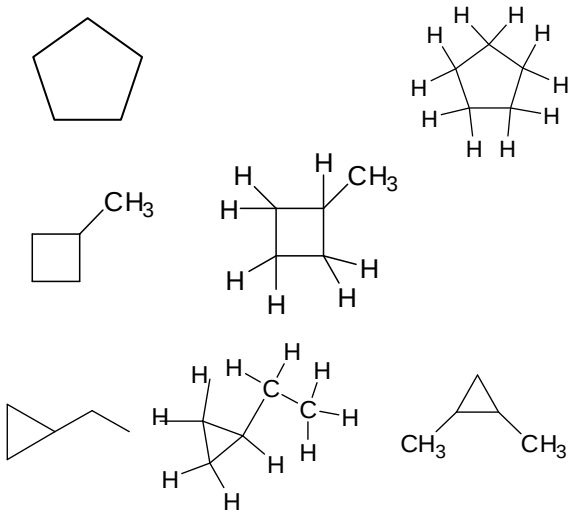
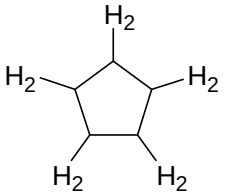
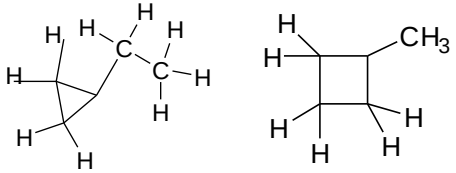
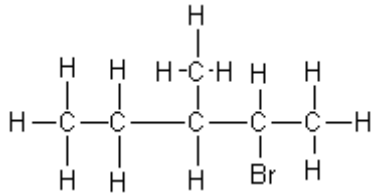
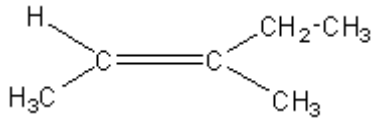
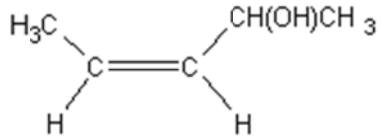
Basic Organics Answers

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
6	a		(Different) boiling points	1	Ignore mp's, references to imf, different volatilities
6	b	i	Compound which have the same <u>molecular</u> formula but different structures/different structural formulae/different displayed formulae	1 1	Accept same no and type of atom for M1 But If same (chemical) formula M1 = 0 but allow M2 If empirical formula CE = 0/2 M2 dependent on M1
6	b	ii	3-methylbut-1-ene	1	only ignore commas and hyphens
6	b	iii	 Allow any correct structure with a cyclic alkane	1	Do not allow  or  i.e with an H missing on one C

6	c		$C_{13}H_{28}$ Making plastics/ used to make polymers or polythene/ used to make antifreeze/ make ethanol/ ripening fruit/ any named additional polymer	1 1	only not used **as** a plastic/polymer/antifreeze not just 'polymers' – we need to see that they are being made

Q	Part	Sub Part	Marking Guidance	Mark	Comments
6	a	i	**3**-bromo-**3**-methylpentane ONLY	1	Must be correct spelling but ignore hyphens and commas
6	a	ii	<u>Electrophilic addition</u> (reaction)	1	Both words needed Accept phonetic spelling
6	a	iii	**M1** Displayed formula of 2-bromo-3-methylpentane  **M2** Position(al) (isomerism)	2	All the bonds must be drawn out but ignore bond angles **Do not forget to award this mark**
6	a	iv	Structure of (E)-3-methylpent-2-ene 	1	The arrangement of groups around the double bond must be clear with the ethyl group attached in the correct order. Ignore bond angles. Accept C_2H_5 for ethyl Be lenient on C ─ C bonds. The main issue here is whether they have drawn an (E) isomer. Accept "sticks" for C ─ H bonds and correct skeletal formula

