Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2024

Chemistry

Assessment Unit AS 2

assessing

Further Physical and Inorganic Chemistry and an Introduction to Organic Chemistry

[SCH24]

TUESDAY 21 MAY, 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.

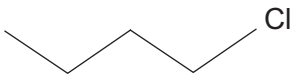
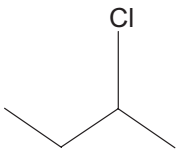
Section A

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

Section B

AVAILABLE MARKS

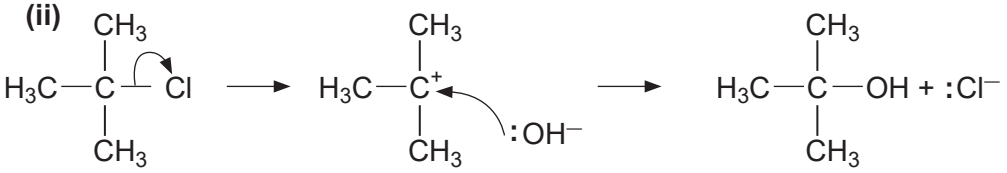
11 (a)

IUPAC name	Skeletal formula	Classification
	 [1]	
1-chloro-2-methylpropane [1]		
2-chlorobutane [1]	 [1]	
		Tertiary [1]

[5]

(b) (i) 2-methylpropan-2-ol [1]

(ii)



[4]

(c) (i) bending and stretching of covalent bonds/molecular vibrations [1]

(ii) 2-chloro-2-methylpropane does not have OH peak/C-Cl peak present in 2-chloro-2-methylpropane [1]

(d)

Reagent	Conditions	Reaction type	Structure of organic product
Potassium hydroxide	Reflux in ethanolic solution	Elimination [1]	$CH_3CH_2CH{=}CH_2$ [1]
Ammonia	Ammonia in ethanol, heat in sealed tube	Substitution [1]	$CH_3CH_2CH_2CH_2NH_2$
Potassium cyanide	Reflux in ethanolic solution	Substitution	$CH_3CH_2CH_2CH_2CN$ [1]

[4]

16

12 **(a)** **(i)** the energy required to break one mole of a given bond [1] averaged over many compounds [1] [2]

(ii) the enthalpy change for a reaction is independent of the route taken [1] provided the initial and final conditions are the same [1] [2]

(b) **(i)** $\frac{1}{2}N_2(g) + O_2(g) \rightarrow NO_2(g)$ [2]

(ii) $\Delta H = -2(-988.0) + 2(-558.1) + 4(+33.2) = +992.6$ kJ

per mole of barium nitrate $= \frac{992.6}{2} = +496.3$ (kJ mol^{-1})
$= +496$ (kJ mol^{-1}) [4]

(c) energy of bonds broken $= 6(412) + 2(348) + 4(496) + (C{=}O)$
$= 5152 + (C{=}O)$

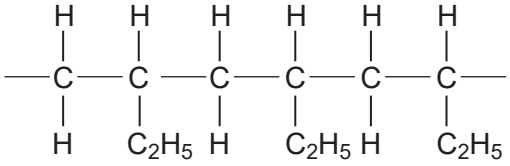
energy of bonds formed $= 6(C{=}O) + 6(463)$
$= 6(C{=}O) + 2778$

$-1821 = 5152 + (C{=}O) - 6(C{=}O) - 2778$
$5(C{=}O) = 4195$
$C{=}O = 839$ (kJ mol^{-1}) [4]

AVAILABLE MARKS

14

13 (a)



[1]

(b) Indicative content

- sigma (covalent) bond formed by linear overlap of atomic orbitals
- pi (covalent) bond formed by sideways overlap of p orbitals
- C═C contains both sigma and pi bonds
- C—C contains sigma bond only
- C═C bond is stronger than C—C
- C═C has shorter bond length than C—C
- C═C more reactive than C—C

Band	Response	Mark
A	Candidates must use appropriate specialist terms using a minimum of 6 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 4 points of indicative content. They must use appropriate spelling, punctuation and grammar and the form and style are of a good standard.	[3]–[4]
C	Candidates must 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	A response not worthy of credit	[0]

[6]

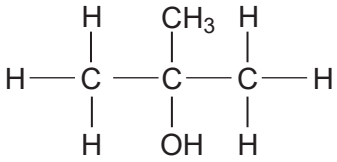
(c) (i) CH_2 [1]

