Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2025

Chemistry

Assessment Unit AS 2

assessing

Further Physical and Inorganic Chemistry
and an Introduction to Organic Chemistry

[SCH24]

TUESDAY 20 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.

Where one response is required to gain a mark, candidates will not gain credit if a correct response is given alongside one or more incorrect responses.
This is referred to as listing.

AVAILABLE MARKS

Section A

1 D

2 B

3 B

4 D

5 B

6 D

7 B

8 B

9 B

10 D

[1] for each correct answer [10] 10

Section A **10**

Section B

AVAILABLE MARKS

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

(ii) ultraviolet light/UV light [1]

(iii) propagation [1]

(iv) any **one** from:
$Br\bullet + Br\bullet \rightarrow Br_2$
$CH_3CH_2\bullet + CH_3CH_2\bullet \rightarrow C_4H_{10}$
$CH_3CH_2\bullet + Br\bullet \rightarrow CH_3CH_2Br$ [1]

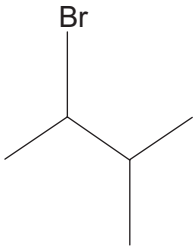
(b) **(i)** limited supply of oxygen [1]

(ii) $C_4H_{10} + 5O_2 \rightarrow CO_2 + 3CO + 5H_2O$ [1]

(c) **(i)** $2CH_2SH + 5\frac{1}{2}O_2 \rightarrow 2CO_2 + 2SO_2 + 3H_2O$ [2]

(ii) (carbon dioxide contributes to) increased greenhouse effect/global warming/rising sea levels/melting of the polar ice caps/flooding of low lying areas/climate change [1]
(sulfur dioxide contributes to) acid rain [1] [2] 10

12 (a) (i)

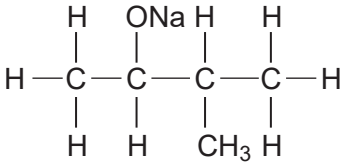


[1]

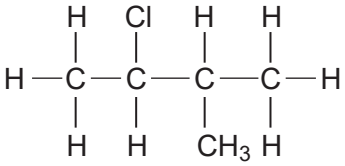
(ii) molecules which have the same molecular formula but a different structural formula [1]

(b) (i) nucleophilic substitution [1]

(ii)

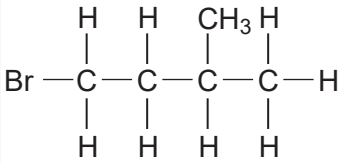
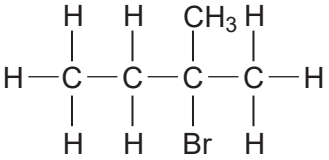


[1]



[1] [2]

(c)

Isomer	Name	Structural formula	Classification	Boiling point/°C
A			Primary	
B	2-bromopentane		Secondary	
C	2-bromo-2-methylbutane			

[1] per correct row [3]

(d) (i) 1-bromo-2,2-dimethylpropane [1]

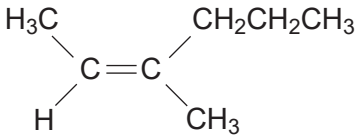
(ii) isomer **B** has no branching/isomer **D** is branched [1]
isomer **B** has greater van der Waals' forces between molecules [1] [2]

AVAILABLE MARKS

11

13 **(a)** **(i)** (restricted rotation about the) C═C [1]
different atoms/groups bonded to each carbon atom of C═C [1] [2]

AVAILABLE MARKS

(ii) 

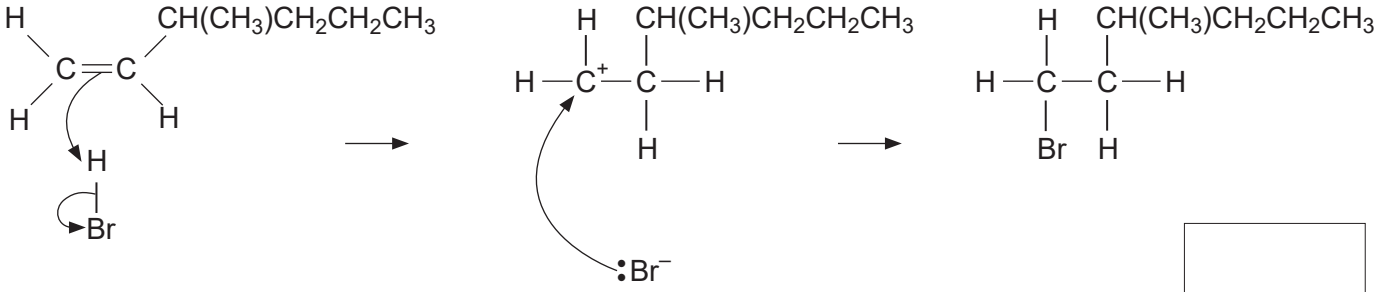
[1]

