OCR
Oxford Cambridge and RSA

Accredited

GCSE (9–1) Combined Science (Chemistry) A (Gateway Science)

H

J250/09 Paper 9 (Higher Tier)

Sample Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 10 minutes

You must have:
- the Data Sheet

You may use:
- a scientific or graphical calculator
- a ruler

First name									
Last name									
Centre number						**Candidate number**				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **20** pages. Any blank pages are indicated.

SECTION A

Answer **all** the questions.

You should spend a maximum of 20 minutes on this section.

1 Which of these is the best explanation of what is meant by a strong acid?

A There is a large amount of acid and a small amount of water.

B There is a small amount of acid and a large amount of water.

C The acid is completely ionised in solution in water.

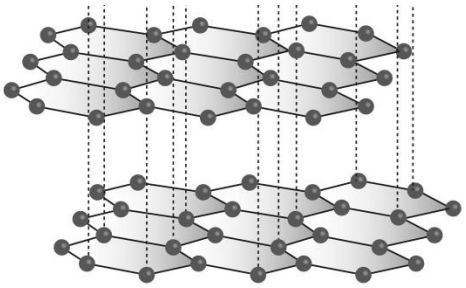
D The acid is partially ionised in solution in water.

Your answer ☐

[1]

2 Look at the diagram.

It shows a structure of carbon.



Which structure of carbon is shown in the diagram?

A diamond

B fullerene

C graphene

D graphite

Your answer ☐

[1]

3 What is the approximate radius of an atom in metres?

A 300×10^{-1}

B 30×10^{-5}

C 3000×10^{-7}

D 3×10^{-13}

Your answer ☐

[1]

4 Hydrogen reacts with fluorine to make hydrogen fluoride.

$$H—H + F—F \rightarrow 2H—F$$

Look at these bond energies.

Bond	Bond energy in kJ/mol
H—H	436
F—F	142
H—F	568

What is the energy change for the reaction between hydrogen and fluorine?

A -558 kJ/mol

B -10 kJ/mol

C +10 kJ/mol

D +558 kJ/mol

Your answer ☐

[1]

5 100 cm^3 of a solution of 1 mol/dm^3 sodium hydroxide is added to 100 cm^3 of a solution of 1 mol/dm^3 hydrochloric acid.

The maximum rise in temperature recorded was T_1.

The experiment is repeated with 50 cm^3 of each solution.

The maximum rise in temperature recorded was T_2.

Which of these statements about temperatures T_1 and T_2 is true?

A T_1 is equal to T_2

B T_1 is half the value of T_2

C T_2 is half the value of T_1

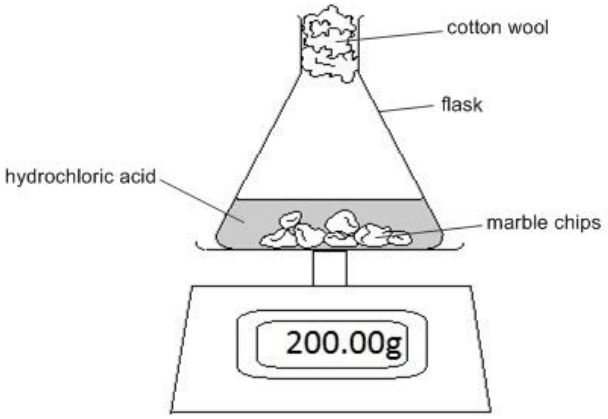
D T_2 is a quarter the value of T_1

Your answer ☐

[1]

6 Look at the diagram.

It shows how the reaction between hydrochloric acid and marble chips (calcium carbonate) can be monitored.



The reading on the balance **decreases** during the reaction.

Which of these statements is the **best** explanation?

A Acid escapes from the flask.

B A gas called hydrogen is made which leaves the flask.

C A gas called carbon dioxide is made which leaves the flask.

D The temperature in the laboratory changes.

Your answer ☐

[1]

7 A solution of lead nitrate, $Pb(NO_3)_2(aq)$ has a concentration of 66.2 g/dm^3.

The relative formula mass, M_r, of lead(II) nitrate is 331.

