edexcel

GCE

Edexcel GCE

Chemistry (6245/01)

January 2006

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Mark Scheme (Results)

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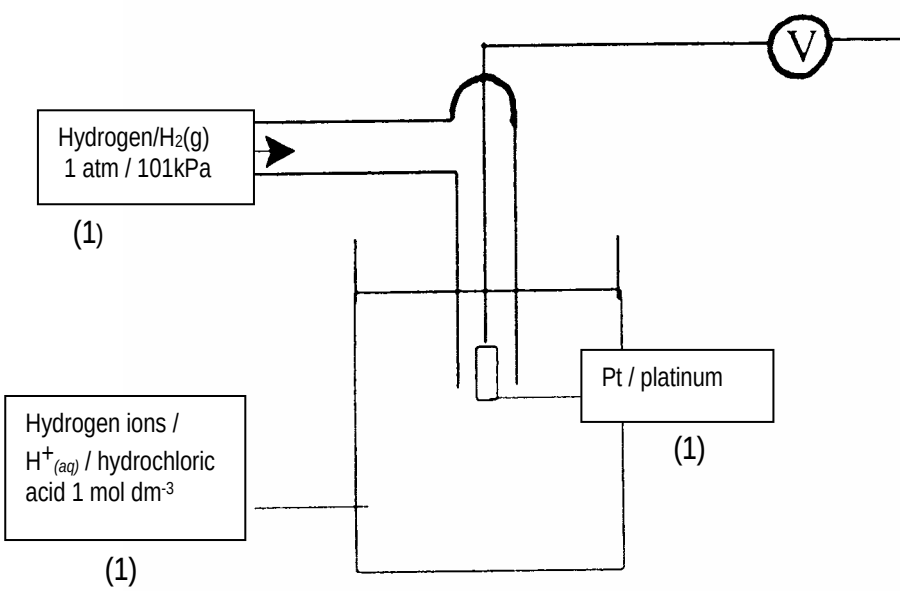
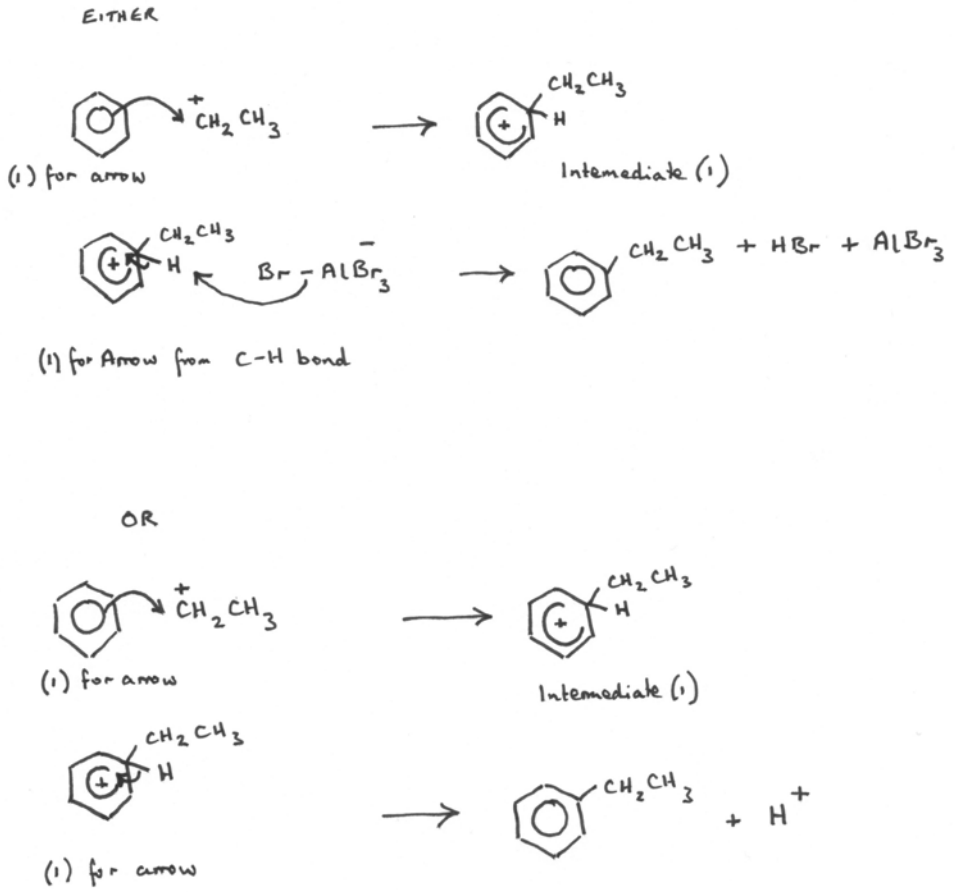
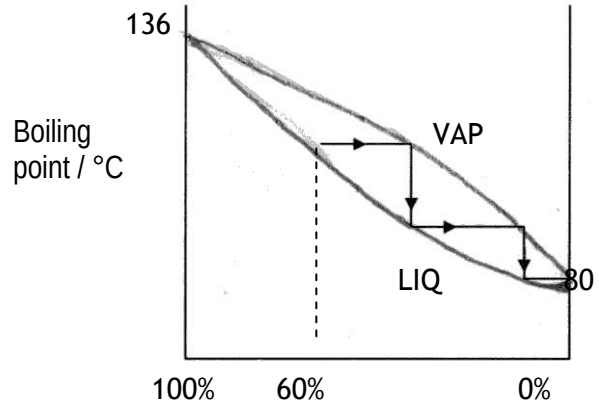
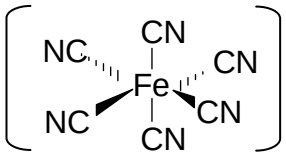
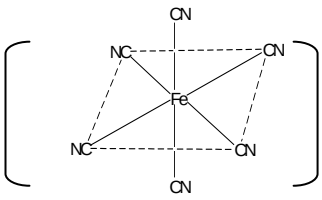
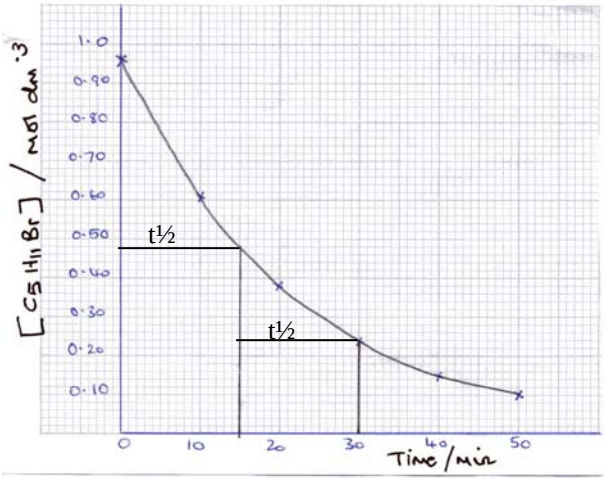
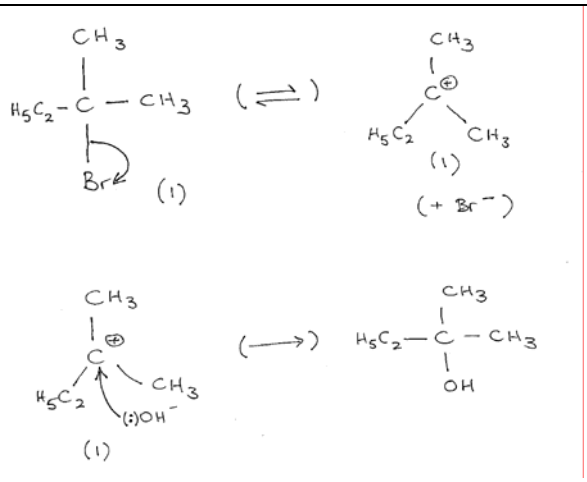
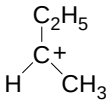
1.	(a)		The emf of a half-cell measured relative to the standard hydrogen electrode **(1)** all solutions at 1 mol dm^{-3} concentration and gases at 1 atm pressure/101kPa and at a stated temperature / 298K **(1)** *Standalone mark* *ALLOW* pressure of 100 kPa	**(2 marks)**
	(b)	(i)	Introducing another metal wire would set up its own p.d. / can only measure a potential difference / need source and sink for electrons / voltmeter requires two connections	**(1 mark)**
		(ii)	 H_2 or H^+ with no conditions **max (2)**	**(3 marks)**
	(c)	(i)	$2Fe(s) + O_2(g) + 2H_2O(l) \rightarrow 2Fe^{2+}(aq) + 4OH^-(aq)$ or multiples *OR* $2Fe(s) + O_2(g) + 2H_2O(l) \rightarrow 2Fe(OH)_2(s)$ Species **(1)** balancing **(1)** *Do not allow species mark if electrons still in equation, but allow balancing mark if 4e on both sides*	**(2 marks)**
		(ii)	$\Delta E^{\theta}_{react}$ = (**+**) 0.84 (V) **(1)** Greater than zero therefore feasible **(1)**	**(2 marks)**

