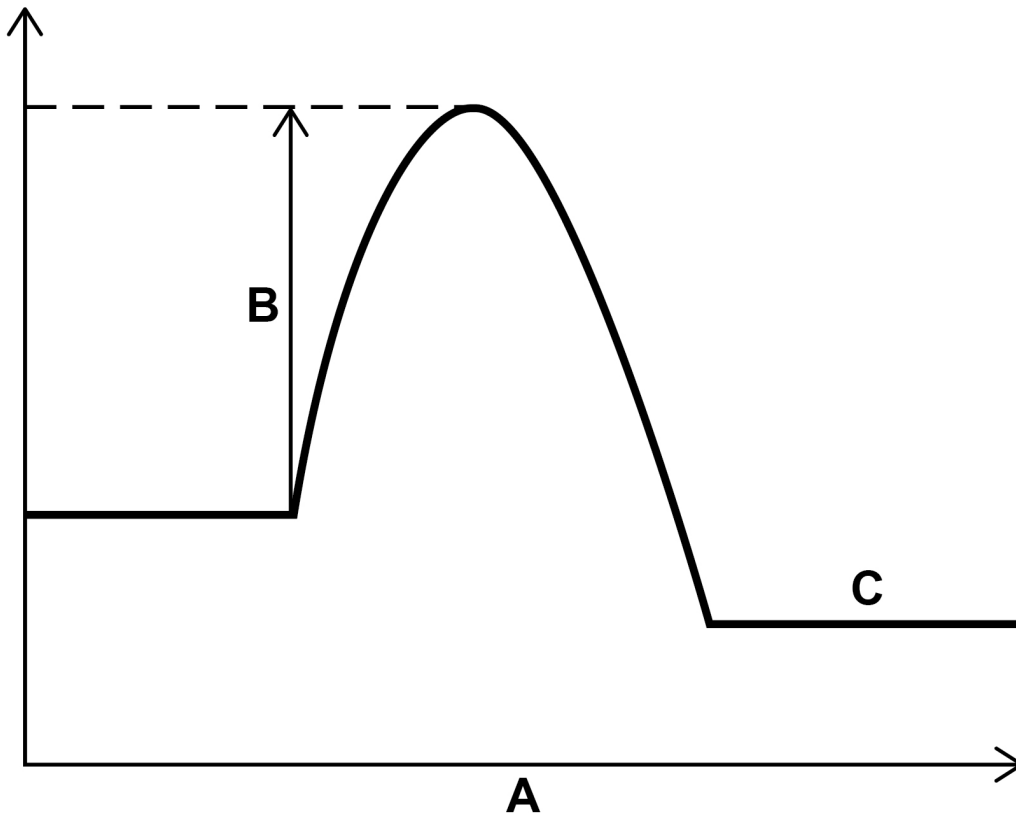
[Turn over]



04.6

FIGURE 6 shows a reaction profile for the reaction of magnesium with hydrochloric acid.

FIGURE 6



What do labels A, B and C represent on FIGURE 6?

Choose answers from the list. [3 marks]

- activation energy
- energy
- overall energy change
- products
- progress of reaction
- reactants

A

B

C

[Turn over]

| |
|---|
| |
| 9 |



| | |
|---|---|
| 0 | 5 |
|---|---|

This question is about acids and alkalis.

| | | | |
|---|---|---|---|
| 0 | 5 | . | 1 |
|---|---|---|---|

Which ion do acids produce in aqueous solution?
[1 mark]

Tick (✓) ONE box.

H^+

OH^-

O^{2-}



05.2

Acids react with alkalis.

What is the name of this type of reaction? [1 mark]

Tick (✓) ONE box.

Decomposition

Electrolysis

Neutralisation

Redox

[Turn over]



05.3

Balance the equation for the reaction between sulfuric acid and potassium hydroxide. [1 mark]



05.4

Universal indicator turns purple in potassium hydroxide solution.

What is the pH of the solution? [1 mark]

Tick (✓) ONE box.

