

**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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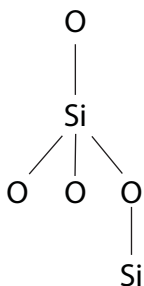
CIE is publishing the mark schemes for the October/November 2009 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



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- 1 (a) CO<sub>2</sub> is simple molecular/simple covalent/has discrete molecules (1)  
CO<sub>2</sub> has induced dipole – induced dipole interactions/ (1)  
van der Waals' forces/weak intermolecular forces (1)  
SiO<sub>2</sub> is giant molecular/giant covalent/macromolecular (1)  
SiO<sub>2</sub> 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  $pV = nRT$

(max 4)

- (ii) there are intermolecular forces between CO<sub>2</sub> molecules/ (1)  
CO<sub>2</sub> molecules have volume (1) [5]

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

- (e) (i) SiO<sub>2</sub> + 2C → SiC + CO<sub>2</sub> **or** (1)  
SiO<sub>2</sub> + 3C → SiC + 2CO (1)

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

[Total: 13]

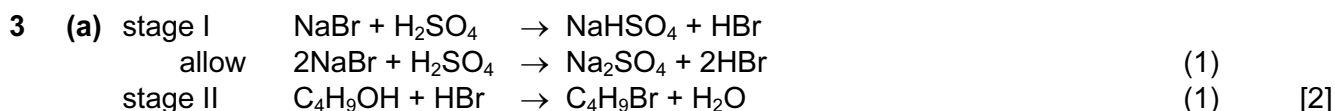


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(d) (i) covalent (1)



[Total: 19]

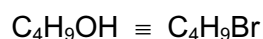


(b)  $n(\text{NaBr}) = n(\text{HBr}) = \frac{35}{103} = 0.34$  (1)

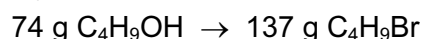
$n(\text{C}_4\text{H}_9\text{OH}) = \frac{20}{74} = 0.27$  (1)

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  $0.208 \text{ mol}$

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]

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(d) inorganic by-product

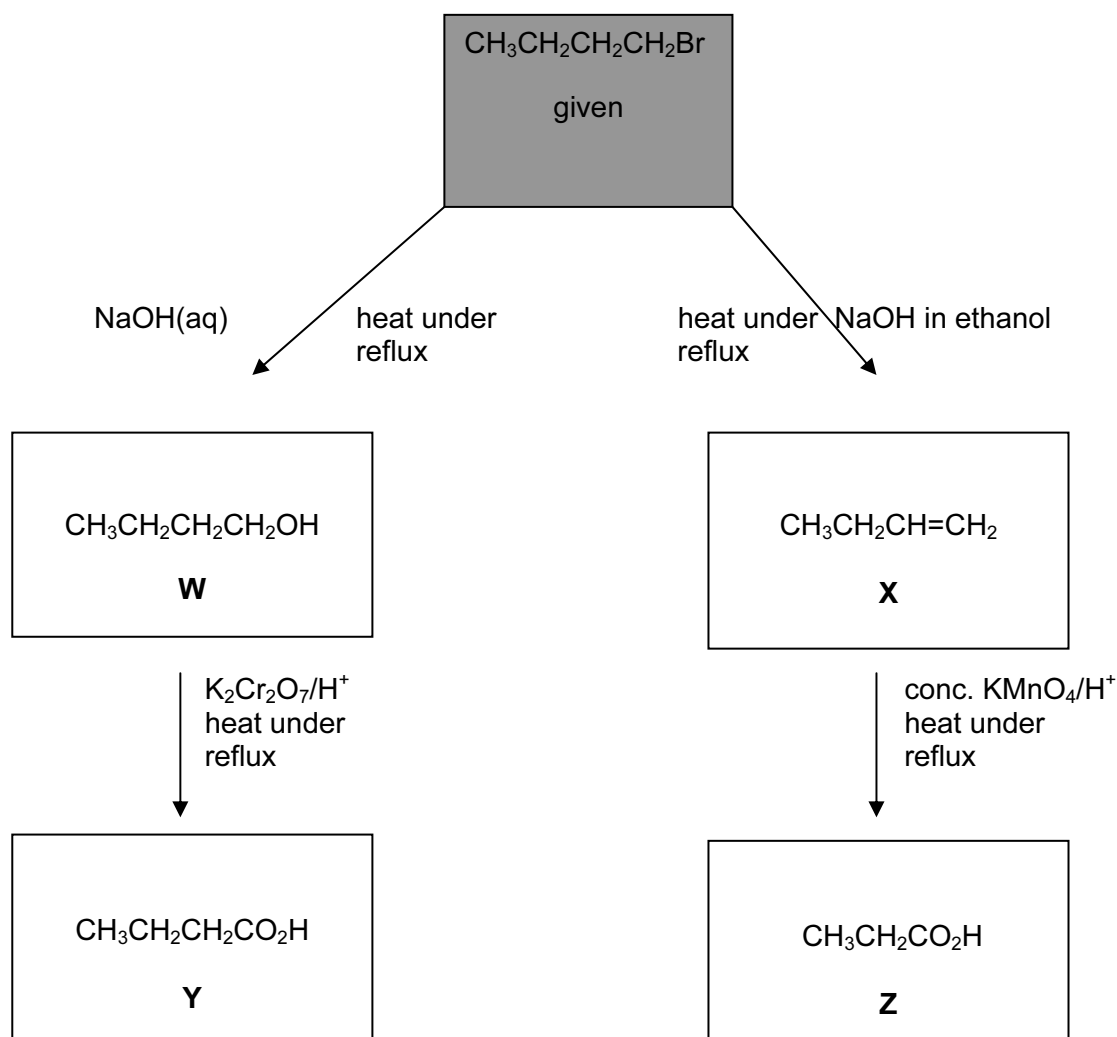
Br<sub>2</sub>/bromine or sulfur dioxide/SO<sub>2</sub> (1)  
 conc. H<sub>2</sub>SO<sub>4</sub> behaves as an oxidising agent (1)

