EXAM PAPERS PRACTICE

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Detailed mark scheme

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Level: CIE AS and A Level (9701)
Subject: Chemistry
Topic: CIE Chemistry
Type: Mark Scheme

Chemistry CIE AS & A Level
To be used for all exam preparation for 2025+

CHEMISTRY AS and A

This to be used by all students studying CIE AS and A level Chemistry (9701) But students of other boards may find it useful

Mark Scheme

Answer 1.

a) The reagents and conditions required for the conversion of butan-1-ol into 1-bromobutane are:

- Sodium bromide / NaBr; [1 mark]
- Sulfuric acid / H_2SO_4; [1 mark]
- Heat under reflux; [1 mark]

OR

- Phosphorous tribromide / PBr_3; [1 mark]
- Dropwise addition / added one drop at a time; [1 mark]

[Total: 3 marks]

- Practice recalling the reagents, conditions, mechanisms and reaction types for all of these conversions as it will help with answering exam questions easily
  - It will also help with your A-level knowledge as there will be more conversions added

b) The type of reaction involved when butan-1-ol is heated with concentrated sulfuric acid causing the loss of a small molecule is:

- Elimination

OR

Dehydration; [1 mark]

The resulting alkene is:

- But-1-ene; [1 mark]

[Total: 2 marks]

- In this case, the small molecule that is lost will be water
  - This means that the alkene formed will be but-1-ene
  - But-2-ene cannot be formed as the hydroxyl group is on carbon 1

c) The second organic product formed when the alkene formed in part **(b)** reacts with hydrogen bromide is:

- 2-bromobutane; [1 mark]

[Total: 1 mark]

- Hydrogen bromide will undergo electrophilic addition, adding across the double bond of the alkene
- In this case, the alkene is but-1-ene
  - This means that the bromine can end up attached to carbon-1 or carbon-2
  - 1-bromobutane will be the minor product as the primary carbocation intermediate is less stable than the secondary carbocation intermediate that forms 2-bromobutane
- You could deduce that the alkene is but-1-ene as this would be the only feasible alkene able to produce 1-bromobutane

Answer 2.

a) A suitable reagent and expected observations are:

- Reagent = acidified potassium dichromate(VI) solution; [1 mark]
- Observation with **G** = colour change from orange to green; [1 mark]
- Observation with **H** = no visible change; [1 mark]

OR

- Reagent = (acidified) potassium manganate(VII) solution; [1 mark]
- Observation with **G** = colour change from purple to colourless; [1 mark]
- Observation with **H** = no visible change; [1 mark]

[Total: 3 marks]

- Compound **G** is a secondary alcohol which can be oxidised to a ketone
- Compound **G** will therefore change acidified potassium dichromate(VI) solution from orange to green
- Compound **H** is a ketone which will not react with acidified potassium dichromate(VI) solution
- The same applies to acidified potassium manganate(VII) solution but the colour change will be from purple to colourless

b) A suitable reagent and expected observations are:

- Reagents = sodium hydroxide
  AND
  Followed by acidified silver nitrate solution; [1 mark]
- Observation with **I** = no visible change; [1 mark]
- Observation with **J** = forms a white precipitate; [1 mark]

[Total: 3 marks]

- The only difference between compounds **I** and **J** is the chlorine atom attached to the methyl group in compound **J**
- This can be tested using the halide ion test of acidified silver nitrate solution after the sample has been reacted with sodium hydroxide solution
  - A nucleophilic substitution reaction occurs with the sodium hydroxide which releases the chlorine as a chloride ion
- Chlorides give a white precipitate, which fully dissolves in dilute ammonia

c) A suitable reagent and expected observations are:

- Reagent = sodium carbonate solution; [1 mark]
- Observation with **K** = no visible change; [1 mark]
- Observation with **L** = effervescence / bubbles of gas form; [1 mark]

[Total: 3 marks]

- Compound **K** is an aldehyde and compound **L** is a carboxylic acid
- **Careful:** It is very tempting to put down Fehling's or Tollens' as your answer but the question says that the reagent should **not** convert compound **K** into compound **L**
  - This means that you must test for the carboxylic acid, not the aldehyde
- This question is testing both your analysis and synthesis knowledge

Answer 3.

a) The reagents and conditions required are:

Conversion of **A** to **B**

- Ethanol; [1 mark]
- Potassium / sodium hydroxide; [1 mark]
- Heat under reflux; [1 mark]

Conversion of **A** to **C**

- Ethanol; [1 mark]
- Potassium cyanide / KCN; [1 mark]
- Heat under reflux; [1 mark]

[Total: 6 marks]

- The conversion of a halogenoalkane like compound **A** to an alkene requires an elimination reaction
- To form the nitrile from a halogenoalkane, a nucleophilic substitution reaction must occur

b) The name of compound **C** is:

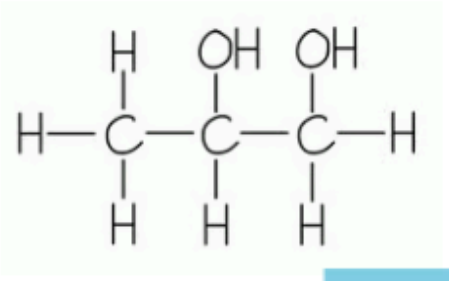
- Butanenitrile; [1 mark]

[Total: 1 mark]

