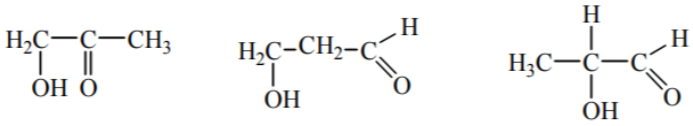
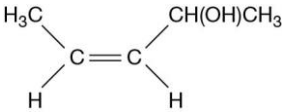
16 Organic analysis
Answers to practice questions

Question number	Answer	Marks	Guidance
1 (a)	*absorption* ***X***: (O–H) (alcohols) *absorption* ***Y***: C=O 	1 1 3	Penalise acid or missing 'alcohol'. Allow carbonyl. Since the OH peak is an alcohol OH peak (which has a slightly higher wave number than an acid OH) you cannot have a carboxylic acid for the answer.
2 (a)	Functional group (isomerism)	1	
2 (b)	**M1** Tollens' (reagent) *(Credit ammoniacal silver nitrate OR a description of making Tollens')* *(Ignore either $AgNO_3$ or $[Ag(NH_3)_2]^{2+}$]* *or "the silver mirror test" on their own, but mark M2 and M3)* **M2** silver mirror OR black solid/precipitate *(NOT silver precipitate)* **M3** (stays) colourless or no change or no reaction **M1** Fehling's (solution) or Benedict's solution *(Ignore $Cu^{2+}(aq)$ or $CuSO_4$ on their own, but mark on to M2 and M3)* **M2** Red solid/precipitate *(Credit orange or brown solid)* **M3** (stays) blue or no change or no reaction Mark on from an incomplete / incorrect attempt at the correct reagent, penalising M1	3	No reagent, CE=0 Allow the following alternatives **M1** (acidified) potassium dichromate(VI) (solution) **M2** (turns) green **M3** (stays) orange / no change OR **M1** (acidified) potassium manganate(VII) (solution) **M2** (turns) colourless **M3** (stays) purple / no change For M3 Ignore "nothing (happens)" Ignore "no observation"
2 (c)	(Both have) C=O ***OR*** a carbonyl (group)	1	
2 (d) (i)	(Free-) radical substitution ONLY	1	Penalise "(free) radical mechanism"
2 (d) (ii)	**Initiation** $Cl_2 \rightarrow 2Cl\bullet$ **First propagation** $Cl\bullet + CH_3CH_2CH_3 \rightarrow \bullet CH_2CH_2CH_3 + HCl$	4	Penalise absence of dot once only. Penalise incorrect position of dot on propyl radical

	OR C_3H_8 **Second propagation** $Cl_2 + •CH_2CH_2CH_3 \rightarrow CH_3CH_2CH_2Cl + Cl•$ ***OR*** C_3H_7Cl **Termination (must make C6H14)** $2 •CH_2CH_2CH_3 \rightarrow C_6H_{14}$ or $CH_3CH_2CH_2CH_2CH_2CH_3$		once only. Penalise C_3H_7 • once only Accept $CH_3CH_2CH_2$ • with the radical dot above / below / to the side of the last carbon. Use of the secondary free radical might gain 3 of the four marks
2 (e)	*Mr* = 44.063#52 (for propane) *Mr* = 43.989#82 (for carbon dioxide) **M1** a correct value for both of these *Mr* values. **M2** a statement or idea that two peaks appear (in the mass spectrum) ***OR*** two molecular ions are seen (in the mass spectrum).	2	Mark independently
3 (a)	Pentan-2-one	1	ONLY but ignore absence of hyphens
3 (b)	Functional group (isomerism)	1	Both words needed
3 (c) (i)		1	Award credit provided it is obvious that the candidate is drawing the Z / cis isomer The group needs to be $CHOHCH_3$ but do not penalise poor C-C bonds or absence of brackets around OH Trigonal planar structure not essential
3 (c) (ii)	Restricted rotation (about the C=C) OR No (free) rotation (about the C=C)	1	
3 (d)	**M1** Tollens' (reagent) *(Credit ammoniacal silver nitrate OR a description of making Tollens')* *(Do not credit Ag^+, $AgNO_3$ or $[Ag(NH3)^{2+}]$ or "the silver mirror test" on their own, but mark M2 and M3)* **M1** Fehling's (solution) / Benedict's *(Penalise $Cu^{2+}(aq)$ or $CuSO_4$ but mark M2 and M3)*	3	If M1 is blank CE = 0, for the clip Check the partial reagents listed and if M1 has a totally incorrect reagent, CE = 0 for the clip Allow the following alternatives **M1** (acidified) potassium

	<table><tr><td>**M2** silver mirror OR black solid or black precipitate</td><td>**M2** Red solid/precipitate *(Credit orange or brown solid)*</td></tr><tr><td>**M3 (**stays) colourless OR no (observed) change / no reaction</td><td>**M3 (**stays) blue OR no (observed) change / no reaction</td></tr></table>		dichromate(VI) (solution); mark on from incomplete formulae or incorrect oxidation state **M2** (turns) green **M3** (stays) orange / no (observed) change / no reaction OR **M1** (acidified) potassium manganate(VII) (solution); mark on from incomplete formulae or incorrect oxidation state **M2** (turns) colourless **M3** (stays) purple / no (observed) change / no reaction In all cases for **M3** Ignore "nothing (happens)" Ignore "no observation"
3 (e) (i)	Spectrum is for **Isomer 1** or named or correctly identified	1	The explanation marks in 3(e)(ii) depend on correctly identifying Isomer 1. The identification should be unambiguous but candidates should not be penalised for an imperfect or incomplete name. They may say "the alcohol" or the "alkene" or the "E isomer"
3 (e) (ii)	**If Isomer 1 is correctly identified, award <u>any two</u> from** • (Strong / broad) absorption / peak in the range **3230 to 3550**#cm^{-1} or specified value in this range or marked correctly on spectrum **<u>and</u>** (characteristic absorption / peak for) **<u>OH</u>** group /**<u>alcohol</u>** group • No absorption / peak in range **<u>1680 to 1750</u>**#cm^{-1} or absence <u>marked correctly</u> on spectrum **<u>and</u>** (No absorption / peak for a) **C=O** group / **<u>carbonyl</u>** group / **<u>carbon-oxygen double bond</u>** • Absorption / peak in the range **<u>1620 to 1680</u>**#cm^{-1} or specified value <u>in this range</u> or <u>marked correctly</u> on spectrum **<u>and</u>**	2	If 3(e)(i) is incorrect or blank, CE=0 Allow the words "dip" OR "spike" OR "trough" OR "low transmittance" as alternatives for absorption. Ignore reference to other absorptions e.g. C-H, C-O

	(characteristic absorption / peak for) **C=C** group / **alkene** / **carbon-carbon double bond**		