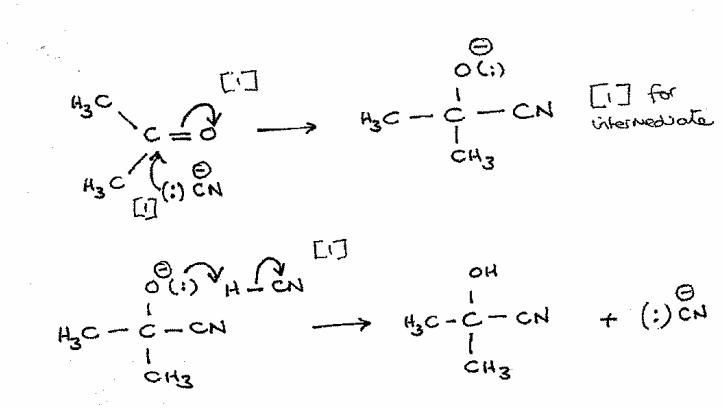
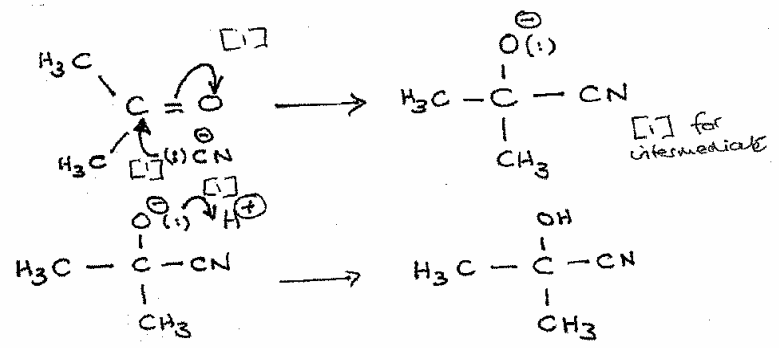
QWC*		(iii)	Zn oxidises preferentially to Fe/Zinc acts as sacrificial (anode) **(1)** If Sn used (and damaged), Fe oxidises preferentially **(1)** *Disallow "oxidises more readily"* E^{θ} Zn^{2+}/Zn more negative than for Fe *OR* E^{θ} Zn/Zn^{2+} more positive than for Fe *OR* E^{θ}_{cell} for Zn being oxidised by O_2 is more positive than for Fe being oxidised by O_2 *OR* similar E^{θ} arguments related to preferential oxidation with Sn **(1)** *disallow "higher" or "bigger" for more negative or more positive*	**(3 marks)**
				Total 13 marks
2	(a)		Delocalisation / π-system **(1)** due to overlap of six *p*-orbitals *OR* Due to overlap of p-orbitals around the ring **(1)** Confers stability/ benzene at a lower energy level / more energy needed to break bonds compared with having three separate π / double bonds / cyclohexatriene, Kekule structure **(1)** *Standalone mark*	**(3 marks)**
	(b)		1^{st} step: sulphuric **and** nitric acid **(1)** concentrated **(1)** Intermediate: Nitrobenzene / $C_6H_5NO_2$ **(1)** 2^{nd} Step: Tin / iron **and conc** HCl (followed by addition of alkali) **(1)** *disallow Sn or Fe as catalyst*	**(4 marks)**

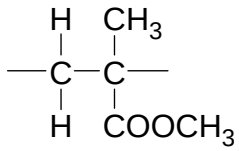
	(c)	(i)	$AlBr_3/FeBr_3$ / $AlCl_3$ / Al_2Cl_6 / $FeCl_3$ / Fe_2Cl_6	**(1 mark)**
		(ii)	$AlBr_3 + CH_3CH_2Br \; CH_3CH_2^+ + AlBr_4^-$ **(1)** *ALLOW $C_2H_5^+$ in this equation only*  **(3)** **<u>Arrows</u>** *Do not allow to $C_2H_5^+$* *ALLOW to point/go to + charge* *ALLOW C_2H_5 in intermediate*	**(4 marks)**
		(iii)	Electrophilic substitution	**(1 mark)**

QWC*	(d)	 % of ethylbenzene in mixture EXPLANATION: At least two horizontal and two vertical tie-lines drawn from 60% ethylbenzene **(1)** Vapour condensed and then reboiled **(1)** Vapour (from 60% ethylbenzene liquid) gets richer in the more volatile component (benzene) / residue gets richer in ethylbenzene **(1)** Pure benzene distilled off / ethylbenzene left as residue **(1)** *4th mark not a stand alone mark* If **no** correct tie lines drawn, **max (2)**	**(4 marks)**
			Total 17 marks

