Oxidation of Alcohols

Question Paper 1

Level	A Level
Subject	Chemistry
Exam Board	AQA
Module	3.3 Organic Chemistry
Topic	3.3.5 Alcohol
Sub-Topic	3.3.5.2 Oxidation of Alcohols
Booklet	Question Paper 1

Time Allowed: **57 minutes**

Score: **/49**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	75%	70%	60%	55%	50%	<50%

Q1. In each of the following questions, you should draw the structure of the compound in the space provided.

(a) Draw the structure of the alkene that would form 1,2-dibromo-3-methylbutane when reacted with bromine.

(1)

(b) Draw the structure of the alcohol with molecular formula $C_4H_{10}O$ that is resistant to oxidation by acidified potassium dichromate(VI).

(1)

(c) Draw the structure of the alkene that has a peak, due to its molecular ion, at *m/z* = 42 in its mass spectrum.

(1)

(d) Draw the structure of the organic product with M_r = 73, made from the reaction between 2-bromobutane and ammonia.

(1)
(Total 4 marks)

Q2. A sample of 2-methylpropan-2-ol was contaminated with butan-2-ol. The student separated the two alcohols using chromatography.

Identify a reagent or combination of reagents that the student could use to distinguish between these alcohols. State what would be observed for each alcohol.

Reagent(s) .....

Observation with 2-methylpropan-2-ol .....

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Observation with butan-2-ol .....

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(Total 3 marks)

Q3. The following pairs of compounds can be distinguished by simple test−tube reactions.

For each pair of compounds, give a reagent (or combination of reagents) that, when added separately to each compound, could be used to distinguish between them. State what is observed in each case.

(a) Butan−2−ol and 2−methylpropan−2−ol

Reagent .....

Observation with butan−2−ol

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Observation with 2−methylpropan−2−ol

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(3)

(b) Propane and propene

Reagent .....

Observation with propane

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Observation with propene

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(3)

(c) Aqueous silver nitrate and aqueous sodium nitrate

Reagent .....

Observation with aqueous silver nitrate

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Observation with aqueous sodium nitrate

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(3)

(d) Aqueous magnesium chloride and aqueous barium chloride

Reagent .....

Observation with aqueous magnesium chloride

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Observation with aqueous barium chloride

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(3)
(Total 12 marks)

Q4.(a) Propanone can be formed when glucose comes into contact with bacteria in the absence of air.

(i) Balance the following equation for this reaction of glucose to form propanone, carbon dioxide and water.

.....$C_6H_{12}O_6$ ⟶ .....CH_3COCH_3 + ...CO_2 + ...H_2O

(1)

(ii) Deduce the role of the bacteria in this reaction.

.....

(1)

(b) Propanone is also formed by the oxidation of propan−2−ol.

(i) Write an equation for this reaction using [O] to represent the oxidising agent.

.....

(1)

(ii) State the class of alcohols to which propan−2−ol belongs.

.....

(1)

(c) A student determined a value for the enthalpy change when a sample of propanone was burned. The heat produced was used to warm some water in a copper calorimeter.
The student found that the temperature of 150 g of water increased by 8.0 °C when 4.50×10^{-3} mol of pure propanone was burned in air.

Use the student's results to calculate a value, in kJ mol^{-1}, for the enthalpy change when one mole of propanone is burned.
(The specific heat capacity of water is 4.18 J K^{-1} g^{-1})

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(3)

(d) Define the term **standard enthalpy of combustion**.

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(3)

(e) Use the mean bond enthalpy data in the table and the equation given below the table to calculate a value for the standard enthalpy change when gaseous propanone is burned.

	C−H	**C−C**	**C−O**	**O−H**	**C=O**	**O=O**
Mean bond enthalpy / kJ mol^{-1}	412	348	360	463	805	496

$$CH_3COCH_3(g) + 4O_2(g) \longrightarrow 3CO_2(g) + 3H_2O(g)$$

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(3)

(f) Suggest **two** reasons why the value obtained by the student in part (c) is different from the value calculated in part (e).

Reason 1 .....

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Reason 2 .....

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(2)
(Total 15 marks)

Q5. Alcohol **A** $(CH_3)_2CHCH(OH)CH_3$ undergoes reactions separately with acidified potassium dichromate(VI) and with concentrated sulfuric acid.

(a) Deduce the IUPAC name for alcohol **A**.

