



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.

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1 (a) (i) between 117° and 120° [1]

(ii)



14 electrons must be shown

single N-N bond

lone pair on each N atom

[1]

[1]

(iii) between 107° and 109° [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

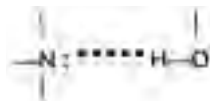
between an O atom of H_2O and a H atom of N_2H_4

or between an N atom of N_2H_4 and a H atom of H_2O

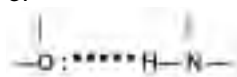
[1]

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

i.e.



or



[1] [3]

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

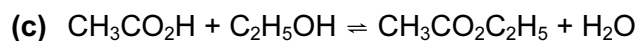
[1] [3]

[Total: 16]

Page 3	Mark Scheme	Syllabus	Paper
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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	$\text{CH}_3\text{CH}_2\text{CH}(\text{I})\text{CH}_3$ [1]	X
concentrated H_2SO_4 heat	X	X	$\text{CH}_3\text{—C=CH}_2$ CH_3 [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 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

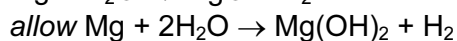
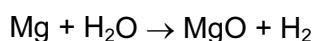
[1]

[1] [4]

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

[1]

[1]



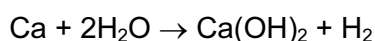
[1]

(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]

(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]

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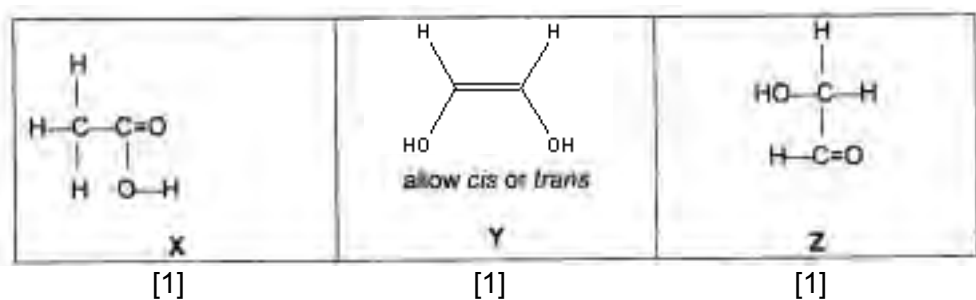
- 4 (a) (i) white ppt. [1]
 AgCl [1]
- (ii) white/steamy/misty fumes [1]
 HCl [1]
- (iii) colourless gas evolved or Na dissolves [1]
 H_2 or CH_3ONa [1] [6]

(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 [1]
candidate's carboxylic acid [**X** above] [1]
gas/ 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]