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GCE

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Chemistry (6246/02)

January 2006

Mark Scheme (Results)

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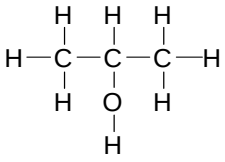
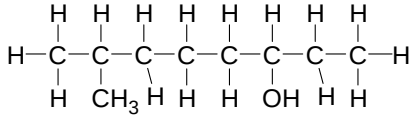
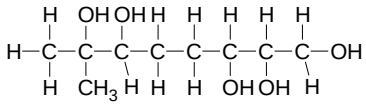
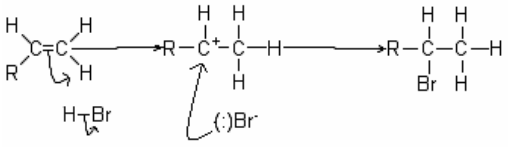
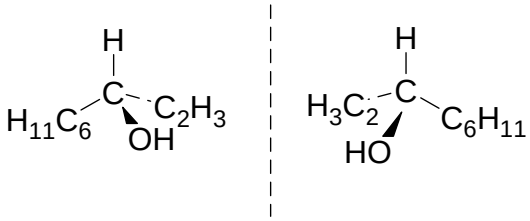
1.	(a)	$3OCl^- \rightarrow 2Cl^- + ClO_3^-$ **(1)** chlorine (in OCl^-) is (simultaneously) oxidised from +1 to +5 **(1)** and reduced from +1 to -1 **(1)** *If only oxidation numbers given* **max 1 (out of 2)** *If oxidation numbers omitted* **max 1 (out of 2)**		**(3 marks)**
	(b)	(i)	blue/black to colourless	**(1 mark)**
		(ii)	no. moles $S_2O_3^{2-}$ used = 12.5 x 0.1 / 1000 = 1.25 x 10^{-3} **(1)** no. moles I_2 = 1.25 x 10^{-3} / 2 = 6.25 x 10^{-4} **(1)** no. moles ClO^- = no. moles I_2 **(1)** no.moles ClO^- in original 10 cm^3 = 10 x 6.25 x 10^{-4} = 6.25 x 10^{-3} **(1)** no.moles ClO^- in 1 dm^3 = 100 x 6.25 x 10^{-3} **(1)** = 0.625	**(5 marks**
		(iii)	mass Cl_2 = 0.625 x 71 = 44.4 (g) *mark consequentially on (ii)* *must be 3s.f. in final answer*	**(1 mark)**
	(c)	Cl_2 is the stronger oxidising agent because Cl_2 oxidises S from (+)2 to (+)6 **(1)** but I_2 oxidises S from (+)2 to (+)2.50 **(1)**		**(2 marks)**
QWC	(d)	Cl_2 oxidises KI / iodide to I_2. or balanced equation **(1)** I_2 reacts with starch/paper to give blue/black **(1)**		**(2 marks)**
				Total for Question: 14 marks

2	(a)		(lattice of) cations/positive ions/Mg^{2+} **(1)** **attracted** to delocalised / sea / cloud of electrons **(1)** which are mobile/can move **(1)**	**(3 marks)**
QWC	(b)		Mg^{2+} smaller (radius) than Ba^{2+} / magnesium **ion** is smaller and has the same charge (as a barium ion) **(1)** *do not allow charge density unless explained* Greater polarisation/distortion of carbonate ion/anion **(1)**	**(2 marks)**
	(c)		*Either* Step 1 : Magnesium in dry ether/ethoxyethane **(1)** add (solid) CO_2 / dry ice **(1)** **Then** add water / dilute acid / or formula or H^+ **(1)** add methanal / HCHO **(1)** **Then** $H^+/Cr_2O_7^{2-}$ or acidified (potassium) dichromate **(1)** *OR* Add KCN/potassium (or sodium) cyanide **(1)** In aqueous ethanol **(1)** **Then** heat / reflux with acid/H^+ **(1)**	**(3 marks)**
	(d)	(i)	$[H_3O^+]$ = 7.94 x 10^{-4} (mol dm^{-3}) **(1)** $[HA]=\frac{[H_3O^+]^2}{Ka}$ OR $\frac{(7.94\times10^{-4})^2}{1.35\times10^{-5}}$ **(1)** [HA] = 0.0467 (mol dm^{-3}) **(1)** *IGNORE S.F.*	**(3 marks)**
		(ii)	$CH_3CH_2COOH+H_2O \rightleftharpoons CH_3CH_2COO^-+H_3O^+$ / $CH_3CH_2COOH \rightleftharpoons CH_3CH_2COO^-+H^+$ **(1)** $[CH_3CH_2COO^-]$ small / acid is only dissociated to a small extent / slightly **(1)** *NOT* "acid not fully/partially dissociated" Adding H^+ causes large change in $[A^-]$, but small change in [HA] **(1)**	**(3 marks)**