What is the concentration, in mol/dm^3, of this solution?

A 2.0×10^{-4} mol/dm^3

B 2.0×10^{-2} mol/dm^3

C 2.0×10^{-1} mol/dm^3

D 5.0×10^{-1} mol/dm^3

Your answer ☐

[1]

8 Which row in the table shows the correct results for an ionic compound?

	Solid compound	**Compound dissolved in water**	**Molten compound**
A	conducts	does not conduct	conducts
B	conducts	conducts	conducts
C	conducts	conducts	does not conduct
D	does not conduct	conducts	conducts

Your answer ☐

[1]

9 The empirical formula of a compound **Y** is CH_2O.

Compound **Y** has a relative formula mass of 90.

What is the molecular formula of compound **Y**?

A $C_2H_2O_4$

B $C_3H_6O_3$

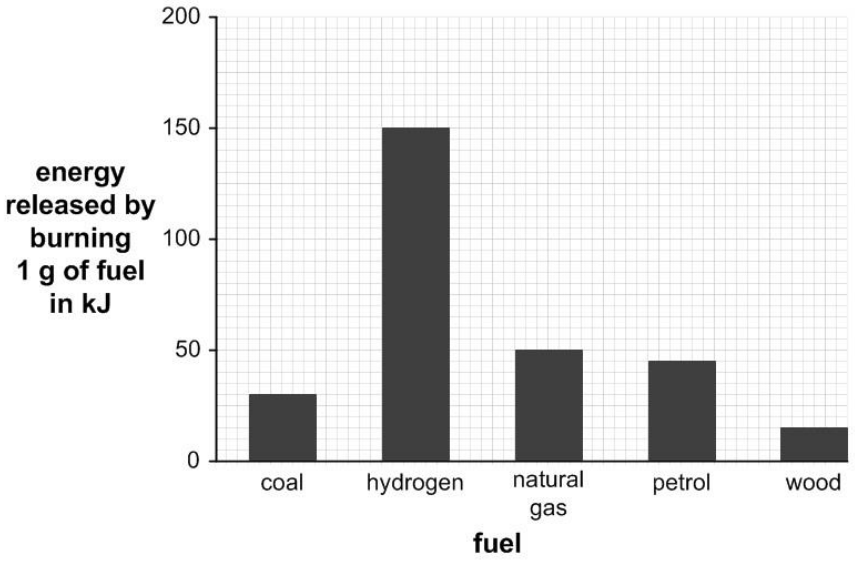
C $C_4H_{10}O_2$

D $C_6H_{12}O_6$

Your answer ☐

[1]

10 The bar chart shows the amount of energy released when 1.0 g of each fuel is completely combusted.



What mass of natural gas is needed to release the same amount of energy as 1.0 g of hydrogen?

A 3.0 g

B 3.3 g

C 6.0 g

D 10.0 g

Your answer ☐

[1]

SECTION B

Answer **all** the questions.

11 Look at the table of data.

Material	Strength (arbitrary units)	Resistance to corrosion	Density (g/cm^3)	Electrical conductivity	Cost (£ per tonne)
Aluminium	222	Good	2.8	Very good	750
Titanium alloy	850	Good	4.4	Good	8000
Carbon-fibre-reinforced-polymer	2457	Good	1.5	Very good	10000
Steel	254	Poor	7.8	Good	65
PVC	69	Good	1.3	Poor	490

(a)* A chair manufacturer is making a garden chair.

The manufacturer needs to decide which material to use to make the chair.

Some of the materials are metals and some are polymers.

Describe and compare the bonding of the materials in the table and suggest which of them would be best for making the chair, giving reasons for your answer.