1

4

7

14



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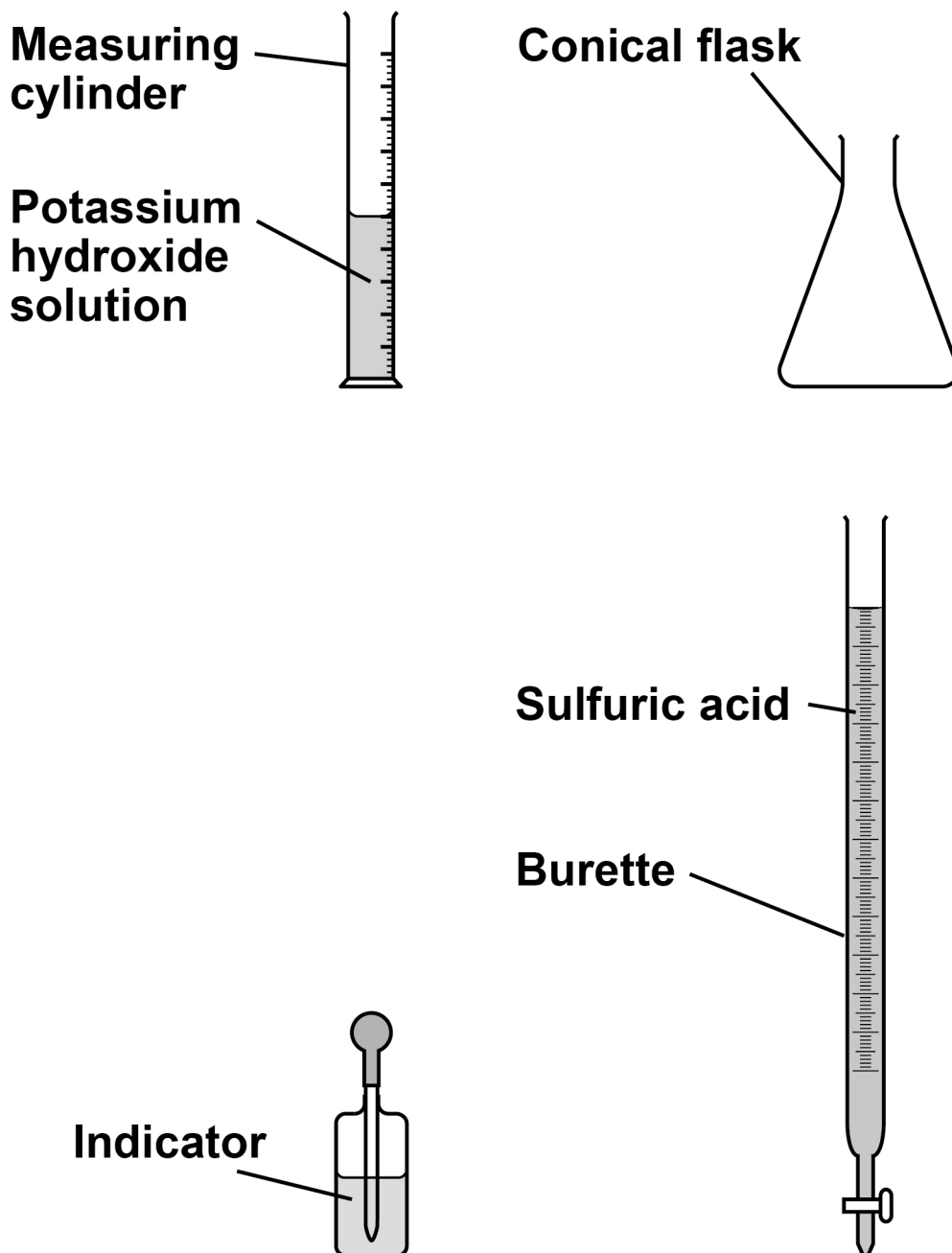
[Turn over]



A student does a titration to find the volume of sulfuric acid that reacts with 25 cm^3 of potassium hydroxide solution.

FIGURE 7 shows the equipment used.

FIGURE 7



| | | | |
|---|---|---|---|
| 0 | 5 | . | 5 |
|---|---|---|---|

The 25 cm³ of potassium hydroxide solution is measured with the measuring cylinder.

Which piece of equipment could the student use to measure the 25 cm³ of potassium hydroxide solution more accurately? [1 mark]

Tick (✓) ONE box.

Beaker

Evaporating basin

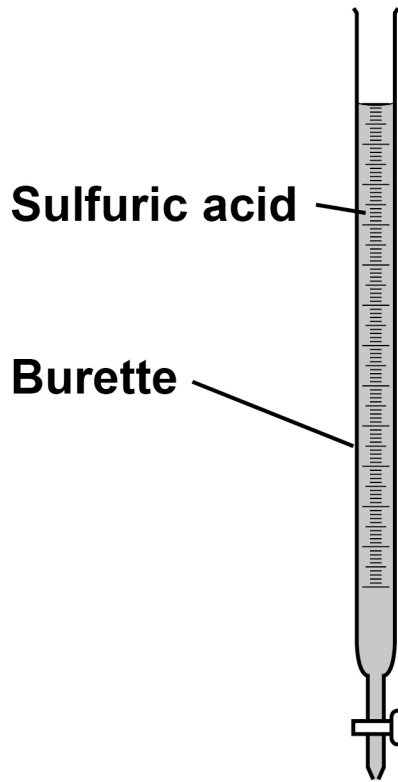
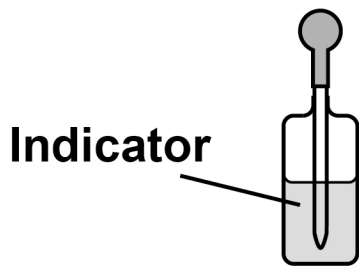
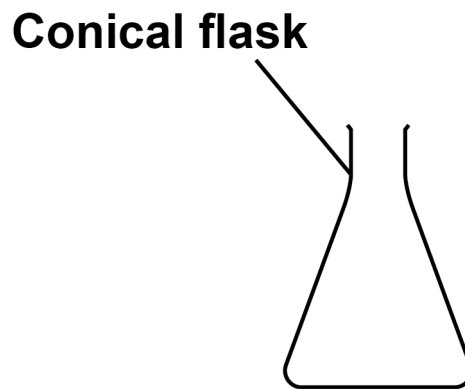
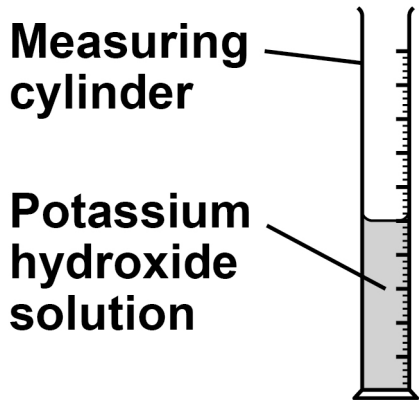
Pipette

