



Rewarding Learning

**ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2019**

Chemistry

Assessment Unit AS 2

assessing

Further Physical and Inorganic Chemistry
and an Introduction to Organic Chemistry

[SCH22]

THURSDAY 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: <ul style="list-style-type: none">• 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) <ul style="list-style-type: none">• 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

- 1 B
- 2 A
- 3 A
- 4 C
- 5 D
- 6 A
- 7 D
- 8 A
- 9 D
- 10 C

[1] for each correct answer

**AVAILABLE
MARKS**

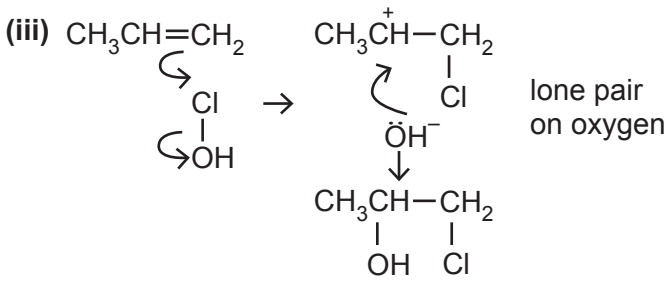
10

Section A

10

Section B

**AVAILABLE
MARKS**

- 11 (a) (i)** $\text{Ca} + 2\text{HNO}_3 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2$ [1]
- (ii)** $\text{CaO} + 2\text{HNO}_3 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O}$ [1]
- (iii)** $\text{CaCO}_3 + 2\text{HNO}_3 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O} + \text{CO}_2$ [1]
- (b)** $\text{Mg} + 4\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + 2\text{NO}_2 + 2\text{H}_2\text{O}$ [1]
- (c) (i)** resistance to decomposition at high temperature [1]
- (ii)** the metal cation is larger and polarises the nitrate ion less [1]
- (d) (i)** the metal oxide (is basic) and forms a soluble hydroxide [1]
- (ii)** $\text{Sr}(\text{NO}_3)_2 = 88 + 2 \times 14 + 6 \times 16 = 88 + 28 + 96 = 212$
 $3.6 \text{ g} = 3.6/212 = 0.01698 = 0.017 \text{ mol}$
 2 mol of nitrate gives 5 mol of gas
 1 mol of nitrate gives 2.5 mol of gas
 $0.017 \text{ mol gives } 0.017 \times 2.5 = 0.0425 \text{ mol of gas} = 0.0425 \times 24 \text{ dm}^3$
 $= 1.02 \text{ dm}^3 = 1.0 \text{ dm}^3$ [3]
- (iii)** nitrogen(IV) oxide is a strongly acidic oxide [1] oxygen [1] [2]
- (e) (i)** points accurately plotted [1]
- (ii)** $35^\circ\text{C} \pm 2^\circ\text{C}$ error [1]
- 12 (a) (i)** bonds broken: $\text{C}=\text{C} + \text{O}-\text{Cl} = 612 + 272 = +884 \text{ kJ}$
 bonds formed: $\text{C}-\text{Cl} + \text{C}-\text{O} + \text{C}-\text{C} = 346 + 358 + 347 = -1051 \text{ kJ}$
 enthalpy of reaction = $+884 - 1051 = -167 \text{ kJ}$ [3]
- (ii)** exothermic reaction with reactants and products labelled
 value of -167 kJ inserted [2]
- (b) (i)** a covalent bond in which there is unequal sharing of the bonding
 electrons [2]
- (ii)** $\delta^- \delta^+$
 $\text{HO}-\text{Cl}$ [1]
- (iii)**  [3]
- for mechanism [3]
 for 3 curly arrows [1] [4]
- (iv)** 1-chloropropan-2-ol or 1-chloro-2-hydroxypropane [2]
- (v)** $\text{CH}_2\text{OHCHClCH}_3$ [1] the (primary) carbocation is less stable/
 the secondary carbocation is more stable [1] [2]

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(vi) the nitrite ion reacts with the carbocation [1]

(c) (i) two reactive groups are present [1]

(ii) $\text{CH}_2\text{ClCHClCH}_3$ [1]
 $\text{CH}_2\text{CNCHOHCH}_3$ [1]
 $\text{CH}_2\text{OHCHOHCH}_3$ [1]
 $\text{CH}_2\text{ClCHBrCH}_3$ [1] [4]

13 (a) (i) 2.42 g dissolves in 1000 cm^3 of water; $2.42/5 = 0.484\text{ g}$ dissolves in 200 cm^3 of water; (0.484 g is about half of 1.1 g) [2]
density of terpineol = 0.93; hence $1.1\text{ g} = 1.1/0.93 = 1.18 = 1.2\text{ cm}^3$
0.616 g undissolved
0.662 cm^3 floats on top [2]
the density of terpineol is less than that of water
hence half of it disappears/dissolves and the rest floats on the surface [2]
to a maximum of [4] [4]