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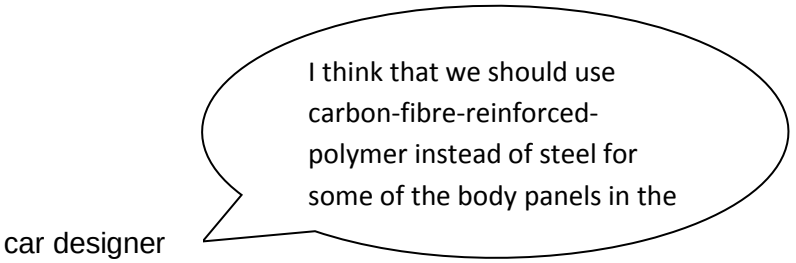
…… **[6]**

(b) A car designer is discussing the material to use in a new car.



Discuss the arguments for and against the use of carbon-fibre-reinforced-polymer instead of steel for car body panels.

Use information from the table.

……

……

……

……

…… **[3]**

(c) Power companies use aluminium wire for over-head power cables.

What are the **two** most important properties of aluminium for this use?

Use information from the table.

……

……

…… **[2]**

(d) Some of the materials are alloys.

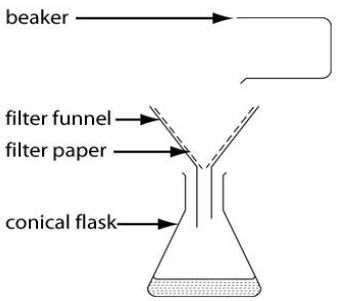
What is an alloy?

……

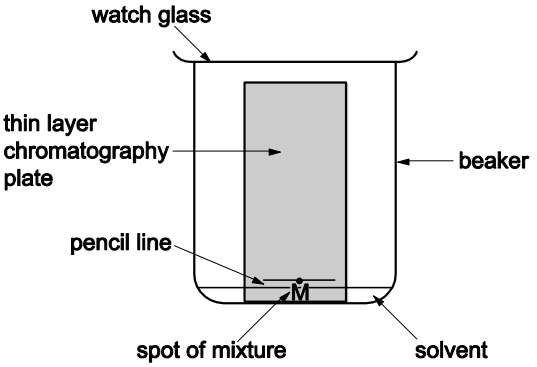
…… **[1]**

12 Look at the diagrams.

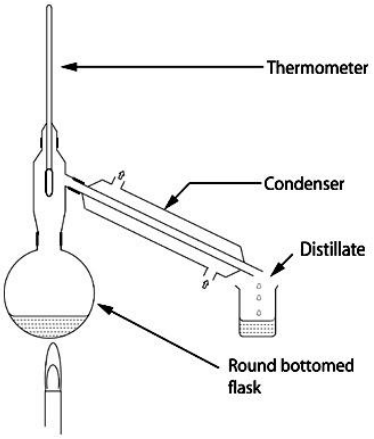
They are not to the same scale.



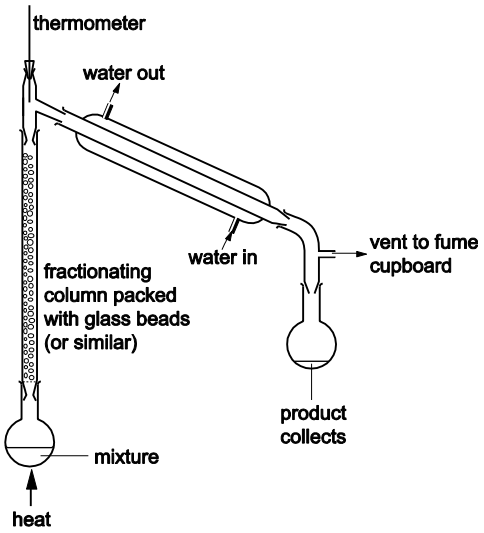
A



B



C



D

(a) Write down the name of the separating technique used in diagram **D**?

…… **[1]**

(b) Lead nitrate solution is added to sodium sulfate solution.

A white precipitate is formed.

Explain how a pure sample of the precipitate can be separated from the mixture.

Refer to one of the diagrams in your answer.

