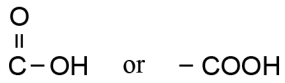
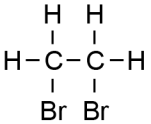
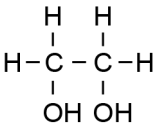
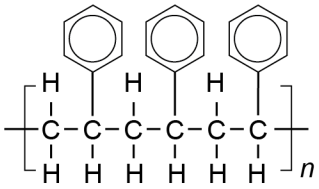
Assessment Schedule – 2024

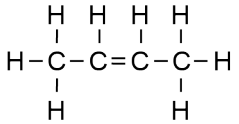
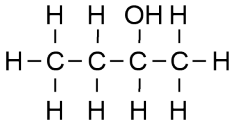
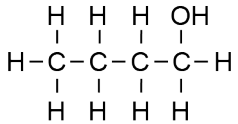
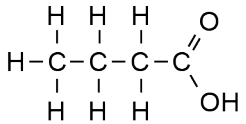
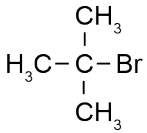
Chemistry: Demonstrate understanding of the properties of selected organic compounds (91165)

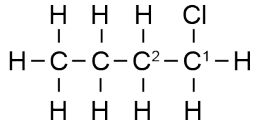
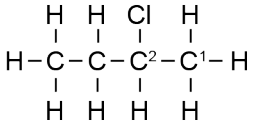
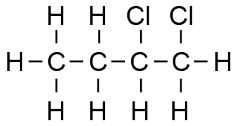
Evidence

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i)	A: (Primary) alcohol / hydroxyl, primary not essential B: Alkene / carbon to carbon double bond	• Correct identification of both groups.		
(ii)	A: Acidified permanganate or dichromate should be added to the sample (and the sample heated.) B: Bromine water or (acidified) permanganate should be added to the sample.	• Two reagents correctly identified. OR		
(iii)	A: Acidified purple permanganate solution becomes colourless OR acidified orange dichromate solution turns green indicating oxidation to a carboxylic acid.  or B: Orange / brown bromine water solution rapidly decolourises (without UV catalyst) as the addition reaction changes the alkene to an alkane, forming a dihaloalkane.  or generic X to represent haloalkane. OR Oxidation/addition with MnO_4^- Or MnO_4^- / H^+ to form a diol / dialcohol. In this process, the purple/pink MnO_4^- turns brown in MnO_4^- or colourless in MnO_4^- / H^+ 	Correct reagent and associated observation or reaction type or product	• Correct reagent. AND THREE of: - observation - reaction type - name - drawing correct for one group.	• A and B are both correctly named with all correct reagents, full observations, reaction type, and named and drawn functional group of products.

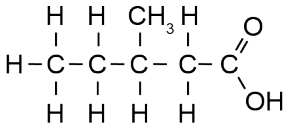
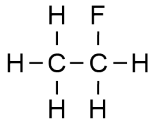
(b)	Mix each unknown solvent in a test tube with water. Alcohols, ethanol and methanol, are soluble/miscible and will mix with water due to their short carbon chain length, resulting in a single layer. Hexane is insoluble/immiscible in water, and will result in two layers. Boiling point test for the two remaining unknowns (alcohols). Ethanol will boil at a higher temperature than methanol due to its increased carbon chain length / mass.	• Identifies ethanol or methanol as alcohols. OR Hexane as an alkane. • ONE correct method and observation.	• Correctly identifies hexane based on solubility, with explanation. OR Correctly identifies that ethanol / methanol will have different boiling points.	• Explains how all three can be identified, including reference to carbon chain length.
(c)(i)		• Correct polymer.		
(ii)	In an addition polymerisation reaction, C=C double bonds are broken in order for new single bonds to form between monomers, joining into long repeating chains called polymers. The monomers have a C=C unsaturated double bond, which is much more reactive than the resulting C–C saturated single bond in the polymer structure. This is why the monomer can undergo addition polymerisation, while the polymer with only single C–C bonds cannot. This increased stability of the polymer relative to the monomer is essential for its uses with food for consumption. The polystyrene plates / bowls / cutlery / produce bags do not react with the food or with the moisture or heat from the food placed within them; therefore keeping it safe for consumption.	• Identifies polymer is saturated / (C–C), or monomer is unsaturated / (C=C). OR States why low reactivity is good for bags, plates etc. • Partial explanation of addition polymerisation.	• Links saturated / (C–C), nature of polymer and unsaturated / (C=C) nature of monomer to reactivity. • Explains addition polymerisation.	• Explains difference of monomer and polymer to undergo addition polymerisation with reference to structure, reactivity and uses

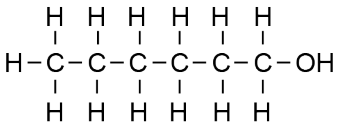
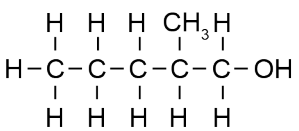
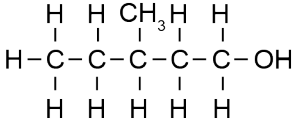
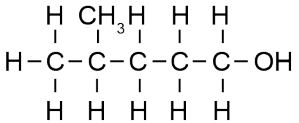
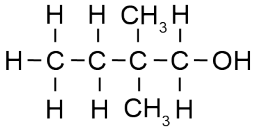
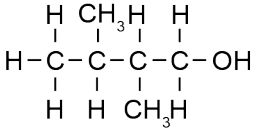
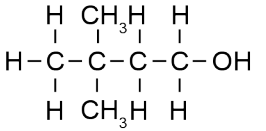
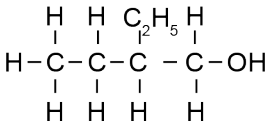
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	2m	3m	2e minor error	2e

