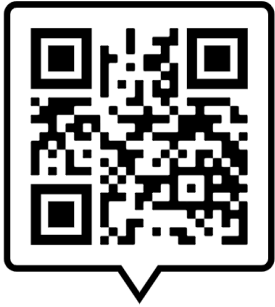


Y12 CHEMISTRY SUMMER WORK

This booklet consists of topics to practice that were your whole classes area for improvement

To improve in any topic, you must learn the content, by watching videos and doing basic recall questions on those topics and then practice applying that information to exam questions.

Topic	Link
Group 7	 SCAN ME
Alcohols	 SCAN ME
Mechanisms	 SCAN ME

SECTION 1 – Retrieval practice:
Inorganic Chemistry

What is oxidation in terms of oxygen?
What is oxidation in terms of electrons?
What does an oxidising agent do?
What is reduction in terms of oxygen?
What is reduction in terms of electrons?
What does a reducing agent do?
What are redox reactions?
What is the oxidation state for an element ie Fe/Cl ₂
What is the oxidation state of a metal in its compound?
What is the oxidation state of an oxygen atom in a compound?
What is the oxidation state of an hydrogen atom in a compound?
What is the oxidation state of Cl in a compound?
What is disproportionation?
What is the oxidation state of chromium in the Cr ²⁺ ion?
What is the oxidation state of chromium in the CrCl ₃ ?
What is the oxidation number of iron in iron (III) oxide?
What is the oxidation state of K in K ₂ MnO ₄ ?
What is the oxidation state of O in K ₂ MnO ₄ ?
What is the oxidation state of Mn in K ₂ MnO ₄ ?
Write a half equation to show a sodium atom forming a sodium ion
Write a half equation for the following change: Cr ₂ O ₇ ²⁻ → Cr ³⁺

Write half equation for $\text{MnO}_4^- \rightarrow \text{Mn}^{2+}$ and $\text{Cl}^- \rightarrow \text{Cl}_2$ then combine them
Why are elements in Group I (alkali metals) and Group II (alkaline earths) known as s-block elements?
Why does atomic radius increase down group 2?
Why does melting point decrease down group 2?
Why does first ionisation energy decrease down group 2?
Why is the second ionisation energy of Magnesium higher than the first ionisation energy?
Why is there such a big jump between the 2nd ionisation energy and the 3rd Ionisation energy of Magnesium?
Write a balanced equation with state symbols for the reaction of Magnesium with steam.
Write a balanced equation with state symbols for the reaction of Barium water
What is the trend in solubility of the Group 2 Hydroxides?
Why do the group 2 metals get more reactive as you go down the group?
What is the trend in solubility of the Group 2 Sulphates?
Why is calcium hydroxide more soluble than magnesium hydroxide and more strongly alkaline?
Describe the chemical test for sulfate ions
Write an ionic equation with state symbols for the reaction in the sulfate test.
Write a balanced equation with state symbols for the combustion of Barium in air.
Write a balanced equation with state symbols for the reaction of calcium with sulfuric acid

Write a balanced equation with state symbols for the reaction of strontium with nitric acid
Why does the boiling point of Group 7 elements increase down the group?
Why does the atomic radius of the Group 7 elements increase down the group?
Why does the electronegativity of the Group 7 elements decrease down the group?
What is the trend in oxidising power of Group 7 elements down the group?
Why does the oxidising power of Group 7 elements decrease down the group?
Write a balanced chemical equation with state symbols for the reaction of Chlorine with Sodium Bromide
Write an balanced ionic equation for the reaction of Bromine with Iodide ions.
What observation would be made with bromine is reacted with sodium chloride?
What observation would be made with chlorine is reacted with sodium iodide?
What observation would be made when solid sodium chloride reacts with concentrated sulfuric acid.
What a balanced equation for when solid sodium chloride reacts with concentrated sulfuric acid.
Write down three observations that would be made when sodium bromide reacts with concentrated sulfuric acid.
Name the three gases produced that would be made when sodium bromide reacts with concentrated sulfuric acid.

Write two ionic equations that show the formation of the three gases formed when sodium bromide reacts with concentrated sulfuric acid.

