

**GCSE (9–1) Combined Science
(Chemistry) A (Gateway Science)
J250/03 Paper 3 (Foundation Tier)
Sample Question Paper**

F

Date – Morning/Afternoon

Time allowed: 1 hour 10 minutes

Version 2

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 What is the name of a reaction that releases heat energy into the surroundings?

A Endothermic
B Exothermic
C Oxidation
D Reduction

Your answer

[1]

- 2 A student investigates the combustion of four liquid fuels.

She uses 1.0 g of each fuel.

Look at her results.

	Fuel	Temperature of water (°C)	
		before heating	after heating
A	Butanol	21	41
B	Ethanol	21	39
C	Methanol	15	37
D	Propanol	22	43

Which fuel releases the **most** energy into the water?

Your answer

[1]

- 3 What is the relative formula mass of calcium hydroxide, $\text{Ca}(\text{OH})_2$?

Use the Periodic Table to help you.

A 57.1
B 58.1
C 74.1
D 114.2

Your answer

[1]

- 4 The symbol for carbon is C.

The symbol for hydrogen is H.

A molecule of a compound contains one carbon atom and four hydrogen atoms.

What is the formula of the compound?

A CH_4

B CH^4

C C_4H

D C^4H

Your answer

☐

[1]

- 5 Which statement shows that lead is a metal?

A It is a dull grey colour.

B It is in Group 4 of the Periodic Table.

C It is in Period 6 of the Periodic Table.

D It is malleable and so can be easily shaped.

Your answer

☐

[1]

- 6 What is the best technique for separating pure water from a solution of sodium chloride in water?

A Crystallisation

B Chromatography

C Distillation

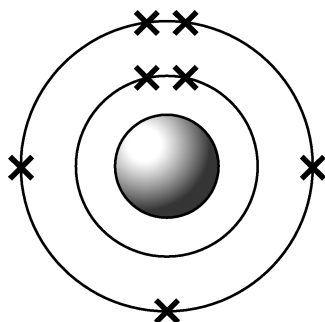
D Filtration

Your answer

☐

[1]

- 7 Look at the diagram of an atom of an element.



What is the position of this element in the Periodic Table?

- A It is in Group 5.
- B It is in Group 7.
- C It is in Period 5.
- D It is in Period 7.

Your answer ☐

[1]

- 8 The **molecular formula** of benzene is C_6H_6 .

What is the **empirical formula** of benzene?

- A CH
- B C_2H_2
- C C_3H_3
- D C_6H_6

Your answer ☐

[1]

- 9 The table shows the indicator colour and pH of four different solutions of the same concentration.

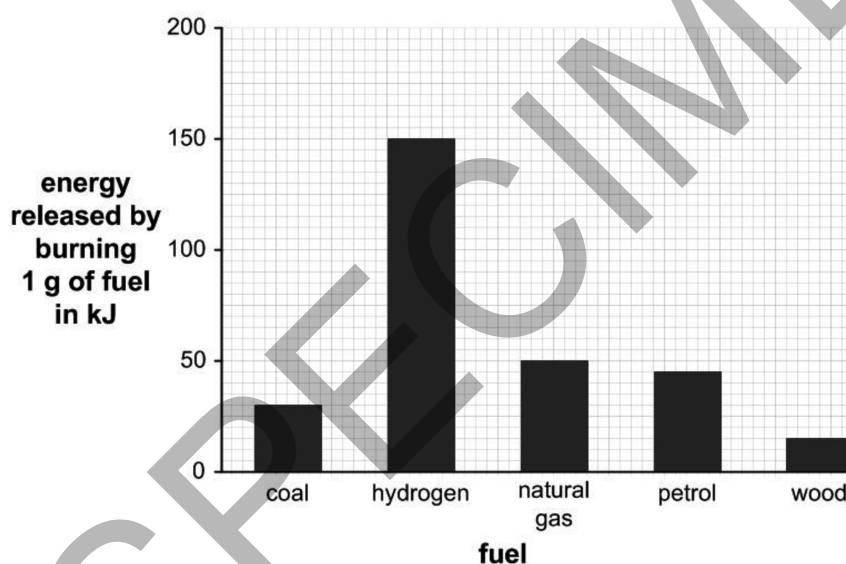
Solution	Colour of universal indicator	pH
A	blue-green	10
B	deep-blue	13
C	orange	5
D	red	1

Which solution is a weak acid?

