

GCE
AS and A Level

Chemistry

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 2: **Specimen mark scheme**

Version 1.1





General Certificate of Education

Chemistry 2420

CHEM2 Chemistry In Action

Mark Scheme

Specimen Paper

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. The specimen assessment materials are provided to give centres a reasonable idea of the general shape and character of the planned question papers and mark schemes in advance of the first operational exams.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Question 1

- (a) The enthalpy change when 1 mol of a compound is completely burnt in oxygen under standard conditions, or 298K and 100kPa (1)
(1)
(1)
- (b) (i) $\text{C}_2\text{H}_6 + 3\frac{1}{2}\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$ (1)
- (ii) $\Delta H = 2 \times \Delta H_f^\ominus(\text{CO}_2) + 3 \times \Delta H_f^\ominus(\text{H}_2\text{O}) - \Delta H_f^\ominus(\text{C}_2\text{H}_6)$ (1)
 $= -788 - 858 - (-85)$ (1)
 $= -1561 \text{ kJ mol}^{-1}$ (1)
- (c) moles methane = $\frac{0.10}{16} = 6.25 \times 10^{-3}$ (1)
 kJ evolved = $6.25 \times 10^{-3} \times 890 = 5.56$ (1)
 $5.56 \times 10^3 \text{ joules} = (mc)\Delta T$ (1)
 $\Delta T = \frac{5.56 \times 10^3}{120} = 46.4 \text{ K}$ (1)

Question 2

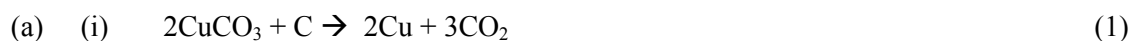
- (a) Peak lower (1)
 and moved to right (1)
 start at the origin and curve crosses once only (1)
- (b) (i) (Rate of reaction) increases (1)
 (At a higher temperature) more molecules/particles (1)
 have the minimum energy needed to react/have activation energy/have successful collisions (1)
Mark CE if incorrect effect given
- (ii) (Rate of reaction) increases (1)
 lowers activation energy (1)
 so that more molecules are able to react (1)
Mark CE if incorrect effect given (1)

Question 3

- (a) Low temperature
 Reaction is exothermic (1)
 Low T reduces effect of heat evolved
or heat evolved opposes the change in temperature (1)
- High pressure
 3 mol gas \rightarrow 1 mol gas (1)
 High p favours fewer moles by lowering p
or forward reaction reduces volume and lowers p (1)
- (b) High T gives a low yield (1)
but Low T gives a low rate \therefore compromise (1)
- increases reaction rate/catalyst surface contact (1)

Question 4

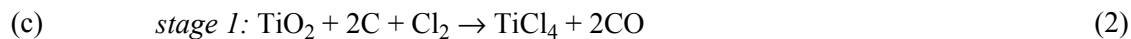
- (a) Gain of electrons (1)
- (b) (i) (+)5 or V or N⁵⁺ (1)
 (+)4 or IV or N⁴⁺ (1)
 (+)2 or II or N²⁺ (1)
- (ii) Reduction (1)
- $4\text{H}^+ + \text{NO}_3^- + 3\text{e}^{(-)} \rightarrow \text{NO} + 2\text{H}_2\text{O}$ (1)
- (iii) $2\text{H}^+ + \text{NO}_3^- + \text{e}^{(-)} \rightarrow \text{NO}_2 + \text{H}_2\text{O}$ (1)
- (iv) $\text{Cu} + 4\text{H}^+ + 2\text{NO}_3^- \rightarrow \text{Cu}^{2+} + 2\text{H}_2\text{O} + 2\text{NO}_2$ (1)
 species (1)
 balanced (1)
 If electrons included, **mark CE if these are not balanced** (1)

Question 5

(ii) Charcoal /carbon /C (1)

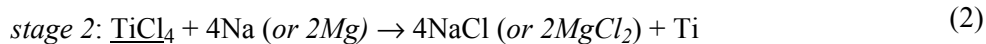
(b) (i) Iron is more reactive / iron ore needs much more heat to extract the iron (1)

Carbon monoxide (1)



(C + Cl₂ in incorrect equation gains 1 mark)

allow equations with $+ \text{C} \rightarrow \text{CO}_2$



(Na or Mg in unbalanced equation gains 1 mark)

