

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

NOVEMBER 2002

GCE Advanced Subsidiary Level

MARK SCHEME

MAXIMUM MARK : 60

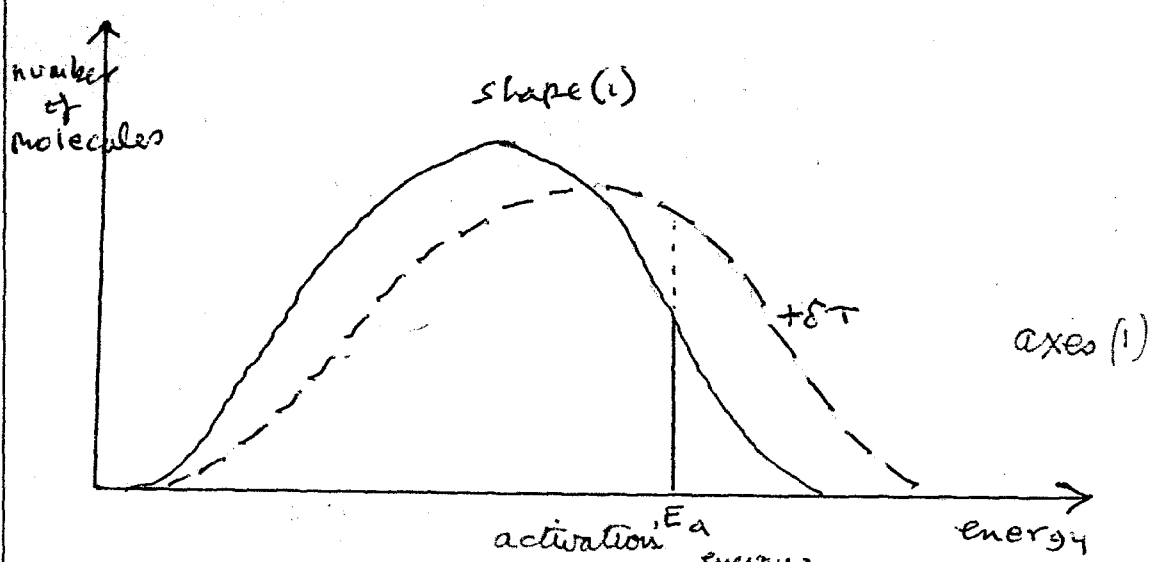
SYLLABUS/COMPONENT :9701 /2

**CHEMISTRY
(STRUCTURED QUESTIONS (AS))**



UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

Page 1	Mark Scheme	Syllabus	Paper
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Question Number	Mark Scheme Details	Part Mark
1 (a)	 <p>not all molecules have the same energy / some have little, some a lot, distributed about a mean. OR asymmetrical / not a normal distribution (1)</p> <p>Molecules require a certain / minimum energy before they can react // only molecules which have this energy can react successfully on collision. (1)</p> <p>line on graph (1)</p> <p>The dotted line on the graph - maximum lower and to the right of the solid line maximum (1)</p> <p>larger area to right of E_a line is the number of molecules with energy greater than E_a. (1)</p> <p>Rate is proportional to number of molecules with E_a (or more) (1)</p> <p>Collision rate faster when molecules speed greater (1) (max 2) [3]</p> <p>[Total: 8]</p>	[2] [1] [2] [3]

