

GCE

Edexcel GCE

Chemistry (6242/01)

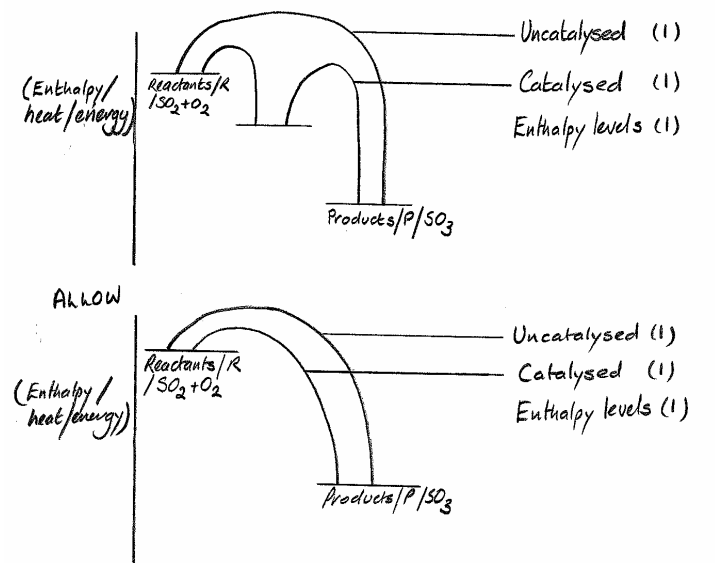
January 2006

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Mark Scheme (Results)

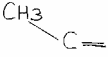
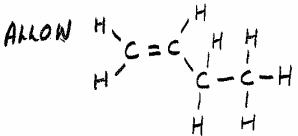


1.	(a)	Dynamic - reaction continuing (all the time) (1) <i>ALLOW</i> rate forward = rate back  Equilibrium - concentrations (of the substances) do not change/remain the same(1) <i>NOT</i> 'concentrations all equal' <i>NOT</i> 'amounts do not change'	(2 marks)	
	(b)	(i)	350-450 °C <i>OR</i> 620-720 K (1)  >1≤5 atm (1) <i>Values can be given in kPa or kNm<sup>-2</sup></i>	(2 marks)
		(ii)	High yield favoured by low temperature (1) High rate favoured by high temperature (1) So, temperature used is a compromise (1) - <i>conditional on first two marks</i>  <i>ACCEPT correct inverse argument</i>	(3 marks)
		(iii)	Too costly for extra yield <i>OR</i> Position of equilibrium is well to right under these conditions <i>OR</i> Corrosion problems at high pressure <i>OR</i> Only need elevated pressure in practice to push gases through system <i>OR</i> Capital cost high <i>OR</i> Maintenance cost high <i>OR</i> High energy cost <i>OR</i> Sulphur dioxide liquefies. <i>NOT</i> "too costly" <i>without explanation</i> <i>NOT</i> too dangerous	(1 mark)
	(c)	(i)	$\Delta H = 2\Delta H_f(\text{SO}_3) - 2\Delta H_f(\text{SO}_2) = (-395 \times 2) - (-297 \times 2)$ (1)  = -196 (kJ mol <sup>-1</sup> ) (1) - <i>IGNORE units</i>  -196 (kJ mol <sup>-1</sup> ) <i>with some working</i> (2)  <i>No consequential mark other than failing to multiply by two to get -98 kJ mol<sup>-1</sup> max (1)</i> <i>Any positive answer (0)</i>	(2 marks)
	QWC	(ii)	$\Delta H_f$ is <b>defined</b> as formation from elements <i>OR</i> $\Delta H_f$ of an element is <b>defined</b> as 0 (in its standard state) <i>OR</i> all elements are given the value zero  'It is an element' <i>on its own</i> (0)	(1 mark)

(d)	(i)	<p><math>V_2O_5</math> OR <math>V_2O_5</math>  NOT name  NOT <math>V^{2+}O_5</math>.  If name and formula given, ignore name.</p>	(1 mark)
	(ii)	 <p>ALLOW endothermic intermediates  ALLOW single hump for catalysed pathway: (energy)  If the diagram shows <math>\Delta H</math> endothermic, then can score the first two marks.</p> <p>If y-axis label is wrong 3<sup>rd</sup> mark can not be awarded  Catalysed and uncatalysed labels missing scores 3<sup>rd</sup> mark only</p> <p>If two diagrams drawn, full credit can be given if the catalysed <math>E_a</math> is clearly less than the uncatalysed.  If <math>\Delta H</math> and <math>E_a</math> confused, then max 2</p>	(3 marks)
QWC	(iii)	<p>Changes mechanism to one of lower <math>E_a</math>  OR to a different route with lower <math>E_a</math> (1)  NOT "Lowers <math>E_a</math>" alone.</p> <p>Reactants (chemically) adsorb on catalyst surface  OR (at given T) more collisions have <math>E &gt; E_a</math> so more successful collisions (1)</p>	(2 marks)
	(e)	<p>Forms (a difficult to condense) mist/fog/smoke/too violent/too exothermic  NOT "extremely reactive"</p>	(1 mark)
Total 18 marks			

