

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL GCSE COMBINED SCIENCE

Paper 2 Chemistry Core

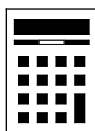
C

Thursday 3 November 2022 07:00 GMT Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

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



Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or 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).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.
- You are expected to use a scientific calculator where appropriate.
- The periodic table is provided as a loose insert.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	



N 0 V 2 2 9 2 0 4 C C 0 1

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Answer **all** questions in the spaces provided.

0 1

This question is about particles.

Atoms contain sub-atomic particles called electrons, neutrons and protons.

0 1 . 1

Which sub-atomic particle has the smallest mass?

[1 mark]

Tick (✓) **one** box.

Electron

☐

Neutron

☐

Proton

☐

0 1 . 2

Why do atoms have no overall electrical charge?

[1 mark]

Tick (✓) **one** box.

Atoms have an equal number of electrons and neutrons.

☐

Atoms have an equal number of electrons and protons.

☐

Atoms have an equal number of neutrons and protons.

☐

0 1 . 3

Complete the sentence.

Choose the answer from the box.

[1 mark]

electrons

neutrons

protons

Isotopes are atoms of the same element with a different
number of _____.

0 1 . 4

An atom of potassium can be represented as:

Mass number 39
Atomic number 19 **K**

What is the total number of sub-atomic particles in the **nucleus** of this
potassium atom?

[1 mark]

Tick (✓) **one** box.

19

☐

20

☐

39

☐

58

☐

Question 1 continues on the next page

Turn over ►

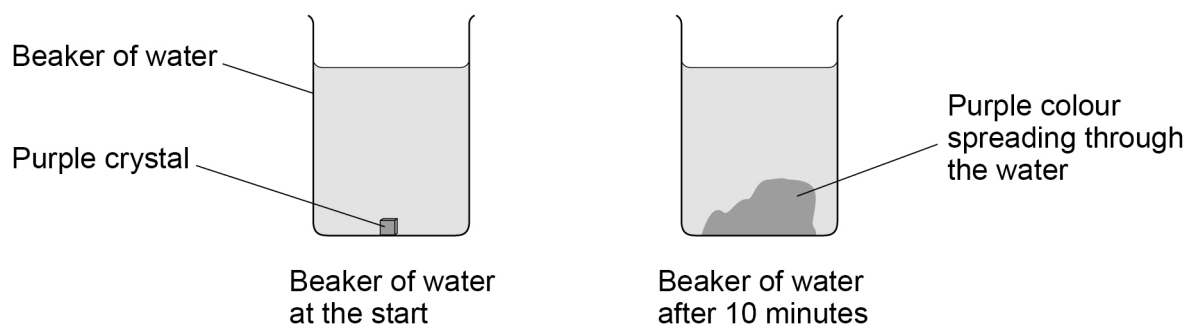


A student dropped a small purple crystal into a beaker of water.

The student observed the beaker of water after 10 minutes.

Figure 1 shows the results.

Figure 1



0 1 . 5 The purple crystal dissolves when added to water.

Which state symbols show the change when the purple crystal dissolves?

[1 mark]

Tick (✓) **one** box.

From (aq) to (g)

☐

From (g) to (l)

☐

From (l) to (s)

☐

From (s) to (aq)

☐

0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

diffusion

neutralisation

precipitation

reduction

The purple colour spreads through the water by _____.



0 1 . 7

The purple crystal is a potassium compound with the formula KMnO_4

What is the total number of atoms in the formula of this compound?

[1 mark]

Tick (✓) **one** box.

3 ☐

4 ☐

6 ☐

7 ☐

0 1 . 8

Element **X** is in the same group in the periodic table as potassium.

Element **X** is more reactive than potassium.

Suggest the name of element **X**.

Use the periodic table.

[1 mark]

8

Turn over for the next question

Turn over ►



0 2

This question is about aluminium and iron.

0 2 . 1

Aluminium and iron are metals.

Which of the following is a property of a metal?

[1 mark]

Tick (✓) **one** box.

Does not bend

☐

Easily hammered into shape

☐

Low melting point

☐

Poor conductor of heat

☐

0 2 . 2

Table 1 gives information about aluminium oxide and iron oxide.**Table 1**

Name	Formula	Relative formula mass (M_r)	Mass of metal in 1 mole of oxide in grams
Aluminium oxide	Al_2O_3	102	54
Iron oxide	Fe_2O_3	160	X

The mass of **iron** in 1 mole of iron oxide is represented by **X** in **Table 1**.Calculate value **X**.Relative atomic masses (A_r): Al = 27 Fe = 56 O = 16

[2 marks]

X = _____ g

0 2 . 3

Aluminium and iron are extracted using different methods.