Test tube

[Turn over]



REPEAT OF FIGURE 7



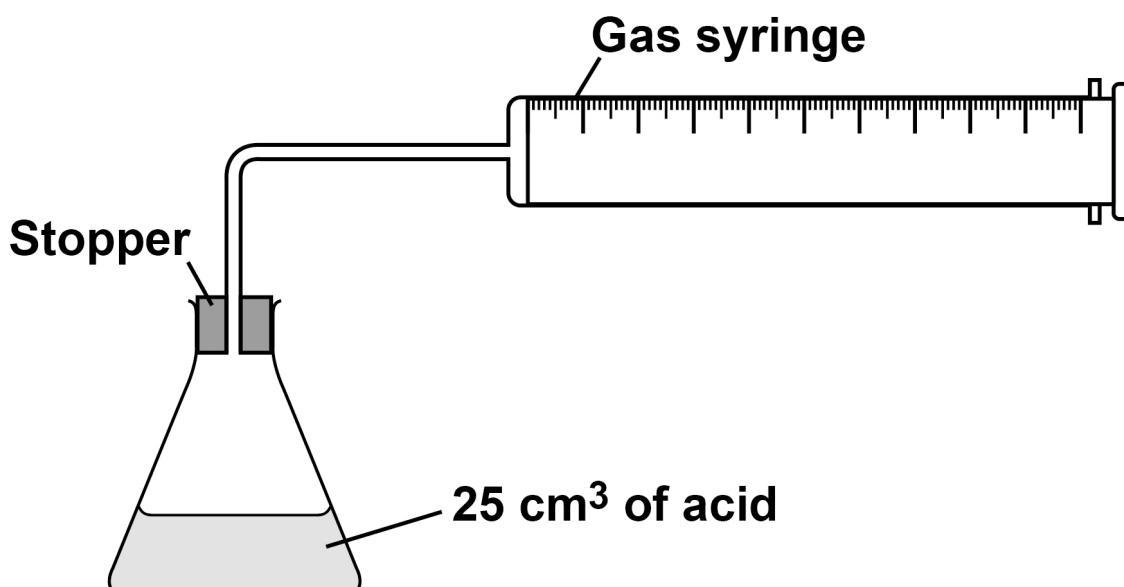
06

This question is about metal carbonates.

A student investigated the reaction of copper carbonate with an acid.

FIGURE 8 shows the apparatus.

FIGURE 8



This is the method used.

1. Pour 25 cm³ of the acid into a conical flask.
2. Weigh 0.10 g of copper carbonate.
3. Remove the stopper and add the copper carbonate to the flask.
4. Quickly replace the stopper.

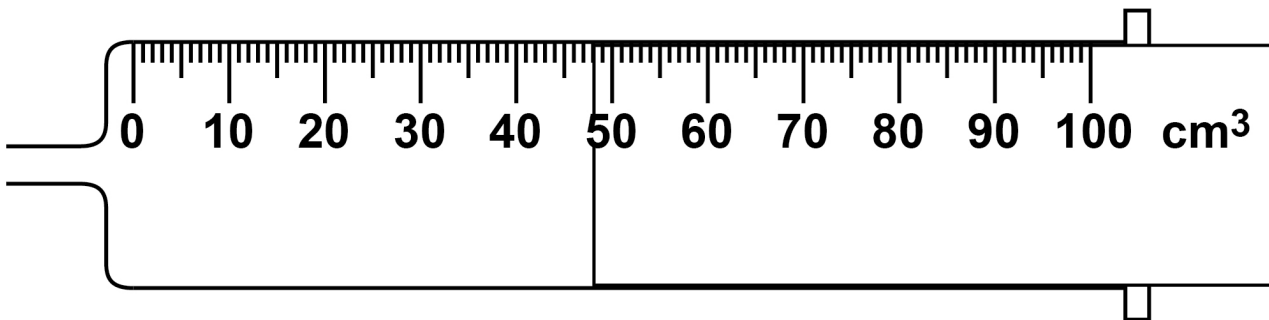


- Record the maximum volume of gas collected in the gas syringe.
- Repeat steps 1 to 5 with different masses of copper carbonate.

