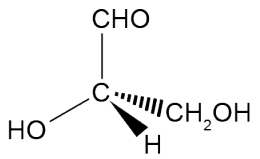
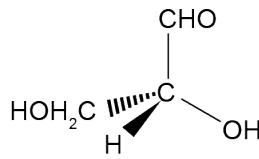
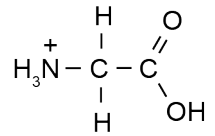
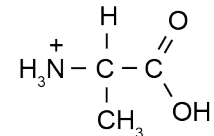
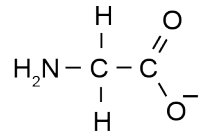
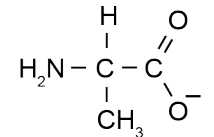


Assessment Schedule – 2018**Chemistry: Demonstrate understanding of the properties of organic compounds (91391)****Evidence Statement**

| Q | Evidence | Achievement | Merit | Excellence |
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| ONE (a) | 3-chlorobutanoyl chloride pentan-2-one $\text{CH}_3\text{-CH}_2\text{-CH(CH}_3\text{)-CH}_2\text{-CH}_2\text{-CHO}$ $\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CH}_2\text{C} \\ \backslash \\ \text{NH}_2 \end{array}$ | <ul style="list-style-type: none"> Three correct. | | |
| (b) | Add water to all three liquids: The water with pentanoyl chloride vigorously / to produce steamy fumes / heat. This is a substitution / hydrolysis reaction to form the carboxylic acid below: $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-COOH}$ Add Tollens' reagent to the remaining two liquids: The pentanal will undergo an oxidation reaction to form pentanoic acid: $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-COOH}$ A silver mirror / black precipitate forms. Add acidified potassium dichromate to the remaining liquid. The pentan-1-ol will be oxidised to form pentanoic acid: $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$. The solution will change colour from orange to green. | <ul style="list-style-type: none"> Identifies TWO of the reaction types occurring. OR One product structure. States TWO of the observations. | <ul style="list-style-type: none"> Identifies correct tests, and observations for TWO liquids plus ONE correct reaction type and ONE product structure. | <ul style="list-style-type: none"> Develops a valid procedure to identify all THREE liquids including correct tests and observations, plus TWO reaction types with structural formulae. |

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| <p>(c) Unknown X has the structural formula below:</p> $\text{CH}_3-\underset{\text{OH}}{\overset{ }{\text{CH}}}-\text{CH}_2-\underset{\text{OH}}{\overset{\text{O}}{\parallel}{\text{C}}}$ <p>There must be a carboxylic acid group (on end of chain) since a carboxylic acid reacts with sodium carbonate to release bubbles of CO₂. The organic product is the salt below: CH₃-CH(OH)-CH₂-COONa</p> <p>There must be a secondary alcohol group (not on end of chain) that can be oxidised by acidified potassium dichromate, because the product must be a ketone since it cannot be further oxidised by Benedict's solution. CH₃-CO-CH₂-COOH</p> <p>For the elimination reaction to form both major and minor products, the -OH group must be on carbon 3 rather than carbon 2, since there would only be one product from elimination if the -OH was on carbon 2.</p> <p>The two organic products are below: CH₂=CH-CH₂-COOH minor CH₃-CH=CH-COOH major</p> <p>The major product forms when the H is removed from the C atom adjacent to the C-OH with the least number of H atoms already attached.</p> | <ul style="list-style-type: none"> Recognises presence of carboxylic acid group in explanation or in structure of X. Recognises ketone product or presence of secondary alcohol group in explanation or in structure of X Identifies alkene / C=C in products of elimination reaction. | <ul style="list-style-type: none"> Links presence of carboxylic acid group to its reaction with sodium carbonate and the structural formula of the salt produced. Links presence of secondary alcohol group to its reaction with acidified potassium dichromate and the structural formula of the ketone produced. Identifies and draws the formation of major and minor products in the elimination reaction. | <ul style="list-style-type: none"> Correct structural formula for X and for THREE of the reaction products with full justification. |
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| NØ | N1 | N2 | A3 | A4 | M5 | M6 | E7 | E8 |
|---------------------------------------|----|----|----|----|---------|----|----|----|
| No response; no relevant evidence. | 1a | 2a | 3a | 4a | 2m / ea | 3m | em | 2e |

| Q | Evidence | Achievement | Merit | Excellence |
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| <p>TWO (a)(i)</p> <p>(ii)</p> <p>(iii)</p> | <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>L-Glyceraldehyde</p> </div> <div style="text-align: center;">  <p>D-Glyceraldehyde</p> </div> </div> <p>Glyceraldehyde can exist as enantiomers because it has an asymmetric carbon atom, i.e. a carbon atom with four different groups attached.</p> <p>The enantiomers can be distinguished based upon their ability to rotate plane polarised light. One enantiomer will rotate the plane polarised light to the left while the other enantiomer will rotate the plane polarised light to the right.</p> | <ul style="list-style-type: none"> Recognises tetrahedral arrangement of groups about chiral C atom. Identifies and describes the asymmetric C atom. Identifies enantiomers rotate (plane) polarised light in opposite directions | <ul style="list-style-type: none"> Two correct enantiomers of glyceraldehyde Explains requirement for optical isomers and how to distinguish between them. | |
| <p>(b)(i)</p> <p>(ii)</p> | <p>Circle around HN–C=O group.</p> <p>Water is used to break the amide (peptide) bond. H is added to one molecule and OH to the other.</p> <p>The NH₂ group gains a proton (H⁺) in acidic conditions / forms NH₃⁺.</p> <p>The COOH group loses a proton (H⁺) in basic conditions / forms COO⁻.</p> <p>Acidic conditions:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p>Basic conditions:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> | <ul style="list-style-type: none"> Identifies amide (peptide) bond. Describes hydrolysis. OR Products show amide (peptide) bond correctly broken. OR Structures show NH₃⁺ in acid conditions and COO⁻ in base. | <ul style="list-style-type: none"> Describes hydrolysis and draws TWO structural formulae of products formed from hydrolysis. OR All four structures correct. OR Explains hydrolysis and ONE correct structure. | <ul style="list-style-type: none"> Explains hydrolysis and draws ALL structural formulae of products formed from BOTH types of hydrolysis. |

