

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

**MARK SCHEME for the October/November 2009 question paper
for the guidance of teachers****9701 CHEMISTRY****9701/22**

Paper 22 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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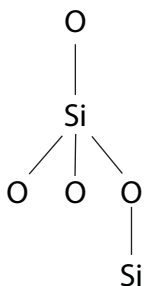
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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	22

- 1 (a) CO₂ is simple molecular/simple covalent/has discrete molecules (1)
 CO₂ has induced dipole – induced dipole interactions/ (1)
 van der Waals' forces/weak intermolecular forces (1)
 SiO₂ is giant molecular/giant covalent/macromolecular (1)
 SiO₂ has strong covalent bonds (1)
 [any 3]

- (b) minimum is 4-valent Si-O (1)
 and at least one Si-O-Si (1)
 i.e.



[2]

- (c) (i) for an ideal gas, **any four** from the following (1)
 the molecules behave as rigid spheres (1)
 there are no/negligible intermolecular forces (1)
 between the molecules (1)
 collisions between the molecules are perfectly elastic (1)
 the molecules have no/negligible volume (1)
 the molecules move in random motion (1)
 the molecules move in straight lines (1)
 the kinetic energy of the molecules is (1)
 directly proportional to the temperature (1)
 the pressure exerted by the gas is due to the collisions (1)
 between the gas molecules and the walls of the container (1)
not an ideal gas obeys $pV = nRT$ (1)
 (max 4)

- (ii) there are intermolecular forces between CO₂ molecules/ (1)
 CO₂ molecules have volume (1) [5]

- (d) graphite has delocalised electrons (1) [1]

- (e) (i) SiO₂ + 2C → SiC + CO₂ **or** (1)
 SiO₂ + 3C → SiC + 2CO (1)

- (ii) diamond **because** SiC is hard (1) [2]

[Total: 13]

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	22

2 (a) (i)

formula of chloride	NaCl	MgCl_2	AlCl_3	SiCl_4	PCl_3	SCl_2
oxidation number of element in the chloride	+1	+2	+3	+4	+3	+2

correct oxidation nos. for NaCl to SCl_2 (1)**(ii) Na to Al**

loss of outer/valence electrons (1)

to give configuration of Ne/to complete octet (1)

Si to S

gain or sharing of outer electrons (1)

to give configuration of Ar/to complete octet (1) [5]

(b) (i) giant lattice (may be in diagram) (1)
with strong ionic bonding (1)**(ii)** ionic (1)**(iii)** -1 (1)**(iv)**
$$\begin{array}{ccc} \dots + & & - \\ : \text{Na} : & & \times \cdot \text{H} \\ \dots & & \end{array}$$

correct numbers of electrons (1)

correct charges (1)

(v)

compound	MgH_2	AlH_3	PH_3	H_2S
oxidation number of element in the hydride	+2	+3	-3	-2

correct oxidation nos. for MgH_2 and AlH_3 (1)correct oxidation nos. for PH_3 and H_2S (1) [8]**(c) (i)**

chloride	sodium	magnesium	aluminium
pH	7	6.5–6.9	1–4

(no mark)

(1)

(1)

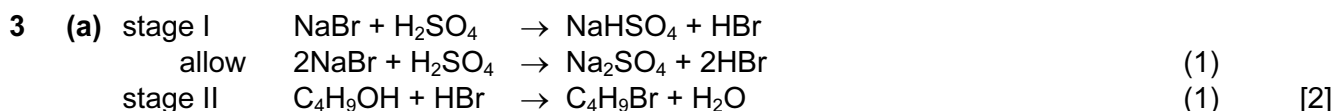
(ii) $\text{NaH} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2$ (1)**(iii)** 10–14 (1) [4]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	22

(d) (i) covalent (1)



[Total: 19]

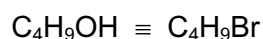


(b) $n(\text{NaBr}) = n(\text{HBr}) = \frac{35}{103} = 0.34$ (1)