3(e)	**M1** S OR S_8 OR S_2 **M2** I_2 (ONLY)	2	Ignore names penalise lower case "i" for iodine, penalise superscripted numbers Mark independently The correct formula must be clearly identified in each case if an equation is written
3(f)(i)	$CH_3CH_2CH=CH_2$	1	Structure of but-1-ene. Ignore name Credit "sticks" for C-H bonds
3(f)(ii)	$CH_3CH_2CH_2CH_2OH$	1	Structure of butan-1-ol. Ignore name Credit "sticks" for C-H bonds
3(f)(iii)	$CH_3CH_2CH_3$	1	Structure of propane. Ignore name Ignore calculations and molecular formula Credit "sticks" for C-H bonds Ignore the molecular ion
3(f)(iv)	CH_3CH_2Br or C_2H_5Br	1	Structure of bromoethane. Ignore name and structure of nitrile Credit "sticks" for C-H bonds

Question	Marking Guidance	Mark	Comments
6(a)	Pentan-2-one	1	ONLY but ignore absence of hyphens
6(b)	Functional group (isomerism)	1	Both words needed
6(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
6(c)(ii)	Restricted rotation (about the C=C) OR No (free) rotation (about the C=C)	1	

6(d)		3	If M1 is blank CE = 0, for the clip Check the partial reagents listed and if M1 has a <u>totally incorrect</u> reagent, CE = 0 for the clip Allow the following alternatives **M1** (acidified) potassium 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"

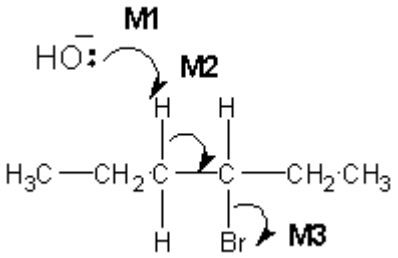
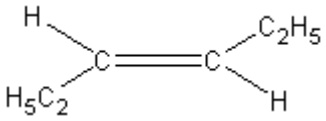
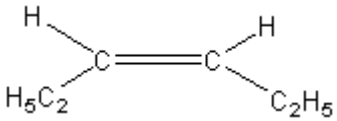
M1 Tollens' (reagent) *(Credit ammoniacal silver nitrate OR a description of making Tollens')* *(Do not credit Ag^+, $AgNO_3$ or $[Ag(NH_3)_2^+]$ or "the silver mirror test" on their own, but mark M2 and M3)*	**M1** Fehling's (solution) / Benedict's *(Penalise $Cu^{2+}(aq)$ or $CuSO_4$ but mark M2 and M3)*
M2 <u>silver mirror</u> OR <u>black solid or black precipitate</u>	**M2** <u>Red solid/precipitate</u> *(Credit <u>orange</u> or <u>brown</u> <u>solid</u>)*
M3 (stays) colourless OR no (observed) change / no reaction	**M3 (**stays) blue OR no (observed) change / no reaction

6(e)(i)	Spectrum is for **Isomer 1** or named or correctly identified	1	The explanation marks in 6(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"

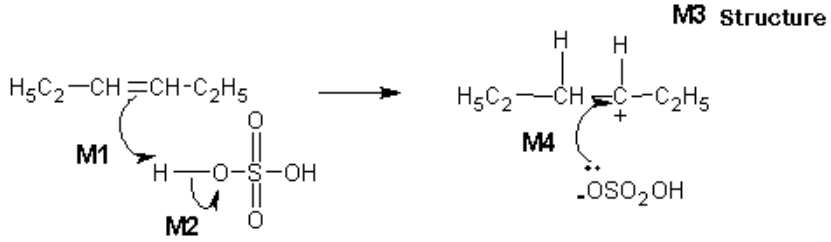
6(e)(ii)	**If Isomer 1 is correctly identified, award <u>any two</u> from** • (Strong / broad) absorption / peak in the range **<u>3230 to 3550</u>** cm^{-1} or specified value <u>in this range</u> or <u>marked correctly</u> on spectrum **<u>and</u>** (characteristic absorption / peak for) **<u>OH</u>** 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) **<u>C=O</u>** 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>** (characteristic absorption / peak for) **<u>C=C</u>** group / **<u>alkene</u>** / **<u>carbon-carbon double bond</u>**	2	If 6(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