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

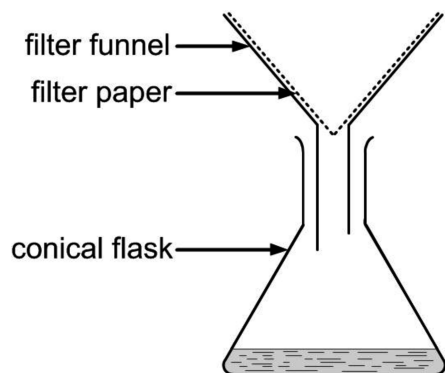
[1]

SECTION B

Answer **all** the questions.

- 11 This question is about different methods for separating components in mixtures.

(a) Look at the diagram.



The equipment shown in the diagram can be used to separate a mixture of sand and water but **cannot** be used to separate salt from a solution in water.

Explain why.

.....

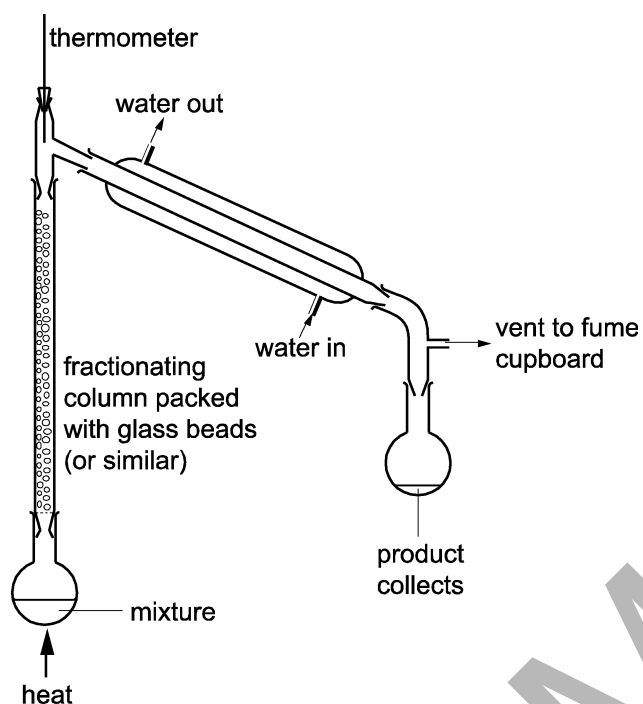
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.....

..... [2]

(b) Look at the diagram.

It shows equipment used for fractional distillation.



Crude oil is a mixture of liquids.

Explain how the equipment shown in the diagram can be used to separate these liquids.

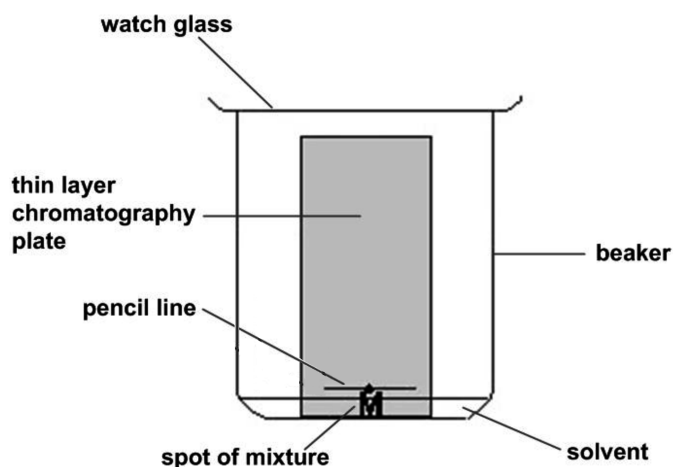
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..... [3]

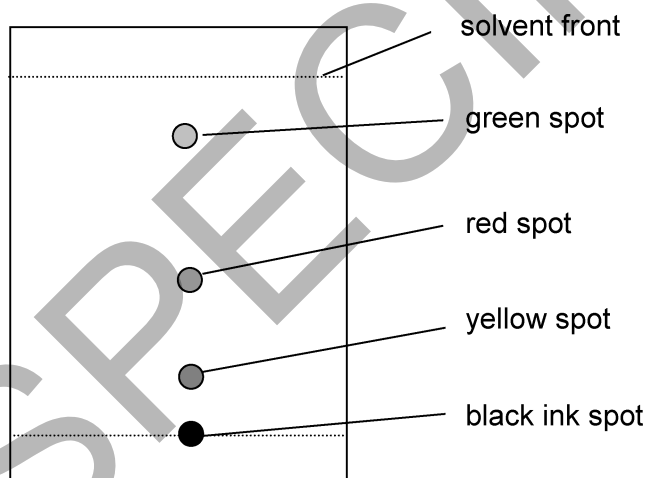
(c) Look at the diagram of thin layer chromatography.