(b) **(i)** contains at least one C═C or C≡C bond [1]

(ii) bromine water [1]
yellow/orange/brown to colourless/decolourises [1] [2]

(c) **(i)** an ion or molecule that attacks regions of high electron density [1]

(ii)



[3]

(iii) minor product [1]
primary carbocation less stable (than secondary) [1] [2]

12

AVAILABLE MARKS

14 (a) (i) Indicative points:

- use a measuring cylinder to measure 50 cm^3 of potassium hydroxide solution and transfer into the polystyrene/paper cup
- record the temperature
- (use a second measuring cylinder to) measure 25 cm^3 of sulfuric acid and add to the potassium hydroxide (solution)
- stir and record the highest temperature reached
- calculate temperature change
- use $q = mc\Delta T$
- use q and moles of water to calculate ΔH

Band	Response	Mark
A	Candidates must use appropriate specialist terms including a minimum of 5 points of indicative content. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
B	Candidates must use appropriate specialist terms including a minimum of 3 points of indicative content. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
C	Candidates' brief and partial response includes a minimum of 2 points of indicative content. They use limited spelling, punctuation and grammar and they have made little use of specialist terms The form and style are of a limited standard.	[1]–[2]
D	A response not worthy of credit	[0]

[6]

(ii) the enthalpy change when one mole of water is produced in a neutralisation reaction under standard conditions [2]

(iii) $q = mc\Delta T = 75 \times 4.2 \times 9 = 2835\,J$
moles of water = 0.05
$\Delta H = \frac{2835}{0.05 \times 1000} = -56.7\ (kJ\ mol^{-1})$ [3]

(b) Energy required when bonds break
= 3(412) + (305) +3(386) + (N–N) + 2.5(496)
= 3939 + (N–N)

Energy released when bonds form
= (916) + 2(803) + 6(463)
= 5300

–1198 = 3939 + (N–N) – 5300
N–N = 163 ($kJ\ mol^{-1}$) [3]

			AVAILABLE MARKS
(c)	**(i)**	the enthalpy change for a reaction is independent of the route taken, provided the initial and final conditions are the same [2]	
	(ii)	$-557 = -51 + 2\Delta_f H^{\ominus}(NO_2) + 2(-286)$ $2\Delta_f H^{\ominus}(NO_2) = 66$ $\Delta_f H^{\ominus}(NO_2) = +33$ (kJ mol^{-1}) [3]	
	(iii)	oxygen is an element [1]	20

15 (a) (i) number of molecules [1]

(ii) no molecules have zero energy [1]

(iii) the minimum amount of energy required for a reaction to occur [1]

(iv) P as it is at a lower energy value [1]

(v) lower peak to right of original
starts at origin and crosses curve once [1]

(b) (i) rate increases [1]
molecules have greater energy so more successful collisions per unit time [1]

position of equilibrium moves to the left [1]
in endothermic direction (to remove heat) [1] [4]

(ii) yield decreases [1]
position of equilibrium moves to the left [1]
fewer gas moles on left/9 moles compared to 10 [1] [3]

(iii) provides an alternative reaction pathway of lower activation energy [1]

(iv) no effect [1]

(v) $K_c = \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$

units: mol dm^{-3} [2]

AVAILABLE MARKS

16

					AVAILABLE MARKS
16	**(a)**	**(i)**	compound 1 [1] metal carbonates react with acid to produce carbon dioxide gas [1]	[2]	
		(ii)	$Sr^{2+}(aq) + SO_4^{2-}(aq) \rightarrow SrSO_4(s)$	[2]	
		(iii)	bubble through limewater (changes from colourless to) milky	[1]	
	(b)	**(i)**	$BaCO_3 \rightarrow BaO + CO_2$	[1]	
		(ii)	Mg^{2+} has a higher charge density/smaller ion [1] carbonate ion is more polarised and destabilised by Mg^{2+} [1]	[2]	
	(c)		moles of $Ba(NO_3)_2 = \frac{3500}{261} = 13.41$ moles of gas = $\frac{13.41}{2} \times 5 = 33.525$ volume of gas = $33.525 \times 24 = 805\ dm^3$	[3]	11
				Section B	**80**
				Total	**90**