		(iii)	[weak acid] = 0.0429 / or moles weak acid = 0.0015 / or vol of weak acid = 15 cm^3 **(1)** [salt] = 0.0286 / or moles salt = 0.001 / or vol of salt = 10 cm^3 **(1)** $[H^+] = K_a$ x (acid/salt) = 2.025 x 10^{-5} **(1)** pH = -log $[H^+]$ = 4.69 **(1)** (allow 1 dp or more) (*consequential throughout*) (*note: allow any correct alternative processing methods for last 2 marks*) (*note: common errors:* *pH = 4.5 / 4.47 etc, with working, scores 3 marks..1 error made.* *pH = 4.9 / 4.87 etc, with working, scores 2 marks.. 2 errors made)*	**(4 marks)**
				Total 18 marks

3	(a)	(i)	CH_3COCH_3 (use expts 1 + 2) as conc doubles, rate doubles first order **(1)** I_2 (use expts 1+3) as conc changes/halves, rate is constant zero order **(1)** *if no explanations max 1 for both orders* H^+ explanation **(1)** first order **(1)** e.g. expts 1+4 or 3+4 as $[CH_3COCH_3]$ doubles and $[H^+]$ doubles, rate x4 but 1st order w.r.t.$[CH_3COCH_3]$ so must be 1st order w.r.t.$[H^+]$ *OR* Expts 2+4 as $[I_2]$ doubles and $[H^+]$ doubles, rate doubles but zero order w.r.t. $[I_2]$ so must be 1st order w.r.t. $[H^+]$	**(4 marks)**
		(ii)	2 *consequential on (a)*	**(1 mark)**
	(b)		rate = $k[CH_3COCH_3][H^+]$ *consequential on (a)***(1)** k (= e.g $1.5 \times 10^{-5} / 0.4 \times 0.4$) = 9.4×10^{-5} **(1)** *consequential on their rate equation* units $dm^3\ mol^{-1}\ s^{-1}$ **(1)**	**(3 marks)**
QWC	(c)		step 1 – slow / rate determining step / step 2 – faster **(1)** iodine has zero order (or is not in rate eqn) so.. does not take part in a slow step / r.d.s. **or** is in a fast step **or** is in mechanism after r.d.s. **(1)**	**(2 marks)**
	(d)		Expt 2 starts at 0.004 and Expt 3 at 0.002 **(1)** Expt 2 : line steeper **(1)** Expt 3 : line parallel **(1)**	**(3 marks)**
	(e)	(i)	(aqueous) sodium (or potassium) hydroxide / carbonate or formulae	**(1 mark)**
		(ii)	water or any dilute acid or formula **(1)**  **(1)** *ALLOW* OH	**(2 marks)**
	(f)		1 peak propanone, 3 peaks propanal **(1)** hydrogen in one environment, hydrogen in three environments **(1)** *[These could be shown on structural formulae]* *ALLOW* e.g. 1 peak propanone because H in one environment, for 1 mark	**(2 marks)**
				(Total 18 marks)

4	(a)	**C=C** add (aqueous) bromine **(1)** red-brown / brown / orange / yellow.. to colourless **(1)** *OR* add alkaline $KMnO_4$ **(1)** brown ppt. **(1)** **OH** add PCl_5 **(1)** steamy/misty/white fumes **(1)** *OR* other suitable test: reagent **(1)** observation **(1)** e.g. Conc H_2SO_4 and carboxylic acid **(1)** (fruity) smell (when poured into water) **(1)** *OR* sodium **(1)** Gas which ignites with squeaky pop **(1)**		**(4 marks)**
	(b)	(i)	 *OR* $(CH_3)_2CH(CH_2)_3CH(OH)C_2H_5$	**(1 mark)**
	(b)	(ii)	mass linalool in lavender oil = 0.65x2 = 1.3 g **(1)** no. moles linalool = 1.3/140 = $9.29x10^{-3}$ **(1)** vol hydrogen = $9.29x10^{-3}$ x2x24000 = 450 / 446 cm^3 / 0.446 dm^3 **(1)** consequential on (i) SF : answer ≥2	**(3 marks)**
	(c)	(i)	 *OR* $(CH_3)_2C(OH)CHOH(CH_2)_2(CHOH)_2CH_2OH$ **(2)** I*f OH only added to one C=C* **(1)**	**(2 marks)**
QWC		(ii)	Product forms more H bonds with water **(1)** more / five not one OH groups **(1)**	**(2 marks)**
	(d)	 for both arrows **(1)** for a carbocation **(1)** for arrow **(1)** for correct product **(1)** *arrow can come from the – on Br, but do not need to show lone pair on Br*		**(4 marks)**

	(e)	optical isomerism **(1)** correct 3D diagrams **(1)** eg.  *Must be drawn as mirror images*	**(2 marks)**
			Total 18 marks
			TOTAL FOR PAPER: 50 MARKS