- (i) The pencil line with the spot of mixture is above the level of solvent.
Why is this important?

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

- (ii) Look at the diagram.



What is the R_f value of the green spot?

Use a ruler to help you.

Answer = [2]

TURN OVER FOR THE NEXT QUESTION

SPECIMEN

- 12 (a) Aluminium, Al , is heated with copper oxide, CuO .

Aluminium oxide, Al_2O_3 , and copper are made.

In this reaction, oxidation and reduction take place.

- (i) Write a **balanced symbol** equation for this reaction.

..... [2]

- (ii) What are oxidation and reduction?

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

- (iii) Which substance is reduced in this reaction?

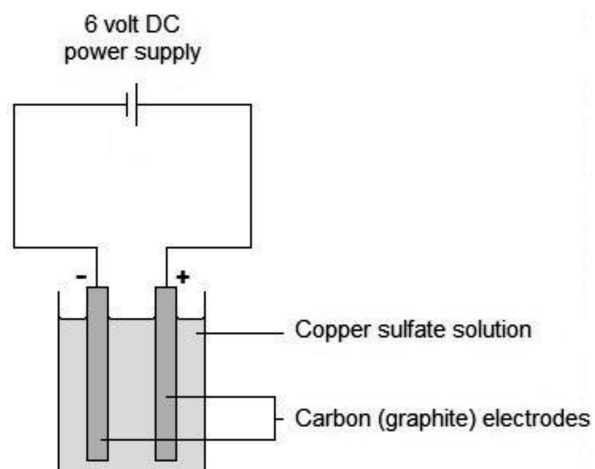
..... [1]

- (iv) Which substance is oxidised in this reaction?

..... [1]

(b) Copper is also made by electrolysis of copper sulfate solution.

Look at the diagram of the apparatus used in this electrolysis.



(i) Describe what you would see at the cathode (negative electrode).

..... [1]

(ii) Molten copper chloride is electrolysed instead of copper sulfate solution.

Copper is made.

Predict the **name** of the other substance that is made.

..... [1]

13 A student investigates a neutralisation reaction.

(a) Complete the general word equation for a neutralisation reaction.

Acid + **Alkali** → + [2]

- (b) • The student measures 25 cm³ of acid using a beaker.
- She measures the temperature of this acid.
 - She then adds 5 cm³ of alkali to the acid in the beaker.
 - She records the maximum temperature obtained.

She repeats the experiments four more times using different volumes of alkali.

She repeats each test twice.

Look at the table of her results.

Volume of alkali (cm ³)	Temperature change (°C)			Mean temperature change (°C)
	Test 1	Test 2	Test 3	
0	0	0	0	
5	9	8	9	
10	10	11	12	
15	14	13	14
20	18	17	17	
25	23	23	24	

- (i) Calculate the mean temperature change for 15 cm³ of alkali and write it in the space in the table.