Draw **one** line from each metal to the method of extraction.**[2 marks]****Metal****Method of extraction**

Aluminium

Iron

Bioleaching using bacteria

Crystallisation

Electrolysis

Phytomining using plants

Reduction using carbon

Question 2 continues on the next page**Turn over ►**

A useful material is produced by mixing aluminium with iron and copper.

0 2 . 4 What name is given to a mixture of aluminium, iron and copper?

[1 mark]

Tick (✓) **one** box.

Alloy

☐

Compound

☐

Molecule

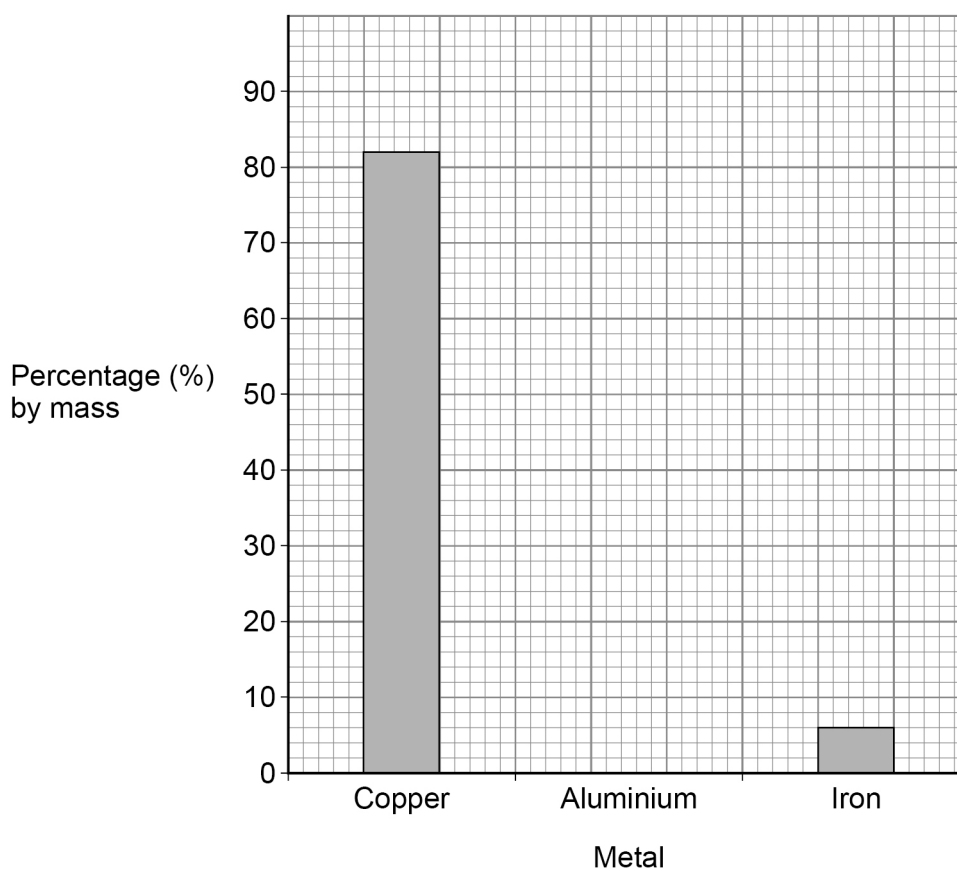
☐

Polymer

☐

Figure 2 shows the percentage (%) by mass of iron and copper in the useful material.

Figure 2



The percentage by mass of aluminium is not shown in **Figure 2**.

0 2 . 5

Calculate the percentage by mass of aluminium in the useful material.

Use **Figure 2**.

[2 marks]

Percentage by mass of aluminium = _____ %

0 2 . 6

Complete **Figure 2** to show the percentage by mass of aluminium in the useful material.

Use your answer from Question **02.5**.

