Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2022

Chemistry

Assessment Unit AS 2

assessing

Further Physical and Inorganic Chemistry
and an Introduction to Organic Chemistry

[SCH24]

FRIDAY 27 MAY, AFTERNOON

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.

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.

Section A

	AVAILABLE MARKS
1 A	
2 B	
3 A	
4 D	
5 C	
6 C	
7 C	
8 B	
9 B	
10 D	
[1] for each correct answer	10
Section A	**10**

Section B

AVAILABLE MARKS

11 **(a)** radical [1]
substitution [1] [2]

(b) $Cl_2 \rightarrow 2Cl\bullet$ [1]

(c) $CH_4 + Cl\bullet \rightarrow \bullet CH_3 + HCl$ [1]
$Cl_2 + \bullet CH_3 \rightarrow CH_3Cl + Cl\bullet$ [1] [2]

(d) $\bullet CH_3 + \bullet CH_3 \rightarrow C_2H_6$ [1]

(e) dichloromethane/trichloromethane/tetrachloromethane [1] 7

12 **(a)** a formula which shows the actual number of atoms of each element in a molecule [1]

(b) **(i)**

C	H	O
54.5	9.1	36.4
4.54	9.1	2.275
2	4	1

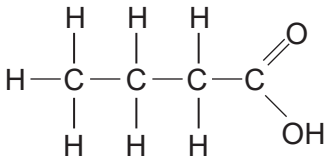
C_2H_4O [3]

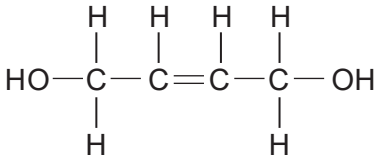
(ii) $(12 \times 2) + (1 \times 4) + (16 \times 1) = 44$

$88 \div 44 = 2$

molecular formula $C_4H_8O_2$ [1]

(iii)





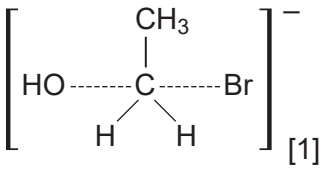
(or other alternatives) [2] [2] 7

13 **(a)** ethanol and (2-)methylpropan-2-ol [1]

(b) **(i)** an ion or molecule, with a lone pair of electrons, that attacks regions of low electron density [2]

(ii) $\overset{\delta+}{C}—\overset{\delta-}{Br}$ [1]

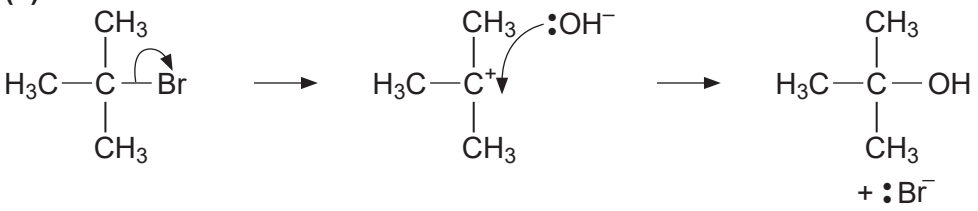
hydroxide ion is negative/has a lone pair and will attack the δ+ carbon [1] [2]

(iii) 

[1]

forms a stable tertiary carbocation/approach of the hydroxide ion is hindered by the four bulky groups [1] [2]

(c)



[4] 11

14 **(a)** **(i)** the enthalpy change when one mole of a substance is completely burnt in oxygen under standard conditions [2]

(ii) the energy required to break one mole of a given bond averaged over many compounds [2]

(b) O═O bond only present in the O_2 molecule [1]

(c)

Bonds broken	Bonds formed
12 (C—H)	8 (C═O)
2 (C—C)	12 (O—H)
7 (O═O)	
Total = 9131	Total = 11992

9131 – 11992 = –2861

–1430.5 kJ mol^{-1} [4]

(d) the reaction has a high activation energy/ no molecules have sufficient energy to react [1] [1] 10

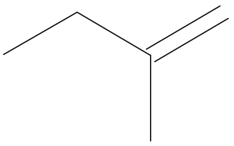
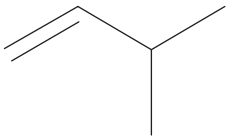
AVAILABLE MARKS