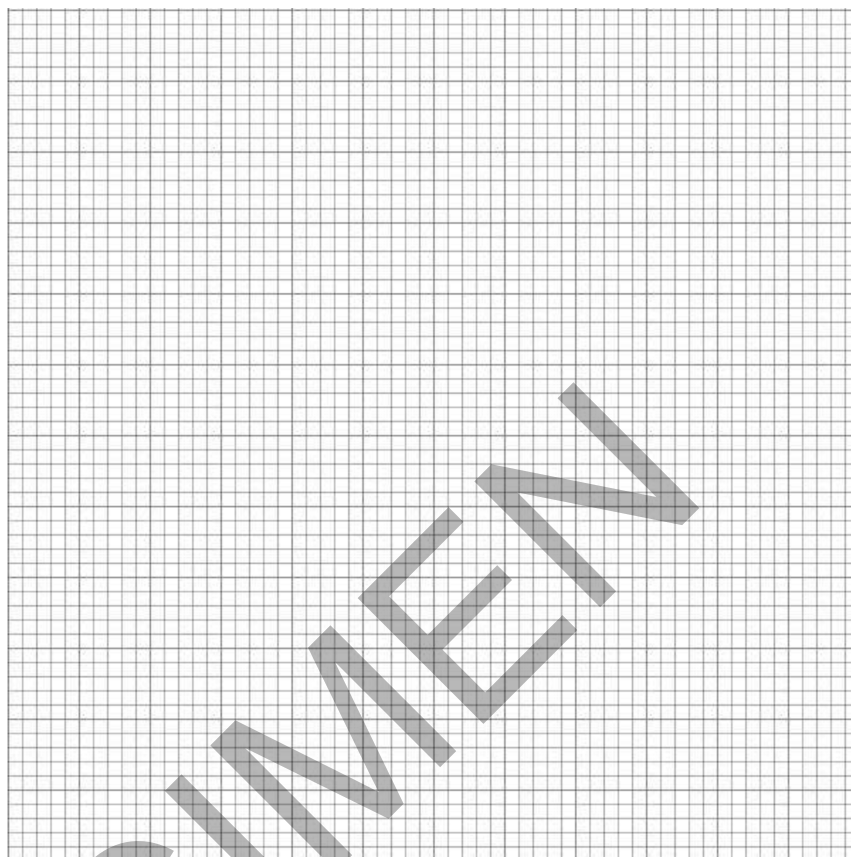
Give your answer to **one** decimal place.

[2]

(ii) Plot the results from **Test 1** on the grid provided.

[2]

temperature
change
(°C)



volume of alkali (cm³)

(iii) One of the points is anomalous.

Which one?

Explain how you can tell from your graph.

.....

.....

.....

[2]

(iv) Draw a line of best fit on your graph.

[1]

- (c) Her friend finds the expected temperature changes in a book.

He tells her that **all** of her temperature changes are lower than expected.

Suggest **one** improvement to her experiment and how this makes the experiment better.

.....

.....

.....

..... [2]

- (d) She wonders how the pH of the acid changes after she has added alkali to the acid.

- (i) Describe what she needs to do in her experiment to find the pH change at the end of the experiment.

.....

.....

..... [1]

- (ii) The acid and alkali react in a 1:1 ratio and have the same concentration.

What would she expect the pH to be when she has added 25 cm³ of alkali?

..... [1]

- 14 (a) Look at the information about an atom of an element.

Number of neutrons	8
Number of protons	7
Number of electrons	7

- (i) What is the mass number of the atom?

..... [1]

- (ii) What is the name of the element?

Use the Periodic Table to help you work out the answer.

..... [1]

- (b) Ethanol has the formula $\text{C}_2\text{H}_5\text{OH}$.

Show that the relative formula mass, M_r , of ethanol is 46.0.

The relative atomic mass, A_r , of C is 12.0, of H is 1.0 and of O is 16.0.

[2]

15

A scientist sees that bubbles of gas are made when he pours hydrochloric acid on to pieces of marble.

- (a) The scientist thinks that the gas produced is carbon dioxide.

Describe a test to prove this and include the result of the test.

.....

 [2]

- (b) The scientist suggests an equation for the reaction between hydrochloric acid and marble.