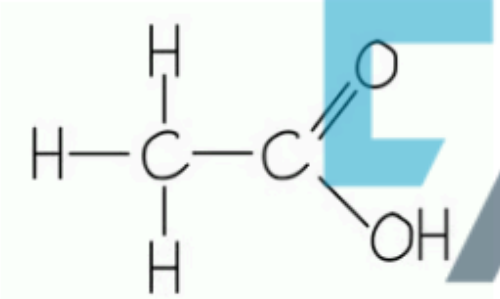
- Nucleophilic substitution involving CN^- ions is an effective way of extending a carbon chain
- When naming a nitrile, ensure that:
  - Your spelling is correct and you do not miss the 'e' in butane
  - You count the correct number of carbons in the main carbon chain
    - Many students will incorrectly give the name of compound **C** as propanenitrile because the original organic molecule was propane-based

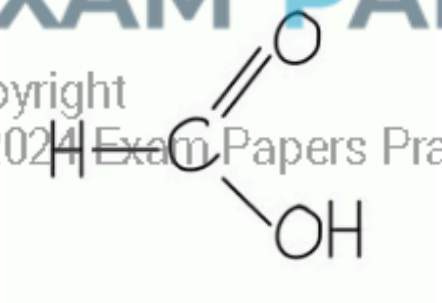
c)

i) The structure of compound **D** is:

-  ; [1 mark]

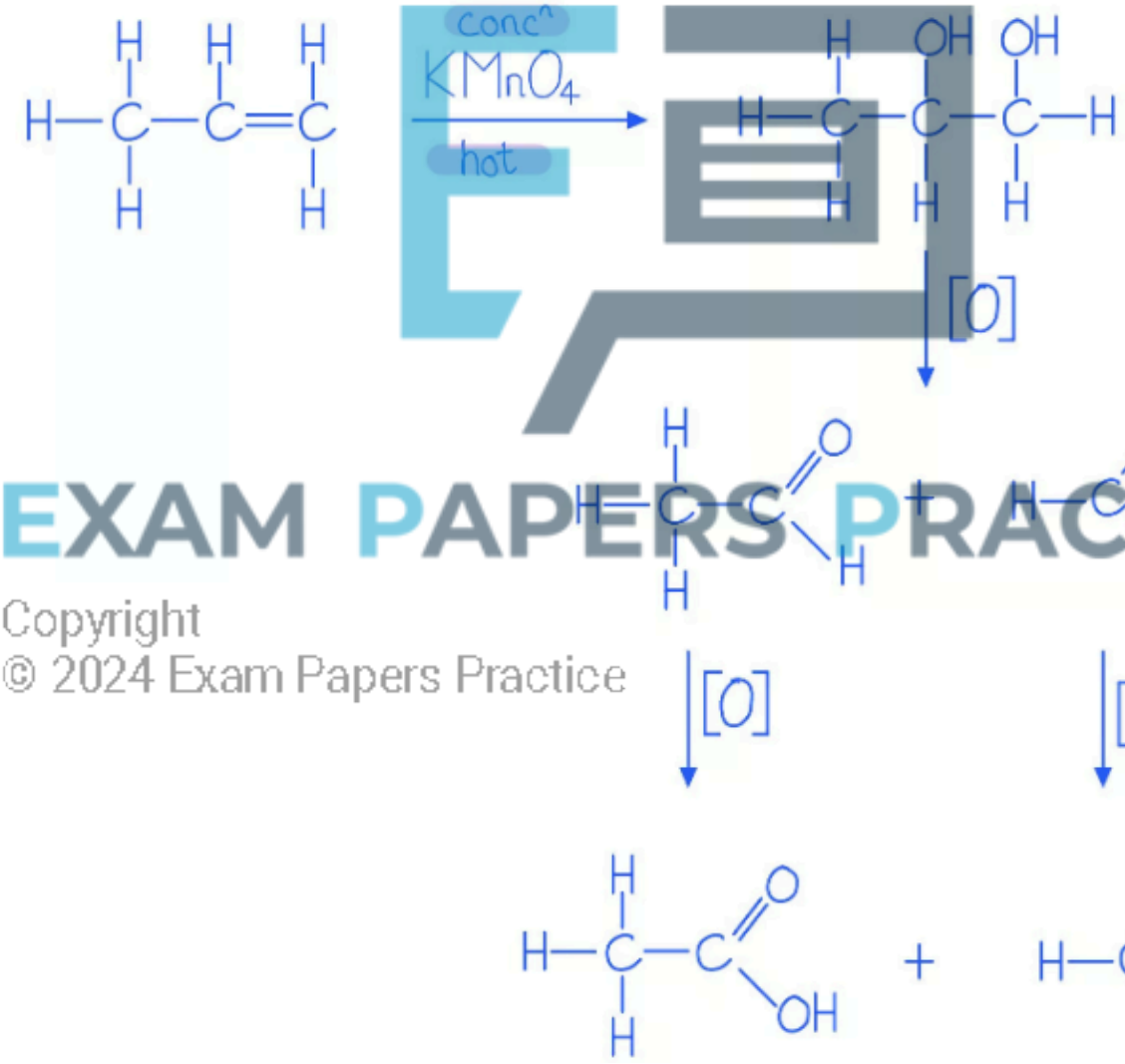
ii) The structure of compounds **E** and **F** are (in any order):