(ii) **A** = 4-methylpent-2-ene [1]
B = butan-1-ol [1] [2]

(iii) 2-methylpentane [1]

(iv) oxidation [1]

(v)



[1]

tertiary alcohol resistant to oxidation [1] [2]

14

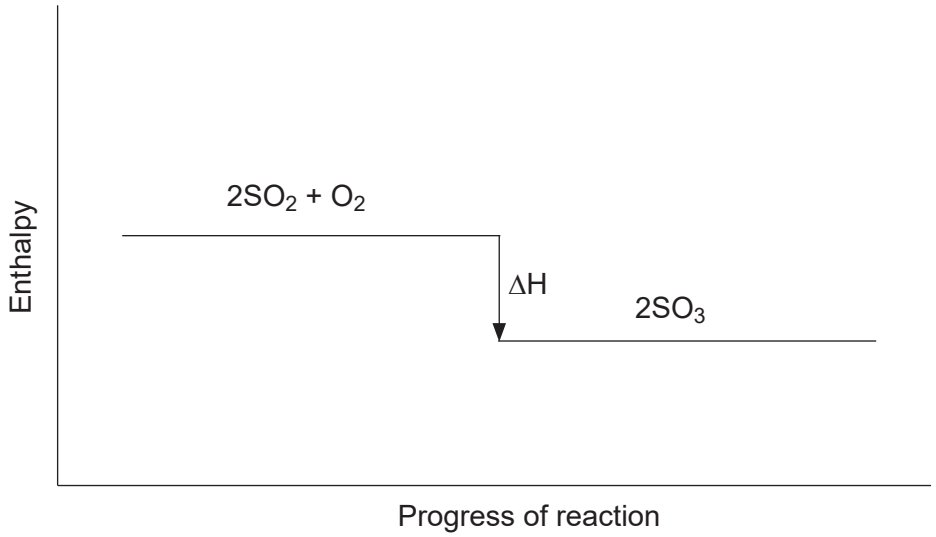
14 **(a)** rate of the forward reaction is equal to the rate of the backwards reaction [1]
a reversible reaction in which the amounts of reactants and products remain constant [1] [2]

(b) $K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$ [1]

units = $mol^{-1}\ dm^3$ [1] [2]

(c) yield increases [1]
position of equilibrium moves to the right [1]
to the side of fewer gas moles (or molecules)/3 moles on left and 2 moles on right [1]
second and third mark dependent on first [3]

(d)



both axes labelled correctly [1]
products enthalpy level lower than reactant enthalpy level and both correctly labelled [1]
enthalpy change from reactants to products and labelled ΔH [1] [3]

(e) $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$ [1] 11

AVAILABLE MARKS

			AVAILABLE MARKS
15	**(a)**	moles of $C_2H_6 = \frac{11850}{30} = 395$ moles of gaseous products = $\frac{395}{4} \times 15 = 1481.25$ volume of gaseous products = 1481.25 × 24 = 35550 dm^3 [3]	
	(b) **(i)**	E_A lower [1] greater area under curve above E_A [1] more molecules with energy greater than or equal to E_A [1] [3]	
	(ii)	starts at origin peak lower and to the right only cuts the other curve once asymptotic at higher energies each error [–1] [2]	
	(c) **(i)**	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ [2]	
	(ii)	46 [1]	
	(iii)	$\frac{1367}{46} = 29.7$ (kJ) [1]	
	(iv)	$\frac{46}{0.79} = 58.23\ cm^3$ $\frac{1367}{58.23} = 23.5$ (kJ) [2]	
	(v)	hydrogen produces water only/hydrogen does not produce a greenhouse gas [1]	15

				AVAILABLE MARKS
16	**(a)**	maximum mass of solute that will dissolve in 100 g of solvent/water at a stated temperature	[1]	
	(b)	**(i)** solubility at 30°C = 28.6 g/100 g water solubility at 20°C = 26.2 g/100 g water difference in solubility = 2.4 per 2 kg = 48 (g)	[2]	
		(ii) $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$	[1]	
	(c)	**(i)** $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$	[1]	
		(ii) (solubility) increases down Group II	[1]	
	(d)	**(i)** $SrCO_3 \rightarrow SrO + CO_2$	[1]	
		(ii) thermal stability increases down the group [1] size of cation increases/charge density of cation decreases [1] cation less able to polarise and destabilise carbonate ion [1]	[3]	10
			Section B	**80**
			Total	**90**