Rewarding Learning

General Certificate of Secondary Education
2016

GCSE Chemistry

Unit 2

Higher Tier

[GCH22]

WEDNESDAY 22 JUNE, MORNING

MARK SCHEME

General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is 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 that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality 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, the examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of 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.

Types of mark scheme
Mark schemes for 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.

				AVAILABLE MARKS
1	(a)	(i)	fluoride reduces tooth decay/less tooth decay in fluoridated areas [1] use of any data to compare [1] [2]	
		(ii)	Any **one** from: no freedom of choice mass medication effects of fluoride in drinking water unknown [1]	
	(b)	(i)	water which does not lather readily with soap [1]	
		(ii)	Sample C [1] requires the greatest volume of soap to obtain a lather [1] [2]	
		(iii)	Sample B – temporary (hardness) [1] Sample D – permanent (hardness) [1] [2]	
		(iv)	Sample B – calcium or magnesium hydrogencarbonate [1] Sample D – calcium or magnesium sulfate/chloride [1] [2]	
		(v)	hydrated sodium carbonate [1]	
		(vi)	contains calcium (ions) so good for teeth/bones/prevent heart disease [1]	
	(c)	(i)	ion exchange [1]	
		(ii)	calcium ions in the hard water removed [1] calcium ions replaced by sodium ions [1] sodium ions do not cause hardness [1] max [2]	
		(iii)	no sodium ions left on column/column filled with calcium ions [1]	16

AVAILABLE MARKS

2 **(a)** same general formula [1]
similar chemical properties [1]
gradation in physical properties [1]
differ by a 'CH_2' unit [1] max [3]

(b) **(i)** C═C/carbon-carbon double bond/allow circled C═C on diagram [1]

(ii) it contains carbon and hydrogen (atoms) only [1]

(iii) carbon monoxide [1] water [1] [2]

(iv) C_3H_5 [1]

(c) **(i)** OH/hydroxyl/allow circled OH on diagram [1]

(ii) $C_6H_{11}OH + 8\frac{1}{2}O_2 \rightarrow 6CO_2 + 6H_2O$
allow correct multiple of balancing numbers
correct formulae of reactants [1]
correct formulae of products [1]
correct balancing [1] [3]

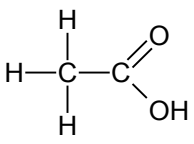
(iii) **Indicative content**

bromine water [1]
red-brown/orange/brown [1] to colourless [1] with cyclohexene
acidified potassium dichromate [1] (solution)
warming [1]
orange [1] to green [1] with cyclohexanol

Response	Mark
Candidates must use appropriate specialist terms to explain chemical tests (using 6–7 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates must use appropriate specialist terms to describe the chemical tests (using 4–5 points of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates partially describe chemical tests (using 2–3 points of indicative content). They use limited spelling, punctuation and grammar and they make little use of specialist terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit	0

[6]

(d) **(i)** CH_3COOH [1]

(ii)


[1]

(iii) only partially ionised in water [1]

				AVAILABLE MARKS
	(iv)	$2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$ correct formulae of reactants [1] correct formulae of products [1] correct balancing [1]	[3]	
	(v)	bubbles [1] solid/sodium carbonate disappears [1] solution remains colourless [1]	max [2]	26
3 **(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)	manganese(IV) oxide/manganese dioxide	[1]	
	(iii)	substance which speeds up (or increases the rate) [1] of a (chemical) reaction [1] without being used up/remains chemically unchanged at the end [1]	[3]	
	(iv)	activation energy	[1]	
(b)	**(i)**			

Temperature (°C)	Time for reaction to finish (s)	Rate = $\frac{1}{\text{time}}$ (s^{-1})
60	42–46 [1]	0.0217–0.0238 [1]

[2]

	(ii)	as temperature increases, rate increases **or** as temperature decreases, rate decreases	[1]	
(c)	**(i)**	$0.01(0)\ s^{-1}$	[1]	
	(ii)	as concentration increases, rate increases **or** as concentration decreases, rate decreases	[1]	
	(iii)	straight line through origin [1] lower than one drawn [1]	[2]	15