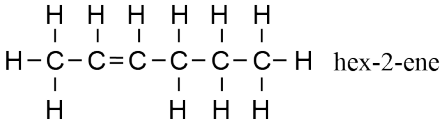
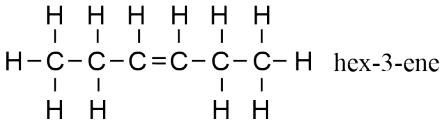
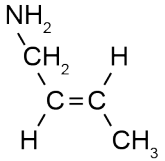
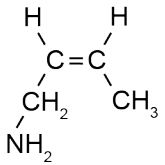
Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)	 **Compound C**  **Compound D**  **Compound E**  **Compound H**			
(ii)	1: KOH / NaOH(*alc*), (heat) 2: $SOCl_2$, PCl_3, PCl_5, HCl	• Any 3 / 10 correct	• Any 6 / 10 correct.	• 10 / 10 correct.
(iii)	W: elimination X: oxidation/addition Y: substitution Z: Acid / base reaction, neutralisation			
(b)	 This is a tertiary haloalkane as the bromine functional group is attached to a carbon atom which itself is attached to three other carbon atoms.	• Correct structure OR explanation.	• Correct structure AND explanation.	

(c)(i)	In this addition reaction the C=C double bond breaks open and a single bond forms in its place. This leaves one more bonding space around each of the carbon atoms involved in the original double bond, in this case C^1 and C^2. The reagent, HCl, is added across the double bond, with one carbon forming a bond with the H atom and the other forming a bond with the Cl atom. There are two products formed, as this new bonding can form both ways round. Products are:  1-chlorobutane, minor  2-chlorobutane major According to Markovnikoff's rule, the major product will form when the carbon from the double bond that originally had the most hydrogens bonded to it, gains the H atom during the addition reaction; in this case C^1. Hence the major product is 2-chlorobutane, as the Cl atom then joins C^2. When the bonding occurs the other way round, it forms the minor product, 1-chlorobutane.	• Correct structures for products (major / minor can be incorrectly assigned) OR States there are two ways that HCl can be added. • Partial explanation of addition reaction.	• Explains major and minor products (but missing aspects of explanation) AND correct structures.	• Explanation of how to identify the major and minor products, and why they occur including correct structures.
(ii)	As the reagent Cl_2 is symmetrical, it means that both of the new bonds that are formed on the carbon structure are C–Cl bonds, so both C^1 and C^2 from the original carbon to carbon double bond will gain a Cl atom in the addition of this reagent. This can only form one product, 1,2-dichlorobutane, a dihaloalkane. By contrast, the asymmetry of the HCl reagent in the first reaction with compound B, results in two possible combinations of bonding of the reagent atoms, H and Cl. As such, either C^1 or C^2 could receive the Cl atom and the other would receive the H. Hence two products are formed, both haloalkanes.  1,2-dichlorobutane	• Identifies symmetry as a factor. OR Draws correct structure.	• Links symmetry and asymmetry of reagent to number of reaction products, including correct structure.	

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	3m	4m	2e minor error	2e

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	<table><tr><td></td><td>but-1-ene Or 1-butene</td></tr><tr><td>  </td><td></td></tr><tr><td></td><td>hexan-3-ol (Or 3-hexanol)</td></tr><tr><td>  </td><td></td></tr></table>	• Any combination of two correct, structures or names.	• All FOUR correct.	

(b)	8 primary alcohol isomers: *Names are given to assist identification in marking only; names are not a requirement of this question.*  hexan-1-ol  2-methylpentan-1-ol  3-methylpentan-1-ol  4-methylpentan-1-ol  2,2-dimethylbutan-1-ol  2,3-dimethylbutan-1-ol  3,3-dimethylbutan-1-ol  2-ethylbutan-1-ol	• TWO correct primary alcohol isomer structures drawn.	• FOUR correct primary alcohol isomer structures drawn.	• SEVEN correct primary alcohol isomer structures drawn.

(c)(i)	1: elimination with concentrated H_2SO_4, produces an alkene, with functional group C=C. It results in 3 products, including H_2O which gets eliminated.  hex-2-ene  hex-3-ene 2: addition with H_2 and Pd / Pt / Ni catalyst, (heat) produces an alkane.	• 2 / 4 correct for Step 1. OR Both correct for Step 2.	• Any 4 / 6 correct.	• 6 / 6 correct. AND
(ii)	An elimination reaction results in the formation of a C=C double bond and eliminates a small molecule (in this case H_2O). The C=C bond can form between the carbon that had the original functional group on it and either of the carbons by its side. Zaytsev's rule dictates that of these two options, the major product will be formed by the carbon that has the fewest hydrogens attached to it, having one of its hydrogens removed to make the H_2O eliminated molecule. However, in this example, compound M has its OH functional group attached to a carbon with two identical carbons adjacent to it; therefore there is no preferential direction for the C=C bond to form, and both products will be formed equally.	• Partial explanation of an elimination reaction. OR States that an elimination reaction could form a double bond in either directions (if structurally possible, but this detail not required for A).	• Explain what determines major / minor products.	Explanation of elimination reaction, options for products, what determines a majority / minority and why they are produced in equal amounts for this situation.
(d)(i)	Compound Q will form geometric isomers.	• Correct compound and isomers.		
(ii)	 trans isomer  cis isomer			

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	3m	4m	2e minor	2e

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 07	08 – 13	14 – 18	19 – 24