(d) *Extraction: form metal oxide* (1)
Or metal oxide implied

reduce **or** react with suitable reducing agent (1)
Consequential on formation of metal oxide

Pollution problems: SO₂ (1) or oxides of S not SO₃ alone (1)
(allow any sensible and correct reducing agent identified)

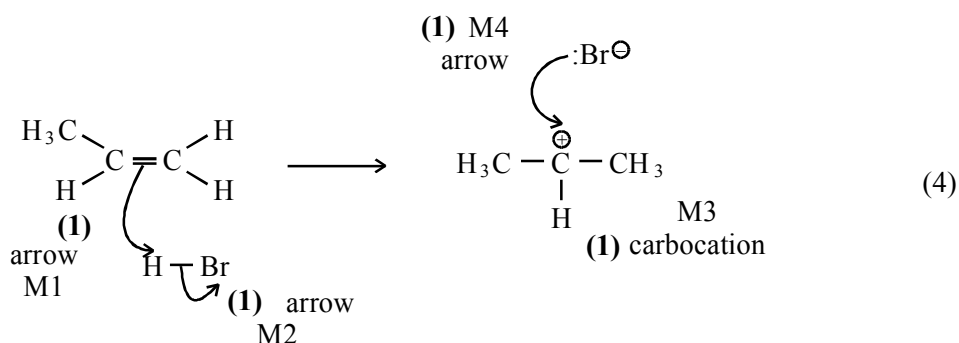
any mention of acid rain (1)
or H₂SO₄
or erosion caused by acid rain
or correct problem due to acid rain

Question 6

- (a) *Trend:* increases (1)
Wrong trend CE=0 and in (b)
- Reason:* More electron shells (1)
OR implies more shell / sub-shells / levels
- (b) *Trend:* decreases (1)
- Explanation:* Metallic bonds weaker (1)
OR weaker attraction between ions (or nuclei) & delocalised electrons
- Atoms (ions) larger (1)
This mark is only scored if previous mark given. **CE if mention molecules, intermolecular forces ionic bonding**
- (c) *Trend:* increases (1)
- Equation for magnesium:* $\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2$ (1)
- Equation for strontium:* $\text{Sr} + 2 \text{H}_2\text{O} \rightarrow \text{Sr}(\text{OH})_2 + \text{H}_2$ (1)
- (d) *Formula:* BaSO_4 (1)
- Use:* Test for sulfate ion (1)
OR Pigment, for x-rays, barium meal, paint

Question 7

(a) (i)



If wrong carbocation, lose structure mark
 If wrong alkene, lose structure mark
 Can still score $\frac{3}{4}$ i.e. penalise M3
 Penalise M2 if polarity included incorrectly
 no bond between H and Br
 bond is shown as $\overset{\cdot}{\text{H}}-\overset{\cdot}{\text{Br}}$ or $\overset{\cdot}{\text{H}}-\overset{\cdot}{\text{Br}}$

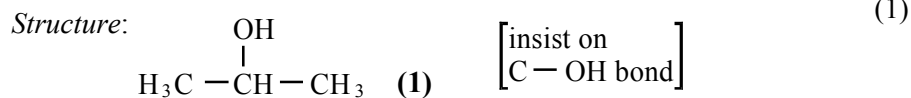
(ii)



credit secondary carbocation here if primary carbocation has been used in (i)

Ignore attack on this carbocation by $\ddot{\text{Br}}^\ominus$

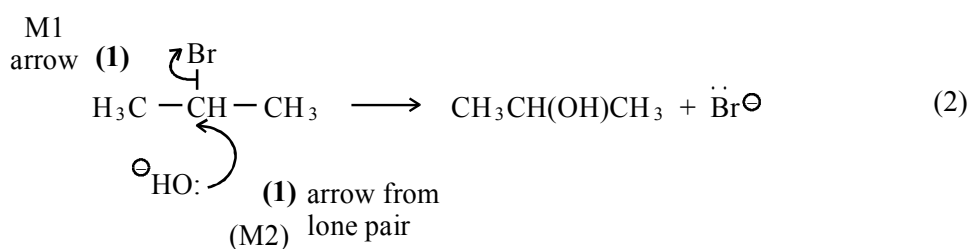
(b) (i)