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(1)

(b) Draw the structure of the organic product, **B**, formed when **A** is oxidised in the reaction with acidified potassium dichromate(VI).

(1)

(c) Two isomeric alkenes, **C** and **D**, are formed when **A** is dehydrated in the reaction with concentrated sulfuric acid.

Name the mechanism for this dehydration reaction.

.....

(1)

(d) Draw the structure of each isomer.

Isomer **C** Isomer **D**

(2)

(e) Name the type of structural isomerism shown by **C** and **D**.

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(1)

(f) List alcohol **A**, product **B** and isomer **C** in order of increasing boiling point.

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(1)

(g) Draw the structure of the isomer of **A** that is **not** oxidised by acidified potassium dichromate(VI).

(1)

(h) Draw the structure of the isomer of **A** that **cannot** be dehydrated to form an alkene by reaction with concentrated sulfuric acid.

(1)
(Total 9 marks)

Q6. Which statement about ethanal is correct?

A It reacts with Tollens' reagent to form silver. ☐

B It has a higher boiling point than ethanol. ☐

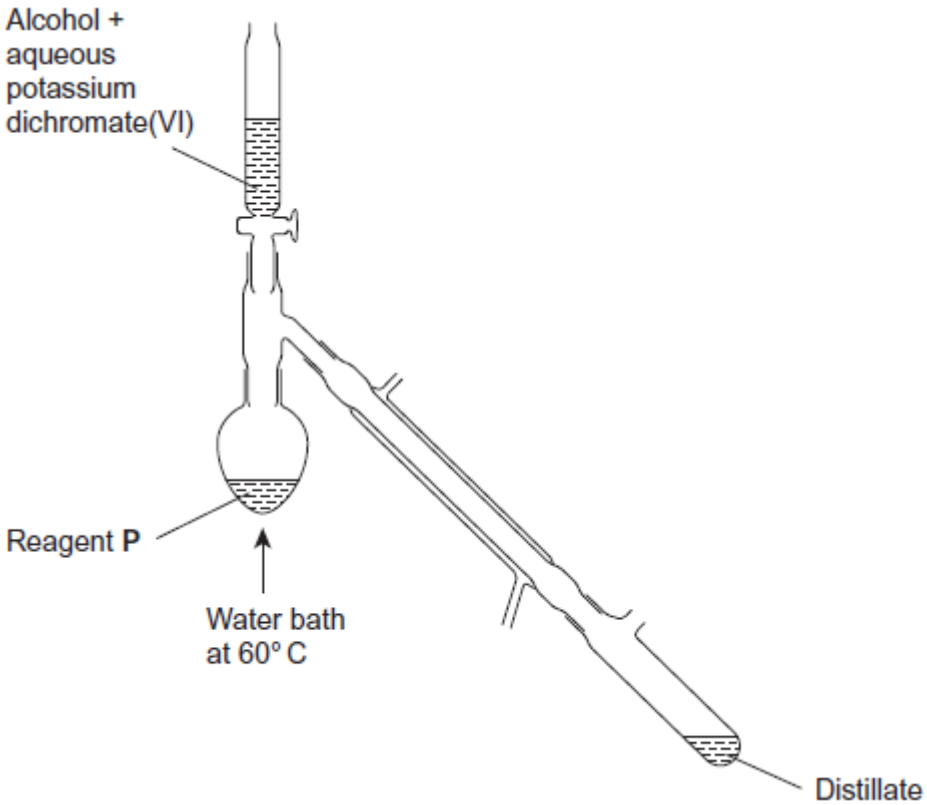
C Its empirical and molecular formulas are different. ☐

D It belongs to a homologous series with general formula $C_nH_{2n+1}O$ ☐

(Total 1 mark)

Q7. This question concerns the oxidation of a primary alcohol.

The experiment was carried out using the distillation apparatus shown in the diagram.
The oxidation product was distilled off as soon as it was formed.



(a) Suggest the identity of reagent **P**.

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(1)

(b) State the chemical change that causes the solution in the flask to appear green at the end of the reaction.

.....

(1)

(c) Give **one** reason why using a water bath is better than direct heating with a Bunsen burner.

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(1)

(d) Suggest a reagent that could be used to confirm the presence of an aldehyde in the

distillate.
State the observation you would expect to make if an aldehyde were present.

Reagent .....

Observation .....

(2)
(Total 5 marks)