Write down five observations that would be made when sodium iodide reacts with concentrated sulfuric acid.

Name the three gases produced when sodium iodide reacts with concentrated sulfuric acid.

Write an ionic equation that shows the formation of iodine and Sulfur Dioxide when sodium iodide reacts with concentrated sulfuric acid.

Write an ionic equation that shows the formation of iodine and sulfur dioxide when sodium iodide reacts with concentrated sulfuric acid.

Write an ionic equation that shows the formation of iodine and sulfur when sodium iodide reacts with concentrated sulfuric acid.

Write an ionic equation that shows the formation of iodine and Hydrogen Sulfide when sodium iodide reacts with concentrated sulfuric acid.

Explain why the ability of halide ions to act as reducing agents increases down the group.

List the four steps for testing an unknown solution for halide ions

What is observation for a positive result to show the presence of chloride ions?

What is observation for a positive result to show the presence of bromide ions?

What is observation for a positive result to show the presence of iodide ions?
Write an ionic equation with state symbols for the formation of silver fluoride
Write an equation with state symbols for the reactions of chlorine with water
Why is the reaction of chlorine with water called a DISPROPORTIONATION reaction?
What is the chemical test for chlorine?
Write a balanced chemical equation with state symbols for the reaction of Chlorine with cold aqueous sodium hydroxide
Explain in terms of the changes in oxidation number why the reaction of Chlorine and cold aqueous sodium hydroxide is an example of a DISPROPORTIONATION reaction.

SECTION 2 – Exam Practice
Halogens

Q1. (a) A student completes a series of test-tube reactions on two solutions, **A** and **B**.

Each solution contains an unknown inorganic compound.

The table below shows the observations in these reactions.

	Solution A	Solution B
Test 1 Add $\text{H}_2\text{SO}_4(\text{aq})$	White precipitate formed	Effervescence
Test 2 Add $\text{HNO}_3(\text{aq})$ followed by $\text{AgNO}_3(\text{aq})$	White precipitate formed	Effervescence
Test 3 Add $\text{NaOH}(\text{aq})$ and warm gently. Hold a piece of damp red litmus paper over the end of the test tube.	No visible change	Red litmus turns blue

Show how the observations can be used to identify the inorganic compound in **Solution A** and the inorganic compound in **Solution B**.

Give **ionic** equations for the reactions that occur.

(6)

(b) Describe a test to confirm that a solution contains hydroxide ions.

(1)

(Total 7 marks)

Q2. A student does a series of reactions with aqueous solutions of some potassium halides (**P**, **Q** and **R**) of equal concentration. Each solution contains a different halide ion (chloride, bromide or iodide).

The student adds 3 drops of bromine water to 3 drops of each aqueous solution of potassium halide. The student also adds 3 drops of the bromine water to 3 drops of water.

Table 1 shows the student's observations.

Table 1

	Observation when 3 drops of bromine water are added
Solution P	Orange solution
Solution Q	Brown solution
Solution R	Orange solution
Water	Orange solution

- (a) Identify the halide ion present in **Q**.

Give the ionic equation for the reaction that occurs when bromine water is added to **Q**.

Halide ion in **Q**

Ionic equation

(2)

- (b) Explain, in terms of oxidising ability, why the observations from these reactions do **not** allow the student to identify the halide ion present in **P** and the halide ion present in **R**.

(2)

- (c) The student does a second experiment to determine the halide ion in each of **P** and **R**.

The student adds a few drops of aqueous silver nitrate solution to 2 cm³ of each potassium halide solution.

Table 2 shows the student's observations.

Table 2

	Student's Observation
P	Precipitate formed
R	Precipitate formed

Describe a further chemical test that the student can complete on the precipitates formed to identify the halide ion present in **P** and the halide ion present in **R**.

Describe how the observations from this test can be used to identify the halide ion present in **P** and the halide ion present in **R**.

(3)

(Total 7 marks)

Q3.

Which species is the best oxidising agent?

- A** Cl₂ ☐
- B** Cl⁻ ☐
- C** Br₂ ☐
- D** Br⁻ ☐

(Total 1 mark)

Q4. A student oxidised a solution of hydrochloric acid with a few drops of sodium chlorate(I) solution. The reaction mixture effervesced and turned pale green. The gas formed bleached universal indicator paper.

