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Mark Scheme (Results)
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GCE

GCE Chemistry (6246/02)

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General Guidance on Marking

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge, and for critical and imaginative thinking. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

Using the mark scheme

The mark scheme gives you:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

/ means that the responses are alternatives and either answer should receive full credit.

( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.

[ ] words inside square brackets are instructions or guidance for examiners.

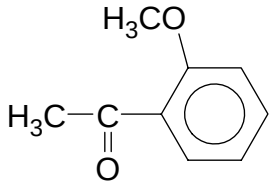
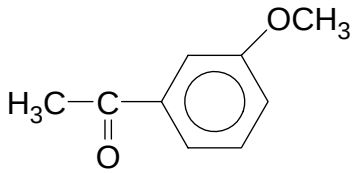
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.

CQ (consequential) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

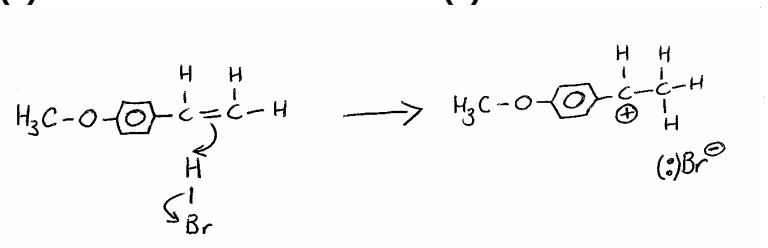
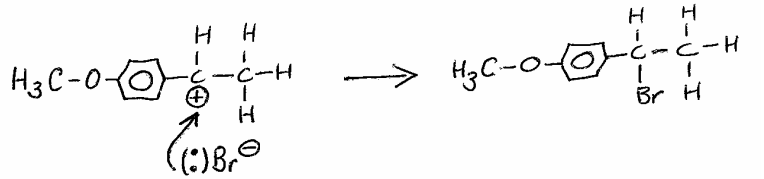
Note:
If a candidate has crossed out an answer and written new text, the crossed out work should be ignored. If the candidate has crossed out work, but written no new text, the crossed out work for that question or part question should be marked, as far as it is possible to do so.

		EXPECTED ANSWER	ACCEPT	REJECT	MARK
1	(a) (i)	$Cu \rightarrow Cu^{2+} + 2e^{(-)}$ **(1)** $Cr_2O_7^{2-} + 14H^+ + 6e^{(-)} \rightarrow 2Cr^{3+} + 7H_2O$ **(1)** $Cr_2O_7^{2-} + 14H^+ + 3Cu \rightarrow 2Cr^{3+} + 7H_2O + 3Cu^{2+}$ **(1)**			**(3 marks)**
	(ii)	initial moles $Cr_2O_7^{2-}$ = 0.00750 **(1)** moles $Cr_2O_7^{2-}$ reacted = 0.00750 – 0.00342=0.00408 **(1)** moles Cu = 3 x 0.00408 = 0.01224 **(1)** mass Cu = 63.5 x 0.01224 = 0.77724 g **(1)** % purity = 97.2 % **(1)** *consequential on equation in (i)* *if >100 % do not award % mark unless commented on* *If not 3SF loses last mark*			**(5 marks)**
	(iii)	$Cu(OH)_2$ / $[Cu(H_2O)_4(OH)_2]$ **(1)** $Cr(OH)_3$ / $[Cr(H_2O)_3(OH)_3]$ **(1)**			**(2 marks)**
	(iv)	$[Cr(OH)_6]^{3-}$/ $[Cr(H_2O)(OH)_5]^{2-}$ / $[Cr(H_2O)_2(OH)_4]^-$ **(1)** green **(1)**	$Cr(OH)_4^-$ pale/light/dark/ bright green		**(2 marks)**

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(b) dissolve in **minimum vol** of boiling/hot water **(1)** filter through heated funnel / filter while hot **(1)** cool and filter (under reduced pressure) **(1)** wash in minimum/cold water (and dry) **(1)**			**(4 marks)**
				Total 16 marks

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
2 (a)	 *OR* 			**(1 mark)**
(b) (i)	4 peaks **(1)** area 3 : 2 : 2 : 3 **(1)** (can score **(2)** because 4 peaks clearly implied) 3 peaks area 3 : 4 : 3 **(1 out of 2)** 3 peaks area 6 : 2 : 2 / 3 : 1 : 1 **(1 out of 2)**			**(2 marks)**
(ii)	$[COC_6H_4OCH_3]^+$ / $[CH_3COC_6H_4O]^+$ charge **essential**			**(1 mark)**
(c) (i)	$LiAlH_4$ / $NaBH_4$ **(1)** Reduction / nucleophilic addition **(1)** secondary alcohol **(1)**	H_2+Ni/Pt/Pd, *OR* Na + ethanol		**(3 marks)**

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(ii) Molecule cannot be superimposed on its mirror image *OR* C atom to which four different groups are joined **(1)**	asymmetric C atom *OR* no plane/centre of symmetry		**(1 mark)**
(d)	(i) concentrated H_2SO_4 *OR* conc. H_3PO_4 *OR* Al_2O_3 *OR* names **(1)** dehydration *OR* elimination **(1)**			**(2 marks)**
	(ii) has two H atoms/two atoms the same at one end of the double bond **(1)**		"can be rotated about double bond"	**(1 mark)**