[1 mark]

9

Turn over for the next question

Turn over ►



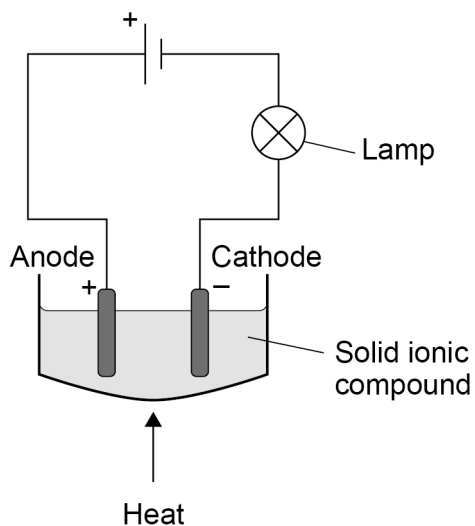
0 3

This question is about electrolysis.

A solid ionic compound is electrolysed.

Figure 3 shows the apparatus.

Figure 3

**0 3 . 1**

Complete the sentence.

Choose the answer from the box.

[1 mark]

boils

dissolves

evaporates

melts

The compound in **Figure 3** starts to conduct electricity when
the compound _____.



0 3 . 2 How does the compound in **Figure 3** conduct electricity when it is heated?

[1 mark]

Tick (✓) **one** box.

Movement of atoms

☐

Movement of electrons

☐

Movement of ions

☐

0 3 . 3 What name is given to the compound in **Figure 3** when the compound conducts electricity?

[1 mark]

Tick (✓) **one** box.

Electrode

☐

Electrolyte

☐

Solution

☐

0 3 . 4 The apparatus shown in **Figure 3** was used for the electrolysis of two different ionic compounds.

Complete **Table 2** with the names of the elements produced at the anode and at the cathode during electrolysis.

[3 marks]

Table 2

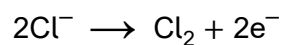
Name of ionic compound	Element produced at the anode	Element produced at the cathode
Sodium chloride	Chlorine	
Lead bromide		

Turn over ►



0	3	.	5
---	---	---	---

The half equation for the reaction at the anode during the electrolysis of sodium chloride is:



Which statement describes this reaction?

[1 mark]

Tick (✓) **one** box.

Chloride ions gain electrons.

☐

Chloride ions lose electrons.

☐

Chlorine molecules gain electrons.

☐

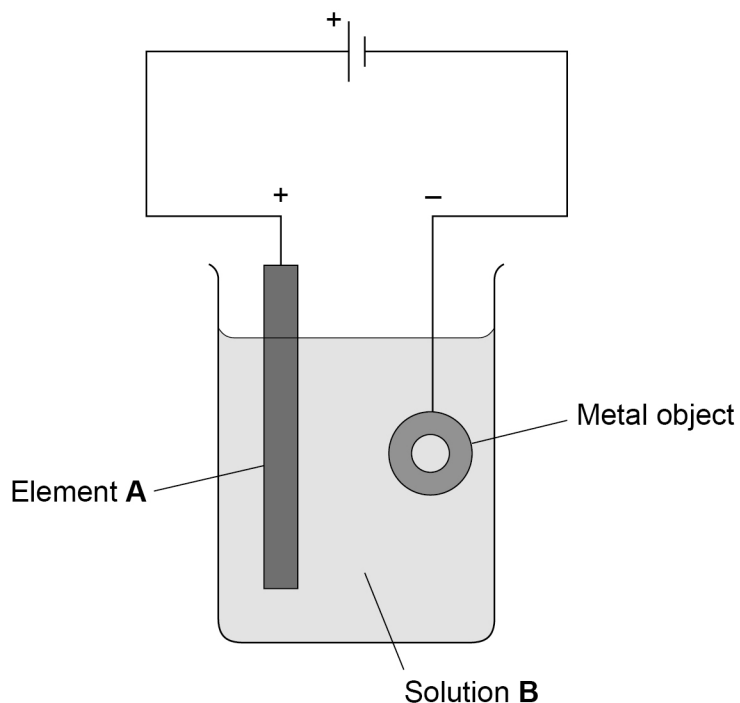
Chlorine molecules lose electrons.

☐

A student did an experiment to electroplate a metal object with copper.

Figure 4 shows the apparatus.

Figure 4



0 3 . 6

Suggest the names of element **A** and of solution **B**.

[2 marks]

Element **A** _____

Solution **B** _____

0 3 . 7

Give **one** reason for electroplating metal objects.