- (a) Write a half-equation for the oxidation of chloride ions.

(1)

- (b) Write a half-equation for the reduction of chlorate(I) ions to chlorine in acidic conditions.

(1)

- (c) Write an overall equation for the redox reaction of chlorate(I) ions with hydrochloric acid.

(1)

- (d) A solution of sodium chlorate(I) was added to a colourless solution of potassium iodide.
Suggest what is observed.

Explain the reaction that leads to this observation.

(3)

(Total 6 marks)

Q5. (a) Describe and explain the trend in the boiling points of the elements down Group VII from fluorine to iodine.

(4)

(b) Describe what you would observe when aqueous silver nitrate, followed by dilute aqueous ammonia, is added to separate aqueous solutions of sodium chloride and sodium bromide.

(4)

(c) State the trend in the oxidising abilities of the elements down Group VII from chlorine to iodine.
Explain how this trend can be shown by displacement reactions between halogens and halide ions in aqueous solutions.
Illustrate your answer with appropriate observations and equations.

(7)

(Total 15 marks)

SECTION 3 – Retrieval practice
Organic Chemistry

What is an alkene?
Why are alkenes described as unsaturated?
Describe the electron density of the double bond
Draw the shape of the carbon-carbon double bond orbitals
What type of isomerism can alkenes exhibit?
What physical feature of alkenes causes their stereoisomerism?
Name a given alkene
What two type of reactions do alkenes typically undergo?
Which three reagents do alkenes typically react with?
What type of reagents do alkenes react with?
What are the products of an electrophilic addition reaction with Br ₂ ?
Draw a reaction mechanism for a given alkene with Br ₂
Why is bromine water used as a test for alkenes?
What are the products of an addition reaction with HBr?
What is a carbocation intermediate?
From a given carbocation, state whether it is primary, secondary or tertiary

Describe the variation in stabilities of the different orders of carbocation
How does stability of carbocations effect the products of an addition reaction with HBr?
Draw a mechanism for an addition reaction of an alkene and HBr. Draw and label the major and minor products.
What is the product of a reaction with an alkene and concentrated H_2SO_4 ?
Draw a mechanism for the reaction between a given alkene and concentrated sulphuric acid
Why can sulphuric acid be considered a catalyst in hydration of alkenes?
What are addition polymers formed from?
How are addition polymers named?
Draw the polymer for a given substituted alkene
Draw the monomer for a given section of polymer

What are the chemical properties of addition polymers?
Why are addition polymers unreactive?
What is PVC?
What is a plasticiser?
What is an alcohol?
Draw the structure of the first three alcohols
Name a given alcohol, diol or triol
What are the physical properties of alcohols?
Explain the physical properties of alcohols
What are the two methods for production of ethanol?
What are the conditions for the production of ethanol from ethene?
What conditions are necessary for the fermentation of glucose?
Give two advantages of production of ethanol from glucose
Give three disadvantages of production of ethanol from glucose
How is ethanol extracted after fermentation of glucose?
Give two advantages of production of ethanol from ethene
Give three disadvantages of production of ethanol from ethene

Write a balanced symbol equation for the complete combustion of a given alcohol

What is a dehydration of an alcohol reaction?

What is the product of a dehydration of an alcohol reaction

What conditions are necessary for dehydration of an alcohol

Draw a mechanism for the acid catalyzed dehydration of a given alcohol

What is the advantage of dehydrating alcohols to form alkenes?

What is an oxidation reaction in organic chemistry?

What can primary alcohols be oxidized to?

What can secondary alcohols be oxidized to?

What can tertiary alcohols be oxidized to?

How is oxidation symbolized in an equation?

What reagent is used for the oxidation of alcohols?

What colour change is observed in the oxidation of alcohols?

Which experimental method is used to convert alcohols to carboxylic acids?

Which experimental method is used to convert alcohols to aldehyde

Which chemical tests can distinguish between aldehydes and ketones?

What is observed when Tollens' reagent is added to aldehydes?

What is observed when Fehling's solution is added to aldehydes?