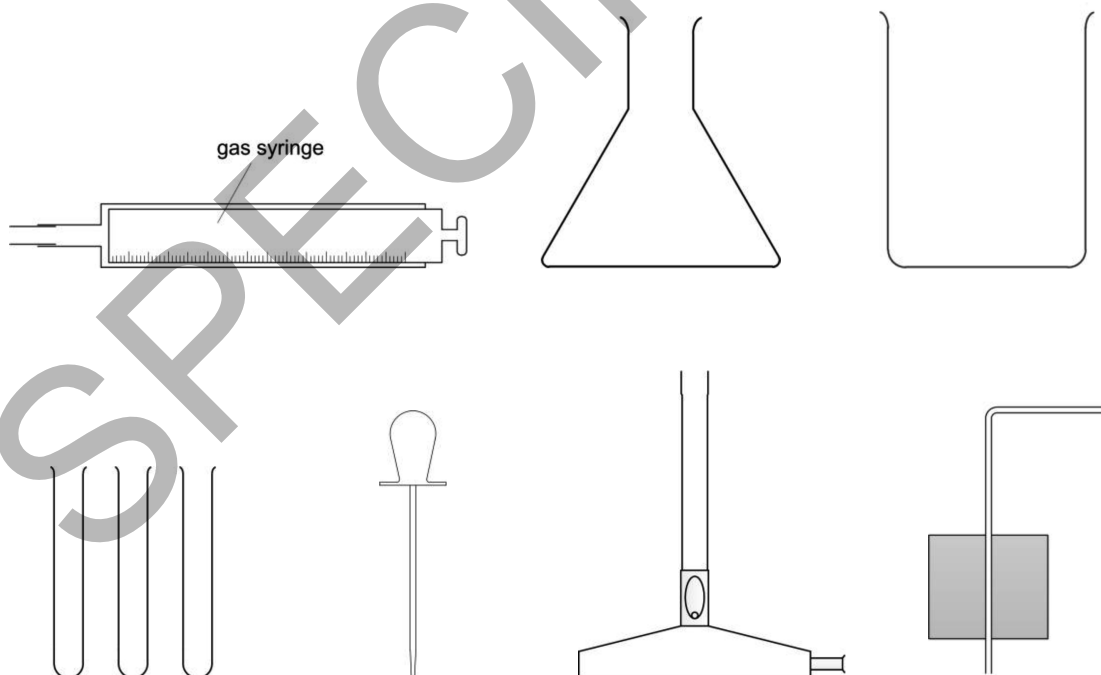
Balance the symbol equation by putting numbers in front of formulae.

Put numbers in front of some or all of the formulae.

[1]

- (c) The scientist wants to collect the gas.

He chooses **some** of the equipment shown in the diagrams.



Describe how he would collect 50 cm³ of the gas from this reaction.

Choose equipment from the diagrams.

You may not need all of the equipment.

Draw a diagram of the assembled apparatus as part of your answer.

SPECIMEN

.....

.....

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.....

.....

[3]

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

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.

SPEC

[6]

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

I think that we should use carbon-fibre-reinforced-polymer instead of steel for some of the body panels in the car.

car designer

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]

END OF QUESTION PAPER

SPECIMEN

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...day June 20XX – Morning/Afternoon

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

J250/03 Paper 3 (Foundation Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 10 minutes

MAXIMUM MARK 60

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:
- where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - 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	B	1	1.1	
2	C	1	2.2	
3	C	1	1.2	
4	A	1	1.1	
5	D	1	2.1	
6	C	1	1.2	
7	A	1	2.1	
8	A	1	2.1	
9	C	1	2.1	
10	A	1	2.2	

SECTION B

Question			Answer	Marks	AO element	Guidance
11	(a)		Sand remains in the filter paper (1) Salt is soluble/passes through the filter paper (1)	2	1.2 1.2	ALLOW because sand is insoluble so remains in the filter paper and salt is soluble so passes through the filter paper (2)
	(b)		Any three from Idea that compounds boil/vaporise (1) Idea that glass beads increase surface area (to improve separation) (1) Idea of temperature gradient in column/cooler at top of column (1) Idea of different boiling points (1) Idea of condensing of gas back to liquid in condenser (1)	3	1.2	
	(c)	(i)	Prevent spot being washed away/dissolving in solvent/spreading across whole of paper / AW (1)	1	2.1	
		(ii)	$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}} = \frac{38 (.0 \text{ mm})}{45.5 (\text{mm})}$ (1) $R_f = 0.84$ (1)	2	1.1 2.1	ALLOW distance moved by substance 37 – 39 mm ALLOW distance moved by solvent 45 – 46 mm ALLOW $R_f = 0.81 – 0.87$

Question			Answer	Marks	AO element	Guidance
12	(a)	(i)	$2\text{Al} + 3\text{CuO} \longrightarrow \text{Al}_2\text{O}_3 + 3\text{Cu}$ Correct formulae (1) Balancing (1)	2	2.1 2.2	
		(ii)	Oxidation is gain of oxygen and reduction is loss of oxygen (1)	1	1.1	ALLOW oxidation is loss of electrons and reduction is gain of electrons (1) Oxidation and reduction both needed for (1)
		(iii)	Copper oxide / CuO (1)	1	2.1	
		(iv)	Aluminium / Al (1)	1	2.1	
	(b)	(i)	Brown/salmon pink solid/deposit/copper appearing / AW (1)	1	1.2	
		(ii)	Chlorine (1)	1	2.1	ALLOW Cl ₂

