

**NOVEMBER 2002**

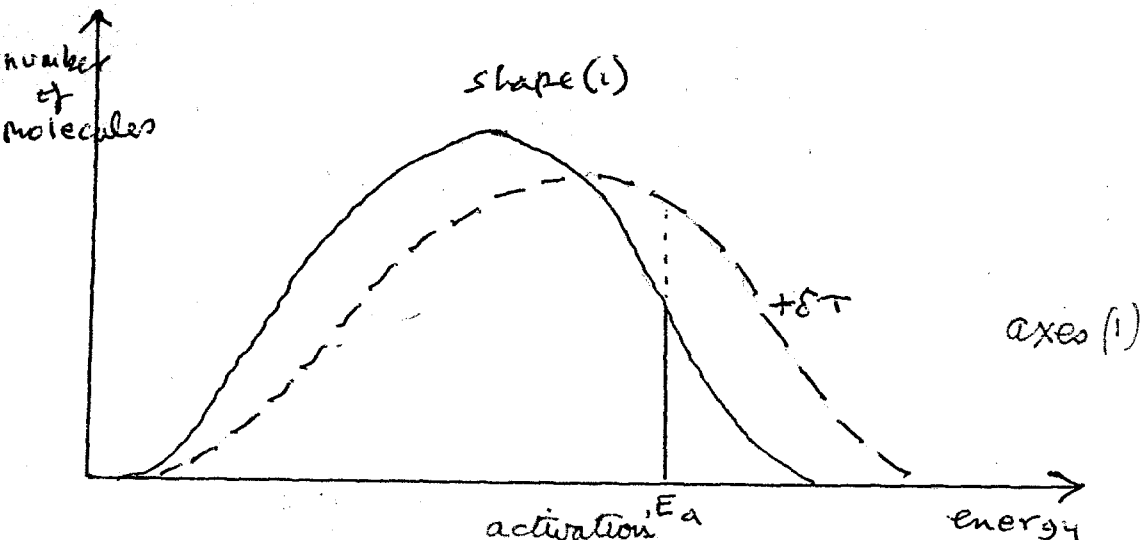
**GCE Advanced Subsidiary Level**

**MARK SCHEME**

**MAXIMUM MARK : 60**

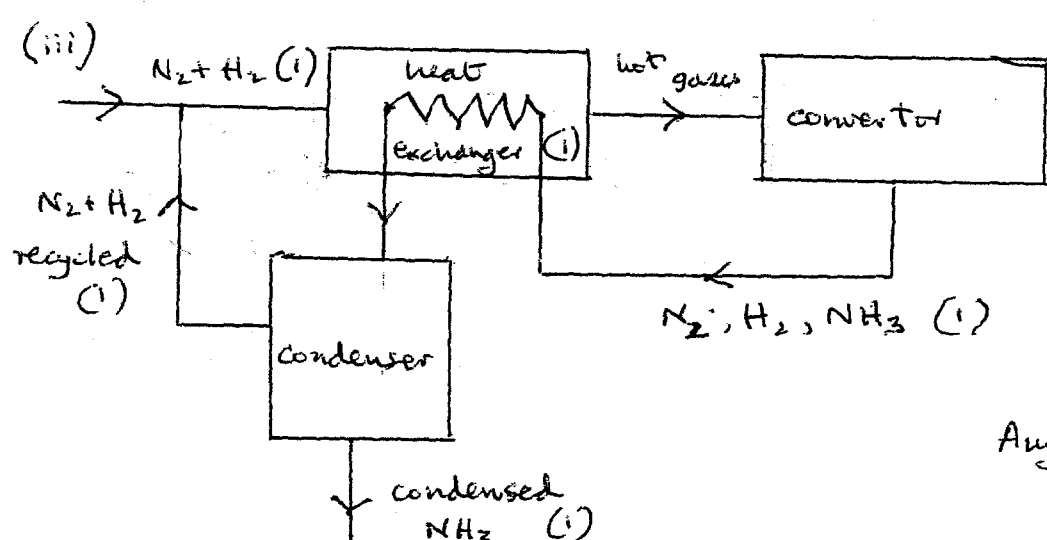
**SYLLABUS/COMPONENT :9701 /2**

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

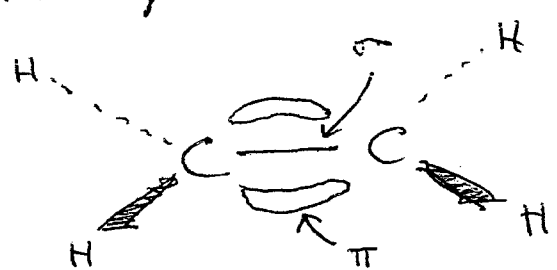
Question Number	Mark Scheme Details	Part Mark
1 (a)		[2]
(b)	<p>not all molecules have the same energy / some have little, some a lot, distributed about a mean.  OR asymmetrical / not a normal distribution (1)</p>	[1]
(c) (i)	<p>Molecules require a certain / minimum energy before they can react // only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

Question Number	Mark Scheme Details	Part Mark
(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 <math>\rightleftharpoons</math> ester + water</p> <p>initially.</p> $\frac{6}{60} = 0.1$ $\frac{6}{46} = 0.13$ $\frac{4.4}{88} = 0.050 + 0$ All three (1) <p>at equilibrium</p> $[0.040]$ $0.13 - 0.06 = 0.07$ $0.050 + 0.06 = 0.11$ $0.06$ all three (1)	
(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		

Question Number	Mark Scheme Details	Part Mark
3 (a)	$\left[ \begin{array}{ccc} & \times \times & \\ \times & \text{Hg} & \times \\ & \times \times & \end{array} \right]^{2+} \quad \left[ \begin{array}{c} \cdot \cdot \\ : \text{O} : \\ \cdot \cdot \\ \times \end{array} \right]^{2-} \quad (1)$	[1]
(b)	(i) $\text{Na}_2\text{O}$ (ii) $\text{MgO}$ or $\text{Al}_2\text{O}_3$ (iii) $\text{SO}_3$ (allow $\text{SO}_2$ ) (iv) $\text{SO}_2$ or $\text{SO}_3$ (v) $\text{SO}_2$	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 $\text{Sb}_2\text{S}_3$ give 3 $\text{CO}_2$ $\therefore 10$ mols $\text{Sb}_2\text{S}_3$ give 15 mol $\text{CO}_2$ (1) $15 \times 24 \text{ dm}^3 = 360 \text{ dm}^3$ (1)	[4]