3	(a)	(i)	Forms **ions** which have partially filled *d*-orbitals *OR* Forms **ions** which have a partially filled *d*-subshell	**(1 mark)**
		(ii)	Scandium / Sc **and** Zinc / Zn	**(1 mark)**
	(b)	(i)	Fe^{2+} [Ar] $3d^6$ Mn^{2+} [Ar] $3d^5$ **(1)** *for both correct*	**(1 mark)**
		(ii)	Fe^{3+} is $3d^5$ / half filled *d*-subshell which is more stable than $3d^6$ **(1)** Mn^{2+} is (already) $3d^5$ (which is more stable than $3d^4$) **(1)**	**(2 marks)**
	(c)		Shape **(1)** Bonding to correct atoms **(1)**  (4-) *OR*  (4-)	**(2 marks)**
	(d)		Two As atoms oxidised from +3 to +5 per mole of As_2O_3 (loss of $4e^-$) **(1)** ∴ if 5 moles oxidised, total $20e^-$ lost / change in oxidation no. = 20 **(1)** ∴ 4 moles MnO_4^- reduced, total $20e^-$ gained / change in oxidation no. 20 ∴ each Mn(VII) gains $5e^-$ /change in oxidation no. 5 **(1)** ∴ Mn(II) / Mn^{2+} **(1)** *NOT standalone mark*	**(4 marks)**
	(e)	(i)	VO_3^- + $2H^+$ / $2H_3O^+$ → VO_2^+ + H_2O / $3H_2O$	**(1 mark)**
		(ii)	No because oxidation no. of V is +5 in VO_2^+ / Oxidation no. of V unchanged (at +5)	**(1 mark)**
		(iii)	First green colour : VO_2^+ **and** VO^{2+} **(1)** Second green colour : V^{3+} / $[V(H_2O)_6]^{3+}$ **(1)** Violet colour : V^{2+} / $[V(H_2O)_6]^{2+}$ **(1)**	**(3 marks)**
				Total 16 marks

4	(a)	(i)	Correct points **(1)** Smooth curve **(1)**  	**(2 marks)**
		(ii)	First half life 15 min (± 1 min) **(1)** Second half life 15 min (± 1 min) **(1)** *If not shown on graph max* **(1)**	**(2 marks)**
		(iii)	1st order **(1)** $t_{½}$ is constant **(1)**	**(2 marks)**
	(b)	(i)	Zero	**(1 mark)**
		(ii)	Rate = k [2-bromo-2-methylbutane] *ALLOW a formula* *Mark consequentially on (a)(iii) and (b) (i)*	**(1 mark)**
		(iii)	 *Mark consequentially on (ii), i.e. If S_N2 mechanism given in (b)(ii, then one mark for each arrow* **(2)** and transition state including sign **(1)**	**(3 marks)**
	(c)	The intermediate /carbocation /  is planar **(1)** (Equal) attack from either side **(1)** (therefore) racemic mixture (produced) **(1) Standalone mark**		**(3 marks)**
				Total 14 marks

5	(a)	(i)	Elimination / dehydration	**(1 mark)**
		(ii)	**Concentrated** sulphuric acid / **concentrated** phosphoric acid / aluminium oxide *ACCEPT correct formula*	**(1 mark)**
		(iii)	Hydrolysis	**(1 mark)**
		(iv)	Esterification	**(1 mark)**
		(v)	CH_3OH / methanol	**(1 mark)**
	(b)	(i)	*EITHER*  *OR*  *Lone pairs not essential* *Arrows may start from minus of O^-* *ALLOW CN^- OR ^-CN*	**(4 marks)**
		(ii)	High $[H^+]$ insufficient CN^- (available for nucleophilic attack) **(1)** Low $[H^+]$ insufficient H^+ / HCN for the second stage **(1)** High [$[H^+]$ surpresses ionisation / shifts equilibrium to left **and** low $[H^+]$ shifts equilibrium to right **max (1)**	**(2 marks)**

	(c)	(i)	(Free) radical / peroxide	**(1 mark)**
		(ii)	 Correct repeating unit **(1)** Continuation bonds dependent on a 2 carbon skeleton unit **(1)**	**(2 marks)**
		(iii)	The polymer chain lengths are different (due to different termination steps) / different size molecules/ different numbers of monomer (units)	**(1 mark)**
				Total 15 marks
				TOTAL FOR PAPER: 75 MARKS