(ii) Indicative content

- add to a separating funnel, allow to settle
- run off the lower layer of water
- add the terpineol to a distillation flask and distil off the water
- collect the terpineol at $214\text{--}216\text{ }^\circ\text{C}$
- add anhydrous sodium sulfate
- leave until clear
- decant/filter off

| Band | Response | Mark |
|------|---|---------|
| A | Candidates must use appropriate specialist terms using a minimum of 7 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 5 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 3 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]

(b) (i) groups of atoms within a molecule absorb infrared radiation because bonds vibrate at characteristic frequency/molecular vibrations [2]

(ii) 1600 or 1700 $\text{ C}=\text{C}$ (for alkene) [1]
3200–3600 $\text{ O}-\text{H}$ for alcohol [1] [2]

(iii) compare the IR spectrum of pure terpineol with the impure, if they are the same the sample is pure [1]

(c) (i) it is tertiary [1] the carbon, attached to the —OH is attached to three carbon atoms [1] [2]

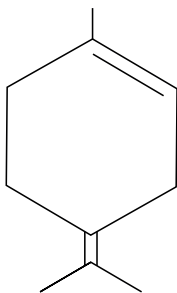
AVAILABLE
MARKS

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(ii) the orange colour remains, there is no change

[1]

(d)



[1]

(e) (i) contains at least one C=C or C≡C

[1]

(ii) add the unsaturated compound to bromine water [1] and shake [1]
the orange colour disappears/goes colourless [1]

[3]

(iii) adding hydrogen to a C=C [1] using nickel [1]

[2]

(iv) $C_{15}H_{24} = 15 \times 12 + 24 \times 1 = 180 + 24 = 204$

$$0.34 \text{ g} = 0.34/204 = 0.00166 \text{ mol}$$

$$80 \text{ cm}^3 = 80/24000 = 0.00333 \text{ mol}$$

$$\text{the ratio of moles} = 0.00333/0.00166 = 2$$

hence there are 2 double bonds in one molecule of cadinene

[3]

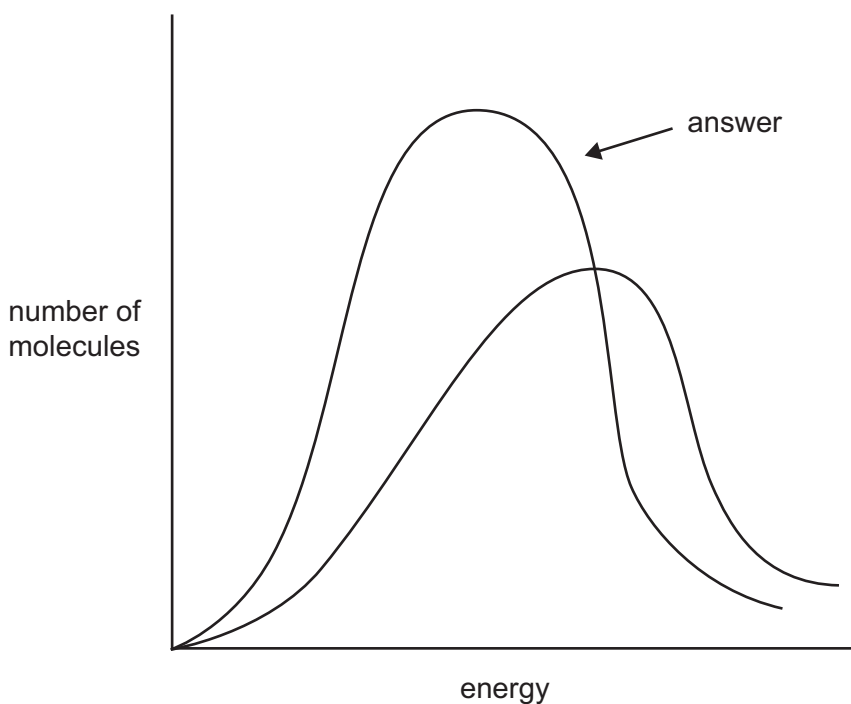
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14 (a) the curve is to the left

the peak is higher

It runs roughly parallel to the original but does not cross far to the right

It does not touch the x-axis



[-1] each error

[2]

| | | | |
|---|------------------|----------------------------|-----------|
| (b) a moving molecule has energy | [1] | AVAILABLE MARKS | |
| (c) at 0,0 there are zero molecules with zero energy | [1] | | |
| (d) no molecules have an energy higher than this value | [1] | | |
| (e) (i) the minimum amount of energy required for a reaction to occur | [2] | | |
| (ii) very fast [1] very low activation energy [1] | [2] | | |
| (iii) (the activation energy) is lowered | [1] | | |
| (f) (i) Contact process | [1] | | |
| (ii) 450 °C [1] reaction is exothermic but high temperature for speed [1] 1–2 atm [1] high pressure should be used but conversion % is high [1] vanadium pentoxide [1] (effective or not poisoned by arsenic) | [5] | | |
| | Section B | | 16 |
| | Total | | 80 |
| | | 90 | |