What is observed when sodium is added to an alcohol?

What is observed when potassium dichromate is added to a primary or secondary alcohol?
What is the test to differentiate between an aldehyde or a ketone?
What is the test and observation for an alkene?
What are the steps to test for a halogenoalkane?
What is the observation when using silver nitrate to test for the different halogenoalkanes?
What is the test and observation for a carboxylic acid?
How can the results from mass spectrometry be used to work out the molecular mass of a compound?
How can high resolution mass spectrometry distinguish between molecules with the same molecular mass?

SECTION 4 – Exam practice

Alcohols

Q6.

This question is about oxidation.

- (a) A student has separate unlabelled samples of propan-1-ol and propan-2-ol but does not know which sample is which alcohol.

The student plans a series of steps to identify the alcohols.

Step 1 Oxidise each sample, distilling off the organic product as it is formed.

Step 2 Identify the organic products using a simple chemical test.

Step 3 Confirm the identities using the infrared spectrum of each original sample.

Give further details of each step in the plan. In your answer include

- an appropriate oxidising agent used in Step 1
- equations, using [O] to represent the oxidising agent, for each reaction in Step 1
- a suitable test and expected observations in Step 2
- how the infrared spectra can be used to confirm the identities.

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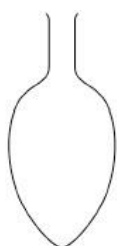
(6)

- (b) A primary alcohol can be oxidised to form a carboxylic acid using an excess of the oxidising agent in part (a).

Give the condition needed for this reaction.

Complete the diagram, adding labels, to show how the apparatus would be set up.

Condition _____



(3)

- (c) During oxidation reactions, anti-bumping granules are often added to the pear-shaped flask containing the reactants.

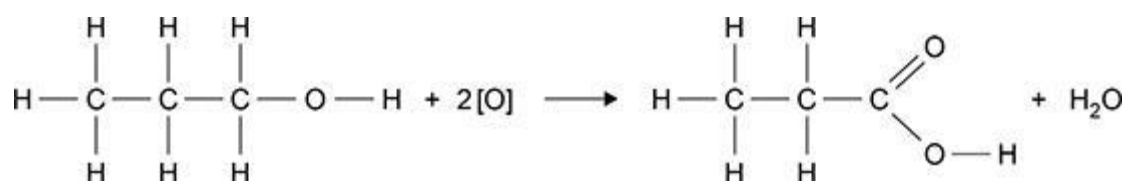
State why anti-bumping granules are used.

(1)

(Total 10 marks)

Q7. This question is about propanoic acid ($\text{CH}_3\text{CH}_2\text{COOH}$).

The equation for the oxidation of propan-1-ol under reflux to form propanoic acid is shown.



- (a) Acidified potassium dichromate(VI) is used as the oxidising agent.

State the colour change in this reaction.

(1)

- (b) A second organic product, **X**, is formed in small quantities.
The boiling point of **X** is 49°C

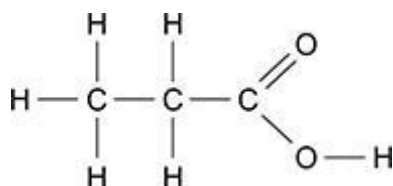
Identify **X**.

(1)

- (c) Propanoic acid molecules cannot be separated from the reaction mixture by simple distillation because propanoic acid forms hydrogen bonds with water molecules.

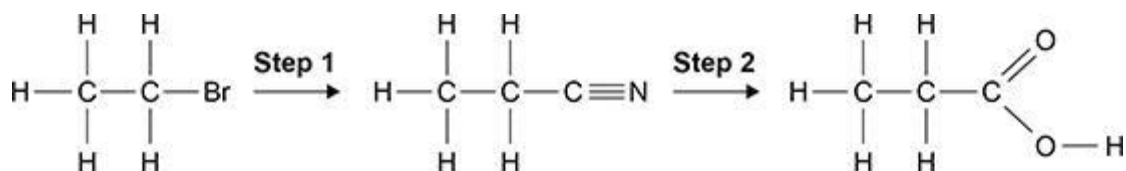
Complete the diagram to show how the propanoic acid molecule interacts with **one** water molecule through hydrogen bonding.