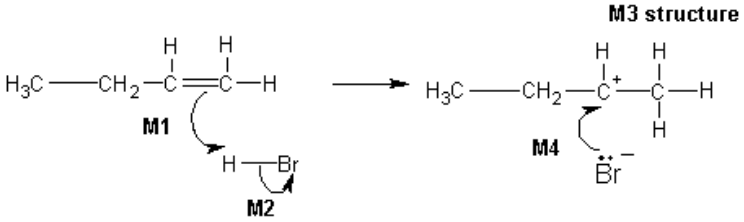
Question	Marking Guidance	Mark	Comments
6(a)	• (Same) General formula /allow a named homologous series with its general formula • Chemically similar/same (chemical) reactions • Same functional group • Trend in physical properties/ eg inc bp as M_r increases • (Molecules) increase by CH_2/M_r = *14*	2	Any two points
6(b)	Fractional distillation/ fractionation/ chromatography	1	Allow GLC
6(c)	(Molecules/compounds/substances) with the same molecular formula / same number and type of atoms but different structural formula/ different displayed formula/ different arrangement of atoms/different structures 2,4-dimethylhexane C_4H_9	1 1 1 1	Allow alkanes with same molecular formula Allow same chemical formula in M1 = 0 but can allow M2 Not different positions in space M2 dependent on M1 Ignore the absence of dash and/or commas

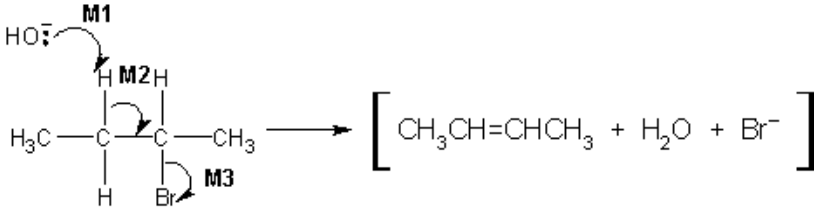
6(d)	less surface contact / less surface area/ less polarisable molecule	1	Allow more spherical or fewer ponts of contact Not smaller molecule/ not more compact molecule/ not shorter chain Allow converse arguments
	so fewer/weaker/less Van der Waals'/vdw forces	1	Must be comparative answer ie not just few VDW forces QoL Assume 'it' refers to the branched isomer

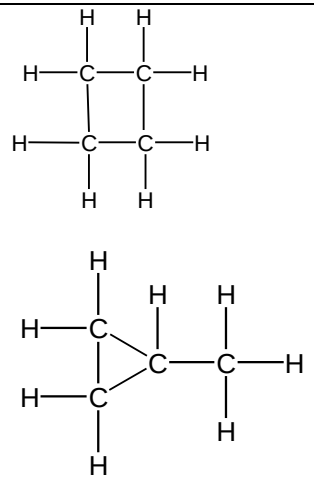
Question	Marking Guidance	Mark	Comments
7(a)(i)	 **M1** must show an arrow from the lone pair on oxygen of a negatively charged hydroxide ion <u>to the correct</u> H atom **M2** must show an arrow from the correct C-H bond to the correct C-C bond. Only award if an arrow is shown <u>attacking</u> the H atom of the correct C-H bond in **M1** **M3** is independent but **CE=0 if nucleophilic substitution** **N.B these are double- headed arrows**	3	Penalise one mark from <u>their</u> total if half-headed arrows are used Penalise **M3** for formal charge on C of the C-Br or incorrect partial charges on C-Br Ignore other partial charges Penalise once only in any part of the mechanism for a line and two dots to show a bond.
7(a)(ii)	**M1** E isomer  **M2** Z isomer 	2	Award 1 mark if both correct stereoisomers but in the wrong places Accept no other alkenes. Be reasonably lenient on the bonds to ethyl (or to CH_2CH_3) since the question is about E and Z positions but penalise once only if connection is clearly to the CH_3 of CH_2CH_3 Accept linear structures

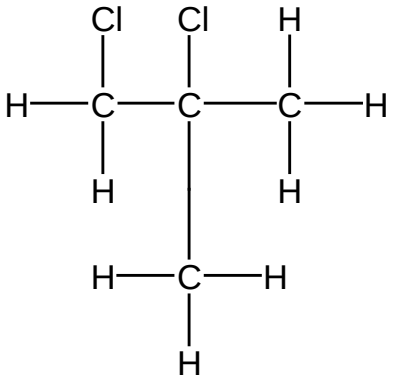
7(a)(iii)	**M1** (Compounds / molecules with) the <u>same structural formula</u> **M2** with <u>atoms/bonds/groups</u> arranged <u>differently in space</u> ***OR*** <u>atoms/bonds/groups</u> that have <u>different spatial arrangements / different orientation</u>.	2	Penalise **M1** if "same structure" Ignore references to " same molecular formula" or "same empirical formula" or any reference to "displayed formula" Mark independently

