

## **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.

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Page 2	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2007	9701	02

1 (a) (i) between  $117^\circ$  and  $120^\circ$  [1]

(ii)



14 electrons must be shown

single N-N bond

lone pair on each N atom

[1]

[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

or van der Waals' forces are weaker

[1] [3]

(c) correct dipole on O—H and N—H bonds [1]

labelled hydrogen bond shown

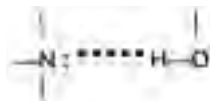
between an O atom of  $\text{H}_2\text{O}$  and a H atom of  $\text{N}_2\text{H}_4$

or between an N atom of  $\text{N}_2\text{H}_4$  and a H atom of  $\text{H}_2\text{O}$

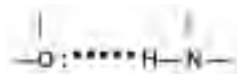
[1]

lone pair on O atom or on N atom *in the H bond*

i.e.



or



[1] [3]

(d) (i)  $\text{CH}_2 = \text{CH}_2 + \text{HCl} \rightarrow \text{CH}_3\text{CH}_2\text{Cl}$  [1]

(ii) electrophilic addition [1]

(iii) there is no further unsaturation

or  $\text{CH}_3\text{CH}_2\text{Cl}$  molecule is saturated

or no possibility of addition

or no free radicals are present

[1] [3]

(e) (i) acid – base/neutralization [1]

(ii) N atom has a lone pair of electrons

or N atom can behave as a base

or N atom can form dative bond

[1]

(iii) each N atom has a lone pair

or each nitrogen atom can behave as a base

or each nitrogen atom can form a dative bond

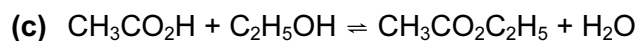
[1] [3]

[Total: 16]

<b>Page 3</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>GCE A/AS LEVEL – May/June 2007</b>	<b>9701</b>	<b>02</b>

- 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 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	$\text{CH}_3\text{CH}_2\text{CH}(\text{I})\text{CH}_3$ [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]

<b>Page 4</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>GCE A/AS LEVEL – May/June 2007</b>	<b>9701</b>	<b>02</b>

**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

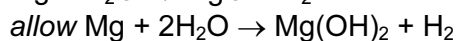
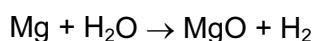
[1]

[1] [4]

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

[1]

[1]



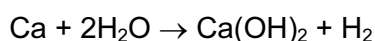
[1]

**(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)**  $2\text{Sr}(\text{NO}_3)_2 \rightarrow 2\text{SrO} + 4\text{NO}_2 + \text{O}_2$   
correct products  
balanced equation

[1]

[1] [4]

**[Total: 17 max. 16]**

Page 5	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2007	9701	02

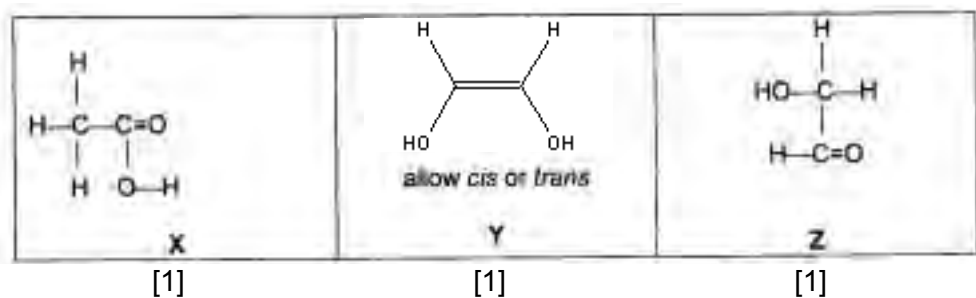
- 4 (a) (i) white ppt. [1]  
 $\text{AgCl}$  [1]
- (ii) white/steamy/misty fumes [1]  
 $\text{HCl}$  [1]
- (iii) colourless gas evolved *or* Na dissolves [1]  
 $\text{H}_2$  *or*  $\text{CH}_3\text{ONa}$  [1] [6]

(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  $\text{NaHCO}_3$  [1]  
candidate's carboxylic acid [**X** above] [1]  
gas/ $\text{CO}_2$  evolved
- (ii) with Tollens' reagent [1]  
candidate's aldehyde [**Z** above] [1] [4]  
Ag mirror/Ag ppt.
- (e) two correct structures [of **Y** above] [1]  
correctly labelled *cis* and *trans* [1] [2]

[Total: 17]