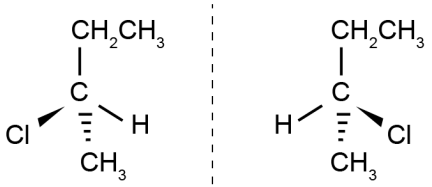
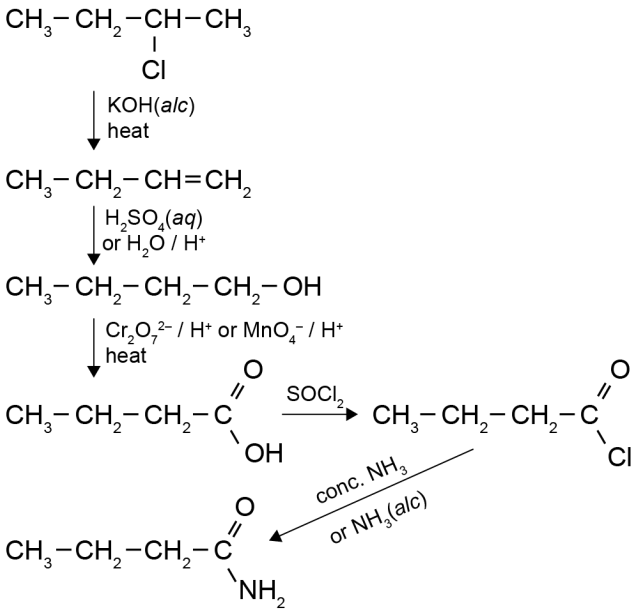
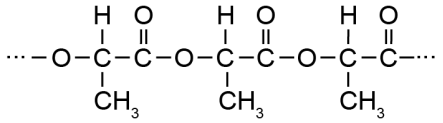
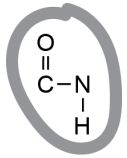
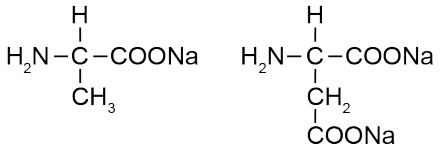
Assessment Schedule – 2024

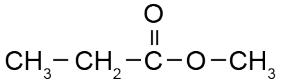
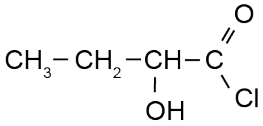
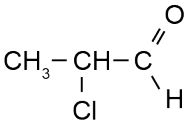
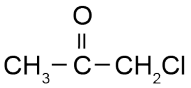
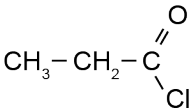
Chemistry: Demonstrate understanding of the properties of organic compounds (91391)

Evidence Statement

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)(i)		• Recognises tetrahedral arrangement of atoms / groups about asymmetric C atom. AND	• Draws TWO correct 3D structures of 2-chlorobutane. AND	
(ii)	2-chlorobutane exists as enantiomers because it is chiral due to an asymmetric (chiral) carbon atom, i.e. a carbon atom with four different atoms or groups (of atoms) attached.	Identifies the asymmetric C atom (accept chiral C atom).	Explains requirement for enantiomers.	
(iii)		• ONE correct conversion with reagent. OR Recognises that the position of the functional group must change.	• THREE correct conversions with reagents.	• Devised a reaction scheme.

(b)(i)		• Draws polymer with ester linkage. AND	• Correctly draws THREE repeating units. AND	
(ii)	The formation of PLA is a condensation (polymerisation) reaction. The small monomers, lactic acid, join together to make a long polyester chain, PLA. For each ester linkage formed, one water molecule is released /when the monomers join/form a link a water molecule is lost forming the ester link/a polyester	Identifies condensation (polymerisation) reaction.	Explains condensation (polymerisation).	
(c)(i)	Circles amide (peptide) linkage. 	• Correctly circles amide (peptide) linkage. AND		
(ii)	Acidic hydrolysis has occurred. Water has been used to split / break the amide (peptide) linkage. The C=O has gained –OH from the water and the N–H has gained an -H from the water. Since the conditions are acidic, the basic $–NH_2$ groups each gain a proton to form $–NH_3^+$groups.	Identifies (acidic) hydrolysis reaction.	• Explains the process of acidic hydrolysis. AND One correct structural formula for organic product of basic hydrolysis.	• Parts (c)(ii) and (iii) correct.
(iii)	 Accept COO^- instead of COONa.	• Draws ONE organic product of basic hydrolysis (may have –COOH instead of –COONa).		

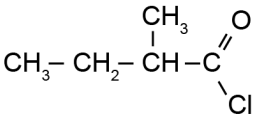
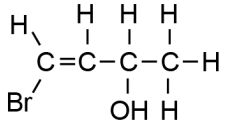
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	3m	4m	1e.	2e

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
TWO (a)(i)	 pentan-3-one 3-chloropropanal 	• THREE correct from part (a)(i). AND	• ALL correct for part (a).	
(ii)	  	TWO correct from part (a)(ii).		