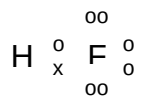
	EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(e) **(1)** for both arrows **(1)** for intermediate  **(1)** for arrow  *Notes:* • *If the wrong carbocation is shown i.e. Br is on the wrong carbon atom, only 1st and 3rd marks are available* • *Lone pair is not essential but if shown arrow must start from it* • *allow arrow from negative charge* • *allow arrow to "+"*			**(3 marks)**

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
QWC	(f) A has van der Waals'/dispersion/London forces **and** dipole-dipole forces **(1)** C has H bonding **and** van der Waals/dispersion/London **and** dipole-dipole forces **(1)** H bonding stronger than van der Waals/dispersion/ London forces **and** dipole-dipole forces **(1)** (therefore more energy required) *Penalise lack of dipole-dipole once only*	van der Waals in C is greater than in A because C has more electrons		**(3 marks)**
				Total 17 marks

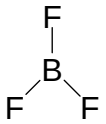
	EXPECTED ANSWER	ACCEPT	REJECT	MARK
3 (a) (i)	working: ((4x 90.4) + (6x –242)) – (4x –46.2) *OR* $\Delta H = \Sigma\Delta H_f$(Products) – $\Sigma\Delta H_f$(Reactants) **(1)** -905.6 kJ mol^{-1} **(1)** *OR* - 906 kJ mol^{-1} Must have the sign and the units. *IGNORE SF*			**(2 marks)**
(ii)	high temp = high rate **(1)** more mols > E_{act} **(1)** high temp = low yield because reaction exothermic **(1)** so compromise temp used to balance rate and yield **(1)** catalyst causes higher rate by alternative route of lower E_{act} **(1)** but same yield as speeds up forward and back reactions *OR* same yield as k unchanged **(1)**	<u>If endothermic in (i)</u> opposite argument		**(6 marks)**
QWC				
(b)	heat change = 50 x 4.18 x 6.5 = 1358.5 J **(1)** for 0.025 mol ÷ heat (J or kJ) by 0.025 mol **(1)** ΔH = –54.3 kJ mol^{-1} / 54300 J mol^{-1} value, sign and unit **(1)** *IGNORE SF*	1359 to give – 54.4 or – 54.36 1360 to give – 54.4 only		**(3 marks)**

	EXPECTED ANSWER	ACCEPT	REJECT	MARK

	(c)	(i)	Add NaOH and warm **(1)** (Damp) red litmus in gas unchanged (showing no NH_4^+) **(1)** Add Al *OR* Devarda's alloy *OR* zinc + NaOH and warm; gas evolved turns red litmus blue (shows NO_3^-) **(1)**			**(3 marks)**
		(ii)	cation same charge *OR* are all +1 **(1)** but ionic radius gets bigger **(1)** so polarises anion less **(1)**	 distorts anion less	atom gets bigger weakens bonds less	**(3 marks)**
						Total 17 marks

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
4 (a) (i)	correct diag (only outer electrons needed) i.e. 	all dots/crosses inner electrons too		**(1 mark)**
(ii)	$H^{\delta+}$ and $F^{\delta-}$ **(1)** Large electronegativity difference *OR* forms strong intermolecular bond **(1)** Through lone pair *OR* because of small size of (H and) F atom(s) **(1)** *Diagram can score 1st and 3rd marks*			**(3 marks)**
(b) (i)	$HF + H_2O \rightleftharpoons H_3O^+ + F^-$ **(1) must** show that water is there $K_a = \frac{[H_3O^+][F^-]}{[HF]}$ *OR* $K_a = \frac{[H^+][F^-]}{[HF]}$ **(1)** *IGNORE state symbols*		$HF \rightleftharpoons H^+ + F^-$	**(2 marks)**

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(ii) moles HF at start = $0.1 \times 0.025 = 0.0025$ **(1)** moles NaOH = moles F^- = $0.12 \times 0.01 = 0.0012$ **(1)** moles HF left = $0.0025 - 0.0012 = 0.0013$ **(1)** ÷ both moles by 0.35 **(1)** ie $[HF]_{eqm} = \frac{0.0013}{0.035} = 0.03714$ (mol dm^{-3}) $[F^-]_{eqm} = \frac{0.0012}{0.035} = 0.03429$ (mol dm^{-3}) $[H^+] = k_a \times \frac{[HF]}{[F^-]} = 0.000562 \times \frac{0.03714}{0.03429}$ $= 0.000609$ (mol dm^{-3}) **(1)** $pH = -\log [H^+] = 3.22$ **(1)** *IGNORE SF*			**(6 marks)**
QWC	(iii) Large reservoir of **both** HF and F^- is needed (to absorb both acid and base) **(1)** however $[F^-]$ is small (so cannot absorb acid) **(1)**			**(2 marks)**

	EXPECTED ANSWER	ACCEPT	REJECT	MARK
	(c) (i) 			**(1 mark)**
	(ii) from 120 ° → 109.5 ° / 109 ° *OR* changes by 10.5/11 ° **(1)** Boron (goes from 3) to 4 electron pairs (around atom) **(1)**			**(2 marks)**
				Total 17 marks