Include in the diagram all the partial charges and lone pairs of electrons involved in this hydrogen bond.



(3)

An alternative method of preparing propanoic acid is shown.



Step 1 involves the reaction of bromoethane with sodium cyanide under reflux in a suitable solvent.

(d) Name and outline the mechanism for **Step 1**.

Name of mechanism _____

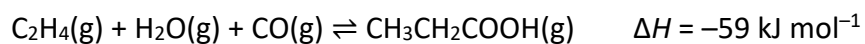
Outline of mechanism

(3)

(e) Suggest one reason why water is **not** a suitable solvent for **Step 1**.

(1)

A third way of making propanoic acid uses the reaction between ethene, steam and carbon monoxide in the presence of a catalyst.



(f) Give an expression for the equilibrium constant (K_c) for this reaction.

$K_c =$

(1)

- (g) The table below shows the amount of each substance in an equilibrium mixture in a container of volume 1.20 dm^3 at a constant temperature.

Substance	$\text{C}_2\text{H}_4(\text{g})$	$\text{H}_2\text{O}(\text{g})$	$\text{CO}(\text{g})$	$\text{CH}_3\text{CH}_2\text{COOH}(\text{g})$
Amount of substance / mol	0.062	0.078	0.062	0.420

Calculate K_c

State the units.

K_c _____

Units _____

(4)

- (h) Predict the effect of increasing the temperature on the yield of propanoic acid.

Explain your answer.

Effect on yield _____

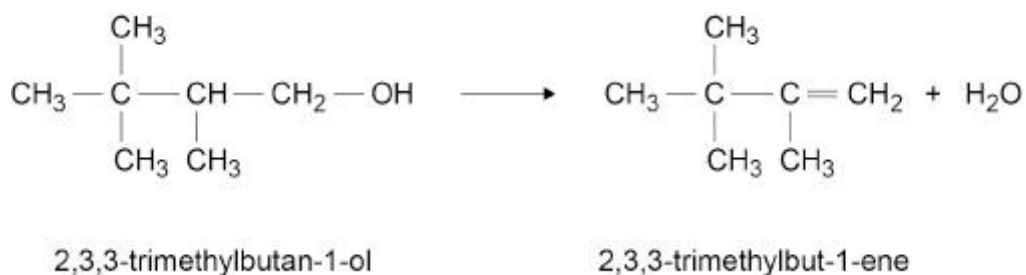
Explanation _____

(3)

(Total 17 marks)

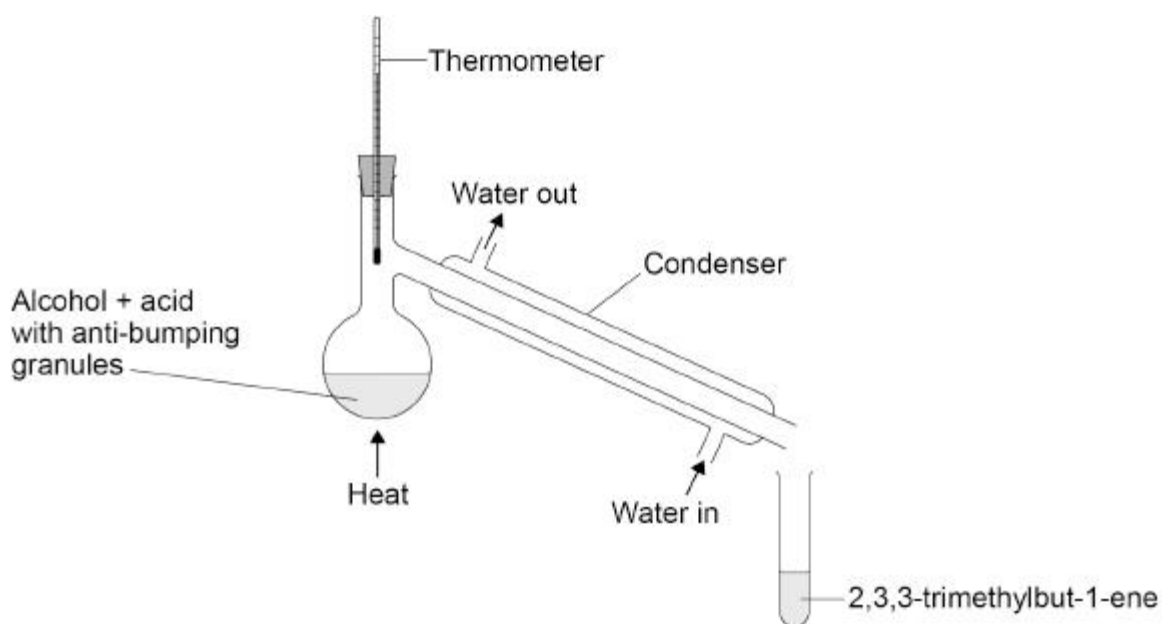
Q8.