……

……

…… **[3]**

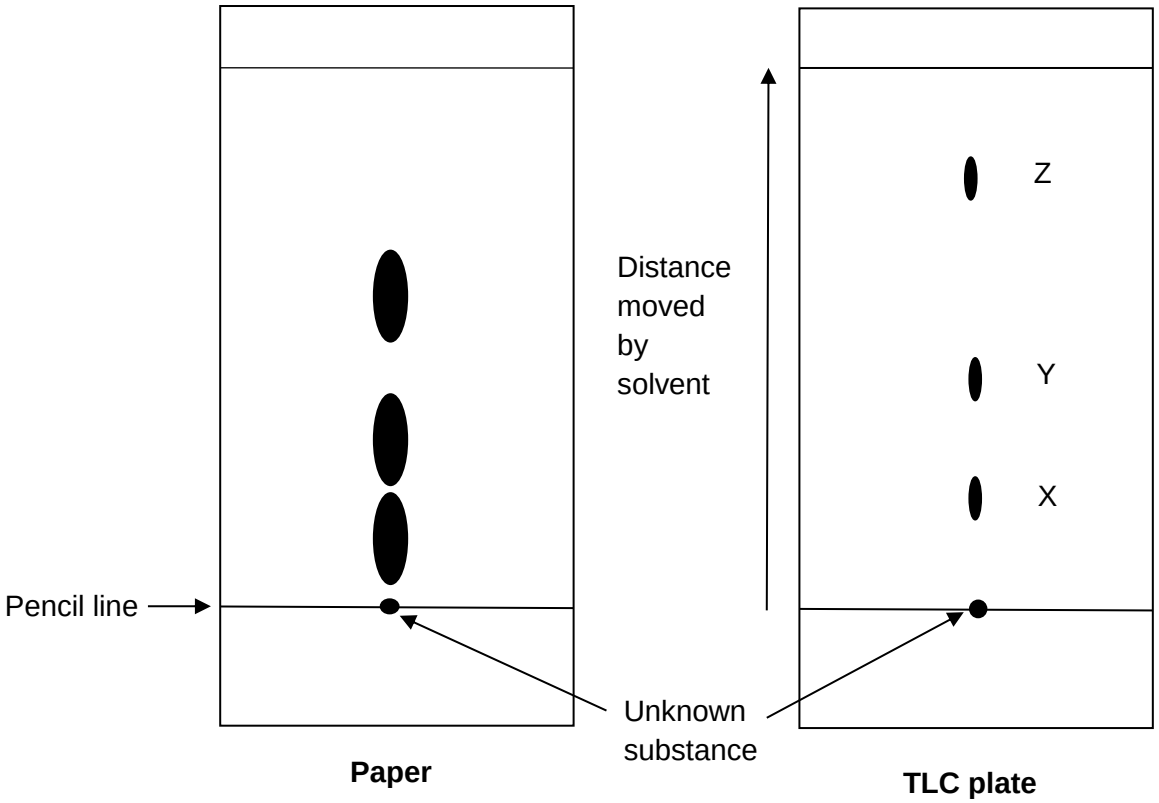
(c) Two scientists investigate an unknown substance.

One scientist uses apparatus **B**.

Another scientist uses the same apparatus but uses a thin layer chromatography (TLC) plate instead of paper.

They put an unknown substance on the centre of the pencil line.

Look at the results.



(i) Use the thin layer chromatogram to work out the R_f value for substance **Y**.

……

……

R_f value =…… **[2]**

(ii) Suggest **two** reasons why TLC might be better than paper.

……

……

……

……

…….. **[2]**

13 This question is about making copper.

(a) Copper is made using a displacement reaction.

Magnesium is added to copper sulfate solution, $CuSO_4$.

Copper and magnesium sulfate solution, $MgSO_4$, are made.

Write a balanced symbol equation for this reaction.

……..... **[1]**

(b) **(i)** In the reaction, magnesium atoms become magnesium ions, Mg^{2+}, and copper ions, Cu^{2+}, become copper atoms.

Write a **balanced ionic equation** for this reaction.

