



Rewarding Learning

**General Certificate of Secondary Education
2024**

Chemistry

Unit 2

Higher Tier

[GCM22]

FRIDAY 14 JUNE, MORNING

**MARK
SCHEME**

General Marking Instructions

Introduction

Mark schemes are intended to ensure that the GCSE examinations are marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria which they should apply in allocating marks to candidates' responses.

Assessment objectives

Below are the assessment objectives for GCSE Chemistry.

Candidates must:

- AO1** Demonstrate knowledge and understanding of:
 - scientific ideas;
 - scientific techniques and procedures.
- AO2** Apply knowledge and understanding of, and develop skills in:
 - scientific ideas;
 - scientific enquiry, techniques and procedures.
- AO3** Analyse scientific information and ideas to:
 - interpret and evaluate;
 - make judgements and draw conclusions;
 - develop and improve experimental procedures.

Quality of candidates' responses

In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking

Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive marking

Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do, rather than penalising candidates for errors or omissions. The exception to this for GCSE Chemistry is when examiners are marking complex calculations when the examiners are briefed to mark by error or omission. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks

Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Marking calculations

In marking answers involving calculations, examiners should apply the 'carry error through' rule so that candidates are not penalised more than once for a computational error. To avoid a candidate being penalised, marks can be awarded where correct conclusions or inferences are made from their incorrect calculations.

Types of mark schemes

Mark schemes for tasks or questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Levels of response

In deciding which level of response to award, examiners should look for the number of indicative content points in candidates responses to ensure that the answer has been written to coincide with the question. In deciding which mark within a particular level to award to any response, quality of communication will be assessed and examiners are expected to use their professional judgement.

The following guidance is provided to assist examiners.

- **Threshold performance:** Response which just merits inclusion in the level and should be awarded a mark at or near the bottom of the range.
- **High performance:** Response which fully satisfies the level description and should be awarded a mark at or near the top of the range.

Quality of written communication

Quality of written communication is taken into account in assessing candidates' responses to all tasks and questions that require them to respond in extended written form. These tasks and questions are marked on the basis of bands of response. The description for each band of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within bands of response as follows:

Band A: Quality of written communication is excellent.

Band B: Quality of written communication is good.

Band C: Quality of written communication is basic.

Band D: Response not worthy of credit

In interpreting these band descriptions, examiners should refer to the more detailed guidance provided below:

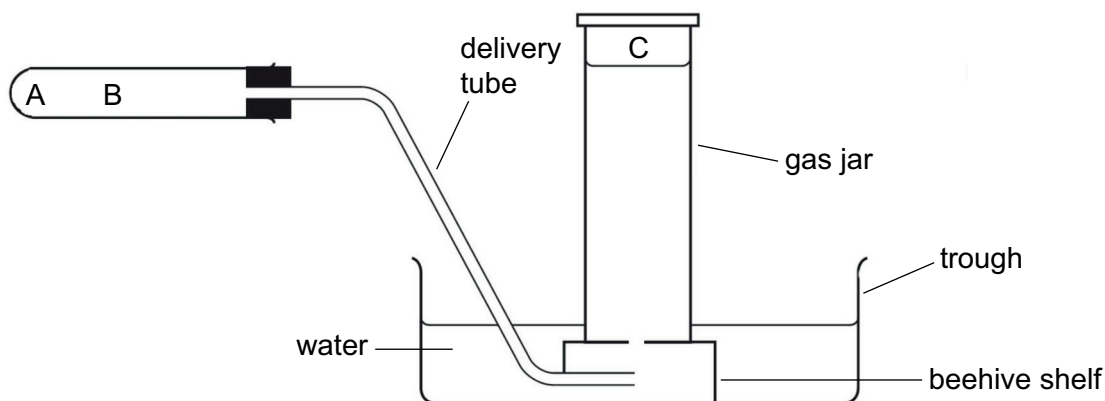
Band A (Excellent): Excellent reference to scientific terminology. The candidate successfully selects and uses the most appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is widespread and accurate use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are of a sufficiently high standard to make meaning clear.

Band B (Good): Good reference to scientific terminology. The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with some clarity and coherence. There is some use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning clear.

Band C (Basic): Basic reference to scientific terminology. The candidate makes only a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary. Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

- 1 (a) (i) Metal 1: iron/Fe [1]
Metal 2: copper/Cu [1]
Metal 3: calcium/Ca [1] [3]
- (ii) $2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}$
correct formulae of reactants [1]
correct formula of product [1]
correct balancing [1] [3]
- (b) (i) $2\text{Al}(\text{s}) + 3\text{H}_2\text{O}(\text{g}) \rightarrow \text{Al}_2\text{O}_3(\text{s}) + 3\text{H}_2(\text{g})$
correct formulae of reactants [1]
correct formulae of products [1]
correct balancing [1]
correct state symbols [1] [4]

(ii)



[1] for each label in correct position [3]

- (iii) aluminium gains oxygen [1]
gain of oxygen is oxidation [1]
steam/water loses oxygen [1]
loss of oxygen is reduction [1]
redox is oxidation and reduction occurring in the same reaction [1] [5]

(c)

aluminium + zinc sulfate solution	✓
copper + steam	
zinc + sodium chloride solution	
magnesium + steam	✓

[1]

(d) (i) half equation 1: as oxidation is loss of electrons [1]

(ii) from blue [1] to colourless [1] [2]

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2 (a) 0.88g [1]