organic by-product

but-1-ene/CH<sub>3</sub>CH<sub>2</sub>CH=CH<sub>2</sub> (1)  
 allow butane and C<sub>4</sub>H<sub>9</sub>OC<sub>4</sub>H<sub>9</sub> (1) [4]  
 conc. H<sub>2</sub>SO<sub>4</sub> behaves as a dehydrating agent (1)

[Total: 10]

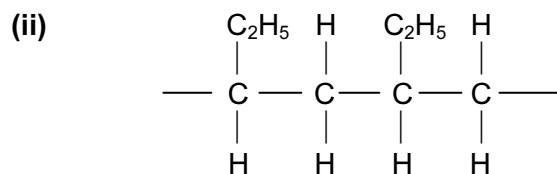
4 (a)



(4 × 1) [4]

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



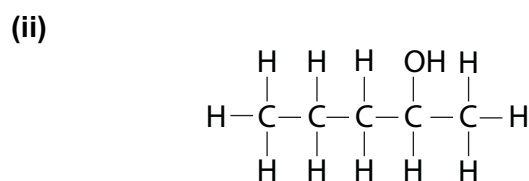
allow ecf on any alkene above (1) [2]

[Total: 6]

5 (a) 2,4-dinitrophenylhydrazine or aqueous alkaline iodine (1)  
↓ ↓  
 yellow-orange-red ppt. yellow ppt. (1) [2]

(b) colourless gas evolved or Na dissolves (1)  
 $\text{C}_4\text{H}_9\text{OH} + \text{Na} \rightarrow \text{C}_4\text{H}_9\text{ONa} + \frac{1}{2}\text{H}_2$  (1) [2]

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

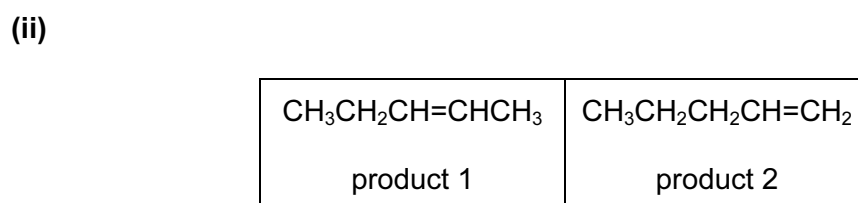


(iii)



(1) [3]

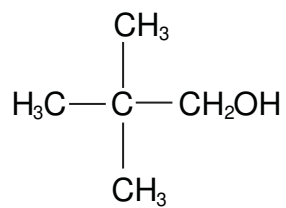
(d) (i) pentan-2-ol (1)



(1 + 1) [3]

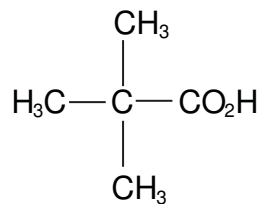
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(e) (i)



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]