Rewarding Learning

General Certificate of Secondary Education
2019

Chemistry

Unit 2

Higher Tier

[GCM22]

WEDNESDAY 12 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 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:

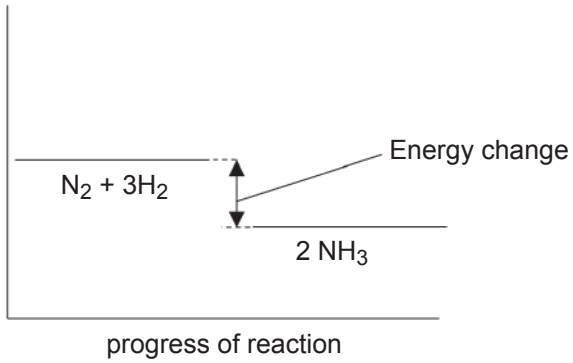
Band A (Excellent): Excellent reference to scientific terminology. The candidate successfully selects and uses the most appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is widespread and accurate use of appropriate specialist vocabulary. 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.

				AVAILABLE MARKS
1	**(a)**	**(i)**	haematite [1]	
		(ii)	oxidation and reduction occurring in the same reaction [1]	
	(b)	**(i)**	carbon monoxide [1] $C + O_2 \rightarrow CO_2$ correct formulae of reactants [1] correct formula of product [1] $CO_2 + C \rightarrow 2CO$ correct formulae of reactants [1] correct formula of product [1] correct balancing [1] [6]	
		(ii)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ correct formulae of reactants [1] correct formulae of products [1] correct balancing [1] [3]	
	(c)	**(i)**	plants burned to produce an ash [1] ash reacted with sulfuric acid [1] [2]	
		(ii)	iron is more reactive than copper [1]	
		(iii)	$Cu^{2+} + 2e^- \rightarrow Cu$ Cu^{2+} on left hand side with arrow and Cu on right hand side [1] $+ e^-$ on left hand side [1] correct balancing [1] [3]	
		(iv)	any **one** from: • avoids noise or dust pollution involved with traditional methods of extraction • produces energy when plants are burned • uses scrap iron • less destructive than conventional method of extraction • less energy used than transporting rocks containing copper ores [1]	18

		AVAILABLE MARKS
2	**(a)** provides an alternative reaction pathway [1] of lower activation energy [1] [2]	
	(b) **(i)** rate of the forward and reverse reactions are equal [1] amounts/concentrations of reactants and products remain constant [1] [2]	
	(ii) rate increases [1] particles gain (kinetic) energy/move faster [1] more successful collisions [1] in a given period of time [1] [4]	
	(iii) increases yield of ammonia [1] the position of equilibrium moves to the right [1] to the side with the fewer moles of gas/to decrease the pressure [1] [3]	
	(c) **(i)** energy required to break the bonds in nitrogen and hydrogen [1] is less than [1] energy released when bonds are formed in ammonia [1] [3]	
	(ii) energy line for products lower than reactants [1] energy change between energy levels [1]	



[2]

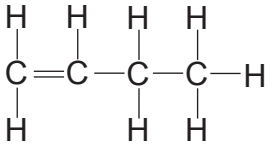
	(iii) Bonds broken: N≡N + 3 × (H—H) = 916 + 3(436) = 2224 [1] Bonds made: 6 × N—H = 6(386) = 2316 [1] Energy change = – [1] 92 [1] [4]	20

AVAILABLE MARKS

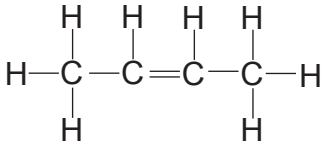
3 **(a)** **(i)** contains only carbon and hydrogen [1]

(ii) C_nH_{2n} [1]

(b) **(i)** but-1-ene but-2-ene



[1]



[1] [2]

(ii) $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$
correct formulae of reactants [1]
correct formulae of products [1]
correct balancing [1] [3]