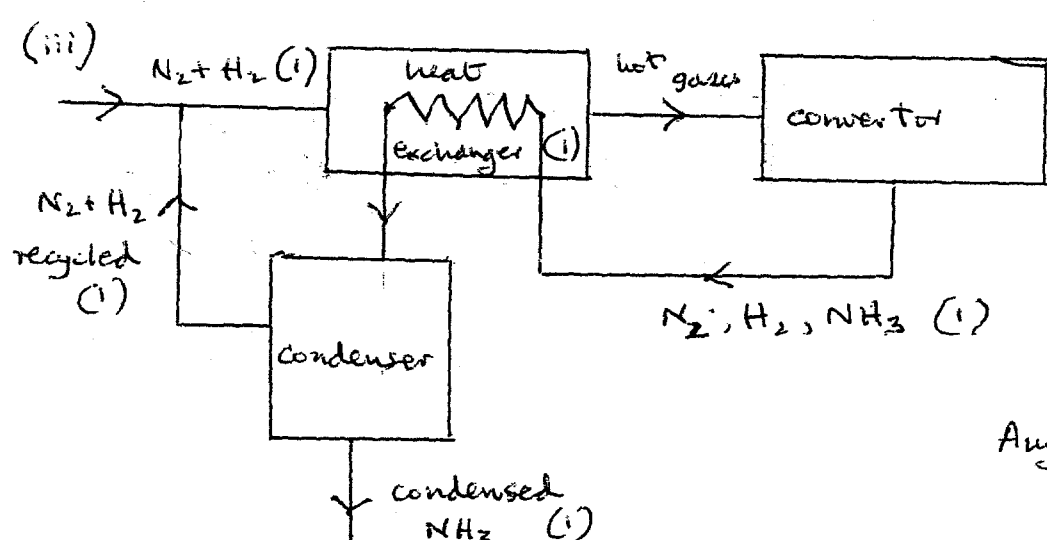
Page 2	Mark Scheme	Syllabus	Paper
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Question Number	Mark Scheme Details	Part Mark
2 (a) (i)	An acid is a proton (H^+) donor (1)	
(ii)	An acid which is partially ionised (1) $HA \rightleftharpoons H^+ + A^-$ must have \rightleftharpoons (1)	[3]
(b) (i)	The forward reaction proceeds at the same rate as the reverse reaction (1)	
(ii)	$K_c = \frac{[ester][H_2O]}{[acid][alcohol]}$ (1)	
(c) (i)	<p>acid + alcohol \rightleftharpoons ester + water</p> <p>initially. $\frac{6}{60} = 0.1$ $\frac{6}{46} = 0.13$ $\frac{4.4}{88} = 0.050 + 0$ All three (1)</p> <p>at equilibrium $[0.040]$ $0.13 - 0.06 = 0.07$ $0.050 + 0.06 = 0.11$ 0.06 all three (1)</p>	
(ii)	$K_c = \frac{0.11 \times 0.06}{0.04 \times 0.07} = 2.36$ (1)	
(iii)	Units 'cancel' / two concn terms 'top & bottom' (1)	4
Total: 10		

Page 3	Mark Scheme	Syllabus	Paper
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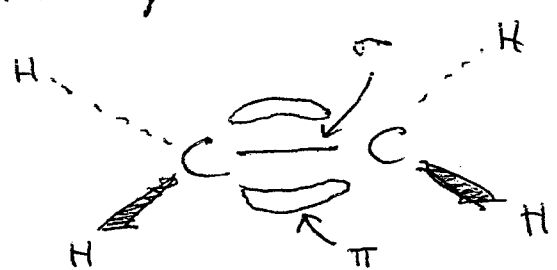
Question Number	Mark Scheme Details	Part Mark
3 (a)	$\left[\begin{array}{ccc} & \times \times & \\ \times & \text{Hg} & \times \\ & \times \times & \end{array} \right]^{2+} \quad \left[\begin{array}{c} \times \times \\ : \ddot{\text{O}} : \\ \times \times \end{array} \right]^{2-} \quad (1)$	[1]
(b)	(i) Na_2O (ii) MgO or Al_2O_3 (iii) SO_3 (allow SO_2) (iv) SO_2 or SO_3 (v) SO_2	1 each [5]
(c)	(i) $\text{Al}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2\text{O}$ (ii) $\text{NaOH} + \text{SO}_2 \rightarrow \text{NaHSO}_3$ or $2\text{NaOH} + \text{SO}_2 \rightarrow \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$	1 each [2]
(d)	(i) $2\text{Sb}_2\text{S}_3 + \underline{9} \text{O}_2 \rightarrow \text{Sb}_4\text{O}_6 + \underline{6} \text{SO}_2 \quad (1)$ (ii) $+3$ or 3 NOT $3+$ (1) (iii) 2 mols Sb_2S_3 give 3CO_2 \therefore 10 mols Sb_2S_3 give 15 mol CO_2 (1) $15 \times 24 \text{ dm}^3 = 360 \text{ dm}^3$ (1)	[4]
	[Total : 12]	