0 6 . 1

FIGURE 9 shows the gas syringe during the experiment.

FIGURE 9



What is the reading on the gas syringe? [1 mark]

_____ cm³

[Turn over]



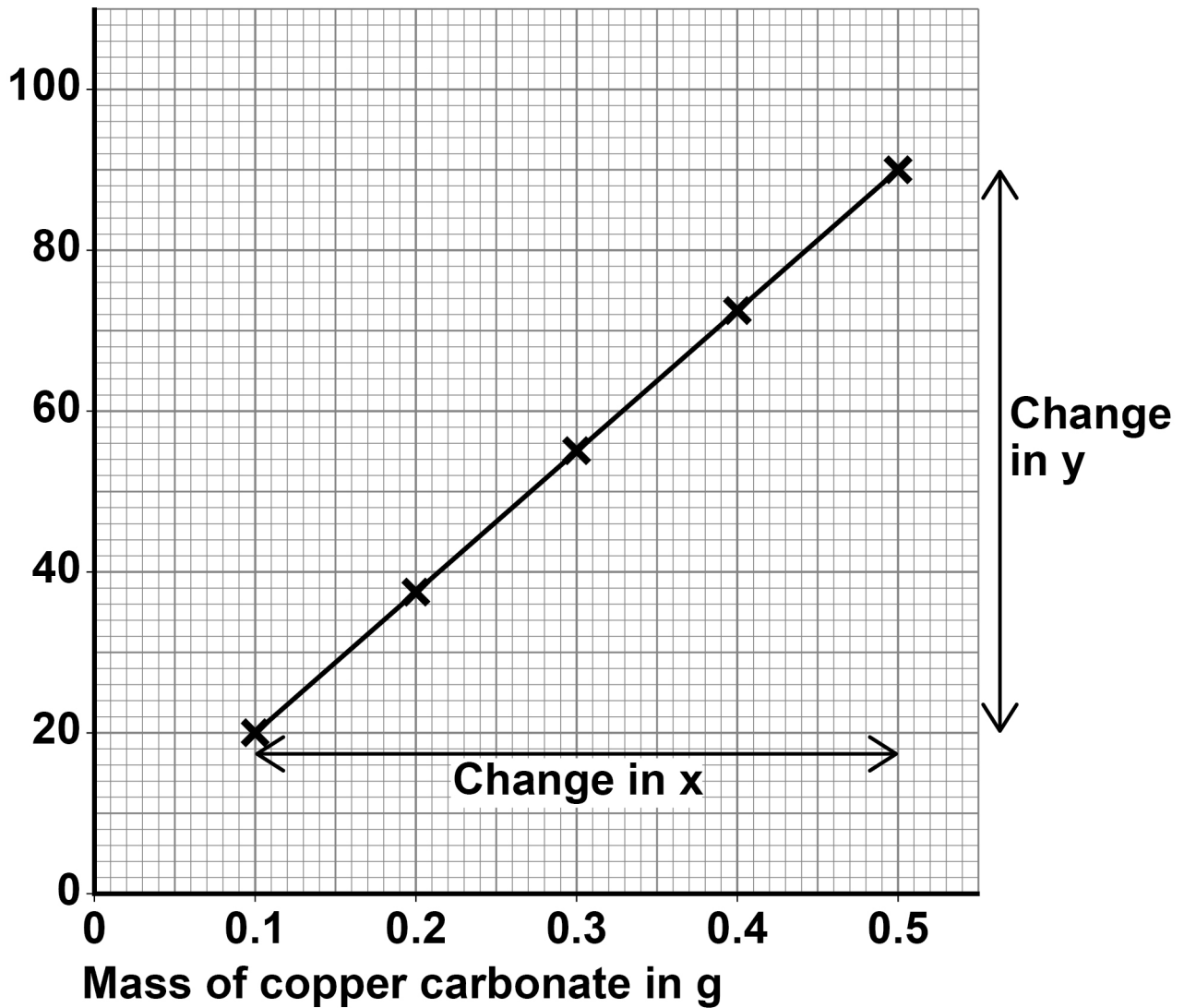
06.2

The student plotted the results on a graph.

FIGURE 10 shows the student's graph.

FIGURE 10

Volume
of gas
in cm^3



Determine the gradient of the line of best fit.

You should:

- calculate the values of the change in y and the change in x
- calculate the gradient of the line of best fit.

[4 marks]

Change in y = _____ cm^3

Change in x = _____ g

Gradient _____

Gradient = _____ cm^3/g

[Turn over]



06.3

Copper chloride was produced in the reaction.

Which acid reacts with copper carbonate to produce copper chloride? [1 mark]

Tick (✓) ONE box.