Name: propan-2-ol (1)
Not 2-hydroxypropane

(ii) Name of mechanism: nucleophilic substitution (both words) (1)
 (NOT $\text{S}_{\text{N}}1$ or $\text{S}_{\text{N}}2$)

Mechanism:



penalise incorrect polarity on C-Br (M1)

Credit the arrows even if incorrect haloalkane

If $\text{S}_{\text{N}}1$, both marks possible

(c) (i) elimination (1)

(ii) base (1)
 OR proton acceptor
 NOT nucleophile

Question 8

Mark Range	<p>The marking scheme for this part of the question includes an overall assessment for the Quality of Written Communication (QWC). There are no discrete marks for the assessment of QWC but the candidates' QWC in this answer will be one of the criteria used to assign a level and award the marks for this part of the question</p> <p style="text-align: center;">Descriptor</p> <p style="text-align: center;">an answer will be expected to meet most of the criteria in the level descriptor</p>
4-5	<ul style="list-style-type: none"> - claims supported by an appropriate range of evidence - good use of information or ideas about chemistry, going beyond those given in the question - argument well structured with minimal repetition or irrelevant points - accurate and clear expression of ideas with only minor errors of grammar, punctuation and spelling
2-3	<ul style="list-style-type: none"> - claims partially supported by evidence - good use of information or ideas about chemistry given in the question but limited beyond this - the argument shows some attempt at structure - the ideas are expressed with reasonable clarity but with a few errors of grammar, punctuation and spelling
0-1	<ul style="list-style-type: none"> - valid points but not clearly linked to an argument structure - limited use of information or ideas about chemistry - unstructured - errors in spelling, punctuation and grammar or lack of fluency

- (a) Kills bacteria / prevents bacterial diseases QWC (1)
 Chlorine is a toxic substance (1)
 $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{HClO}$ (1)
- (b) $\text{Cl}_2(\text{aq})$ to $\text{Br}^-(\text{aq})$; yellow-orange or yellow-red or yellow-brown solution QWC (1)
 $2\text{Br}^- + \text{Cl}_2 \rightarrow 2\text{Cl}^- + \text{Br}_2$ (1)
 or molecular equation
- $\text{Cl}_2(\text{aq})$ to $\text{I}^-(\text{aq})$; brown/black solution formed or black/brown/grey ppt/solid QWC (1)
 $2\text{I}^- + \text{Cl}_2 \rightarrow 2\text{Cl}^- + \text{I}_2$ (1)
or molecular equation
- (c) Bromide:- Brown/orange fumes (1)

	Bromine produced	(1)
	Sulphur dioxide produced	(1)
Iodide:-	Purple fumes or black/brown/grey solid QWC or smell of bad eggs	(1)
	Iodine produced	(1)
	SO ₂ , S, H ₂ S produced (one mark each)	(3)
Half-equations	2Br ⁻ → Br ₂ + 2e ⁻	(1)
	OR 2I ⁻ → I ₂ + 2e ⁻	
	H ₂ SO ₄ + 2e ⁻ + 2H ⁺ → SO ₂ + 4H ₂ O	(1)
	OR H ₂ SO ₄ + 6e ⁻ + 6H ⁺ → S + 4H ₂ O	
	OR H ₂ SO ₄ + 8e ⁻ + 8H ⁺ → H ₂ S + 4H ₂ O	
Overall equation	Any correct equation based on half-equations	QWC (1)

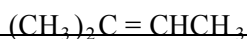
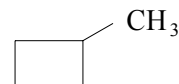
Question 9

- (a) Allow 1 mark each for any correctly drawn primary, secondary and tertiary alcohol of molecular formula C₄H₈O (3)
- Tertiary alcohol cannot be oxidised (1)

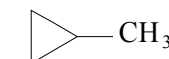
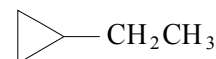
- (b) Region 1500–400 cm⁻¹ (1)
- exact match to spectrum of known compound (1)

- (c) **A** CH₃CH₂CH₂OH or CH₃CH(OH)CH₃ (1)
- B** CH₃CH₂-O-CH₃ (1)

- C** one alkene e.g. (6)
- D** one cycloalkane e.g. (6)



(1)

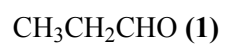


(1)

etc
9



E



F