			AVAILABLE MARKS
15	**(a)**	a reaction in which all the reactants and products are in the same physical state [1]	
	(b)	**(i)** $K_c = \frac{[NO]^2}{[N_2][O_2]}$ [1] no units [1] [2]	
		(ii) position of equilibrium lies to the left hand side/small amount of product formed [1]	
	(c)	no effect [1] same number of molecules/moles of gas on the LHS and RHS [1] [2]	
	(d)	yield increases [1] position of equilibrium moves to the right [1] the (forward) reaction is endothermic/absorbs the heat [1] [3]	9
16	**(a)**	**(i)** atom: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 5s^2$ [1] cation: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6$ [1] [2]	
		(ii) outer electrons in strontium are further from the nucleus/ more shielded than those in magnesium [1] outer electrons are lost more readily [1] [2]	
	(b)	$Sr + 2H_2O \rightarrow Sr(OH)_2 + H_2$ [1]	
	(c)	$SrO + 2HNO_3 \rightarrow Sr(NO_3)_2 + H_2O$ [2]	
	(d)	**(i)** no precipitate with strontium nitrate/colourless solution/no change [1] white precipitate with magnesium nitrate [1] [2]	
		(ii) $Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s)$ [2]	
		(iii) any soluble sulfate, e.g. sodium sulfate [1]	12

17 **(a)** molecules which have the same molecular formula but a different structural formula [1]

AVAILABLE MARKS

(b)

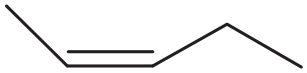
IUPAC name of isomer	Skeletal formula
pent-1-ene	
	
pent-2-ene	
2-methylbut-2-ene	
3-methylbut-1-ene	

[1] per row [5]

(c) Indicative content

AVAILABLE MARKS

- Correct structure:

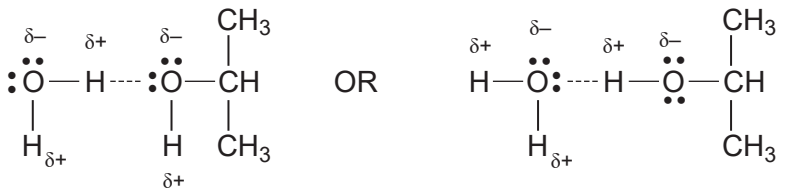
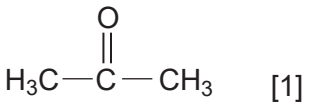


or structural formula

- C of CH_3 higher priority than hydrogen
- C of C_2H_5 higher priority than hydrogen
- highest priority groups on the same side
- restricted rotation about the C═C
- molecule on left has two identical (methyl) groups attached to one of the carbon atoms in the C═C
- molecule on right has two different atoms/groups attached to each of the carbon atoms in the C═C

Band	Response	Mark
A	Candidates must use appropriate specialist terms using a minimum of 5 points of indicative content. They must use good spelling, punctuation and grammar and the form and style are of an excellent standard.	[5]–[6]
B	Candidates must use appropriate specialist terms using a minimum of 3 points of indicative content. They must use satisfactory spelling, punctuation and grammar and the form and style are of a good standard.	[3]–[4]
C	Candidates use a minimum of 2 points of indicative content. They use limited correct spelling, punctuation and grammar and the form and style are of a basic standard.	[1]–[2]
D	Response not worthy of credit.	[0]

[6] 12

				AVAILABLE MARKS
18	**(a)**	**(i)**	hydrogen bonds between propan-2-ol molecules [1] are stronger than van der Waals' forces between hydrocarbon molecules [1] [2]	
		(ii)	 [2]	
	(b)	**(i)**	reagent: potassium dichromate(VI) [1] conditions: acidified [1] heat [1] observations: orange to green [1] [4]	
		(ii)	 [1] propanone [1] [2]	
		(iii)	C—O/O—H peak in propan-2-ol [1] spectrum C=O peak in ketone [1] spectrum [2]	12
			Section B	**80**
			Total	**90**