Hydrochloric acid

Nitric acid

Sulfuric acid



06.4

The reaction between copper carbonate and the acid produced a gas.

What was the gas? [1 mark]

Tick (✓) ONE box.

Carbon dioxide

Chlorine

Hydrogen

Oxygen

[Turn over]



A different student produced a pure, dry sample of copper chloride using the same reaction.

This is the method used.

1. Add excess copper carbonate to the acid.
2. Filter the mixture.
3. Heat the solution gently until crystals start to form.
4. Leave for 24 hours.
5. Remove the crystals.
6. Rinse with water and dry the crystals.

0 6 . 5

Why was the solution heated gently in STEP 3?
[1 mark]

Tick (✓) ONE box.

To evaporate acid

To evaporate copper carbonate

To evaporate water



| | | | |
|---|---|---|---|
| 0 | 6 | . | 6 |
|---|---|---|---|

How should the solution be heated gently in **STEP 3**?
[1 mark]

[Turn over]

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| 9 |



07

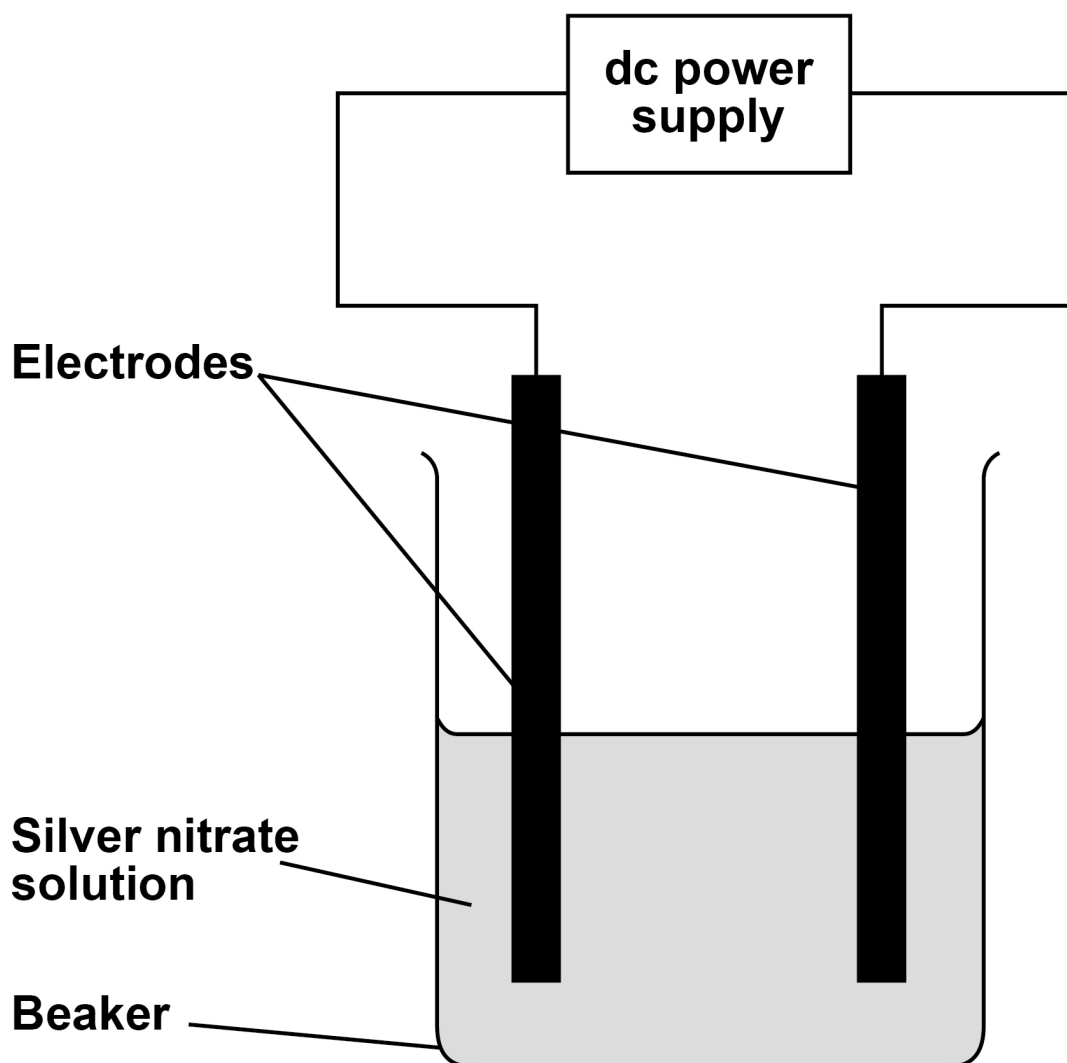
This question is about electrolysis.

Some students investigated the electrolysis of silver nitrate solution.

This electrolysis produces silver at the negative electrode.

FIGURE 11 shows the apparatus.

FIGURE 11



This is the method used.