(b) 150 – 160s [1]

(c) **indicative content**

- measure 25 cm³ of hydrochloric acid using a measuring cylinder/pipette and place in conical flask
- weigh 2.0g of marble chips using a top-pan balance
- place conical flask containing acid on balance
- add marble chips, start stopclock and record initial mass
- record mass every 20 seconds
- until mass no longer changes/consecutive mass measurements are the same

Band	Response	Mark
A	Candidates must use appropriate specialist terms including a minimum of 5 points of indicative content. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
B	Candidates must use appropriate specialist terms including a minimum of 3 points of indicative content. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
C	Candidates' brief and partial response includes a minimum of 2 points of indicative content. They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of a limited standard.	[1]–[2]
D	A response not worthy of credit.	[0]

[6]

(d) starts at (0,0), remains higher, levels off at same loss in mass [1]

(e) (i) loss in mass decreases/gradient decreases as time increases [1]

(ii) (reacting) particles used up [1]
fewer successful collisions [1]
in a given period of time [1] [3]

AVAILABLE
MARKS

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- 3 (a) (i) (similar) chemical properties [1]
- (ii) differ by a CH₂ unit/physical properties [1]
- (iii) compounds/molecules which contain only carbon and hydrogen (atoms) [1]

(b) (i)

	Homologous series	Number of carbon atoms	Name	Structural formula	Molecular formula
A		4	but-2-ene		C ₄ H ₈
B	Alcohol			$ \begin{array}{ccccc} & \text{H} & \text{H} & \text{H} & \\ & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & \\ & \text{H} & \text{OH} & \text{H} & \end{array} $	C ₃ H ₇ OH
C	Alkane	4			C ₄ H ₁₀
D			methanoic acid	$ \begin{array}{c} \text{O} \\ \\ \text{H} - \text{C} \\ \\ \text{OH} \end{array} $	HCOOH

[2] per correct row [8]

(ii) B [1]
orange to green [1] [2]

(iii) C₄H₈ + 6O₂ → 4CO₂ + 4H₂O
correct formulae of reactants [1]
correct formulae of products [1]
correct balancing [1] [3]

(iv) hydrogen [1]

(v) partially ionised in solution [1]

(vi) addition [1]

(c) (i)
$$\begin{array}{ccccc}
 & \text{H} & \text{H} & & \\
 & | & | & & \\
 \text{H} & - \text{C} & - \text{C} & - \text{H} & \\
 & | & | & & \\
 & \text{H} & \text{H} & &
 \end{array}$$
[1]

(ii) add bromine water [1]
orange to colourless [1] [2]

AVAILABLE
MARKS

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			AVAILABLE MARKS			
4	(a)	(i) bauxite	[1]	15		
		(ii) alumina	[1]			
		(iii) dissolve (aluminium oxide) in molten cryolite	[1]			
		(iv) liquid/solution which conducts electricity and is decomposed by it	[1]			
	(b)	(i) keep heat in	[1]			
		(ii) 900 – 1000 °C	[1]			
		(iii) any two from: high melting point good conductor of electricity inert	[2]			
		(iv) anode wears away/anode has to be replaced periodically	[1]			
		(v) cathode: $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$ Al^{3+} on left and Al on right [1] $+\text{e}^-$ on left [1] correct balancing [1] anode: $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$ O^{2-} on left and O_2 on right [1] $+\text{e}^-$ on right [1] correct balancing [1]	[6]			
		Each mark is dependent on previous mark	[6]			
	5	(a)	(i) conical flask [1] containing zinc and hydrochloric acid [1] delivery tube [1] gas syringe [1]		[4]	
			(ii) moles of $\text{H}_2 = \text{moles of Zn} = \frac{90}{24\,000} = 3.75 \times 10^{-3}$ [1] moles of Zn = 3.75×10^{-3} [1] mass of Zn = $3.75 \times 10^{-3} \times 65 = 0.24375$ [1] g		[3]	
			(iii) % purity = $\frac{0.24375}{0.325} \times 100 = 75$ (%)		[1]	
			(b)		(i) pink to colourless [2] (wrong way round [1])	[2]
		(ii) $\frac{17.4 \times 0.25}{1000} = 4.35 \times 10^{-3}$	[1]			
(iii) $\frac{4.35 \times 10^{-3}}{2} = 2.175 \times 10^{-3}$		[1]				
(iv) $2.175 \times 10^{-3} \times 10 = 0.02175$		[1]				
(v) $\frac{3.72}{0.02175} = 171$		[1]				
(vi) $A_r = 171 - 34 = 137$ [1] identity = barium/Ba [1]		[2]				
				16		

			AVAILABLE MARKS
6	(a)	(i) yield of hydrogen increases [1] position of equilibrium moves to the right [1] favours forward reaction which is endothermic [1] (second and third mark dependent on first mark)	[3]
		(ii) position of equilibrium moves to the left [1] 3 moles of gas on left and 5 moles on right/moves to fewer gas moles or smaller gas volume [1]	[2]
		(iii) atom economy = $\frac{8}{52}$ [1] × 100 = 15.4 [1] %	[3]
	(b)	energy required to break bonds = 4(412) + 4(O–H) = 1648 + 4(O–H) [1] energy released when bonds are made = 2(803) + 4(436) = 3350 [1] kJ 150 = 1648 + 4(O–H) – 3350 4(O–H) = 1852 [1] O–H = 463 [1]	[4]
		Total	12
			100