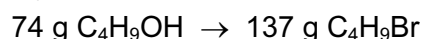
$n(\text{C}_4\text{H}_9\text{OH}) = \frac{20}{74} = 0.27$ (1)

NaBr/HBr is in an excess – no mark just for this answer [2]

(c) method 1, using mass



if yield is 100%,



$15.4 \text{ g C}_4\text{H}_9\text{OH}$ would produce $\frac{137 \times 15.4}{74} = 28.5 \text{ g C}_4\text{H}_9\text{Br}$ (1)

$\% \text{ yield} = \frac{22.5 \times 100}{28.5} = 78.9$ (1)

or methods using moles

method 2

$n(\text{C}_4\text{H}_9\text{OH}) = \frac{15.4}{74} = 0.208$

for 100% yield $n(\text{C}_4\text{H}_9\text{Br})$ would be $0.208 \times 137 = 28.5\text{g}$ (1)

$\% \text{ yield} = \frac{22.5 \times 100}{28.5} = 78.9$ (1)

method 3

$n(\text{C}_4\text{H}_9\text{OH}) = \frac{15.4}{74} = 0.208 \text{ mol}$

for 100% yield $n(\text{C}_4\text{H}_9\text{Br})$ would be 0.208 mol

actual $n(\text{C}_4\text{H}_9\text{Br}) = \frac{22.5}{137} = 0.164 \text{ mol}$ (1)

$\% \text{ yield} = \frac{0.164 \times 100}{0.208} = 78.8$ (1) [2]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	22

(d) inorganic by-productBr₂/bromine or sulfur dioxide/SO₂

(1)

conc. H₂SO₄ behaves as an oxidising agent

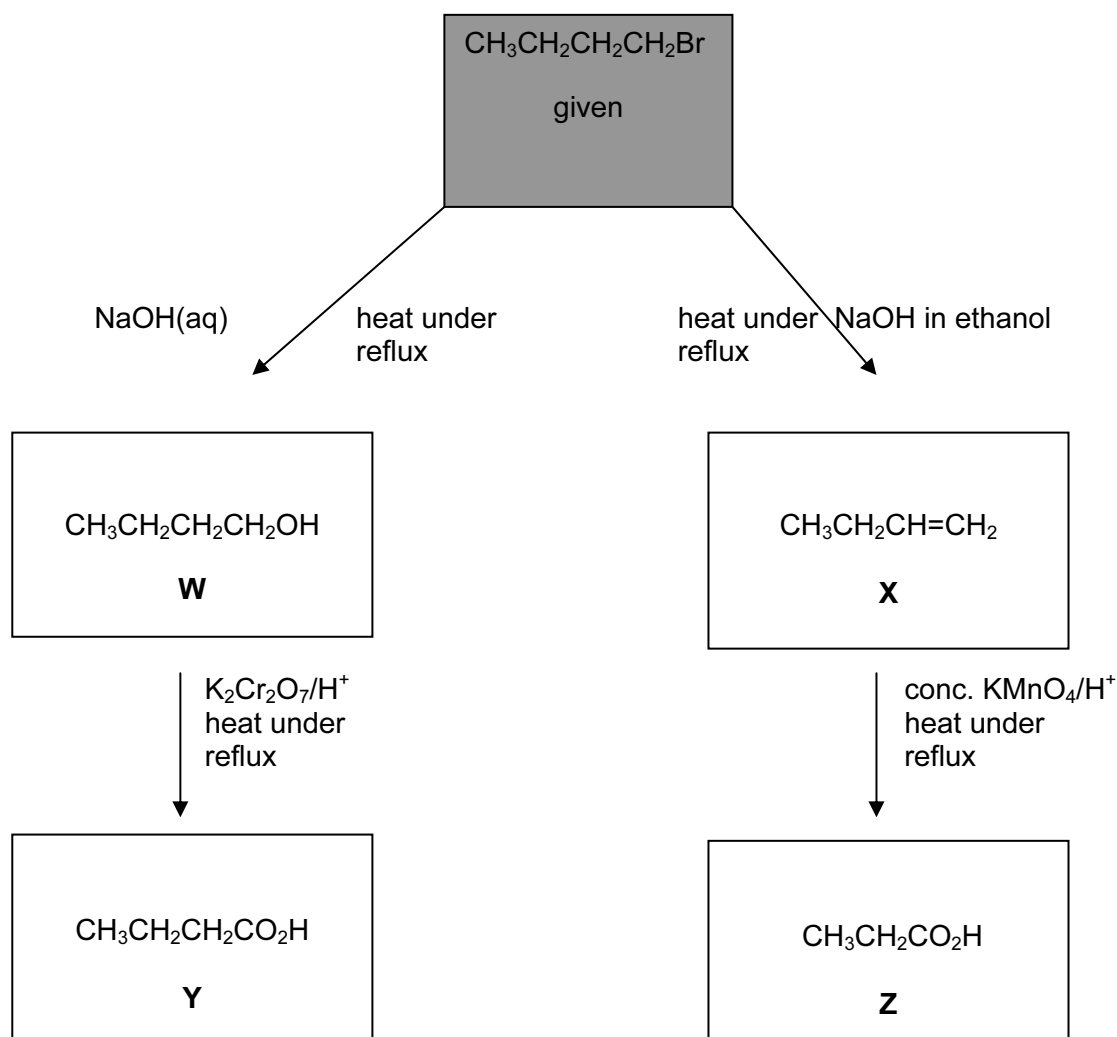
(1)