…….. **[2]**

(ii) Write a **balanced half equation** to show what happens to magnesium in this reaction.

Use e^- to represent an electron.

…….. **[2]**

(c) Explain why this displacement reaction is also a reduction/oxidation reaction.

Use ideas about electrons in your answer.

……

……

……

…….. **[3]**

14 **(a)** The mass number of an element is 23.

The atomic number of the same element is 11.

(i) How many protons and how many neutrons are there in an atom of this element?

Number of protons:.....

Number of neutrons:..... **[2]**

(ii) This element forms an **ion** with a charge of +1.

Work out the number of electrons in an **ion** of this element.

Number of electrons:..... **[1]**

(b) Another element has an atomic number of 17.

Calculate the mean mass of an atom of this element. Quote your answer to **three** significant figures.

(The Avogadro constant is 6.022×10^{23} atoms / mol.)

mean mass……g **[2]**

(c) Element **Z** has the electronic structure 2.8.8.1.

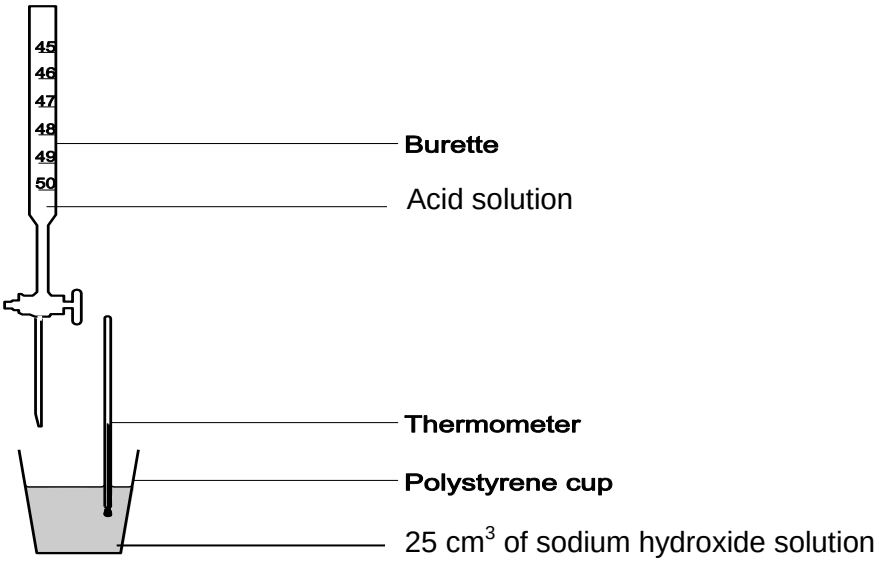
Explain how you can tell that the element is potassium.

……

…… **[1]**

15 A scientist investigates an acid solution.

Look at the diagram of the apparatus the scientist uses.



(a) **(i)** The scientist adds universal indicator to the sodium hydroxide solution.

What colour is the universal indicator in the sodium hydroxide solution?

……. **[1]**

(ii) Universal indicator is a mixed indicator.

Name a single indicator.

…… **[1]**

(b) The scientist adds acid in 5 cm^3 portions to the sodium hydroxide solution.

After each addition, the scientist measures the temperature of the reaction mixture.

