

**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.

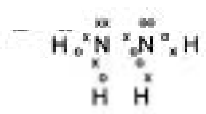
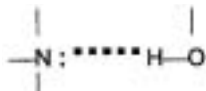

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- 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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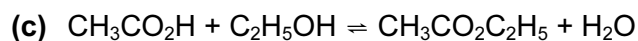
- 1 (a) (i) between  $117^\circ$  and  $120^\circ$  [1]
- (ii) 
- 14 electrons must be shown [1]  
single N-N bond [1]  
lone pair on each N atom [1]
- (iii) between  $107^\circ$  and  $109^\circ$  [1] [4]
- (b) ethene – van der Waals' forces [1]  
hydrazine – hydrogen bonds [1]
- hydrogen bonds are stronger [1] [3]  
or van der Waals' forces are weaker
- (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  $H_2O$
- 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] [3]  
or  $CH_3CH_2Cl$  molecule is saturated  
or no possibility of addition  
or no free radicals are present
- (e) (i) acid – base/neutralization [1]
- (ii) N atom has a lone pair of electrons [1]  
or N atom can behave as a base  
or N atom can form dative bond
- (iii) each N atom has a lone pair [1] [3]  
or each nitrogen atom can behave as a base  
or each nitrogen atom can form a dative bond

[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 <sup>-3</sup>	$\frac{(0.5 - x)}{V}$	$\frac{(0.5 - x)}{V}$	$\frac{(0.1 + x)}{V}$	$\frac{(0.1 + x)}{V}$	

$K_c = \frac{(0.1 + x)^2}{(0.5 - x)^2} = 4$  [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	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$	$(\text{CH}_3)_3\text{COH}$
reagent(s) and conditions			
red phosphorus and iodine heat under reflux	X	$\text{CH}_3\text{CH}_2\text{CH}(\text{I})\text{CH}_3$ [1]	X
concentrated $\text{H}_2\text{SO}_4$ heat	X	X	$\text{CH}_3\text{C}(\text{CH}_3)=\text{CH}_2$ [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]

[5]

[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 <sup>2+</sup>	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

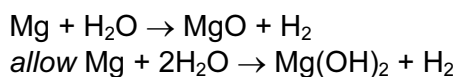
[1]

[1] [4]

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

[1]

[1]



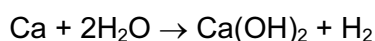
[1]

(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]

(ii)  $2Sr(NO_3)_2 \rightarrow 2SrO + 4NO_2 + O_2$   
correct products  
balanced equation

[1]

[1] [4]

[Total: 17 max. 16]

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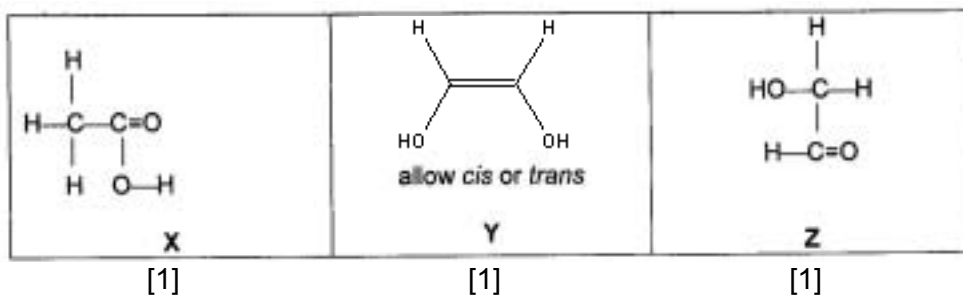
- 4 (a) (i) white ppt.  
AgCl [1]  
[1]
- (ii) white/steamy/misty fumes  
HCl [1]  
[1]
- (iii) colourless gas evolved or Na dissolves  
H<sub>2</sub> or CH<sub>3</sub>ONa [1]  
[1] [6]

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

= 3.33 : 6.7 : 3.33 [1]

= 1 : 2 : 1 [2]

(c)



[3]

- (d) (i) with solid NaHCO<sub>3</sub>  
candidate's carboxylic acid [X above] [1]  
gas/CO<sub>2</sub> 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]