- 1. Weigh the negative electrode.**
- 2. Set up the apparatus shown in FIGURE 11.**
- 3. Switch on the power supply.**
- 4. Switch off the power supply after five minutes.**
- 5. Rinse the negative electrode with water and allow to dry.**
- 6. Reweigh the negative electrode.**
- 7. Repeat steps 1 to 6 for different times.**

[Turn over]



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07.1

Some silver did not stick to the negative electrode but fell to the bottom of the beaker.

The students needed to weigh this silver.

How could the students separate the silver from the silver nitrate solution? [1 mark]

Tick (✓) ONE box.

By chromatography

By crystallisation

By distillation

By filtration

[Turn over]



TABLE 5 shows the students' results.

TABLE 5

| Time in minutes | Mass of silver in g |
|------------------------|----------------------------|
| 0 | 0.00 |
| 5 | 0.06 |
| 10 | 0.12 |
| 15 | 0.18 |
| 20 | 0.24 |
| 25 | 0.30 |

07.2

Draw a graph on FIGURE 12 on the opposite page.

You should:

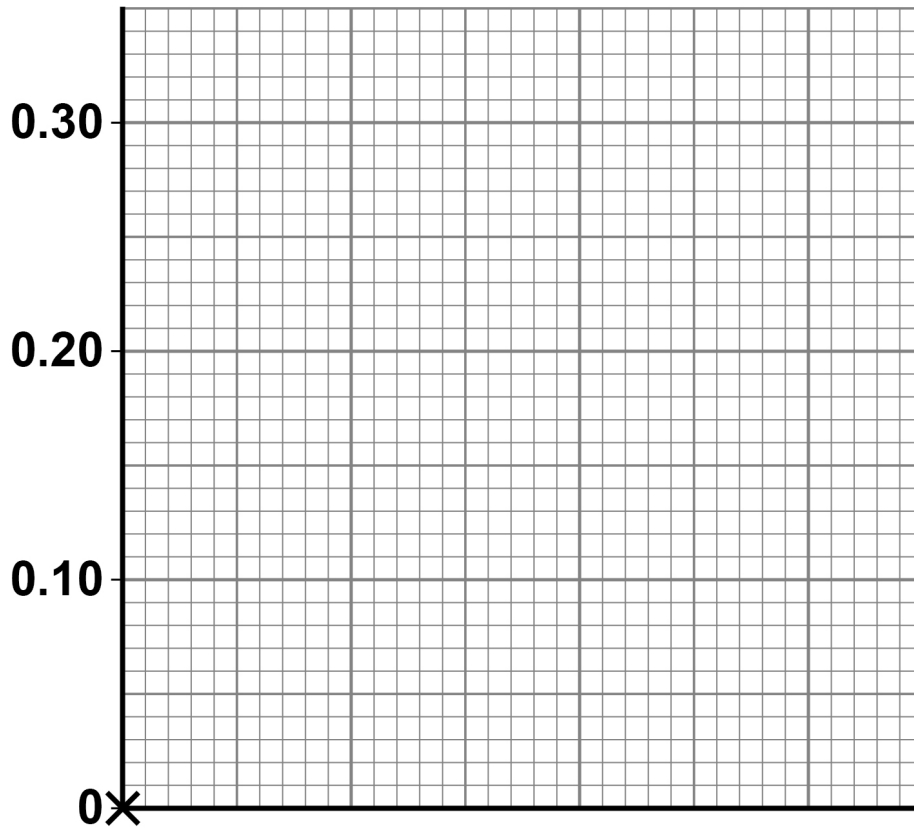
- **use a suitable scale for the x-axis**
- **plot the data from TABLE 5**
- **draw a line of best fit.**

[4 marks]



FIGURE 12

Mass of
silver
in g



Time in minutes

0 7 . 3

Determine the mass of silver that would be produced after 12 minutes.

Use FIGURE 12. [1 mark]

Mass of silver = _____ g

[Turn over]



07.4

A student investigated the electrolysis of two aqueous salt solutions.

Hydrogen is produced at the negative electrode when the metal in the salt solution is more reactive than hydrogen.

Complete TABLE 6 to show what the student would **OBSERVE** at the negative electrode for each salt solution. [2 marks]

TABLE 6

| Salt solution | Observation at negative electrode |
|-----------------|-----------------------------------|
| Copper sulfate | |
| Sodium chloride | |



07.5

A teacher demonstrates the electrolysis of molten lead bromide.

The products at the electrodes are lead and bromine.

Why should the teacher do the demonstration in a fume cupboard? [1 mark]

[Turn over]



07.6

Two other molten compounds are electrolysed.

Complete TABLE 7 to show the molten compounds and the products. [3 marks]

TABLE 7

| Molten compound electrolysed | Product at the negative electrode | Product at the positive electrode |
|------------------------------|-----------------------------------|-----------------------------------|
| Zinc chloride | | |
| | Potassium | Iodine |

12

| | |
|---|---|
| 0 | 8 |
|---|---|

This question is about carbon and its compounds.