-  ; [1 mark]

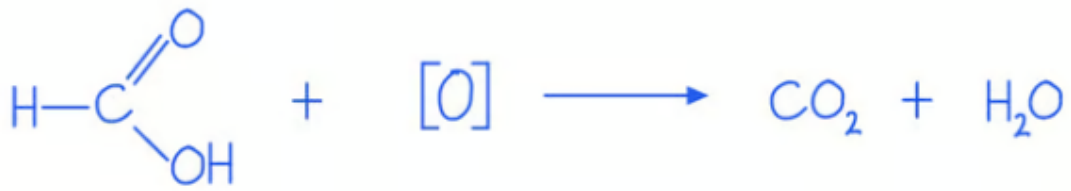
-  ; [1 mark]

[Total: 3 marks]

- When an alkene reacts with potassium manganate(VII) the conditions will cause different products
- If **cold** and **dilute** a diol is formed
- If **hot** and **concentrated** the conditions are harsher causing the C-C double bond to completely break
- The O-H groups in the diol formed are further oxidised to ketones, aldehydes, carboxylic acids or carbon dioxide gas
- The actual products formed depend on what is bonded to the carbon atoms in the alkene



- In these conditions, the methanoic acid formed can be oxidised to carbon dioxide and water



Answer 4.

a) The reagents and equation for the one-step process converting but-2-ene into butan-2-ol are:

Reagents:

- Steam / water vapour / H_2O (g); [1 mark]
- Phosphoric acid / H_3PO_4 catalyst
  OR
  Sulfuric acid / H_2SO_4 catalyst; [1 mark]

Equation:

- $CH_3CHCHCH_3 + H_2O \rightarrow CH_3CHOHCH_2CH_3$; [1 mark]

[Total: 3 marks]

- The reaction converting an alkene directly into an alcohol is hydration requiring steam and a strong acid catalyst such as phosphoric or sulfuric acid
- This can also be described as electrophilic addition

b) The reaction scheme, including reagents and conditions for the **two** step process is:

$$\text{But}-2-\text{ene} \xrightarrow{\text{Step 1}} 2-\text{bromobutane} \xrightarrow{\text{Step 2}} \text{butan}-2-\text{ol}$$

Intermediate compound:

- 2–bromobutane; [1 mark]

Step 1 reagent:

- Hydrogen bromide; [1 mark]

Step 2 reagent:

- Aqueous sodium hydroxide / NaOH (aq)
  OR
  Aqueous potassium hydroxide / KOH (aq); [1 mark]

[Total: 3 marks]

- This reaction uses HBr as the electrophile
- It is an electrophilic addition reaction involving heterolytic bond fission

c) Using but-1-ene gives a lower yield of butan-2-ol because:

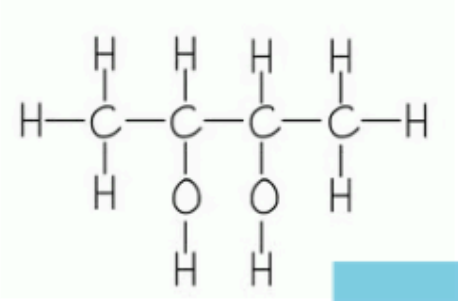
- (When the alkene double bond breaks open in but-1-ene) it can form a primary and a secondary carbocation intermediate; [1 mark]
- (Resulting in the) formation of butan-1-ol and butan-2-ol; [1 mark]

[Total: 2 marks]

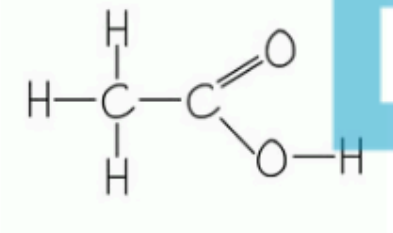
- But-2-ene is a symmetrical alkene and will only form butan-2-ol
- But-1-ene is not a symmetrical alkene and can form two carbocation intermediates
  - This results in the formation of a major and a minor product
  - You should be able to apply and explain Markownikoff's rule in writing as well as by drawing mechanisms

d) The displayed formula for both reactions are:

Reaction with cold, dilute MnO_4^- ions:

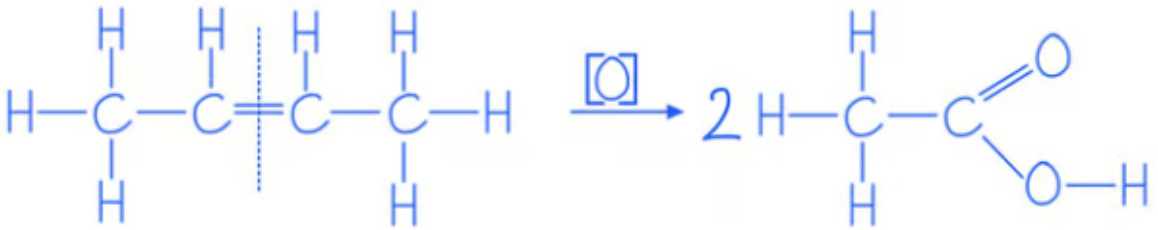
-  ; [1 mark]

Reaction with hot, concentrated MnO_4^- ions:

-  ; [1 mark]

[Total: 2 marks]

