Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2023

Chemistry

Assessment Unit AS 2

assessing

Further Physical and Inorganic Chemistry
and an Introduction to Organic Chemistry

[SCH24]

TUESDAY 23 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 C	
2 B	
3 D	
4 B	
5 B	
6 A	
7 D	
8 C	
9 B	
10 B	
[1] for each correct answer	10
Section A	**10**

Section B

AVAILABLE MARKS

11 (a) $CaCO_3 + 2NaCl \rightarrow CaCl_2 + Na_2CO_3$ [2]

(b) (i) 34/181 × 100 = 18.8% [2]

(ii) $3.25 \times 10^6/53.5 = 6.075 \times 10^4$ moles NH_4Cl = moles NH_3

$6.075 \times 10^4 \times 17 = 1.033 \times 10^6$ g NH_3 = 1.033 tonnes NH_3

% yield = 0.92/1.033 × 100 = 89.1% [3] 7

12 (a) (i) a reaction in which all the reactants and products are not in the same physical state. [1]

(ii) the temperature is 200 °C/water boils at 100 °C. [1]

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

(ii) 25 × 4.2 × 5.5 = 577.5 J

577.5/1000 = 0.5775 kJ

moles K_2CO_3 = 2.5/138 = 0.0181

0.5775/0.0181 = –31.9 kJ mol^{-1} [3]

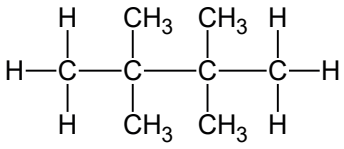
(iii) 2(29.1) – (–31.9) = +90.1 kJ [2] 9

13 (a) (i)

[1]

(ii) molecules which have the same molecular formula but a different structural formula [2]

(iii)



[1]

2,2,3,3–tetramethylbutane/tetramethylbutane [1] [2]

(b) (i) $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$ [2]

(ii) incomplete combustion occurs/high carbon content [1]

(iii) 5.00 dm^3 = 5000 cm^3

mass isooctane = 0.692 × 5000 = 3460 g

heat energy released = 3460 × 47.9 = 165734 = 166000 (kJ) [3]

					AVAILABLE MARKS
(c)	**(i)**	0.03% to 0.04%/0.01%		[1]	
	(ii)	global warming any acceptable alternative		[1]	
(d)	**(i)**	large surface area		[1]	
	(ii)	metal used is expensive		[1]	
	(iii)	$2NO + 2CO \rightarrow N_2 + 2CO_2$		[2]	
	(iv)	a substance which increases the rate of a chemical reaction but does not get used up		[1]	
	(v)	Maxwell-Boltzmann		[1]	
	(vi)	provides an alternative route of lower activation energy	[1]		
		more molecules have $E > E_A$/greater area under curve	[1]		
		more successful collisions per second	[1]	[3]	22
14 **(a)**		atomic radius increases down the group	[1]		
		outer electrons further from nucleus	[1]	[2]	
(b)	**(i)**	$2Mg + O_2 \rightarrow 2MgO$		[1]	
	(ii)	$O^{2-} + H_2O \rightarrow 2OH^-$	[1]		
		(formation of hydroxide ions) alkali is formed	[1]	[2]	
(c)	**(i)**	produces steam		[1]	
	(ii)	(bright) white light	[1]		
		white solid formed	[1]	[2]	
	(iii)	$Mg + H_2O \rightarrow MgO + H_2$		[1]	
	(iv)	it has low solubility/insoluble		[1]	
	(v)	0.08/24 = 0.00333 moles Mg = 0.00333 moles H_2			
		volume $H_2 = 0.00333 \times 24000 = 80\,cm^3$	[2]		
		not all Mg reacts/side reactions/impurities in Mg/some hydrogen dissolves	[1]	[3]	
(d)		$MgO + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$		[1]	14

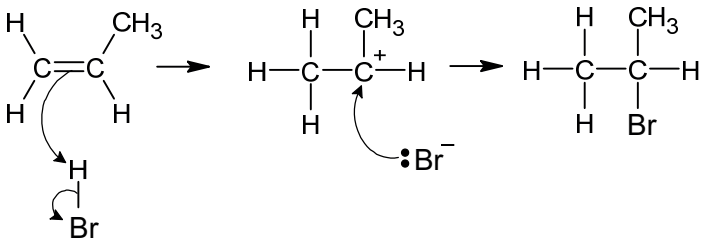
AVAILABLE MARKS

15 **(a)** **A** = electrophilic [1] addition [1]

B = nucleophilic [1] substitution [1] [4]

(b) **(i)** $C_3H_6 + HBr \rightarrow C_3H_7Br$ [1]

(ii) 2-bromopropane [1]

(iii) 

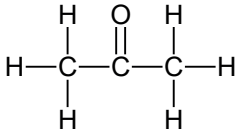
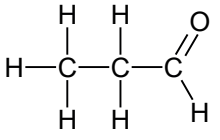
[3]

(c) **(i)** NaOH/KOH [1]

(ii) heat under reflux [1]

aqueous solution [1] [2]

(iii) elimination [1]

(d) **(i)**  [1]  [1] [2]

(ii) acidified potassium dichromate(VI) [1]

(e) **(i)** radical substitution [1]

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

(iii) $C_3H_8 + Cl\bullet \rightarrow C_3H_7\bullet + HCl$ [1]

$C_3H_7\bullet + Cl_2 \rightarrow C_3H_7Cl + Cl\bullet$ [1] [2]

(iv) $C_3H_7\bullet + Cl\bullet \rightarrow C_3H_7Cl$ [1]

(v) $2C_3H_7\bullet \rightarrow C_6H_{14}$ [1]

(f) Indicative content

- butan-1-ol has the highest boiling point
- pentane has the lowest boiling point
- butan-1-ol – van der Waals' forces and permanent dipole dipole attractions/hydrogen bonding between the molecules
- butanal – permanent dipole dipole attractions and van der Waals' forces between the molecules
- pentane – van der Waals' forces between the molecules
- hydrogen bonds are stronger than permanent dipole dipole attractions, which are stronger than van der Waals' forces
- more energy needed to break the stronger intermolecular forces

Band	Response	Mark
A	Candidates must use appropriate specialist terms including a minimum of 6 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 4 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	Response not worthy of credit	[0]

[6] 28

Section B **80**

Total **90**

AVAILABLE MARKS