[1 mark]

10

Turn over ►



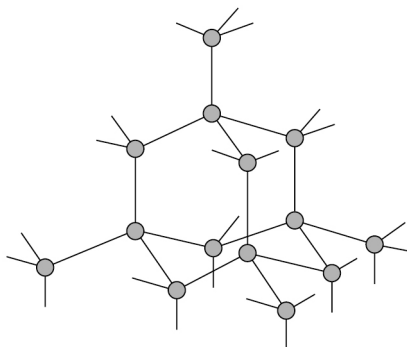
0 4

This question is about structure and bonding.

Diamond is a structure formed by the element carbon.

Figure 5 represents the structure of diamond.

Figure 5



0 4 . 1

Complete the sentence.

Choose the answer from the box.

[1 mark]

gained

lost

shared

When a carbon atom forms a chemical bond in diamond,
electrons are _____.

0 4 . 2

What type of structure is diamond?

[1 mark]

Tick (✓) **one** box.

Giant structure

☐

Ionic lattice

☐

Metallic structure

☐

Polymer

☐


0 4 . 3 Which of the following is a property of diamond?

[1 mark]

Tick (✓) **one** box.

Good electrical conductor

☐

Hard

☐

Low melting point

☐

Slippery

☐

Question 4 continues on the next page

Turn over ►



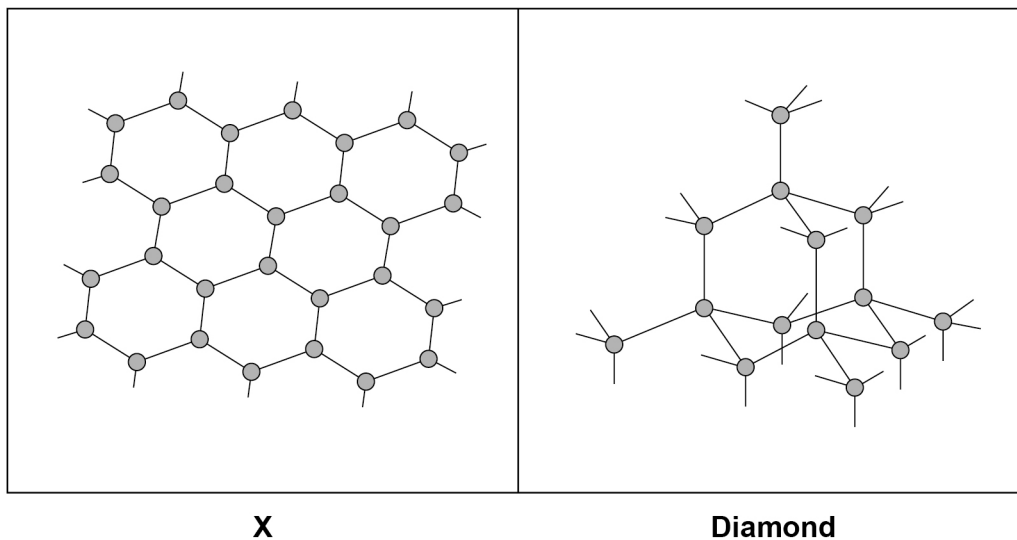
X is another structure formed by carbon.

Figure 6 represents the structure of **X** and the structure of diamond.

Figure 6

Key

● = carbon atom



0 4 . 4 Give **two** differences between the structure of **X** and the structure of diamond.

Use **Figure 6**.

[2 marks]

- 1 _____
- _____
- _____
- 2 _____
- _____
- _____



A gas is produced when **X** is burned.

0 4 . 5 24 dm³ of the gas is produced when 12 g of **X** is burned.

Calculate the volume of the gas produced when 0.20 g of **X** is burned.

[2 marks]

Volume of gas = _____ dm³

0 4 . 6 What is the formula of the gas produced when **X** is burned?

[1 mark]

Tick (✓) **one** box.

CH₄ ☐

CO₂ ☐

H₂ ☐

O₂ ☐

8

Turn over for the next question

Turn over ►



0 5

This question is about ammonia.

Ammonia is produced when nitrogen gas reacts with hydrogen gas.

The word equation for the reaction is:

**0 5****. 1**

Ammonia is produced on a large scale.

The conditions for the reaction are:

- a temperature of 450 °C
- a pressure of 200 atmospheres.

Give **two** changes to the conditions that will increase the rate of the reaction.