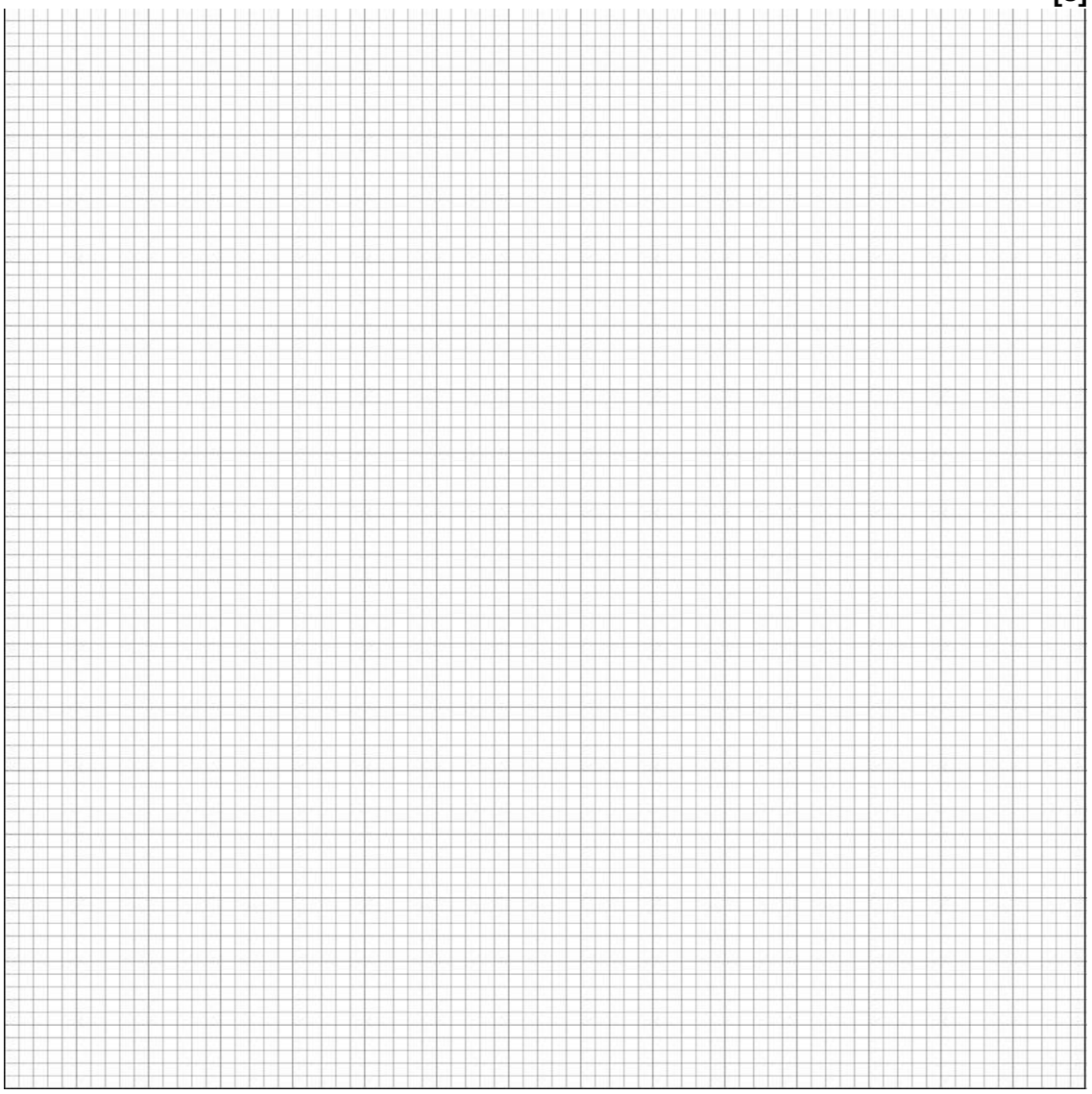
Look at the table of results. One of the results is anomalous.

Volume of acid added in cm^3	Temperature in °C
0	23
5	27
10	35
15	41
20	44
25	43
30	42
35	37
40	33
45	36
50	28

(i) Plot these results on the grid provided. Draw two intersecting lines of best fit:

- One line shows the temperature increasing
- One line shows the temperature decreasing

[3]



(ii) What volume of acid is needed to just neutralise 25cm^3 of sodium hydroxide solution in this investigation.

volume of acid……..cm^3 **[1]**

(iii) Write the ionic equation of the neutralisation of an acid with an alkali.

…….. **[1]**

(iv) How could you improve the results from this investigation?

……

……

…….. **[2]**

16 Magnesium sulfate crystals can be used as bath salts. They are made in a laboratory by reacting magnesium carbonate with sulfuric acid.