This question is about the preparation of 2,3,3-trimethylbut-1-ene.



The preparation is done by heating the alcohol with concentrated phosphoric acid, that acts as a catalyst.

The figure below shows the apparatus used.



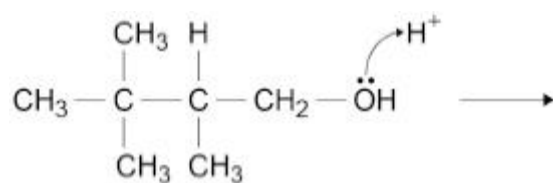
The distillate is collected in the range 77–82 °C

- (a) Explain why the water should enter the condenser at the bottom and not at the top.

(2)

(b) Name and complete the mechanism for this reaction.

Name of mechanism _____



(4)

(c) In a similar experiment, 12.0 cm³ of 2,3,3-trimethylbutan-1-ol ($M_r = 116.0$) produces 6.12 g of 2,3,3-trimethylbut-1-ene.

Calculate the percentage yield.

density of 2,3,3-trimethylbutan-1-ol = 0.818 g cm⁻³

Percentage yield _____

(5)

(Total 11 marks)

Q9.

Which statement is **not** correct for both primary and secondary alcohols?

- A** They are easily oxidised to carboxylic acids by acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution.
- B** They can be formed from bromoalkanes by hydrolysis.
- C** They form esters with carboxylic acids.
- D** They show hydrogen bonding in the liquid state.

☐☐☐☐

(Total 1 mark)

Q10.

Which compound produces $(\text{CH}_3)_2\text{CHCOCH}_3$ on oxidation?

- A** 2-methylpropan-1-ol
- B** 2,2-dimethylpropan-1-ol
- C** 2-methylbutan-2-ol
- D** 3-methylbutan-2-ol

☐☐☐☐

(Total 1 mark)

Q11.

2-Methylpentane-1,2,4-triol is refluxed with an excess of acidified potassium dichromate(VI).

What is the molecular formula of the main organic product?