4 (a) Indicative content

AVAILABLE MARKS

Formation

- sulfur (present in fossil fuels) reacts with oxygen (in the air)/undergoes combustion to form sulfur dioxide [1]
- $S + O_2 \rightarrow SO_2$ [2]
- sulfur dioxide reacts with water in the air to form sulfurous acid [1]
- $SO_2 + H_2O \rightarrow H_2SO_3$ [2]

Environmental effects

- corrosion of limestone buildings and statues [1]
- kills fish in rivers and lakes [1]
- defoliates trees [1]

Prevention

- remove sulfur from fossil fuels before combustion [1]
- burn less fossil fuels/use renewable energy sources [1]
- remove sulfur dioxide from industrial waste gases [1]

Response	Mark
Candidates must use appropriate specialist terms to explain fully the formation of acid rain (using 10–12 points of indicative content) including two balanced symbol equations. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[7]–[9]
Candidates must use appropriate specialist terms to explain fully the formation of acid rain (using 6–9 points of indicative content) including one balanced symbol equation. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[4]–[6]
Candidates describe briefly and partially the formation of acid rain (using 2–5 points of indicative content). They use limited spelling, punctuation and grammar and they make little use of specialist terms. The form and style are of a limited standard.	[1]–[3]
Response not worthy of credit	0

[9]

(b)

- Bonds broken in N_2 and O_2 [1]
- Bond breaking requires energy [1]
- Bond making in NO_2 [1]
- Bond making releases energy [1]
- Less energy is released when bonds form than is taken in to break bonds [1]

[5]

14

				AVAILABLE MARKS
5	**(a)**	**(i)**	same volume of copper(II) sulfate [1] same concentration of copper(II) sulfate [1] same mass of metal/same number of moles of metal [1] max [2]	
		(ii)	magnesium the repeat result was not similar/far apart [1]	
		(iii)	magnesium [1] temperature rise was greatest [1] [2]	
		(iv)	no reaction/silver cannot displace copper/silver below copper in the reactivity series [1]	
		(v)	two metals/gold and silver give the same result [1]	
		(vi)	$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$ correct formulae of reactants [1] correct formulae of products [1] [2]	
	(b)	**(i)**	iron(III) oxide [1] calcium carbonate [1] [2]	
		(ii)	B [1] C [1] E [1] A [1] [4]	
	(c)	**(i)**	bauxite [1]	
		(ii)	$Al^{3+} + 3e^- \rightarrow Al$ $Al^{3+} \rightarrow Al$ [1] correct e^- [1] correct balancing [1] [3]	
		(iii)	$2O^{2-} \rightarrow O_2 + 4e^-$ $O^{2-} \rightarrow O_2$ [1] correct e^- [1] correct balancing [1] [3]	22

				AVAILABLE MARKS
6	**(a)**	$(NH_4)_2CO_3 \rightarrow 2NH_3 + CO_2 + H_2O$ [1] for correct formula of reactant [1] for correct formulae of products [1] for correct balancing	[3]	
	(b)	**(i)** $\frac{0.868}{124}$ [1] = 0.007 [1]	[2]	
		(ii) 0.007 × 2 [1] = 0.014 [1]	[2]	
		(iii) $\frac{0.014 \times 1000}{0.175}$ [1] = 80 [1]	[2]	
	(c)	**(i)** yellow/orange [1] to red/orange [1]	[2]	
		(ii) 18.0/18 [2] 18.2 [1]	[2]	
		(iii) $\frac{18 \times 0.175}{1000}$ [1] = 0.00315 [1]	[2]	
		(iv) $\frac{0.00315}{2}$ [1] = 0.001575 [1] use of any other ratio apart from 2:1 = [0] × 2 gains [1]	[2]	
		(v) 0.001575 × 10 = 0.01575 [1]	[1]	
		(vi) $\frac{2.52}{0.01575}$ [1] = 160 [1]	[2]	
		(vii) 160 – 106 = 54 [1]/18 = 3 [1]	[2]	22
			Total	**115**