

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2007 question paper

9701 CHEMISTRY

9701/02

Paper 2 (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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.


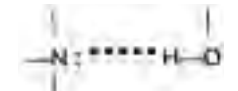
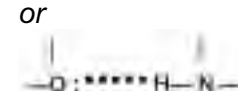
Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



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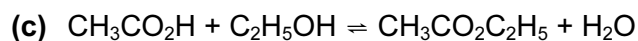
- 1 (a) (i) between 117° and 120° [1]
- (ii)  [1]
 14 electrons must be shown [1]
 single N-N bond [1]
 lone pair on each N atom [1]
- (iii) between 107° and 109° [1] [4]
- (b) ethene – van der Waals' forces [1]
 hydrazine – hydrogen bonds [1]
 hydrogen bonds are stronger [1]
 or van der Waals' forces are weaker [3]
- (c) correct dipole on O—H and N—H bonds [1]
 labelled hydrogen bond shown [1]
 between an O atom of H_2O and a H atom of N_2H_4
 or between an N atom of N_2H_4 and a H atom of H_2O [1]
 lone pair on O atom or on N atom *in the H bond*
- i.e. 
 or  [1] [3]
- (d) (i) $CH_2 = CH_2 + HCl \rightarrow CH_3CH_2Cl$ [1]
 (ii) electrophilic addition [1]
 (iii) there is no further unsaturation [1]
 or CH_3CH_2Cl molecule is saturated [1]
 or no possibility of addition [1]
 or no free radicals are present [3]
- (e) (i) acid – base/neutralization [1]
 (ii) N atom has a lone pair of electrons [1]
 or N atom can behave as a base [1]
 or N atom can form dative bond [1]
 (iii) each N atom has a lone pair [1]
 or each nitrogen atom can behave as a base [1]
 or each nitrogen atom can form a dative bond [3]

[Total: 16]

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- 2 (a) rate of forward reaction equals
rate of backward reaction
or equilibrium concentrations remain constant
while reaction is occurring [1] [1]

(b)
$$K_c = \frac{[\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5][\text{H}_2\text{O}]}{[\text{CH}_3\text{CO}_2\text{H}][\text{C}_2\text{H}_5\text{OH}]}$$
 [1] [1]



initial moles	0.5	0.5	0.1	0.1	
equil. moles	$(0.5 - x)$	$(0.5 - x)$	$(0.1 + x)$	$(0.1 + x)$	[1]
equil. concn./ mol dm ⁻³	$\frac{(0.5 - x)}{V}$	$\frac{(0.5 - x)}{V}$	$\frac{(0.1 + x)}{V}$	$\frac{(0.1 + x)}{V}$	

$$K_c = \frac{(0.1 + x)^2}{(0.5 - x)^2} = 4$$
 [1]

gives $x = 0.3$ [1]

$n(\text{CH}_3\text{CO}_2\text{H}) = n(\text{C}_2\text{H}_5\text{OH}) = 0.2$ and

$n(\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5) = n(\text{H}_2\text{O}) = 0.4$ [1]

allow ecf on wrong equil. moles subject to $x < 0.5$ [4]

(d)

alcohol reagent(s) and conditions	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$	$(\text{CH}_3)_3\text{COH}$
red phosphorus and iodine heat under reflux	X	$\begin{array}{c} \text{CH}_3\text{CH}_2\text{CHCH}_3 \\ \\ \text{I} \end{array}$ [1]	X
concentrated H_2SO_4 heat	X	X	$\begin{array}{c} \text{CH}_3-\text{C}=\text{CH}_2 \\ \\ \text{CH}_3 \end{array}$ [1]
$\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$ heat under reflux	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$ [1]	$\text{CH}_3\text{CH}_2\text{COCH}_3$ [1]	no reaction [1]

[Total: 11]

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3 (a)

	1s	2s	2p	3s	3p	3d	4s	4p	4d
Ca	2	2	6	2	6	0	2	0	0
Sr ²⁺	2	2	6	2	6	10	2	6	

[1]

[1]

[2]

(b) (i) more shells of electrons

[1]

(ii) outermost shell has been removed

[1]

(iii) outermost electrons are further from nucleus/there are more shells
increased shielding

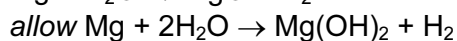
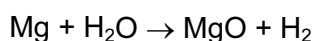
[1]

[1] [4]

(c) (i) very slow reaction
formation of bubbles of gas

[1]

[1]



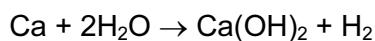
[1]

(ii) faster reaction than with Mg

[1]

white suspension formed
or evolution of gas
or calcium dissolves/disappears

[1]



[1]

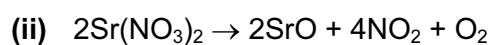
allow 1 mark in (i) or (ii) if gas is described as colourless

[1] [7]

(d) (i) gas evolved
gas is brown

[1]

[1]



correct products

[1]

balanced equation

[1] [4]

[Total: 17 max. 16]

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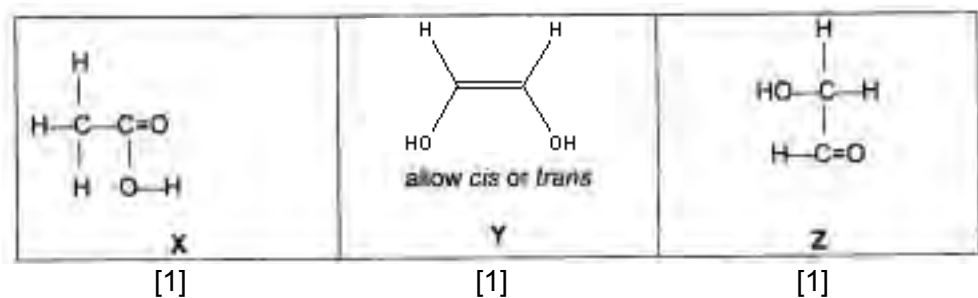
- 4 (a) (i) white ppt. AgCl [1]
[1]
- (ii) white/steamy/misty fumes HCl [1]
[1]
- (iii) colourless gas evolved or Na dissolves H_2 or CH_3ONa [1]
[1] [6]

(b) $\text{C}:\text{H}:\text{O} = \frac{40}{2} : \frac{6.7}{1} : \frac{53.3}{16}$ [1]

$= 3.33 : 6.7 : 3.33$ [1]

$= 1 : 2 : 1$ [2]

(c)



[3]

- (d) (i) with solid NaHCO_3
candidate's carboxylic acid [**X** above] [1]
gas/ CO_2 evolved [1]
- (ii) with Tollens' reagent
candidate's aldehyde [**Z** above] [1]
Ag mirror/Ag ppt. [1] [4]
- (e) two correct structures [of **Y** above] [1]
correctly labelled *cis* and *trans* [1] [2]

[Total: 17]