[2 marks]

1 _____

2 _____

0 5**. 2**

Ammonia is produced at a rate of 25 g/s.

Calculate the time taken to produce 5000 g of ammonia.

Use the equation:

$$\text{Time} = \frac{\text{mass of product}}{\text{rate of reaction}}$$

[2 marks]

Time = _____ s



A student did some chemical tests on ammonia solution.

Table 3 shows the results.

Table 3

Test	Result
Measure the approximate pH of the solution	pH = 12
Add a solution containing iron(III) ions	brown precipitate

0 5 . 3 Describe how the student can measure the approximate pH of the ammonia solution. **[2 marks]**

0 5 . 4 Which of the following describes ammonia solution?

Use **Table 3**.

[1 mark]

Tick (✓) **one** box.

acidic

☐

alkaline

☐

neutral

☐

Question 5 continues on the next page

Turn over ►



0 5 . 5

In a different experiment the student added a solution containing iron(III) ions to substance **Y**.

A brown precipitate was produced.

What is substance **Y**?

[1 mark]

Tick (✓) **one** box.

Barium chloride solution

☐

Nitric acid

☐

Silver nitrate solution

☐

Sodium hydroxide solution

☐

8



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0 6

This question is about organic compounds.

Table 4 shows the melting points of some organic compounds.

Table 4

Formula of organic compound	Melting point in °C
$C_{11}H_{23}COOH$	45
$C_{13}H_{27}COOH$	55
$C_{15}H_{31}COOH$	63
$C_{17}H_{35}COOH$	69
$C_{19}H_{39}COOH$	76

0 6 . 1

Describe how the melting point changes when the number of carbon atoms in the organic compound increases.

Use **Table 4**.

[1 mark]

0 6 . 2

All the organic compounds in **Table 4** contain the same functional group.

What is the name of this functional group?

[1 mark]

Tick (✓) **one** box.

Alcohol

☐

Carboxylic acid

☐

Ester

☐


0 6 . 3 The molecular formula of $C_{11}H_{23}COOH$ is $C_{12}H_{24}O_2$

Complete the molecular formula of $C_{19}H_{39}COOH$

[1 mark]

C _____ H _____ O₂

0 6 . 4 The compounds in **Table 4** can be obtained from plants and used to produce biofuels.

Biofuels are an alternative to hydrocarbon fuels obtained from crude oil.

Which of the following is a **disadvantage** of using a biofuel instead of a hydrocarbon fuel obtained from crude oil?

[1 mark]

Tick (✓) **one** box.

Smaller carbon footprint

☐

Less farmland available for growing food crops

☐

Produced from a solid resource

☐

Produced from a renewable resource

☐

Question 6 continues on the next page

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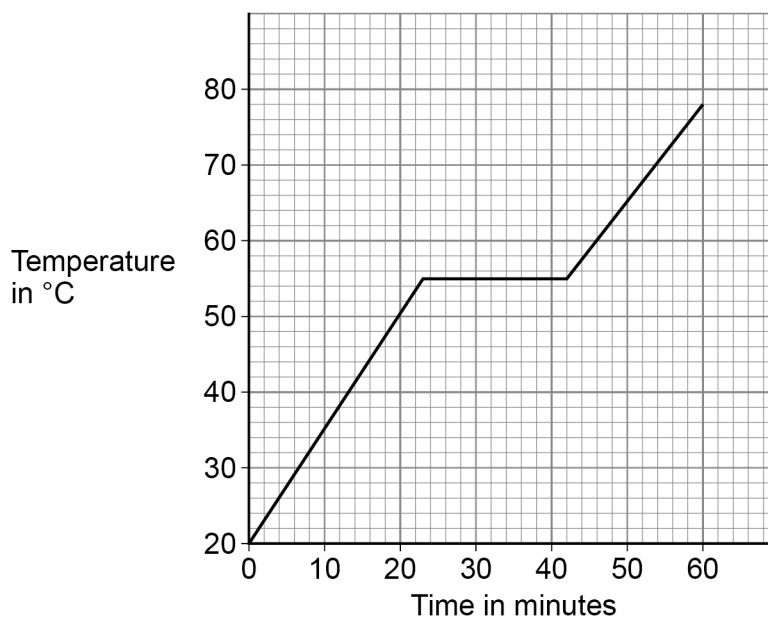


A student investigated a change of state of one of the compounds in **Table 4**.