Fullerenes are molecules of carbon atoms.

The first fullerene to be discovered was Buckminsterfullerene (C_{60}).

| | | | |
|---|---|---|---|
| 0 | 8 | . | 1 |
|---|---|---|---|

What shape is a Buckminsterfullerene molecule?
[1 mark]

| | | | |
|---|---|---|---|
| 0 | 8 | . | 2 |
|---|---|---|---|

Give ONE use of a fullerene. [1 mark]

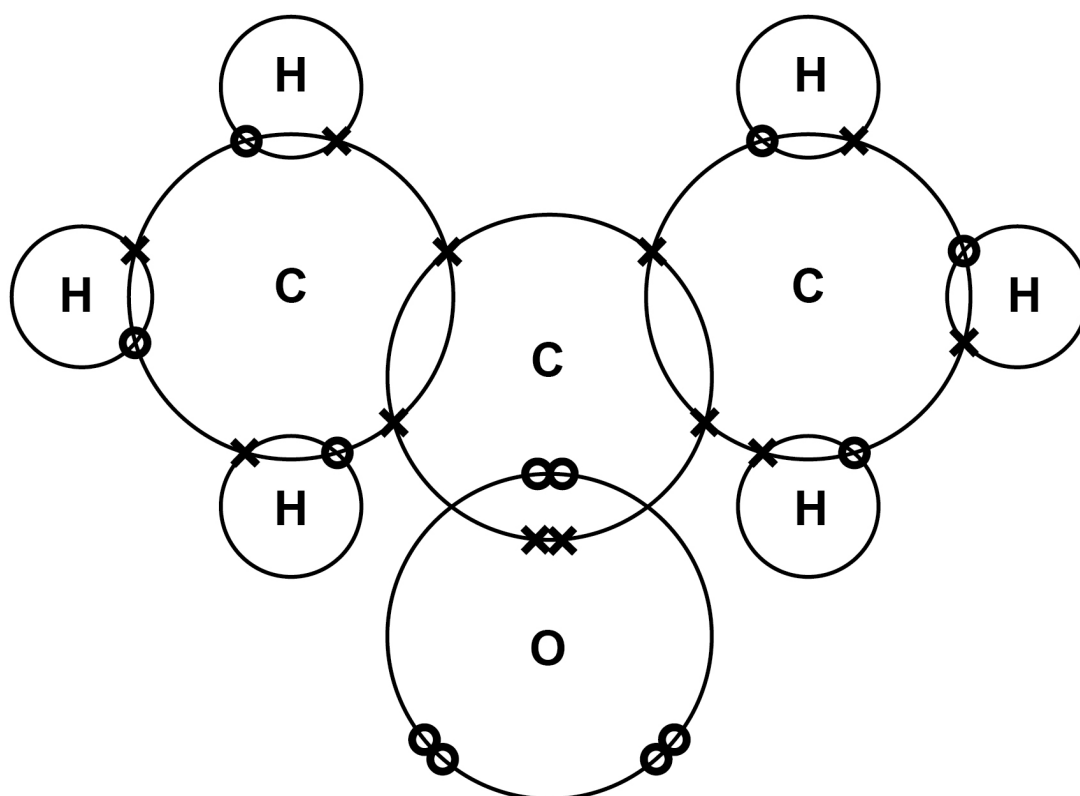
[Turn over]



Propanone is a compound of carbon, hydrogen and oxygen.

FIGURE 13 shows the dot and cross diagram for a propanone molecule.

FIGURE 13



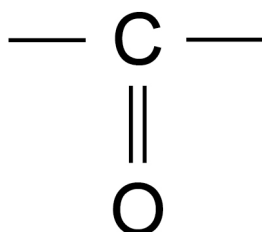
| | | | |
|---|---|---|---|
| 0 | 8 | . | 3 |
|---|---|---|---|

Complete FIGURE 14 to show a propanone molecule.

Use a line to represent each single bond.

Use FIGURE 13. [1 mark]

FIGURE 14



| | | | |
|---|---|---|---|
| 0 | 8 | . | 4 |
|---|---|---|---|

Determine the molecular formula of propanone.

Use FIGURE 13. [1 mark]

Molecular formula = _____

[Turn over]



| | | | |
|---|---|---|---|
| 0 | 8 | . | 5 |
|---|---|---|---|

Propanone is a liquid with a low boiling point.

Why does propanone have a low boiling point?
[1 mark]

Tick (✓) ONE box.

The covalent bonds are strong.

The covalent bonds are weak.

The intermolecular forces are strong.

The intermolecular forces are weak.