(b)	Compound A: $CH_3-CH=CH_2$ Compound B: $CH_3-CH_2-CH_2OH$ Compound C: $CH_3-CH_2-C(=O)-OH$ Compound D: $CH_3-CH_2-CH_2Cl$ Compound E: $CH_3-CH_2-CH_2-NH_3^+$ R1: $Cr_2O_7^{2-}$ / H^+ OR MnO_4^-/H^+ R2: HCl R3: concentrated NH_3 OR NH_3(*alc*) R4: H_2O / H^+ OR H_2SO_4(*aq*), plus heat (under reflux)	• FIVE correct.	• SEVEN correct.	• ALL compounds and reagents correct.
(c)(i) & (ii)	**Compound 1** reacts with acidified potassium dichromate to change the colour from orange to green because it has a primary alcohol group that can be oxidised to form a carboxylic acid (by gaining oxygen and losing hydrogen). No silver mirror is formed when heated with Tollens' reagent since the Ag^+ ion is not a strong enough oxidant to oxidise an alcohol group. **Compound 3** reacts with blue Fehling's reagent to form an orange-red solid since the aldehyde group can be oxidised to a carboxylic acid (by gaining an oxygen). The colour changes from a purple solution to a brown solid upon addition of potassium permanganate since the C=C bond breaks as the alkene group is oxidised (to form a diol). **Compound 4** produces steamy fumes upon addition of bromine water since the acyl chloride group undergoes a substitution reaction with the water in the solution; the acyl chloride group has its –Cl replaced with an –OH to produce a carboxylic acid and gaseous HCl (steamy fumes). The colour changes from orange to colourless since the C=C bond breaks as an addition reaction occurs.	• Selects THREE correct compounds. • Identifies at least TWO reaction types using compounds 1, 3, and 4 only. • Recognises at least THREE functional groups using compounds 1, 3, and 4 only.	• Links FOUR observations to functional groups using compounds 1, 3 and 4 only • Explains THREE reaction types using compounds 1,3, and 4 only.	• Justifies the TWO compounds in terms of observations, functional groups, and reaction types with third compound with one minor error.

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

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
THREE (a)(i)	The concentrated H_2SO_4 functions as both a dehydrating agent to remove water as the carboxylic acid and the alcohol react to form the ester, and as a catalyst to speed up the rate of the reaction.	• Describes ONE function of the concentrated H_2SO_4.		
(ii)	Heating under reflux allows the reaction mixture to be heated to increase the rate of the reaction without the loss of volatile organic reactants or products. This ensures a greater yield of organic product (ethyl propanoate).	• Recognises ONE reason why the reaction mixture is heated under reflux.	• Explains TWO reasons why the reaction mixture is heated under reflux.	• Explains why heating under reflux is required.
(iii)	The sodium carbonate neutralises the concentrated H_2SO_4 and any remaining propanoic acid.	• Identifies the sodium carbonate neutralises any remaining acid.		AND
(iv)	The reaction mixture is heated to approximately 97–101 °C (99.1 °C) to purify the ethyl propanoate. As the reaction mixture is heated, any unreacted ethanol will be removed and discarded first, since it has a boiling point of 78.3 °C. (However, it is possible that any unreacted ethanol will have been removed in the aqueous layer in step 4, since ethanol is soluble in water.) Once the temperature reaches 97–101 °C (99.1 °C), the ethyl propanoate will evaporate, since it has a boiling point of 99.1 °C. The ethyl propanoate vapour will rise and enter the condenser, where it is cooled and condensed to form pure liquid ethyl propanoate. Any unreacted propanoic acid will still be in the reaction mixture, since it has a higher boiling point of 141 °C. (However, since any unreacted propanoic acid should have reacted in step 3 to form a salt, it should have been removed with the aqueous layer in step 4.)	• Recognises that the reaction mixture needs to be distilled as the compounds have a different boiling point to purify the ethyl propanoate.	• Explains how distillation purifies the ethyl propanoate with reference to evaporation / condensation and the boiling point of ethyl propanoate. • No data required	Justifies how distillation was used to purify the ethyl propanoate with reference to the boiling point of ethyl propanoate and at least one of the other boiling points from the table. Note that instead of referring to one of the other boiling points, students may explain removal of ethanol and / or propanoic acid in the aqueous layer.

(b)(i)	**Compound C** • Compound C does not have an asymmetric carbon atom, and therefore cannot exist as enantiomers. • Compound C has an amine group – NH_2 which is basic, and therefore turns damp red litmus paper blue. • Compound C has an aldehyde group that can be oxidised by Tollens' reagent to therefore produce a silver mirror.	• Chooses Compound C.	• Explains choice of Compound C in terms of at least TWO properties.	
(ii)		• Draws a branched chain / acyl chloride group / asymmetric C atom. AND		
(iii)		• Draws a C=C double bond / secondary alcohol group.	• Draws correct structural formula for either (ii) OR (iii).	• Draws correct structural formulae for (ii) AND (iii), AND explains choice of Compound C, with reference to all properties provided.

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

Cut Scores

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