The student heated the solid compound using an electrical heater and recorded the temperature.

Figure 7 shows the results.

Figure 7



0 6 . 5

Suggest **one** reason why the student did **not** heat the compound using a Bunsen burner.

[1 mark]

0 6 . 6

Describe the change in the temperature of the compound during the **first 40 minutes**.

Use data from **Figure 7**.

[3 marks]



0 6 . 7

Determine the time taken for the temperature of the compound to change from 60 °C to 70 °C.

Use **Figure 7**.

[2 marks]

Time taken = _____ minutes

0 6 . 8

Table 4 is repeated below.

Table 4

Formula of organic compound	Melting point in °C
$C_{11}H_{23}COOH$	45
$C_{13}H_{27}COOH$	55
$C_{15}H_{31}COOH$	63
$C_{17}H_{35}COOH$	69
$C_{19}H_{39}COOH$	76

Which compound was used in the experiment?

Use **Table 4** and **Figure 7**.

[1 mark]

Tick (✓) **one** box.

$C_{11}H_{23}COOH$

☐

$C_{13}H_{27}COOH$

☐

$C_{15}H_{31}COOH$

☐

$C_{17}H_{35}COOH$

☐

$C_{19}H_{39}COOH$

☐

Turn over ►



0 6 . 9

Which statement describes the changes to the movement and arrangement of molecules in the compound when the temperature increases?

[1 mark]

Tick (✓) **one** box.

Molecules move faster and closer together.

☐

Molecules move faster and further apart.

☐

Molecules move slower and closer together.

☐

Molecules move slower and further apart.

☐

12

Turn over for the next question

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0 7

This question is about pure substances and mixtures.

0 7 . 1

Which of the following is a pure substance?

[1 mark]Tick (✓) **one** box.

Air

☐

Ethanol

☐

Steel

☐**0 7 . 2**

Measures of purity are important in medicines.

A 2.0 g sample of medicine contained 0.010 g of a drug.

Calculate the percentage (%) by mass of the drug in the medicine.

[2 marks]

Percentage by mass = _____ %



0 7 . 3 Mixtures can be separated.

Draw **one** line from each mixture to the method used to separate that mixture.

[2 marks]

Mixture	Method used to separate the mixture
	Chromatography
	Crystallisation
Crude oil	Filtration
Food colourings	Fractional distillation
	Freezing

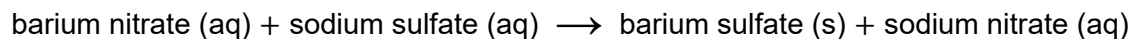
Question 7 continues on the next page

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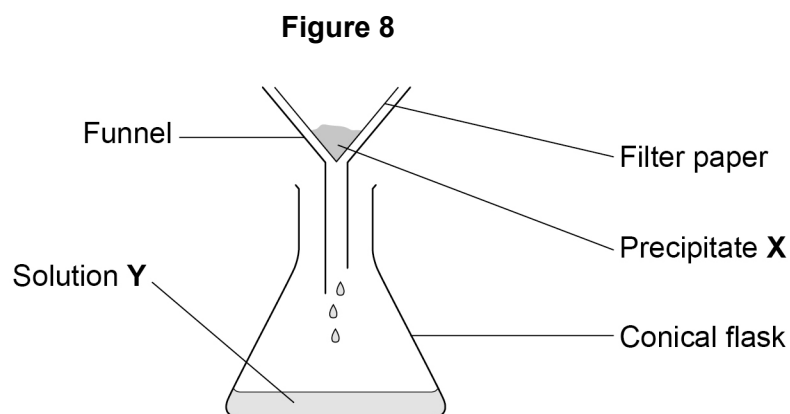
A student added sodium sulfate solution to barium nitrate solution.

The word equation for the reaction is:



The student filtered the mixture.

Figure 8 shows the apparatus.



0 7 . 4 The sodium sulfate solution had a concentration of 0.1 mol/dm^3 .

The student added a solution containing 0.005 moles of sodium sulfate to the barium nitrate solution.

Calculate the volume of the sodium sulfate solution.

Use the equation:

$$\text{Volume} = \frac{\text{moles}}{\text{concentration}}$$

Give your answer in cm^3 .

[3 marks]

Volume of sodium sulfate solution = _____ cm^3



0 7 . 5 Solution **Y** collected in the conical flask in **Figure 8**.

