



*Rewarding Learning*

**General Certificate of Secondary Education  
2023**

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**Chemistry**

Unit 2

Higher Tier

**[GCM22]**

**TUESDAY 13 JUNE, MORNING**

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**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 candidate 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.

	Potassium	Copper
1 (a) Three observations when the metal is heated in air		red-brown solid [1] glows red [1] blue-green flame [1] black solid forms [1] does not burn [1] Max [3]
Balanced symbol equation for reaction of metal with oxygen	$4K + O_2 \rightarrow 2K_2O$ correct formulae of reactants [1] correct formula of product [1] correct balancing [1]	
Three observations during reaction of the metal with cold water	any <b>three</b> from: <ul style="list-style-type: none"> <li>• floats/stays on surface</li> <li>• fizzes</li> <li>• moves</li> <li>• heat released</li> <li>• colourless solution formed</li> <li>• lilac flame</li> <li>• melts to a (silvery) ball</li> <li>• disappears</li> <li>• explosion/crackle [3]</li> </ul>	
Balanced symbol equation for the reaction of the metal with cold water	$2K + 2H_2O \rightarrow 2KOH + H_2$ correct formulae of reactants [1] correct formulae of products [1] correct balancing [1]	

[12]

- (b) Step 1: plants are grown on land containing copper compounds and these are absorbed by the plants [1]  
 Step 2: plants are harvested, burned to produce ash which contains the metal compounds [1]  
 Step 3: an acid is added to the ash to produce a solution of the dissolved metal compounds (leachate) [1]  
 Step 4: copper can be obtained from solution by displacement using scrap iron [1] [4]

- (c) (i) most reactive: magnesium  
 zinc  
 lead  
 least reactive: silver [1]

- (ii)  $Mg + 2AgNO_3 \rightarrow Mg(NO_3)_2 + 2Ag$   
 correct formulae of reactants [1]  
 correct formulae of products [1]  
 correct balancing [3]

- (iii) magnesium loses electrons [1]  
 loss of electrons is oxidation [1]  
 zinc **ions** gain electrons [1]  
 gain of electrons is reduction [1]  
 redox is oxidation and reduction occurring simultaneously/in the same reaction [1] [5]

AVAILABLE  
MARKS

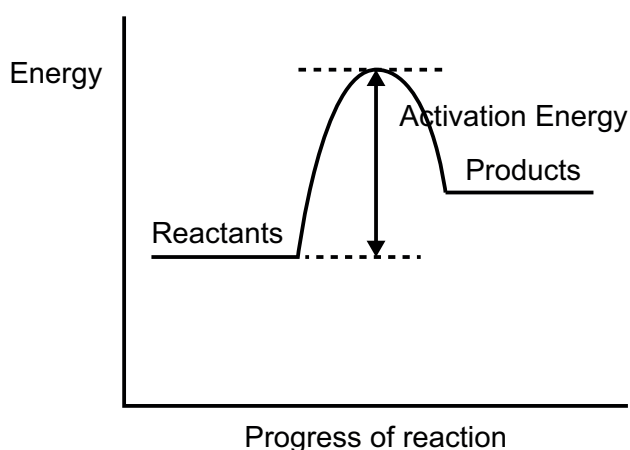
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- 2 (a) (i) a reaction in which the reactants can change into products and the products can change back into the reactants [1]
- (ii) position of equilibrium moves to the left [1]  
an increase in temperature favours the reverse endothermic reaction [1] [2]
- (iii) yield increases [1]  
position of equilibrium moves to the right [1]  
to the side with the fewer moles of gas/to decrease pressure [1] [3]
- (b) (i)  $\text{Zn(s)} + \text{H}_2\text{SO}_4\text{(aq)} \rightarrow \text{ZnSO}_4\text{(aq)} + \text{H}_2\text{(g)}$   
correct formulae of reactants [1]  
correct formulae of products [1]  
correct state symbols [1] [3]
- (ii) effect: increases [1]  
explanation: increased surface area [1]  
more successful collisions [1]  
per unit time [1] [4]
- (c) (i) provides an alternative reaction pathway [1]  
of lower activation energy [1] [2]
- (ii) starts at (0,0), remains above graph, levels off at same volume/96 cm<sup>3</sup> [1]