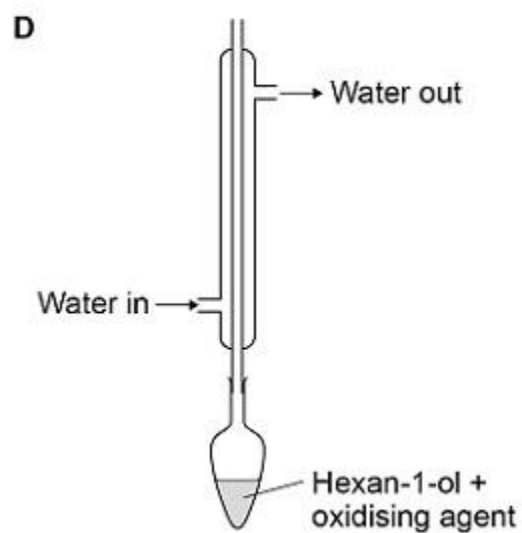
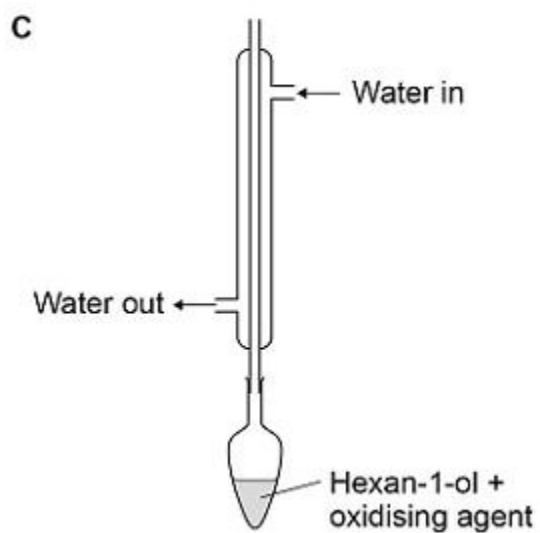
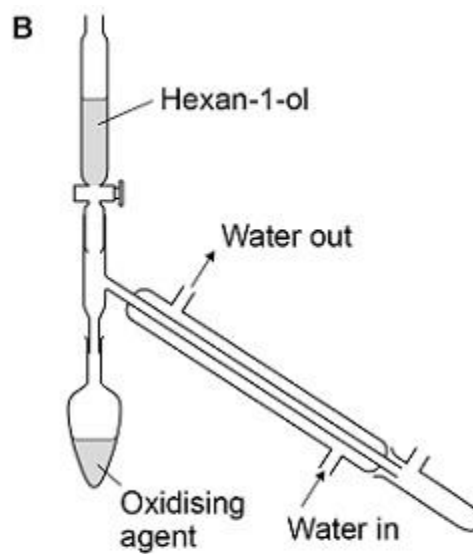
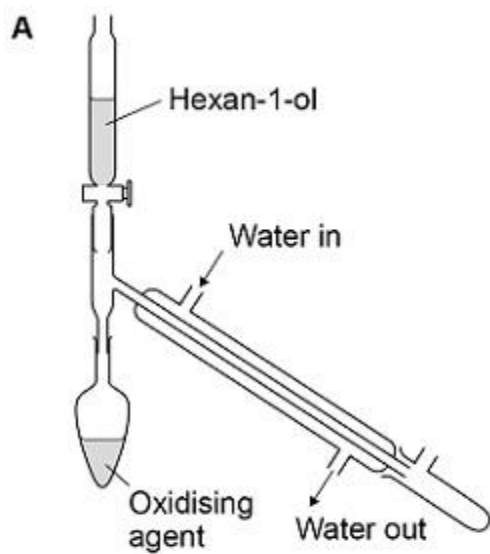
- A** $\text{C}_6\text{H}_8\text{O}_4$
- B** $\text{C}_6\text{H}_{10}\text{O}_3$
- C** $\text{C}_6\text{H}_{10}\text{O}_4$
- D** $\text{C}_6\text{H}_{12}\text{O}_3$

☐☐☐☐

(Total 1 mark)

Q12.

Which diagram shows the correct apparatus for the conversion of hexan-1-ol to hexanal?



A ☐

B ☐

C ☐

D ☐

(Total 1 marks)

Q13.

Ethanol can be oxidised by acidified potassium dichromate(VI) to ethanoic acid in a two-step process.



- (a) In order to ensure that the oxidation to ethanoic acid is complete, the reaction is carried out under reflux.

Describe what happens when a reaction mixture is refluxed and why it is necessary, in this case, for complete oxidation to ethanoic acid.

(3)

- (b) Write a half-equation for the overall oxidation of ethanol into ethanoic acid.

(1)

- (c) The boiling points of the organic compounds in a reaction mixture are shown in the following table.

Compound	ethanol	ethanal	ethanoic acid
Boiling point / °C	78	21	118

Use these data to describe how you would obtain a sample of ethanal from a mixture of these three compounds. Include in your answer a description of the apparatus you would use and how you would minimise the loss of ethanal. Your description of the apparatus can be either a description in words or a labelled sketch.

(5)

- (d) Use your knowledge of structure and bonding to explain why it is possible to separate ethanal in this way.

(2)

- (e) A student obtained a sample of a liquid using the apparatus in part (c).

Describe how the student could use chemical tests to confirm that the liquid contained ethanal and did **not** contain ethanoic acid.

(5)

(Total 16 marks)