Solution **Y** is a solution of a pure ionic compound.

Name the ionic compound.

[1 mark]

0 7 . 6 Describe how to obtain crystals of the pure ionic compound from solution **Y**.

[2 marks]

0 7 . 7 Precipitate **X** collected in the filter paper in **Figure 8**.

What is the colour of precipitate **X**?

[1 mark]

Tick (✓) **one** box.

Cream

☐

Green

☐

White

☐

Yellow

☐

12

Turn over for the next question

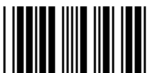
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0 8

Alkanes and alkenes are hydrocarbons.

0 8 . 1The general formula of an alkane is C_nH_{2n+2}

An alkane is produced when 2 moles of carbon (C) combine with 3 moles of hydrogen (H_2).

Complete the molecular formula of this alkane.

[1 mark]

C _____ H _____

Alkenes are unsaturated hydrocarbons.

0 8 . 2

Give the general formula for alkenes.

[1 mark]

0 8 . 3

What is meant by 'unsaturated'?

[1 mark]_____
_____**0 8 . 4**

What is meant by 'hydrocarbon'?

[1 mark]_____
_____**0 8 . 5**

Name a substance used to test for the presence of an alkene.

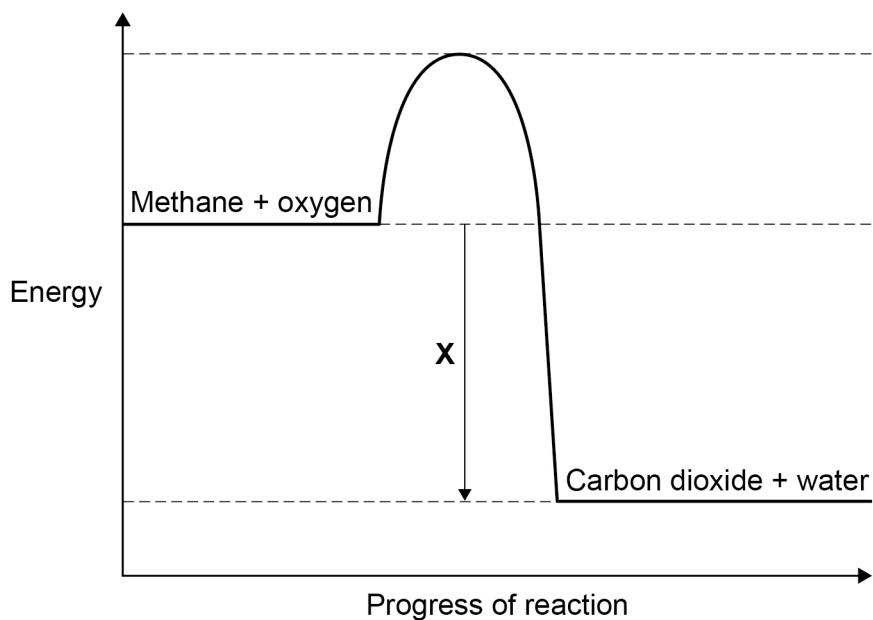
[1 mark]

Turn over ►

Methane (CH_4) is used as a fuel.

Figure 9 shows the energy level diagram for the complete combustion of 1 mole of methane.

Figure 9

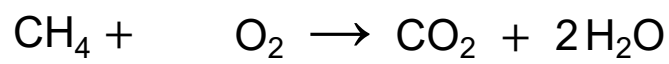


0 8 . 6 What does the energy change labelled **X** on **Figure 9** represent?

[1 mark]

0 8 . 7 Balance the equation for the complete combustion of methane.

[1 mark]



0 8 . 8

During the complete combustion of methane:

- existing bonds are broken
- new bonds are formed.

Explain why the energy change labelled **X** in **Figure 9** has a negative value.

Refer to the energy changes when bonds are broken and formed.

[2 marks]

9

Turn over for the next question

Turn over ►



0 9

A student investigated the thermal decomposition of Group 2 metal carbonates.

The word equation for the reaction is:



This is the method used:

1. Record the mass of an empty boiling tube
2. Add the metal carbonate to the boiling tube and record the total mass
3. Heat the boiling tube and metal carbonate for 3 minutes
4. Allow the boiling tube and contents to cool
5. Record the mass of the boiling tube and contents
6. Repeat steps 3 to 5.

0 9

. 1

Suggest why the student repeated steps 3 to 5 of the method.