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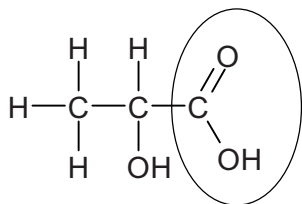
- 3 (a) (i) fractional [1] distillation [1] [2]
- (ii) a compound/molecule consisting of hydrogen and carbon only [1]
- (b) (i) any **three** from:
- the same general formula
  - show similar chemical properties
  - show a gradation in their physical properties
  - differ by a CH<sub>2</sub> group
- [3]
- (ii) C<sub>n</sub>H<sub>2n+2</sub> [1]
- (c) (i) C<sub>14</sub>H<sub>30</sub> → C<sub>12</sub>H<sub>26</sub> + C<sub>2</sub>H<sub>4</sub> [1]
- (ii) correct labels on axes [1]  
 energy of products higher than reactants [1]  
 reaction pathway with activation energy correctly labelled [1] [3]



- (iii) minimum energy required for a reaction to occur [1]
- (d) bonds broken = 2(C—C) + 8(C—H) + 5(O=O)  
 = 2(C—C) + 8(412) + 5(496) = 2(C—C) + 5776 [1]  
 bonds made = 6(C=O) + 8(O—H)  
 = 6(803) + 8(463) = 8522 [1]  
 energy change = -2050 = 2(C—C) + 5776 - 8522  
 2(C—C) = -2050 - 5776 + 8522  
 2(C—C) = 696 [1]  
 (C—C) = 348 [1] [4]

- (e) (i) x = 3    y = 6    z = 3 [1]

(ii)



[1]

- (iii) partially ionised in solution/water [1]

- (iv) green solid/green copper(II) carbonate [1]  
 solid disappears/copper(II) carbonate disappears [1]  
 fizzing/bubbles/effervescence [1]  
 blue solution forms [1]

max [3]

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(ii) acidified [1]  
potassium dichromate [1] [2]

(iii) propanoic acid [1]

(g) (i) a long chain molecule made of repeating units/made by joining small molecules together [1]

(ii) polythene/poly(ethene) [1]



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4 (a) (i) electrolyte [1]

(ii) the bulb would light [1]

(b) (i) reduction [1]

(ii)  $2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$   
Br<sup>-</sup> on left and Br<sub>2</sub> on right [1]  
correct position of e<sup>-</sup> [1]  
correct balancing [1] [3]

(iii) red-brown/pungent [1] gas [1] evolved [2]

(c) (i) lithium chloride → lithium + chlorine [1]

(ii) inert [1]

(iii) graphite [1]

(iv) ions move and carry the charge [1]

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5 (a) **indicative content:**

- rinse burette with acid
- fill burette with acid
- ensure jet is filled/no air bubbles
- read at bottom of meniscus (at eye level)
- add dropwise near the end point/near rough titre value
- swirl the flask (to mix reactants)

Band	Response	Mark
A	Candidates must use appropriate specialist terms [5–6 indicative content points]. Relevant material is organised with a high degree of clarity and coherence. They must use excellent spelling, punctuation and grammar and the form and style are of a very high standard.	[5]–[6]
B	Candidates must use appropriate specialist terms [3–4 indicative content points]. Relevant material is organised with some clarity and coherence. They use good spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
C	Candidates give a brief description [at least 2 indicative content points]. The organisation of material may lack clarity and coherence. They use limited spelling, punctuation and grammar and they have limited use of specialist terms. The form and style are of limited standard.	[1]–[2]
D	A response not worthy of credit.	[0]

[6]

(b) (i) moles of  $\text{H}_2\text{SO}_4 = 4.84 \times 10^{-3}$  [1]

(ii) moles of  $\text{Na}_2\text{CO}_3$  in  $25.0 \text{ cm}^3 = 4.84 \times 10^{-3}$  [1]

(iii) moles of  $\text{Na}_2\text{CO}_3$  in  $250 \text{ cm}^3 = 0.0484$  [1]

(iv)  $M_r = 124$  [1]

(v)  $x = 1$  [1]

(c) moles of  $\text{NaHCO}_3 = \frac{3.36}{84} = 0.04$  [1]

moles of  $\text{CO}_2 = \frac{0.04}{2} = 0.02$  [1]

volume of  $\text{CO}_2 = 0.02 \times 24 = 0.48$  [1]  $\text{dm}^3$  [3]

(d)  $750 \text{ (dm}^3\text{)}$  [1]

(e) (i) limewater [1]

(ii) colourless to milky [1]  
in excess colourless solution forms [1] [2]

**Total**

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**100**