This can be shown in the equation below.

$$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + \mathbf{A} + H_2O$$

(a) **(i)** What is represented in the equation above as **A**?

A …… **[1]**

(ii) Give the test for this substance.

……

…… **[1]**

(b) What is the maximum mass of magnesium sulfate which could be formed when 6.72 g of magnesium carbonate is reacted with sulfuric acid?

mass of magnesium sulfate ……. **[5]**

END OF QUESTION PAPER

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OCR
Oxford Cambridge and RSA

…day June 20XX – Morning/Afternoon

GCSE (9–1) Combined Science (Chemistry) A (Gateway Science)
J250/09 Paper 9 (Higher Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 10 minutes

MAXIMUM MARK 60

DRAFT

This document consists of 16 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:
   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)
   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:
Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.
The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.
The communication statement determines the mark within a level.

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9–1) in Combined Science A (Gateway Science):

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

SECTION A

Question	Answer	Marks	AO element	Guidance
1	C	**1**	**1.2**	
2	D	**1**	**1.1**	
3	C	**1**	**1.1**	
4	A	**1**	**2.1**	
5	A	**1**	**2.2**	
6	C	**1**	**1.2**	
7	C	**1**	**2.1**	
8	D	**1**	**1.1**	
9	B	**1**	**2.1**	
10	A	**1**	**2.2**	

SECTION B

Question			Answer	Marks	AO element	Guidance
11	(a)*		*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** **Describes the bonding of both materials** **AND** **Makes a comparison** **AND** **Makes a choice with a justified reason** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** **Describes the bonding of both materials** **OR** **Describes the structure of one material AND** **makes a choice with a justified reason** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1(1–2 marks)** **Describes the bonding of one material** **OR** **makes a choice with a justified reason** *The information is basic and communicated in an unstructured*	**6**	**1.1 x 3** **3.2a x 3**	**AO1.1: Knowledge of bonding in metals and polymers** Bonding in polymers: • Covalent bonds in molecule/Macromolecule. • Weak intermolecular forces. • Some have cross linkages. Bonding in metals: • Cationic lattice. • Free/mobile pool of electrons. Comparison • Polymers are weaker because intermolecular forces are weaker than metallic bonds. • Metals conduct electricity because of free electrons. **AO3.2a: Analyse information in the table to make judgements** • Not carbon-fibre-reinforced-polymer – too expensive. • Aluminium – strong, corrosion resistant, low density so easy to carry but quite expensive. • Steel – strong, cheap but higher density so heavy to carry, corrodes/rusts but can be painted to make look better and

Question			Answer	Marks	AO element	Guidance
			way. The information is supported by limited evidence and the relationship to the evidence may not be clear. **0 marks** *No response or no response worthy of credit.*			resist corrosion. • PVC – corrosion resistant, low density means cost per chair is low, easy to carry, easy to shape, may not be strong enough. • Titanium - strong, corrosion resistant, fairly low density but very expensive.
	(b)		*Against* Carbon-fibre-reinforced-polymer very expensive (so only used in luxury cars) (1) *For* **Any two from** Carbon-fibre-reinforced-polymer stronger than steel/ORA (1) Carbon-fibre-reinforced-polymer lower density/ORA (1) Carbon-fibre-reinforced-polymer has better corrosion resistance/ORA (1)	**3**	**3.1b x 3**	Must have an argument for and against for full marks. **ALLOW** carbon-fibre-reinforced-polymer would be no good for crumple zones **ALLOW** carbon-fibre-reinforced-polymer's lower density will result in better fuel economy
	(c)		Conduction of electricity (1) Low density/corrosion resistance (1)	**2**	**3.2b x 2**	
	(d)		Mixture of a metal and other element(s)/mixture of two or more metals (1)	**1**	**1.1**	