	[Total : 12]	

Question Number	Mark Scheme Details	Part Mark
4 (a)	$\text{CH}_4 + \text{H}_2\text{O} \rightarrow 3\text{H}_2 + \text{CO}$	1
(b)	<p>(i) <math display="block">\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 \quad \rightleftharpoons \text{necessary (1)}</math></p> <p>(ii) <math>\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)}</math></p> <p>(iii)  <p style="text-align: right;">Any 4</p> </p>	4 [6]
(c)	<p>Reaction <math>4 \rightarrow 2</math> (mols, vols) favoured by high P (1)</p> <p>Collision frequency greater at high P (1)</p>	[2]
(d)	$\text{NH}_3 + 2\text{O}_2 \rightarrow \text{HNO}_3 + \text{H}_2\text{O}$	[1]
(e)	$\text{H}_2\text{O} + \text{Co}(\text{NH}_2)_2 \rightarrow 2\text{NH}_3 + \text{CO}_2$ $-287 + (-320.5) \rightarrow -162 \quad -414.5 \quad (1)$ $-607.5 \rightarrow -576.5$ $\Delta H = 31 \text{ kJ mol}^{-1} \quad (1)$	[2]
[Total: 12]		



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><math>\therefore \frac{88}{151} \times \frac{100}{60} \times 15</math> 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><math>\sigma</math> and <math>\pi</math> 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 <math>\text{H}^+/\text{MnO}_4^-</math> or <math>\text{OH}^-/\text{MnO}_4^-</math></p>	
(ii)	$\text{CH}_3\text{CO}_2\text{H} + \text{HOC}_5\text{H}_{11} \longrightarrow \text{CH}_3\text{CO}_2\text{C}_5\text{H}_{11} + \text{H}_2\text{O}$ <p>(1)</p> <p>conc <math>\text{H}_2\text{SO}_4</math> + heat/reflux (1)</p> <p>condition mark is only awarded when the reagent is correct</p>	[4]
	[Total = 10]	