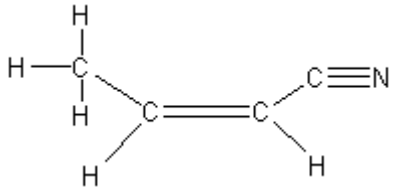
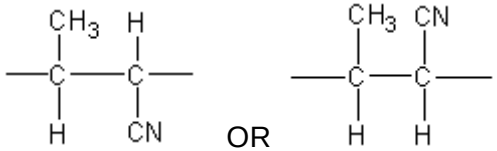
7(b)	 **M1**must show an arrow from the double bond towards the H atom of the H – O bond OR HO on a compound with molecular formula for H_2SO_4 M1 could be to an H+ ion and M2 an independent O – H bond break on a compound with molecular formula for H_2SO_4 **M2** must show the breaking of the O ─ H bond. **M3** is for the structure of the carbocation. **M4** must show an arrow from the lone pair of electrons on the correct oxygen of the negatively charged ion towards a correct (positively charged) carbon atom. **NB The arrows here are double-headed**	4	**M1** Ignore partial negative charge on the double bond. **M2** Penalise partial charges on O – H bond if wrong way and penalise formal charges In M2 do not penalise incorrect structures for H_2SO_4 **M4** NOT HSO_4^- For **M4**, credit <u>as shown</u> or <u>$^-$:OSO$_3$H</u> ONLY with the negative charge anywhere on this ion OR <u>correctly</u> drawn out with the negative charge placed correctly on oxygen Penalise once only in any part of the mechanism for a line and two dots to show a bond <u>Max 3 of any 4 marks</u> for wrong organic reactant or wrong organic product (if shown) Accept the correct use of "sticks"

Question	Marking Guidance	Mark	Comments
8(a)	Position(al) (isomerism)	1	
8(b)	 **M1** must show an arrow from the double bond towards the H atom of the H–Br molecule **M2** must show the breaking of the H–Br bond. **M3** is for the structure of the secondary carbocation. **M4** must show an arrow from the lone pair of electrons on the negatively charged bromide ion towards the positively charged carbon atom of either a primary or secondary carbocation. **NB The arrows here are double-headed**	4	Penalise one mark from <u>their</u> total if half-headed arrows are used M1 Ignore partial negative charge on the double bond. M2 Penalise partial charges on H–Br bond if wrong way and penalise formal charges Penalise M3 if there is a bond drawn to the positive charge Penalise once only in any part of the mechanism for a line and two dots to show a bond <u>Maximum any 3 of 4 marks</u> for wrong reactant or primary carbocation. If Br_2 is used, <u>maximum 2 marks</u> for their mechanism Do not penalise the use of “sticks”

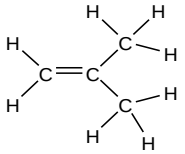
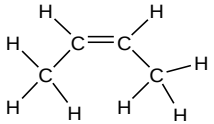
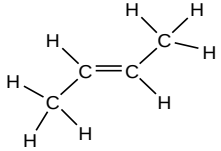
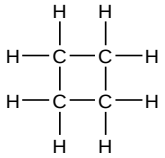
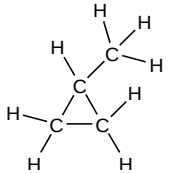
8(c)	 **M1** must show an arrow from the lone pair on oxygen of a negatively charged hydroxide ion <u>to a correct</u> H atom **M2** must show an arrow from a C-H bond adjacent to the C-Br bond towards the appropriate C-C bond. Only award if an arrow is shown attacking the H atom of an adjacent C-H (in M1) **M3** is independent provided it is from their <u>original molecule</u>. Award full marks for an E1 mechanism in which M2 is on the correct carbocation. **NB The arrows here are double-headed**	3	Penalise one mark from <u>their</u> total if half-headed arrows are used Penalise M1 if covalent KOH Penalise M3 for formal charge on C of the C-Br or incorrect partial charges on C-Br Penalise M3 if an extra arrow is drawn from the Br of the C-Br bond to, for example, K^+ Ignore other partial charges Penalise once only in any part of the mechanism for a line and two dots to show a bond. <u>Maximum any 2 of 3 marks</u> for wrong reactant <u>or</u> wrong product (if shown) <u>or</u> a mechanism that leads to but-1-ene Accept the correct use of “sticks” for the molecule except for the C-H being attacked