Question			Answer	Marks	AO element	Guidance
12	(a)		Fractional distillation	1	1.2	**DO NOT ALLOW** distillation
	(b)		(Use apparatus A) Filter / pour the mixture in the funnel, liquid runs through into conical flask (1) Wash precipitate with distilled water (1) Dry the precipitate (1)	3	1.2	**ALLOW** AW throughout
	(c)	(i)	Distance moved by spot = 29 mm +/- 2 mm **AND** distance moved by solvent = 69 mm +/- 2 mm (1) R_f = 29÷ 69 = 0.42 (1)	2	1.2	Both distances correct for first mark **ECF** for R_f value **ALLOW** values between 0.38 – 0.46
		(ii)	**Any two from** Takes less time to separate/solvent moves faster (1) Spots are more distinct/better separated (1) The solvent moves more evenly (1)	2	2.2	

Question			Answer	Marks	AO element	Guidance
13	(a)		$Mg + CuSO_4 \longrightarrow Cu + MgSO_4$ (1)	1	2.1	
	(b)	(i)	$Mg + Cu^{2+} \longrightarrow Mg^{2+} + Cu$ (2)	2	2.2	**ALLOW** $Mg + Cu^{2+}$ (1) (reactants) **ALLOW** $Mg^{2+} + Cu$ (1) (products)
		(ii)	$Mg \longrightarrow Mg^{2+} + 2e^-$ / $Mg - 2e^- \longrightarrow Mg^{2+}$ (2)	2	2.2	**ALLOW** $Mg \longrightarrow Mg^{2+}$ (1)
		(c)	Mg loses electrons/Cu gains electrons (1) Mg is oxidised (1) Cu ions are reduced(1)	3	2.1	**ALLOW** oxidation is loss of electrons and reduction is gain of electrons (1)

Question			Answer	Marks	AO element	Guidance
14	(a)	(i)	Protons = 11 (1) Neutrons = 12 (1)	2	1.1	
		(ii)	10	1	1.1	**ECF** number of electrons/protons minus 1 (1)
	(b)		$35.5 / 6.022 \times 10^{23}$ (1) 5.90×10^{-23} (g) (1)	2	2.1	1 mark for $5.8950514 \times 10^{-23}$ or correctly rounded but not to 3 sig. fig.
	(c)		(add up number of electrons) and this is the atomic number (and look up on periodic table) (1)	1	1.1	**ALLOW** has 19 electrons and on the Periodic Table, element number 19 is potassium **ALLOW** element is in Group 1 and Period 4 **DO NOT ALLOW** it has 19 electrons on its own

Question			Answer	Marks	AO element	Guidance
15	(a)	(i)	Blue/indigo/violet/purple (1)	1	1.2	
		(ii)	Litmus / phenolphthalein / methyl orange (1)	1	1.2	
	(b)	(i)	Correct labelled axes with appropriate scale so that the graph occupies at least ½ of grid provided (1) Correct plotting of all points to within ½ square (1) Two lines of best fit ignoring anomalous result (1)	3	2.2 2.2 3.2a	
		(ii)	21.5 cm^3 (1)	1	3.2b	**ALLOW** 21 – 22 cm^3
		(iii)	$H^+ + OH^- \longrightarrow H_2O$	1	1.1	
		(iv)	**Any 2 from** Measure to higher precision/measure to 1dp (1) Reduce heat loss/put lid on polystyrene cup (1) Add acid in smaller portions / use a temperature probe while adding acid continuously (1)	2	3.3b	**DO NOT ALLOW** use digital thermometer unless linked to precision

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	Carbon dioxide (1)	1	1.1	
		(ii)	Turns limewater milky (1)	1	1.2	**DO NOT ALLOW ECF** Only award the mark if answer to Q16 a(i) is correct.
	(b)		Relative formula mass of $MgCO_3$ = 84.3 (1) Amount of $MgCO_3$ 6.72 ÷ 84.3 = 0.0797 (1) Ratio is 1:1 so amount of $MgSO_4$ is also 0.0797 (1) Relative formula mass of $MgSO_4$ = 120.4 (1) Mass of $MgSO_4$ = 0.0797 × 120.4 = 9.6 g (1)	5	2.2	**ALLOW** 0.08 **ALLOW** 9.5977 or 9.632

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