(c) **(i)** $C_7H_{16} \rightarrow C_3H_6 + C_4H_{10}$
correct formula of reactant [1]
correct formulae of products [1] [2]

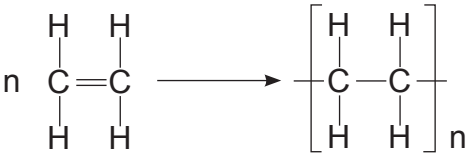
(ii) butane [1]

(iii) substantial energy required to break the strong (covalent) bonds [1]

(d) **(i)** addition [1]

(ii) chloroethene/vinyl chloride [1]

(iii)



correct structure of monomer [1]
correct structure of polymer [1]
n before monomer and after polymer [1] [3]

(e) Indicative content

- C═C/carbon–carbon double bond [1]
- bromine water [1]
- changes from orange/yellow/brown [1]
- to colourless [1]
- $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$ [2]

Band	Response	Mark
A	Candidates must use appropriate specialist terms to fully describe and explain the test for C═C functional group [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 to describe and explain the test for C═C functional group [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 describe and explain briefly the test for C═C functional group [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]

AVAILABLE MARKS

22

					AVAILABLE MARKS
4	**(a)**	**(i)**	moles of $HNO_3 = \frac{24.0 \times 0.75}{1000} = 0.018$ mol [1]		
			moles of $Ca(OH)_2 = \frac{0.018}{2} = 0.009$ mol [1]		
			concentration of $Ca(OH)_2 = 0.009 \times 40 = 0.36$ [1] mol/dm^3	[3]	
		(ii)	$0.36 \times 74 = 26.64$ [1] g/dm^3	[1]	
	(b)		mass of $Ca(NO_3)_2 = 32\,800$ [1] g		
			moles of $Ca(NO_3)_2 = \frac{32\,800}{164} = 200$ [1] mol		
			moles of gas $= \frac{200}{2} \times 5 = 500$ [1] mol		
			volume of gas $= 500 \times 24 = 12\,000$ [1] dm^3	[4]	
	(c)	**(i)**	equal volumes of gas contain the same number of particles [1] under the same conditions of temperature and pressure [1]	[2]	
		(ii)	$160 \times 2 = 320$ [1] dm^3	[1]	11

5 **(a)** decomposition (of a liquid electrolyte) using (a direct current of) electricity [1]

(b) **(i)** graphite [1]

(ii) good conductor of electricity [1]
inert/unreactive [1] [2]

(iii) bromine/lead is toxic [1]

(iv) anode [1]

(c)

	Negative electrode	**Positive electrode**
Observations at the electrode		red-brown [1] pungent [1] gas [1] **max** [2]
Name of electrolysis product	lead [1]	bromine [1]
Half equation for the reaction at the electrode	$Pb^{2+} + 2e^- \longrightarrow Pb$ Pb^{2+} on left and arrow and Pb on right [1] $+ e^-$ on left [1] correct balancing [1]	$2Br^- \longrightarrow Br_2 + 2e^-$ Br^- on left and arrow and Br_2 on right [1] $+ e^-$ on right [1] correct balancing [1]

[10]

AVAILABLE MARKS

16

6 **(a)** **(i)** $2H_2O_2 \rightarrow 2H_2O + O_2$
correct formula of reactant [1]
correct formulae of products [1]
correct balancing [1] [3]

(ii) MnO_2 [1]

(iii) Apply a glowing splint [1] relights [1] [2]

(b)

	Magnesium	**Sulfur**
Observation during heating	white light [1]	yellow solid melts [1] to form a red liquid [1] blue flame [1] pungent smell [1] **max** [2]
Appearance of product after reaction with oxygen	white solid [1]	colourless/misty gas [1]
Nature of oxide formed (acidic or basic)	basic [1]	acidic [1]

[7]

Total

AVAILABLE MARKS

13

100