Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2022

Chemistry

Assessment Unit AS 3

assessing

Module 3: Practical Examination
Practical Booklet B (Theory)

[SCH32]

WEDNESDAY 1 JUNE, MORNING

MARK SCHEME

General Marking Instructions

Introduction

The main purpose of the mark scheme is to ensure that examinations are marked accurately, consistently and fairly. The mark scheme provides examiners with an indication of the nature and range of candidates' responses likely to be worthy of credit. It also sets out the criteria which they should apply in allocating marks to candidates' responses.

Assessment objectives

Below are the assessment objectives for **GCE Chemistry**:

Candidates should be able to:

AO1	Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures.
AO2	Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: in a theoretical context in a practical context when handling quantitative and qualitative data
AO3	Analyse, interpret and evaluate scientific information, ideas and evidence (in relation to particular issues) make judgements and reach conclusions develop and refine practical design and 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 17 or 18-year-old which is the age at which the majority of candidates sit their GCE 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 GCE Chemistry is when examiners are marking complex calculations and mechanisms 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 17 or 18-year-old GCE 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 but the quality of communication is basic should be awarded a mark at the bottom of the range.
- ***High performance:*** Response which fully satisfies the level description for both content and quality of communication should be awarded a mark at 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 on theory examination papers that require them to respond in extended written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

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

Level C: Quality of written communication is basic.
Level B: Quality of written communication is good.
Level A: Quality of written communication is excellent.

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

Level 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.

Level 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.

Level 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.

COVID-19 Context
Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021-2022 only.

AVAILABLE MARKS

1 **(a)** mass of water = 15.22 g
mass of solid = 1.01 g
solubility = 6.64 (g/100 g water) [3]

(b) solubility of hydroxides increases (down the group)
solubility of sulfates decreases (down the group) [1]

(c) **(i)**

BaO_2	–1
H_2O	–2
$Ba(OH)_2$	–2
O_2	0

[2]

(ii) moles of $O_2 = \frac{117}{24\,000} = 4.875 \times 10^{-3}$

mass of $BaO_2 = 4.875 \times 10^{-3} \times 2 \times 169 = 1.648\,g$

$\% = \frac{1.648}{2.0} = 82.4\%$ [3]

(iii) relights a glowing splint [1]

(iv) flame test [1]
green/apple green flame [1] [2]
or
add a sulfate ion solution [1] white precipitate [1]

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2 **(a)**

Sample	Test	Observations
1	Add 1 half-spatula measure of solid sodium carbonate to 2 cm^3 of the mixture in a test tube.	effervescence test tube feels cool solid disappears solution remains colourless
2	Add 1 half-spatula measure of solid phosphorus pentachloride to 2 cm^3 of the mixture in a test tube.	misty fumes/steamy fumes hissing sound solid disappears test tube warms up **any two** [2]
3	Add 2 cm^3 of acidified potassium dichromate(VI) solution to 2 cm^3 of the mixture in a test tube. Warm in a water bath.	solution changes from orange to green **both colours required** [1]
4	Add a 1 cm strip of magnesium ribbon to 5 cm^3 of the mixture in a test tube.	fizzing magnesium disappears test tube warms up solution remains colourless **any two** [2]

[5]

(b) chloroethane [1]

(c) $3CH_3CH_2OH + 16H^+ + 2Cr_2O_7^{2-} \rightarrow 3CH_3COOH + 11H_2O + 4Cr^{3+}$ [2]

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3 **(a)** weigh out accurately 1.75 g of solid H_2A [1]
dissolve in approximately 100 cm^3 of deionised water in a beaker [1]
transfer to a 250 cm^3 volumetric flask [1]
ensuring all rinsings go into the flask [1]
add deionised water until the bottom of the meniscus is on the line [1]
stopper and invert to mix [1] [6]

(b) **(i)** any **two** from:
swirling the conical flask [1]
adding dropwise near the end point [1]
reading from the bottom of the meniscus [1] [2]

(ii) phenolphthalein as it is a weak acid strong base titration [1]

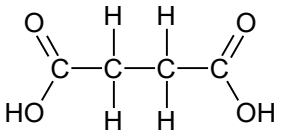
(iii) moles of NaOH = $\frac{20.4 \times 0.145}{1000} = 2.958 \times 10^{-3}$

moles of $H_2A = \frac{2.958 \times 10^{-3}}{2} = 1.479 \times 10^{-3}$

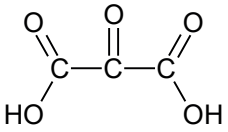
moles of H_2A in 250.0 cm^3 = 0.01479

relative formula mass of $H_2A = \frac{1.75}{0.01479} = 118$ [4]

(c) either:



or



or correct suitable with M_r of 118 [1]

AVAILABLE MARKS

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				AVAILABLE MARKS
4	**(a)**	**(i)**	dissolves both reactants/acts as solvent/mutual solvent [1]	
		(ii)	$CH_3CH_2CH_2CH_2Br + H_2O \rightarrow CH_3CH_2CH_2CH_2OH + HBr$ [1]	
		(iii)	has lone pair(s) of electrons [1]	
	(b)	**(i)**	breaking up molecules by reaction with water [1]	
		(ii)	cream [1]	
		(iii)	silver chloride/AgCl [1]	
		(iv)	1-iodobutane faster than 1-bromobutane faster than 1-chlorobutane [1] C—I bond weaker than C—Br which is weaker than C—Cl [1] [2]	
		(v)	tertiary faster than secondary faster than primary [1]	
	(c)	**(i)**	to dissipate the heat [1]	
		(ii)	maximise yield [1]	
		(iii)	repeated boiling and condensing of a (reaction) mixture [1]	
		(iv)	antibumping granules [1]	
		(v)	Any **four** from: attach fractionating column to pear shaped flask [1] attach still head/sidearm [1] insert thermometer [1] sidearm/still head connected to condenser angled downwards [1] collection vessel [1] [4]	
		(vi)	mass of 1-chlorohexane = 10 × 0.88 = 8.8 g mole of 1-chlorohexane = $\frac{8.8}{120.5}$ = 0.07303 theoretical yield of hexan-1-ol = 0.07303 × 102 = 7.449 g actual yield of hexan-1-ol = 4.4 × 0.82 = 3.608 g percentage yield = $\frac{3.608}{7.449}$ × 100 = 48.4% [4]	21
			Total	**55**