- You should know the reactions of alkenes with both cold dilute $KMnO_4$ and hot concentrated $KMnO_4$
- The reaction of hot concentrated $KMnO_4$ with an alkene results in the breaking of the double bond
- As there is only one CH_3 group either side of the double bond, two molecules of ethanoic acid are formed
  - Therefore there is only one type of compound formed from this reaction



- **Careful:** You are asked for the displayed formulas, so the OH group should be drawn as O-H

Answer 5.

a) A suitable reagent and conditions for reaction **1** is:

- Reagents = conc H_2SO_4 / conc H_3PO_4; [1 mark]
- Conditions = heat
  OR
  Pass vapour over hot Al_2O_3; [1 mark]

[Total: 2 marks]

- Reaction 1 is the dehydration of an alcohol which forms an alkene
- Dehydration is a reaction in which a water molecule is removed from a larger molecule
- A dehydration reaction is a type of elimination reaction
- Look for the changes in the compound to help you identify suitable reagents and conditions

b)

i) An equation for reaction **2**, using [O] to represent the oxidising agent

- $C_4H_9OH + 2[O] \rightarrow C_3H_7CO_2H + H_2O$; [1 mark]

ii) A suitable reagent and conditions for reaction **2**.

- Reagent = sodium dichromate / $Na_2Cr_2O_7$
  OR
  Potassium dichromate / $K_2Cr_2O_7$; [1 mark]
- Conditions = H^+ / acidified
  AND
  (Heat under) reflux; [1 mark]

[Total: 3 marks]

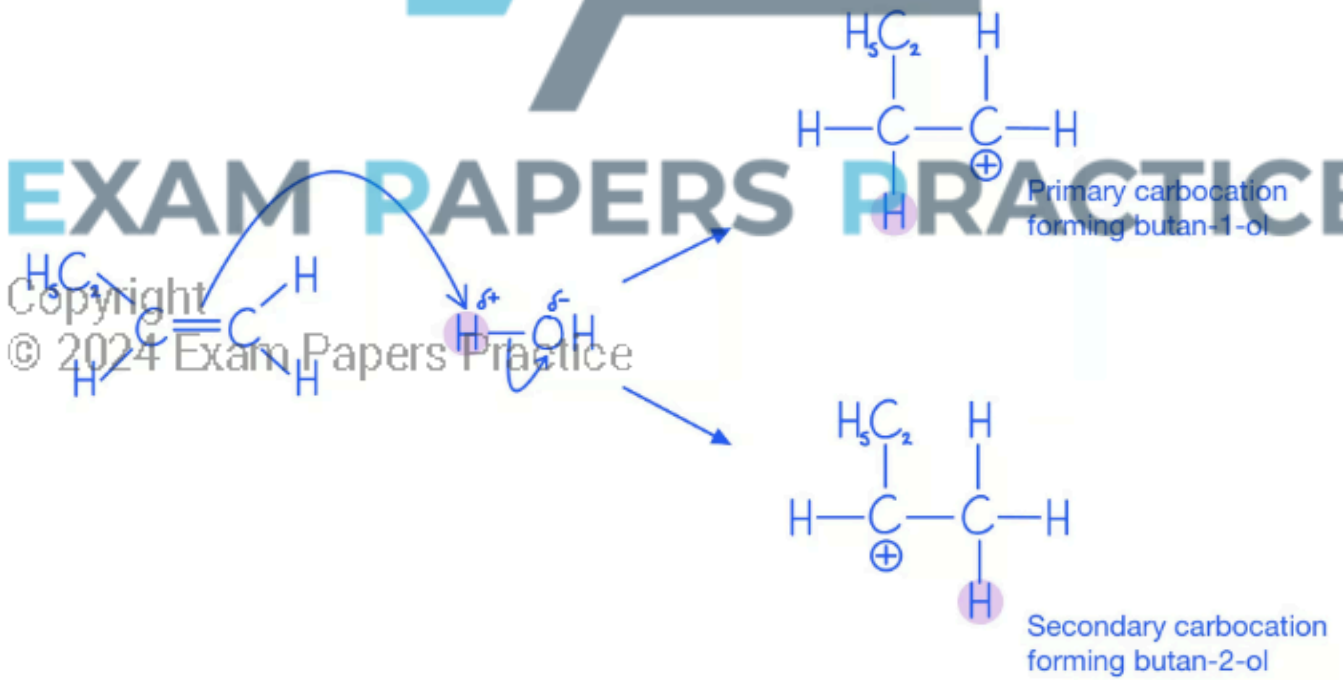
- Reaction 2 is the oxidation of butan-1-ol to form butanoic acid
- Primary alcohols oxidise to form aldehydes and then carboxylic acids
- This is the full oxidation, as the reaction scheme does not show the aldehyde has been produced
- If the product was the aldehyde then distillation apparatus would be used, not reflux

c) The structures of U and V are:

- **U** = $CH_3CH_2CH(OH)CH_3$
  OR
  U = $CH_3CH_2CH_2CH_2OH$; [1 mark]
- **V** = $CH_3CH_2CHBrCH_3$
  OR
  V = $CH_3CH_2CH_2CH_2Br$; [1 mark]

[Total: 2 marks]

- Reacting but-1-ene with steam will form an alcohol
  - A secondary alcohol will be the major product, and the primary alcohol will be the minor product
  - This is due to the difference in stability of the primary and secondary carbocation
- The first step of this addition mechanism is shown below:



- It is not specified if a minor or major product is formed so it doesn't matter which one you choose
- The primary alcohol will then undergo a nucleophilic substitution reaction with HBr and form 1-bromobutane
- The secondary alcohol will react in the same way but will form 2-bromobutane

d) Suitable reagent and conditions for reaction **3** are:

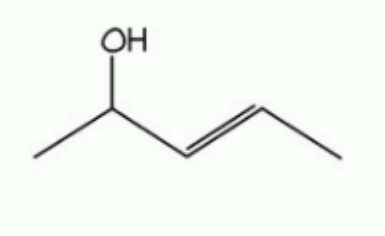
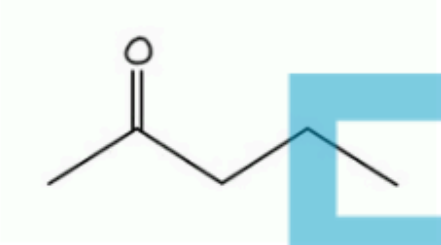
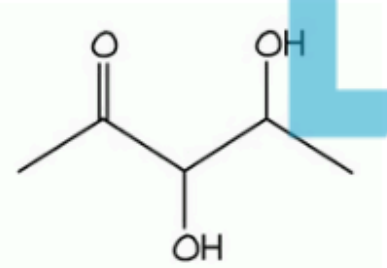
- Reagent = KOH / NaOH; [1 mark]
- Conditions = ethanol / alcohol
  AND
  Heat / reflux; [1 mark]

[Total: 2 marks]

- Reaction 3 is an elimination reaction
  - Depending on your answer for compound V, 1-bromobutane or 2 bromobutane are reacting to form but-1-ene ($CH_3CH_2CH_2CH_2Br$ will form $CH_3CH_2CH=CH_2$) so a H and Br atom must be eliminated from the molecule
- This reaction requires extreme conditions so heat is required in alcoholic conditions
- In aqueous conditions, nucleophilic substitution will occur

Answer 6.

a) The correct skeletal structures for compounds **B**, **C** and **D** are:

- **B** =  ;[1 mark]
- **C** =  ;[1 mark]
- **D** =  ;[1 mark]

[Total: 3 marks]

- Compound **A** contains a C=O group (ketone) and a carbon=carbon double bond (alkene)
- The reaction of $LiAlH_4$ with compound **A** will reduce the ketone group (C=O) to an OH group but will not react with the C=C group
- H_2 and Ni will react with the C=C double bond and saturate it
- Cold, acidified $KMnO_4$ (aq) will react with alkenes to form a diol

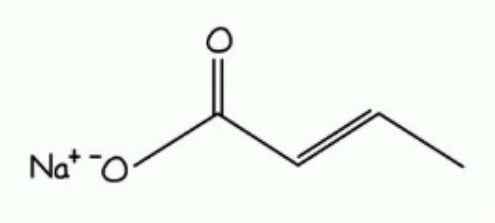
b) The colour change is:

- Purple to colourless; [1 mark]

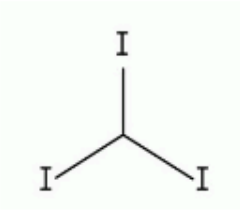
[Total: 1 mark]

- For the reactions of alkenes with cold, acidified potassium manganate, the colour change is purple to colourless
- The same colour change occurs during the oxidation of alcohols to aldehydes, carboxylic acids and ketones

c) The skeletal structures of both these compounds are:

- 

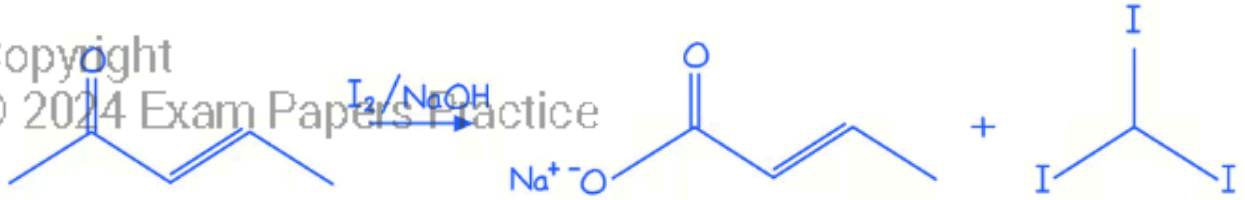
; [1 mark]

- 

; [1 mark]

[Total: 2 marks]

- This reaction is called the iodoform reaction
- It forms a salt and tri-iodomethane
- The question states that iodine and hydroxide ions react with compound **A** to form two products
  - Tri-iodomethane has the formula CHI_3 and is a yellow precipitate
- The overall reaction is:



d) The name of compound **A** is

- Pent-3-en(e)-2-one
  OR
  3-penten-2-one; [1 mark]

[Total: 1 mark]

- In compound **A**, there are 5 carbons in the main chain, therefore you must use the prefix 'pent'
- The carbonyl group is the highest priority group on the second carbon so '2-one' will be the suffix
- Compound **A** contains a C=C on the third carbon atom, so '3-ene' should be in the name

Answer 7.

a) The mechanisms for each step are:

- Reaction **1** = electrophilic addition; [1 mark]
- Reaction **3** = nucleophilic addition; [1 mark]

[Total: 2 marks]