2	(a)	Heat/enthalpy/energy change (for a reaction)/ $\Delta H$ (1)  is independent of the pathway /route (between reactants and products) <i>OR</i> depends only on its initial and final state (1) <i>Both marks can score from a diagram and equation</i>	(2 marks)
	(b)	(i) $\Delta H = \{(4x + 435) + (2x + 498)\}$ (1)  $+ \{(2x - 805) + (4x - 464)\}$ (1) <i>IGNORE signs for first two marks, ie marks for total enthalpies of bonds broken and made.</i>  $= - 730 \text{ (kJmol}^{-1}\text{)}$ (1) <i>3<sup>rd</sup> mark is consequential on their values for first two marks</i>  $+ 730 \text{ (kJmol}^{-1}\text{)}$ (max 2)	(3 marks)
		(ii) (Enthalpy of) combustion <i>DO NOT penalise "standard"</i>	(1 mark)
		(iii) At 1 atm pressure <i>OR</i> 101/100 kPa <i>OR</i> 1 bar (1) stated temperature (1) <i>ACCEPT 298 K / 25 °C</i>	(2 marks)
		(iv) Reaction has H <sub>2</sub> O(g) (rather than H <sub>2</sub> O(l)) (1) So not standard conditions (1) - <i>2<sup>nd</sup> mark is conditional on the 1<sup>st</sup></i> Average bond enthalpies used (so not specific) (1 max)	(2 marks)
QWC	(c)	(Exothermic so) products are at lower energy than reactants (1)  <b>Reactants</b> are therefore thermodynamically unstable (with respect to products) (1) <i>Consequential on 1<sup>st</sup> mark</i> <i>NOT 'reaction' or 'system' is thermodynamically unstable</i> <i>Can argue from point of view of products.</i>  <i>E<sub>a</sub> is high (for noticeable reaction at room temperature) (1)</i> <i>NOT 'E<sub>a</sub> high' on its own</i>  So <b>reactants</b> are kinetically stable (with respect to products) (1) <i>Consequential on 3<sup>rd</sup> mark</i>  <i>If "reaction" instead of reactants is used (3 max)</i>	(4 marks)
			Total 14 marks

3	(a)	(i)	(Free) radical <i>ACCEPT</i> homolytic radical <i>NOT</i> radical ion	(1 mark)
		(ii)	$\text{CH}_3\text{CH}_3 + \text{Br}_2 \rightarrow \text{CH}_3\text{CH}_2\text{Br} + \text{HBr}$ OR $\text{C}_2\text{H}_6 + \text{Br}_2 \rightarrow \text{C}_2\text{H}_5\text{Br} + \text{HBr}$  <i>ACCEPT multiple substitution only if the equation balances</i> <i>Can be full structural formula</i> <i>If H<sub>2</sub> is one product then (0)</i>	(1 mark)
	(b)	(i)	$\text{CH}_2=\text{CH}_2 + \text{Br}_2 \rightarrow \text{BrCH}_2\text{CH}_2\text{Br} / \text{CH}_2\text{BrCH}_2\text{Br} / \begin{array}{c} \text{CH}_2-\text{CH}_2 \\   \quad   \\ \text{Br} \quad \text{Br} \end{array}$  Ethene shown with double bond + Br <sub>2</sub> (1) product (1)	(2 marks)
		(ii)	1,2 (-) dibromoethane only - <i>mark independently of (i)</i> <i>IGNORE punctuation</i>	(1 mark)
QWC	(c)	Ethene has a π / double bond (1)  Ethane has σ only / single only / no π / no double bond (1)  π (in ethene) weaker than C-H (in ethane) / high electron density in C=C <b>relative to C-H bond</b> (1)	(3 marks)	
				Total 8 marks

