

MARK SCHEME for the May/June 2007 question paper

9701 CHEMISTRY

9701/02 Paper 2 (AS Structured Questions), maximum raw mark 60

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	GCE A/AS LEVEL – May/June 2007	9701	02

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

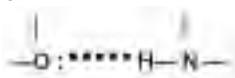
[1]

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	$(0.5 - x)$	$(0.5 - x)$	$(0.1 + x)$	$(0.1 + x)$
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	$\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)_2$ I [1]	X
concentrated H_2SO_4 heat	X	X	$\text{CH}_3\text{---C}=\text{CH}_2$ 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]

[Total: 11]

Page 4	Mark Scheme	Syllabus	Paper
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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]

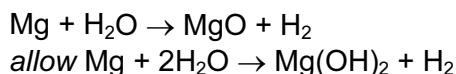
[2]

(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 [1]
formation of bubbles of gas [1]

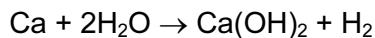


[1]

(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 [1]
gas is brown [1]

(ii) $2\text{Sr}(\text{NO}_3)_2 \rightarrow 2\text{SrO} + 4\text{NO}_2 + \text{O}_2$ [1]
correct products [1]
balanced equation [1] [4]

[Total: 17 max. 16]

Page 5	Mark Scheme	Syllabus	Paper
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4 (a) (i) white ppt.
 AgCl [1]
[1]

(ii) white/steamy/misty fumes
 HCl [1]
[1]

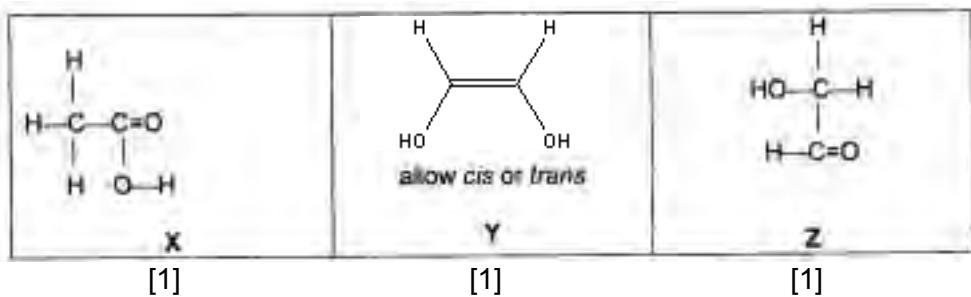
(iii) colourless gas evolved or Na dissolves
 H_2 or CH_3ONa [1]
[1] [6]

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

$= 3.33 : 6.7 : 3.33$ [1]

$= 1 : 2 : 1$ [2]

(c)



[3]

(d) (i) with solid NaHCO_3
candidate's carboxylic acid [X above]
gas/ CO_2 evolved [1]
[1]

(ii) with Tollens' reagent
candidate's aldehyde [Z above]
Ag mirror/Ag ppt. [1]
[1] [4]

(e) two correct structures [of Y above]
correctly labelled cis and trans [1]
[1] [2]

[Total: 17]