Question			Answer	Marks	AO element	Guidance
13	(a)		<u>Salt</u> (1) <u>Water</u> (1)	2	1.1 1.1	Either order
	(b)	(i)	$(14 + 13 + 14) = 41 \div 3$ (1) 13.7 (1)	2	1.2	
		(ii)	With appropriate scale so that the graph occupies at least $\frac{1}{2}$ of grid provided (1) Correct plotting of all points to within $\frac{1}{2}$ square (1)	2	2.2	
		(iii)	Result at $5\text{cm}^3/9^\circ\text{C}$ (1) because it does not fit the pattern/the temperature change is too high (1)	2	3.2a	
		(iv)	Line of best fit ignoring anomalous result (1)	1	2.2	
	(c)		Any improvement AND linked reason Insulate beaker/use polystyrene beaker/put a lid on the beaker (1) To reduce heat loss (1) Stir mixture (1) To ensure an even temperature (1) Make sure temperature reached is the maximum (1) To ensure reaction is complete/AW (1) Use a measuring cylinder/pipette/burette to measure the volume (1) To reduce error/uncertainty in measuring the volume (1)	2	3.3b	ALLOW make sure alkali and acid at same temperature (1) to ensure no heating or cooling effect at the start (1)

Question			Answer	Marks	AO element	Guidance
	(d)	(i)	Add universal indicator to acid then record colour change when mixed with alkali (1) OR Place pH probe into acid and record value then mix with alkali, place in pH probe and record new value (1)	1	2.2	ALLOW add universal indicator and note the colour change ALLOW place probe into mixture and read off value
		(ii)	(pH) 7 (1)	1	2.2	

Question			Answer	Marks	AO element	Guidance
14	(a)	(i)	15 (1)	1	1.1	
		(ii)	Nitrogen (1)	1	1.1	
	(b)		(2 x 12.0) + (6 x 1.0) + (1 x 16.0) Correct use of number of atoms (1) Correct use of A_r (1)	2	2.1	

Question			Answer	Marks	AO element	Guidance
15	(a)		Add limewater (1) Turns milky/white precipitate (1)	2	1.2	
	(b)		2 in front of HCl (1)	1	2.1	DO NOT ALLOW if any number in front of other formulae
	(c)		1. Suitable choice of equipment including gas syringe (1) 2. Correct assembly of equipment to make it gas tight (1) Description includes 3. Bung attached quickly to prevent gas loss/gas may escape at the start/ the need to add acid quickly (1)	3	2.2	MP1 and MP2 can be obtained from diagram and/or description

Question	Answer	Marks	AO element	Guidance
16 (a)*	<p><i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i></p> <p>Level 3 (5–6 marks) Describes the bonding of both materials AND Makes a comparison AND Makes a choice with justified reasons.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) Describes the bonding of both materials OR Describes the structure of one material AND makes a choice with justified reasons.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1(1–2 marks) Describes the bonding of one material OR makes a choice with justified reasons.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p>	6	1.1 x 3 3.2a x 3	<p>AO1.1: Knowledge of bonding in metals and polymers</p> <p>Bonding in polymers:</p> <ul style="list-style-type: none"> • Covalent bonds in molecule/Macromolecule. • Weak intermolecular forces. • Some have cross linkages. <p>Bonding in metals:</p> <ul style="list-style-type: none"> • Cationic lattice. • Free/mobile pool of electrons. <p>Comparison</p> <ul style="list-style-type: none"> • Polymers are weaker because intermolecular forces are weaker than metallic bonds. • Metals conduct electricity because of free electrons. <p>AO3.2a: Analyse information in the table to make judgements</p> <ul style="list-style-type: none"> • 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 resist corrosion.

Question			Answer	Marks	AO element	Guidance
			0 marks <i>No response or no response worthy of credit.</i>			<ul style="list-style-type: none"> 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)		<i>Against</i> Carbon-fibre-reinforced-polymer very expensive (so only used in luxury cars) (1) <i>For</i> Any two from Carbon-fibre-reinforced-polymer stronger than steel/OR A (1) Carbon-fibre-reinforced-polymer lower density/OR A (1) Carbon-fibre-reinforced-polymer has better corrosion resistance/OR A (1)	3	3.1b	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	
	(d)		Mixture of a metal and other element(s)/mixture of two or more metals (1)	1	1.1	

Summary of updates

Date	Version	Change
May 2018	2	We've reviewed the look and feel of our papers through text, tone, language, images and formatting. For more information please see our assessment principles in our "Exploring our question papers" brochures on our website

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