4	(a)	<p>(i)</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <math display="block">\begin{array}{c} \text{H}_3\text{C} \quad \text{CH}_3 \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \diagdown \\ \text{H} \quad \text{H} \end{array}</math> <p>(1)</p> </div> <div style="text-align: center;"> <math display="block">\begin{array}{c} \text{H}_3\text{C} \quad \text{H} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \diagdown \\ \text{H} \quad \text{CH}_3 \end{array}</math> <p>(1)</p> </div> </div> <p>Can show C in straight line if H's clearly cis or trans.          If H is missing once but bond is shown, no penalty.          If all H's missing then (1) only awarded for both structures</p> <p>ALLOW </p>	(2 marks)
		<p>(ii)</p> <p>(Both have) no/restricted rotation about C=C (rotation would require <math>\pi</math> bond to break) (1)</p> <p>but but-1-ene has two identical groups on a doubly bonded carbon atom (1)</p> <p>but-2-ene does not(1)</p> <p>OR other way round</p>	3 marks)
		<p>(iii)</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <math display="block">\begin{array}{c} \text{H} \quad \text{H} \\   \quad / \\ \text{H}-\text{C}-\text{C}=\text{C} \\   \quad   \quad \diagdown \\ \text{H} \quad \text{H}-\text{C}-\text{H} \\   \\ \text{H} \end{array}</math> </div> <div style="text-align: center;"> <p>OR</p> <math display="block">\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}</math> </div> <div style="text-align: center;"> <p>OR</p> <math display="block">\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{H} \\   \\ \text{C}-\text{H} \\ / \quad \backslash \\ \text{H}-\text{C} \quad \text{C}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}</math> </div> </div> <p>ALLOW </p> <p>Do not need to show all bonds eg can be -CH<sub>3</sub>, -C<sub>2</sub>H<sub>5</sub></p>	(1 mark)
	(b)	<p>(i)</p> <div style="text-align: center;"> <math display="block">\begin{array}{c} \text{CH}_3 \quad \text{H} \\   \quad   \\ -\text{C} - \text{C}- \\   \quad   \\ \text{H} \quad \text{H} \end{array}</math> </div> <p>Skeleton (1)          Indication of continuation conditional on a two carbon saturated chain in the skeleton. (1)</p>	(2 marks)
		<p>(ii)</p> <p>Unreactive OR non-biodegradable (1)</p> <p>So occupies/fills site OR remains in the site OR causes visual pollution (1)          2<sup>nd</sup> mark consequential on 1<sup>st</sup>          NOT "Do not decompose/decay" for 1<sup>st</sup> mark but allow 2<sup>nd</sup> mark</p>	(2 marks)
Total 10 marks			

5	(a)	(i)	$\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ OR $\text{C}_2\text{H}_5\text{CH}(\text{OH})\text{CH}_3$ OR $\text{CH}_3\text{CH}_2\underset{\text{OH}}{\text{CH}}\text{CH}_3$	(1 mark)
		(ii)	<p>Potassium dichromate(VI) (1)  + sulphuric acid (1) - <i>conditional on an oxidising agent being there</i>  <b>ALLOW</b> conc sulphuric acid  <b>ALLOW</b> (dilute) hydrochloric acid OR (dilute) nitric acid [<b>NOT</b> conc]  <b>ACCEPT formulae</b>  <b>ALLOW</b> acidified dichromate ions (2)  <b>ALLOW</b> <math>\text{H}^+/\text{Cr}_2\text{O}_7^{2-}</math> (2)  <b>ALLOW</b> acidified potassium/sodium dichromate(VI) (2)  <b>ALLOW</b> Acidified dichromate 1 (out of 2)  <b>NOT</b> potassium manganate(VII) for potassium dichromate(VI)  <b>NOT</b> potassium(VI) dichromate</p> <p>Heat/boil (under reflux)/warm (1) - <i>conditional on an oxidising agent being there</i>  <b>ALLOW</b> reflux</p>	(3 marks)
		(iii)	<p>Heat/boil/reflux/warm in aqueous (ethanolic) (1)  <b>NOT</b> 'ethanolic' alone</p> <p>potassium / sodium hydroxide (1)  <b>ALLOW</b> <math>\text{OH}^-</math>(aq) / hydroxide ions  <b>NOT</b> "hydroxide" on its own</p>	(2 marks)
		(iv)	$\text{CH}_3\text{CH}=\text{CHCH}_3$	(1 mark)
	(b)		$(\text{CH}_3)_3\text{COH}$	(1 mark)
	(c)	(i)	$\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$	(1 mark)
		(ii)	<p>Use of ethanol as solvent (instead of water)  <b>NOT</b> 'presence of ethanol' alone.</p>	(1 mark)
				Total 10 marks
				TOTAL FOR PAPER: 60 MARKS