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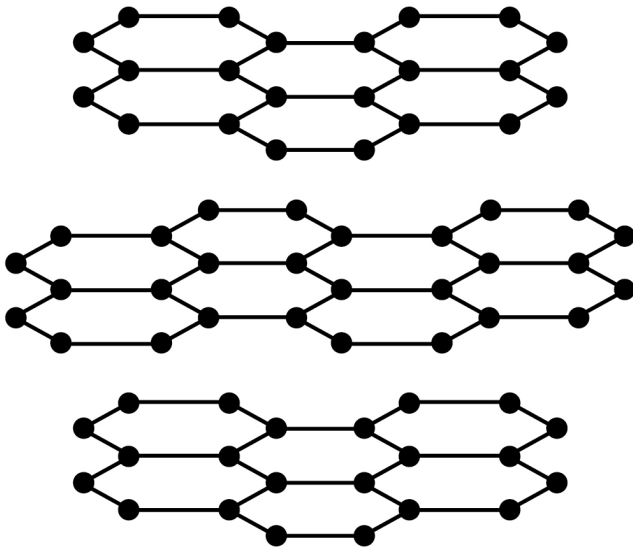
[Turn over]



08.6

FIGURE 15 represents the structure of graphite.

FIGURE 15



Explain why graphite is:

- a good electrical conductor
- soft and slippery.

You should answer in terms of structure and bonding.
[6 marks]



[Turn over]

| |
|-------|
| |
| <hr/> |
| 11 |



| | |
|---|---|
| 0 | 9 |
|---|---|

This question is about atomic structure and the periodic table.

Gallium (Ga) is an element that has two isotopes.

| | | | |
|---|---|---|---|
| 0 | 9 | . | 1 |
|---|---|---|---|

Give the meaning of 'isotopes'.

**You should answer in terms of subatomic particles.
[2 marks]**



09.2

TABLE 8 shows the mass numbers and percentage abundances of the isotopes of gallium.

TABLE 8

| Mass number | Percentage abundance (%) |
|-------------|--------------------------|
| 69 | 60 |
| 71 | 40 |

Calculate the relative atomic mass (A_r) of gallium.

Give your answer to 1 decimal place. [2 marks]

Relative atomic mass (1 decimal place) =

[Turn over]



Gallium (Ga) is in Group 3 of the modern periodic table.

0 9 . 3

Give the numbers of electrons and neutrons in an atom of the isotope ${}_{31}^{69}\text{Ga}$ [2 marks]

Number of electrons _____

Number of neutrons _____

0 9 . 4

What is the most likely formula of a gallium ion?
[1 mark]

Tick (✓) ONE box.

Ga^+

Ga^-

Ga^{3+}

Ga^{3-}



| | | | |
|---|---|---|---|
| 0 | 9 | . | 5 |
|---|---|---|---|

Gallium was discovered six years after Mendeleev published his periodic table.

Give TWO reasons why the discovery of gallium helped Mendeleev's periodic table to become accepted.
[2 marks]

1

2

[Turn over]

| |
|---|
| |
| 9 |

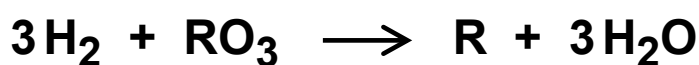


| | |
|---|---|
| 1 | 0 |
|---|---|

This question is about the extraction of metals.

Element R is extracted from its oxide by reduction with hydrogen.

The equation for the reaction is:



| | | | |
|---|---|---|---|
| 1 | 0 | . | 1 |
|---|---|---|---|

The sum of the relative formula masses (M_r) of the reactants ($3\text{H}_2 + \text{RO}_3$) is 150

Calculate the relative atomic mass (A_r) of R.

Relative atomic masses (A_r): H = 1 O = 16

[2 marks]



Relative atomic mass (A_r) of R = _____

10.2

Identify element R.

You should use:

- your answer to QUESTION 10.1
- the periodic table.

[1 mark]

Identity of R = _____

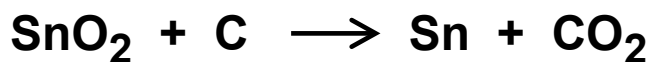
[Turn over]



10.3

Carbon is used to extract tin (Sn) from tin oxide (SnO₂).

The equation for the reaction is:



Calculate the percentage atom economy for extracting tin in this reaction.

Relative atomic masses (A_r):

C = 12 O = 16 Sn = 119

[3 marks]

Percentage atom economy = _____ %



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[Turn over]



10.4

Tungsten (W) is a metal.

Tungsten is extracted from tungsten oxide (WO_3).

All other solid products from the extraction method must be separated from the tungsten.

TABLE 9 shows information about three possible methods to extract tungsten from tungsten oxide.

TABLE 9

| Method | Reactant | Relative cost of reactant | Products |
|--------|----------|---------------------------|----------------------------------------------------------------|
| 1 | Carbon | Low | Tungsten solid Carbon dioxide gas Tungsten carbide solid |
| 2 | Hydrogen | High | Tungsten solid Water vapour |
| 3 | Iron | Low | Tungsten solid Iron oxide solid |



Evaluate the three possible methods for extracting tungsten from tungsten oxide. [4 marks]

[Turn over]



END OF QUESTIONS

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| Question | Mark |
| 1 | |
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| TOTAL | |

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