[1 mark]

The student calculated the mass of the metal carbonate and the mass of the metal oxide.

Table 5 shows the results.

Table 5

Name of metal carbonate	Formula of metal carbonate	Relative formula mass (M_r) of metal carbonate	Mass of metal carbonate in grams	Mass of metal oxide in grams
Magnesium carbonate	MgCO_3	84	2.1	1.0
Calcium carbonate	CaCO_3	100	2.5	1.4
Strontium carbonate	X	148	3.7	2.6



0 9 . 2 Calculate the number of moles of magnesium carbonate used in the investigation.

Use **Table 5**.

[2 marks]

Number of moles = _____

0 9 . 3 The formula of strontium carbonate is represented by **X** in **Table 5**.

Determine the formula of strontium carbonate.

Use the periodic table.

[1 mark]

0 9 . 4 The word equation for the reaction is:

metal carbonate $\rightarrow$ metal oxide + carbon dioxide

No atoms are lost or made during a chemical reaction.

Determine the mass of carbon dioxide produced during the thermal decomposition of 2.5 g of calcium carbonate.

Use **Table 5**.

[1 mark]

Mass of carbon dioxide = _____ g

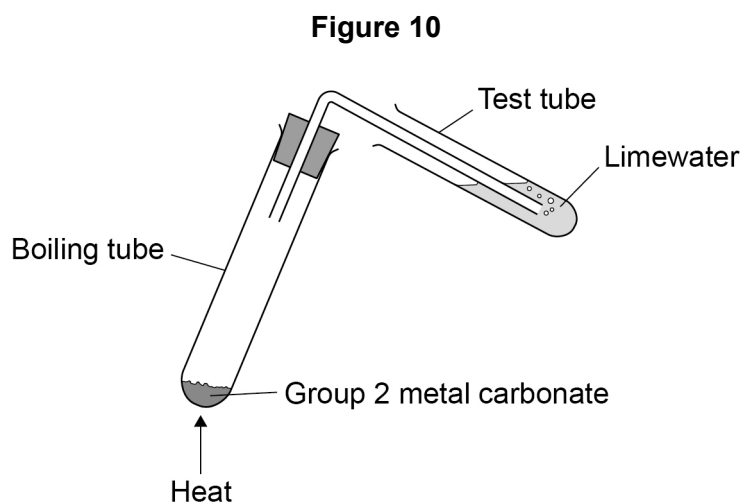
Question 9 continues on the next page

Turn over ►



The student investigated the thermal decomposition of Group 2 metal carbonates using a different method.

Figure 10 shows the apparatus.



0 9 . 5 The test tube in **Figure 10** contains limewater.

Name the compound that is dissolved in water to produce limewater.

[1 mark]

0 9 . 6 Describe the change in the appearance of the limewater during the experiment.

[2 marks]

From _____ to _____



0 9 . 7

Describe how the student could use the apparatus in **Figure 10** to compare how easily each metal carbonate decomposes when heated.

Include any measurements the student should take.

[4 marks]

12

Turn over for the next question

Turn over ►



1 0

This question is about acids, bases and salts.

1 0 . 1

Acids react with bases to produce salts.

What is the name of this type of reaction?

[1 mark]

1 0 . 2Magnesium hydroxide reacts with hydrochloric acid to produce salt **A**.Give the name of salt **A**.**[1 mark]**

1 0 . 3Copper(II) hydroxide reacts with acid **B** to produce copper(II) sulfate.Give the name of acid **B**.**[1 mark]**

1 0 . 4The symbol for a hydroxide ion is OH^-

What is the formula of copper(II) hydroxide?

[1 mark]Tick (✓) **one** box.

CuOH

☐Cu₂OH☐Cu(OH)₂☐Cu₂(OH)₂☐

1 0 . 5 Copper hydroxide is a base but **not** an alkali.

Suggest why copper hydroxide is **not** an alkali.

[1 mark]

1 0 . 6 Hydrochloric acid reacts with sodium hydroxide solution to produce sodium chloride.

Complete the ionic equation for this reaction.

[1 mark]



Question 10 continues on the next page

Turn over ►



A student did a titration.

- burette and stand
- 25.0 cm³ pipette and pipette filler
- conical flask.

- hydrochloric acid
- sodium hydroxide solution
- indicator solution.

[6 marks]

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12

END OF QUESTIONS



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