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| (c) | <p>Step 1: Add NaBH_4 / LiAlH_4 / LiBH_4 to reduce butanal to butan-1-ol:</p> $\begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H} - \text{C} - & \text{C} - & \text{C} - & \text{C} - \text{OH} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}$ <p>Step 2: Add concentrated H_2SO_4 to the butan-1-ol, and heat. This will produce but-1-ene:</p> $\begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H} - \text{C} - & \text{C} - & \text{C} = & \text{C} - \text{H} \\ & & & \\ \text{H} & \text{H} & & \end{array}$ <p>Step 3: Add dilute H_2SO_4 (H^+ / H_2O). This will produce butan-1-ol and butan-2-ol. It is the butan-2-ol that will be used in step 4:</p> $\begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H} - \text{C} - & \text{C} - & \text{C} - & \text{C} - \text{H} \\ & & & \\ \text{H} & \text{H} & \text{OH} & \text{H} \end{array}$ <p>Step 4: Add H^+ / $\text{Cr}_2\text{O}_7^{2-}$ or (H^+) / MnO_4^-, and heat. The butan-2-ol will be oxidised to butanone:</p> $\begin{array}{cccc} \text{H} & \text{H} & \text{O} & \text{H} \\ & & & \\ \text{H} - \text{C} - & \text{C} - & \text{C} - & \text{C} - \text{H} \\ & & & \\ \text{H} & \text{H} & & \text{H} \end{array}$ <p>An acceptable alternative scheme would be to convert the butan-1-ol from step 1 into a haloalkane; then the haloalkane could undergo elimination, followed by the above steps 3 and 4. However, this method would be five steps instead of only four.</p> | <ul style="list-style-type: none"> Identifies reagent for ONE step, with name or structural formula of product from the reaction. <p>OR</p> <ul style="list-style-type: none"> Workable sequence with two correct structures or names. | <ul style="list-style-type: none"> Workable scheme with correct steps (that would produce butanone) and THREE correct structures. | <ul style="list-style-type: none"> Devises a reaction scheme to convert butanal into butanone, including all appropriate reagents, conditions, and structural formulae of products. |
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| Ø | N1 | N2 | A3 | A4 | M5 | M6 | E7 | E8 |
|---------------------------------------|----|----|----|----|---------|----|----|----|
| No response; no relevant evidence. | 1a | 2a | 3a | 4a | 2m / ea | 3m | em | 2e |

| Q | Evidence | Achievement | Merit | Excellence |
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| THREE (a)(i) (ii) | $\text{--O--CH}_2\text{--COO--CH}_2\text{--COO--CH}_2\text{--CO--}$ The formation of PGA is a condensation polymerisation reaction. In a condensation reaction, small monomers join together releasing water. Water is released for each ester linkage formed / because the monomers have two functional groups they react at both ends | <ul style="list-style-type: none"> Shows ester linkage in polymer chain. Identifies reaction as condensation / esterification. OR Water / H & OH is removed. | <ul style="list-style-type: none"> Draws THREE repeating units. Explains condensation or polymerisation process. | <ul style="list-style-type: none"> Draws THREE repeating units of polymer chain and full explanation of condensation polymerisation. |
| (b)(i) (ii) (iii) (iv) | ethyl butanoate $\text{CH}_3\text{--CH}_2\text{--CH}_2\text{--COO--CH}_2\text{--CH}_3$ Heat under reflux: Diagram 2. Increases rate because it is able to be heated No loss of products / reactants because they are condensed back into the mixture Increases the amount of products / yield because reactants / products are prevented from escaping Distillation could be used to purify the ester (diagram 1). The reaction mixture is heated to the boiling point of the ester which is different from both the alcohol and carboxylic acid reactants. The ester will evaporate from the mixture and enter the condenser where it is cooled back to the liquid to be collected. The ester has therefore been separated from the reaction mixture. | <ul style="list-style-type: none"> Correct name or structural formula of ethyl butanoate. Correctly identifies apparatus for BOTH reflux and distillation Recognises heating under reflux prevents loss of volatile organic compounds / speeds up rate of reaction / increases yield. Identifies distillation separates ester from reaction mixture based on its boiling point. OR Description of distillation process. | <ul style="list-style-type: none"> Correct diagram for heating under reflux TWO advantages and ONE explanation. Correct diagram for distillation plus process based on different boiling points and separation / purification explained by evaporating, cooling, condensing and collecting. | <ul style="list-style-type: none"> Fully explains the advantages of heating under reflux AND Fully explains the use of distillation to purify the ester from reaction mixture. |

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

Cut Scores

| Not Achieved | Achievement | Achievement with Merit | Achievement with Excellence |
|---------------------|--------------------|-------------------------------|------------------------------------|
| 0 – 8 | 9 – 14 | 15 – 19 | 20 – 24 |