organic by-productbut-1-ene/CH₃CH₂CH=CH₂allow butane and C₄H₉OC₄H₉

(1)

conc. H₂SO₄ behaves as a dehydrating agent

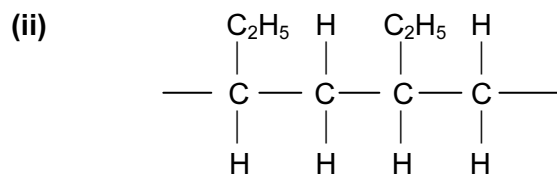
(1) [4]

[Total: 10]**4 (a)**

(4 × 1) [4]

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	22

(b) (i) X
allow ecf on any alkene above (1)



allow ecf on any alkene above (1) [2]

[Total: 6]

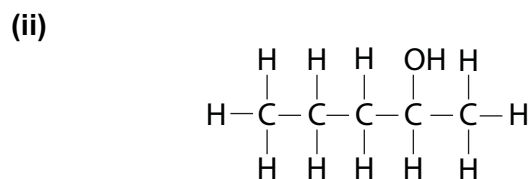
5 (a) 2,4-dinitrophenylhydrazine or aqueous alkaline iodine (1)

\downarrow
 yellow-orange-red ppt. \downarrow
 yellow ppt. (1) [2]

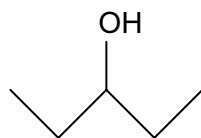
(b) colourless gas evolved or Na dissolves (1)



(c) (i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ (1)



(iii)



(1) [3]

(d) (i) pentan-2-ol (1)

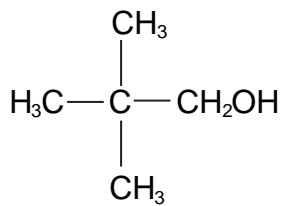
(ii)

$\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_3$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$
product 1	product 2

(1 + 1) [3]

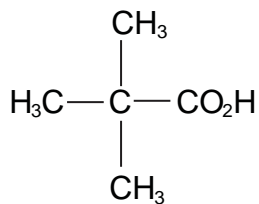
Page 7	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9701	22

(e) (i)



or $\text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{OH}$ (1)

(ii)



or $\text{CH}_3\text{C}(\text{CH}_3)_2\text{CO}_2\text{H}$

allow ecf on (e)(i)

(1) [2]

[Total: 12]