- Propene to propanol involves the electrophilic addition of alkenes
- Compound **G** has to be a a ketone to form the hydroxynitrile, therefore the mechanism is nucleophilic addition

b) The reagents and conditions are:

Reaction **1**

- Steam; [1 mark]
- Phosphoric acid; [1 mark]

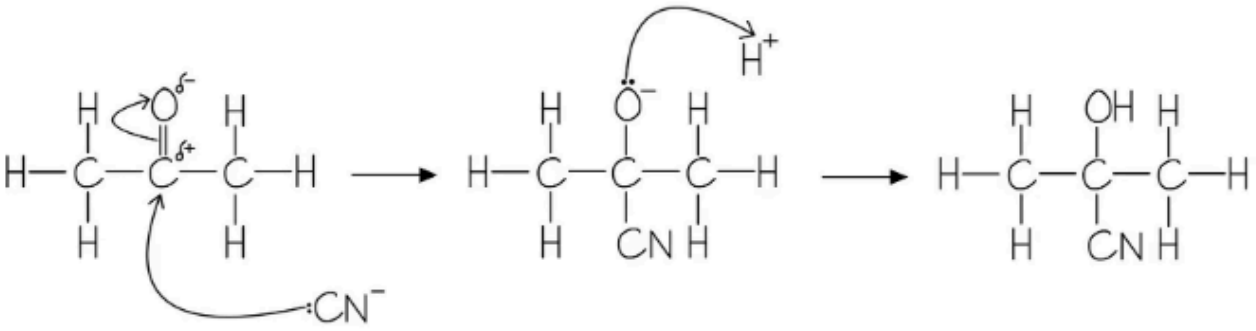
Reaction **2**

- Acidified potassium dichromate
  OR
  Acidified potassium manganate; [1 mark]
- Heat
  AND
  Reflux; [1 mark]

[Total: 4 marks]

- You could also be asked the colour changes for the oxidation of an alcohol
- For acidified potassium dichromate it is orange to green and for acidified potassium manganate it is purple to colourless
- Propan-2-ol is a secondary alcohol so will oxidise to form a ketone
- Heating under reflux is required for this reaction

The reaction mechanism is:



- Correct partial charges, charges and lone pairs on atoms; [1 mark]
- Curly arrow from lone pair on CN nucleophile to δ+C atom in C=O bond; [1 mark]
- Curly arrow from C=O bond to O atom; [1 mark]
- Curly arrow from lone pair on O atom to H+ ion; [1 mark]

[Total: 4 marks]

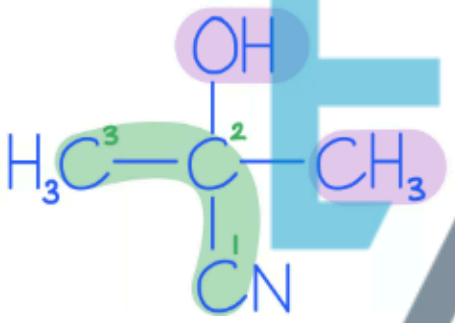
- The nucleophilic addition of hydrogen cyanide to carbonyl compounds is a two-step process
  - HCN is formed by the reaction of KCN or NaCN with sulfuric acid
  - It is toxic so is formed 'in situ'
- In step 1, the cyanide ion attacks the δ+ carbonyl carbon to form a negatively charged intermediate
  - You must show the negative charge on the intermediate
- In step 2, the negatively charged oxygen atom in the reactive intermediate quickly reacts with aqueous H^+ (either from HCN, water or dilute acid) to form a 2-hydroxynitrile

d) 2-hydroxy-2-methylpropanenitrile does not exhibit optical isomerism because:

- No chiral carbon; [1 mark]
- As 2 of the groups / 2 methyl groups on carbon atom; [1 mark]

[Total: 2 marks]

- Optical isomers must contain a chiral carbon
- A chiral carbon has 4 different atoms or groups of atoms bonded to it
  - In 2-hydroxy-2-methylpropanenitrile, there are two methyl groups
- It can help to draw out the structure and identify the main carbon chain
  - In nitriles, the CN carbon is the first carbon



Answer 8.

a) Suitable reagents for the synthesis of Compound **A** via step **1** are:

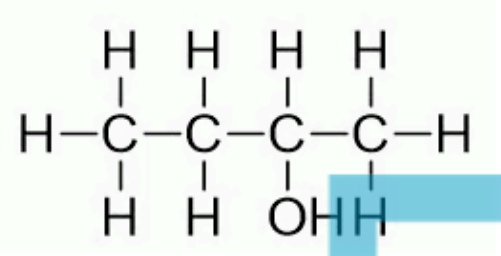
- $K_2Cr_2O_7$ / $Cr_2O_7^{2-}$ / (potassium) dichromate
  OR
  $KMnO_4$ / MnO_4^- / (potassium) permanganate; [1 mark]
- H_2SO_4 / H^+ / acidified / with acid
  OR
  Heat; [1 mark]
- Oxidation; [1 mark]

[Total: 3 marks]

- An ester is made from a carboxylic acid and alcohol
- A carboxylic acid cannot be produced from the second molecule which is a ketone, so the first step in producing **A** must be the oxidation of an aldehyde to carboxylic acid

b)

i) The name and structure of the molecule that is produced from step **2** are:

- Butan-2-ol; [1 mark]
-  ; [1 mark]

ii) The name of the type of reaction that is involved in step **2** and a suitable reagent for the process are

- Reduction; [1 mark]
- $LiAlH_4$ / lithium aluminium hydride / lithium tetrahydridoaluminate
  OR
  $NaBH_4$ / sodium borohydride / sodium tetrahydridoborate; [1 mark]

[Total: 4 marks]

- The reduction of a ketone produces a secondary alcohol
  - This secondary alcohol is required to produce the branched chain ester
- Lithium tetrahydridoaluminate, $LiAlH_4$, is much more reactive than sodium tetrahydridoborate, $NaBH_4$, so is more dangerous to use in the laboratory
- For the purposes of this question, both reagents are suitable answers

c) The synthesis of ethanol from ethane in two steps:

Step 1: Ethane to chloroethane

- Reagent: chlorine / Cl_2; [1 mark]
- Conditions: UV light / high temps; [1 mark]
- Reaction type: (free radical) substitution / halogenation ; [1 mark]

Step 2: Chloroethane to ethanol

- Reagent: aqueous sodium hydroxide / NaOH (aq) / aqueous potassium hydroxide / KOH (aq) ; [1 mark]
- Condition hot / heat under reflux; [1 mark]
- Reaction type: (nucleophilic) substitution / hydrolysis ; [1 mark]

[Total: 6 marks]

- The conversion of an alkane to a halogenoalkane would be very impractical industrially as it is hard to control the extent of halogenation and to prevent multiple products from forming, however, here it is included to test your ability to apply your knowledge of organic reactions to solve problems in synthesis
- The type of mechanisms are shown in brackets, but they are not essential for the mark

d)

i) The names of four possible substances **A** to **D**:

- A = propanone, B = propan-2-ol, C = propene D = 1-bromopropane / 1-chloropropane / 1-iodopropane; [1 mark]

ii) The reagents and conditions for step **4** are:

- Aqueous sodium hydroxide / NaOH (aq)
  OR
  Aqueous potassium hydroxide / KOH (aq); [1 mark]
- Heat under reflux; [1 mark]

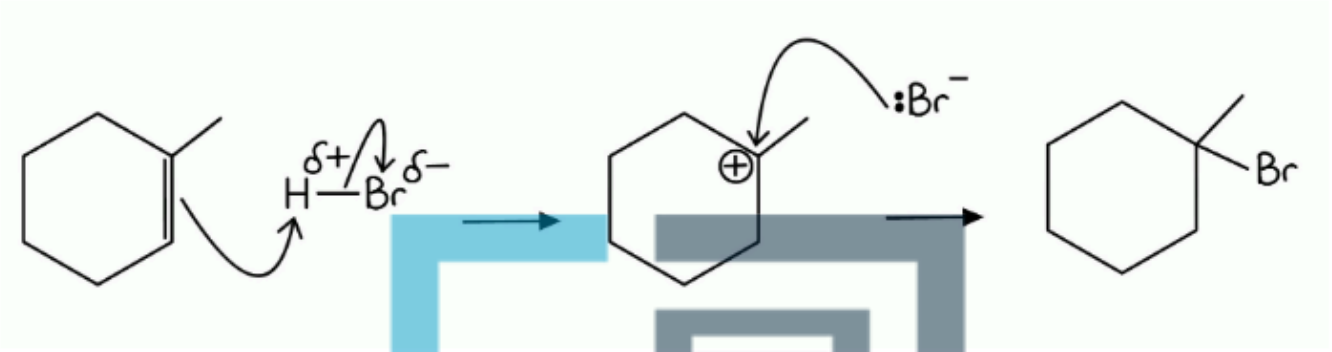
[Total: 3 marks]

- **B** must be secondary alcohol formed by reduction of a three carbon ketone, which gives **A** as propanone and **B** as propan-2-ol
- **C** can only be a three carbon alkene, so must be propene
- In order to finish with propan-1-ol, the halogen must be on the first carbon in **D**, so it will be a 1-*halo*propane

Answer 9.

a) The name and mechanism for the reaction between compound **E** and hydrogen bromide, HBr is:

- Electrophilic addition; [1 mark]



- Curly arrow from C=C to H in H-Br
  AND
  δ+ H and δ- Br shown; [1 mark]
- Curly arrow from H-Br bond to Br atom; [1 mark]
- Tertiary carbocation identified and labeled; [1 mark]
- Curly arrow from lone pair in :Br- to carbocation; [1 mark]
- Correct structure of the major product; [1 mark]

[Total: 6 marks]

- The methyl group next to the C=C double bond will mean a tertiary carbocation can be produced
  - These are more stable than secondary carbocations
  - Therefore the major product will be 1-bromo-1-methylcyclohexane

b) A major and minor product are produced because:

- The major product is formed as the intermediate would contain a tertiary carbocation; [1 mark]
- The minor product is produced as the intermediate would contain a secondary carbocation; [1 mark]
- Tertiary carbocations are more likely to bond with the Br atom as they are more stable
  OR
  Secondary carbocations are more likely to bond with the H atom as they are less stable; [1 mark]

[Total: 3 marks]

- This is due to Markovnikov's rule regarding addition across the C=C of an asymmetric alkene
  - The H-Br will add across the double bond (C=C)
  - The H atom will most likely form a bond with the least substituted carbon atom leaving a tertiary carbocation
  - This tertiary carbocation will form a bond with the Br atom

c) A possible starting molecule is:

- 2-methylcyclohexanol
  OR
  1-methylcyclohexanol; [1 mark]

The reagent required is:

- Al_2O_3
  OR
  Conc. acid; [1 mark]

[Total: 2 marks]

- The question asks to suggest a possible starting molecule, however, based on the reactions you are expected to know at this level, it must be an alcohol
- The only reaction you know which produces an alkene is the dehydration / elimination of an alcohol
- The alcohol group can be placed on either side of where the double bond should be
- You are not expected to know the reaction mechanism for this type of reaction

Answer 10.

a) The mechanisms are:

- Step **1** = nucleophilic substitution; [1 mark]
- Step **2** = oxidation; [1 mark]

[Total: 2 marks]

- You should recognise that the reagents $K_2Cr_2O_7$ / H_2SO_4 in step 2 are used to oxidise an alcohol
- This then allows you to figure out that step 1 is going from a halogenoalkane to an alcohol, which is nucleophilic substitution

b) Compound **H** is:

- Butanoic acid; [1 mark]

[Total: 1 mark]

- As the starting compound is 1-chlorobutane then the alcohol formed will be a primary alcohol, butan-1-ol
- As step 2 is carried out by heating under reflux then the resulting compound will be a carboxylic acid
- If this step was carried out using distillation an aldehyde would have been produced

c) The alkene required is:

- But-1-ene; [1 mark]

The reagent required is

- Hydrogen chloride; [1 mark]

[Total: 2 marks]

- 1-chlorobutane is the minor product made when but-1-ene, an unsymmetrical alkene, undergoes electrophilic addition
  - 2-chlorobutane would be the major product formed
- But-2-ene and HCl will only produce 2-chlorobutane as a product

d) The functional group of the final compound in the reaction scheme in part (a) would be:

- A ketone (rather than a carboxylic acid); [1 mark]
- (As) secondary alcohols are oxidised to ketones when heating under reflux; [1 mark]

[Total: 2 marks]

- Using the reaction scheme given in part (a), if 2-cholorobutane is used then reaction step 1 will result in a secondary alcohol - butan-2-ol
- Heating a secondary alcohol under reflux will result in a ketone being produced

Answer 11.

a) To work out the identity of compound **Y**:

- M_r(compound **Y**) = $\frac{2.754\ g}{0.027\ moles}$ = 102.00 g mol^{-1}; [1 mark]
- Pentanoic acid; [1 mark]

[Total: 2 marks]

- There is a lot of information given in the question and the first step will be to calculate the molar mass of compound Y
- You know that it contains 5 C atoms so that is 5 x 12 = 60 g mol^{-1} of the molar mass accounted for, leaving 42 g mol^{-1}
- You are aware that it is an oxidation product so must contain at least 1 O atom
  - If 1 O atom was present, 26 g mol^{-1} would be due to H, which is not feasible
  - If 2 O atoms are present, 10 g mol^{-1} would be due to H, which gives a credible product
- This gives the formula to be $C_5H_{10}O_2$
- Carboxylic acids contain 2 O atoms and are obtained through the oxidation of primary alcohols when refluxed with acidified potassium dichromate

b) The formula for compound **W** and formation of compound **Z** is:

- Compound **W** is $CH_3CH_2CH_2CH_2COOCH_2CH_2CH_2CH_2CH_3$
  OR
  $C_{10}H_{20}O_2$; [1 mark]
- Compound **Z** is water / H_2O
  AND
  Produced by a condensation reaction between pentanoic acid and pentanol / compounds **X** and **Y**; [1 mark]

[Total: 2 marks]

- You should be aware that the reaction between an alcohol and carboxylic acid produces an ester and water
  - In this reaction, concentrated sulfuric acid, H_2SO_4, is used as a catalyst
- The formation of the ester eliminates a water molecule through a condensation reaction
  - **Careful:** A condensation reaction does **not** mean that water is formed; it actually means that a small molecule is lost
- The name of compound **W** is pentyl pentanoate

c) A student could prevent the full oxidation of compound **X** by:

- Distill off aldehyde as soon as it is produced; [1 mark]
- Perform the reaction above the boiling point of the aldehyde / pentanal; [1 mark]

[Total: 2 marks]

- The full oxidation of a primary alcohol such as Compound **X** will produce
  - An aldehyde followed by a carboxylic acid
- If we want to prevent this full oxidation, we **must** alter the reaction conditions and use different apparatus
  - A Liebig condenser is used for this purpose
  - This piece of apparatus is ideal for the separation of an organic product from its reacting mixture
  - It allows the distillate to be collected in an approximate boiling point range

d) The formula of the isomer and the reason it can not react with acidified potassium dichromate, $H^+/K_2Cr_2O_7$ is:

- $CH_3C(CH_3)OHCH_2CH_3$; [1 mark]
- It doesn't react because it is a tertiary alcohol; [1 mark]

[Total: 2 marks]

- Earlier, compound **X** was identified to be an alcohol with 5 carbons, which gives it the molecular formula $C_5H_{11}OH$
- For the isomer to not react with acidified potassium dichromate, it must be a tertiary alcohol
- If you are unsure it is best to draw out the molecule
- The only isomer which gives a tertiary alcohol is 2-methylbutan-2-ol