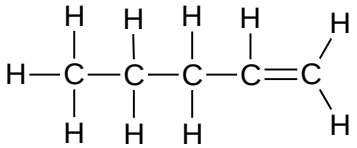
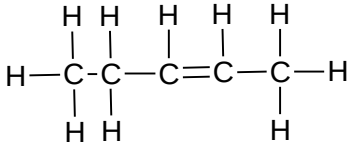
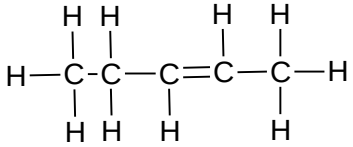
Question	Marking Guidance	Mark	Comments
2(a)(i)	(Compounds with the) same molecular formula But different structural formula / different displayed formula/different structures / different skeletal formula	1 1	Allow same number and type of atom for M1 Ignore same general formula. M2 dependent on M1 Not different positions of atoms/bonds in space.
2(a)(ii)	But-2-ene	1	Allow but-2-ene. Allow but 2 ene. Ignore punctuation.
2(a)(iii)	(2)-methylprop-(1)-ene	1	Do not allow 2-methyleprop-1-ene.
2(a)(iv)		1	Do not allow skeletal formulae. Penalise missing H and missing C
2(b)(i)	$C_4H_8 + 2O_2 \rightarrow 4C + 4H_2O$	1	Accept multiples.

Question	Marking Guidance	Mark	Comments
8(a)	2-bromo-2,3-dimethylbutane	1	Ignore punctuation.
	$C_nH_{2n+1}Br$ or $C_nH_{2n+1}X$ or $C_xH_{2x+1}Br$	1	Any order.
	Stronger / more <u>vdw</u> (forces) <u>between molecules</u>	1	QoL
	(of 1-bromohexane)		Allow converse arguments for Z Not just more IMF. Ignore size of molecule.
8(b)		1	
	C_2H_4Cl	1	Any order.

Question	Marking Guidance	Mark	Comments
9(a)(i)	Structure of (Z)-but-2-enenitrile with or without either or both of the CH_3 and the CN groups displayed 	1	Penalise C–NC Do <u>not</u> penalise C–H_3C Ignore bond angles.
9(a)(ii)	Restricted <u>rotation</u> / no (free) <u>rotation</u> about the double bond / about the C=C ***OR*** does not <u>rotate</u> (about the double bond)	1	Must use the word <u>rotate / rotation.</u>
9(b)	Repeating unit of polyalkene 	1	All the bonds relevant to the unit must be drawn out including those on either side of the unit. There is no need to expand either the CH_3 or the CN Penalise C–NC Penalise “sticks”. Ignore brackets. Penalise “n”

9(c)	**Feature 1** Absorption / peak in the range **2220 to 2260** cm^{-1} or specified value in this range or marked correctly on spectrum **and** (characteristic absorption / peak for) **C≡N / CN** group / **nitrile / cyanide** group **Feature 2** Absorption / peak in the range **1620 to 1680** cm^{-1} or specified value in this range or marked correctly on spectrum **and** (characteristic absorption / peak for) **C=C** group / **alkene** / **carbon-carbon double bond**	2	Allow the words "dip" ***OR*** "spike" ***OR*** "trough" ***OR*** "low transmittance" as alternatives for absorption. Allow a peak at 2200 cm^{-1} to 2220 cm^{-1} **in this case.** Ignore reference to other absorptions eg C-H Either order.

4(b)(iv)			Must show unambiguous structure Penalise lack of displayed formula once only
		1	
	 	1	
	 	1	

8(b)		1	
		1	
	Z-pent-2-ene		If no M2 and M3 **ALLOW** 1 mark if both structures **OR** both names correct
		1	**NOT** cis and trans
	E-pent-2-ene		
	no free rotation around C=C	1	**ALLOW** no rotation of C=C
	2 different atoms/groups on each of the C=C Cs owtte	1	**IGNORE** 'functional'