Page 4	Mark Scheme	Syllabus	Paper
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Question Number	Mark Scheme Details	Part Mark
4 (a)	$\text{CH}_4 + \text{H}_2\text{O} \longrightarrow 3\text{H}_2 + \text{CO}$	1
(b)	<p>(i) $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 \quad \xrightarrow{\text{necessary}} \quad (1)$</p> <p>(ii) $\left. \begin{array}{l} \cdot \text{ pressure over } 100 \text{ atm} \\ \cdot \text{ temp } 400 - 600^\circ\text{C range} \\ \cdot \text{ iron or iron oxide (catalyst)} \end{array} \right\} \text{ all } (1)$</p> <p>(iii) </p> <p style="text-align: right;">Any 4</p>	1 1 4 [6]
(c)	<p>Reaction $4 \rightarrow 2$ (mols, vols) favoured by high P (1)</p> <p>Collision frequency greater at high P (1)</p>	[2]
(d)	$\text{NH}_3 + 2\text{O}_2 \longrightarrow \text{HNO}_3 + \text{H}_2\text{O}$	[1]
(e)	$\text{H}_2\text{O} + \text{Co}(\text{NH}_2)_2 \longrightarrow 2\text{NH}_3 + \text{CO}_2$ $-287 + (-320.5) \longrightarrow -162 \quad -414.5 \quad (1)$ $-607.5 \longrightarrow -576.5$ $\Delta H = 31 \text{ kJ mol}^{-1} \quad (1)$	[2]
[Total: 12]		

Question Number	Mark Scheme Details	Part Mark
5	<div> $H^+/Cr_2O_7^{2-}$ <div>A, B, C</div> </div> <div> H^+/MnO_4^- <div>C, E</div> </div> <div> H_2/Rt <div>E</div> </div> <div> Cu^{2+} (Fehling) <div>C</div> </div> <div> 2,4-DNP <div>C, D</div> <div>1 each</div> </div> <div> Br_2 <div>E</div> </div> <p>Each wrong answer in a box invalidates a correct answer</p>	9 max

Page 6	Mark Scheme	Syllabus	Paper
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Question Number	Mark Scheme Details	Part Mark
6		
(a)	$\begin{array}{c} \text{CH}_3 \\ \\ \text{C}_2\text{H}_5 - \text{CH} - \text{CH}_2\text{OH} \end{array} \quad \text{etc (1)}$	[1]
(b)(i)	$\text{C}_5\text{H}_{11}\text{OH} + \text{HBr} \longrightarrow \text{C}_5\text{H}_{11}\text{Br} + \text{H}_2\text{O (1)}$	
(ii)	<p>88 g alcohol required for 151 g bromide (1)</p> <p>$\therefore \frac{88}{151} \times \frac{100}{60} \times 15$ g required for 15 g bromide (60% yield)</p> <p>$= 14.57$ g allow 14.5 to 14.6 g (1)</p>	[3]
(c)	 <p>a neat drawing of a double bond (1)</p> <p>σ and π labels (1)</p>	[2]
(d)(i)	$\text{C}_5\text{H}_{11}\text{OH} \xrightarrow[\text{reflux (1)}]{\text{H}^+/\text{Cr}_2\text{O}_7^{2-} \text{ (1)}} \text{C}_4\text{H}_9\text{CO}_2\text{H}$ <p>accept $\text{H}^+/\text{MnO}_4^-$ or $\text{OH}^-/\text{KMnO}_4^-$</p>	
(ii)	$\text{CH}_3\text{CO}_2\text{H} + \text{HO C}_5\text{H}_{11} \longrightarrow \text{CH}_3\text{CO}_2\text{C}_5\text{H}_{11} [+ \text{H}_2\text{O}]$ <p>(1)</p> <p>conc H_2SO_4 + heat/reflux (1)</p> <p>condition mark is only awarded when the reagent is correct</p>	[4]
[Total: 10]		