AS LEVEL CHEMISTRY

2.2.1 ALCOHOLS

2.2.2 HALOGENOALKANES

2.2.3 MODERN ANALYTICAL TECHNIQUES

TEST

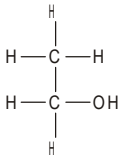
Answer all questions

Max 59 marks

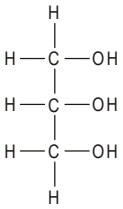
Name	……..
Mark	……../59 ……....% Grade ……

1. Ethanol and glycerol (propane-1,2,3-triol) are both produced industrially on a large scale.

Ethanol is manufactured by both fermentation and the hydration of ethene.
Glycerol is produced as a by-product of soap manufacture.



ethanol



glycerol

The relatively low volatility of alcohols such as ethanol can be explained by the existence of intermolecular bonds.

(i) Explain what is meant by the terms:

low volatility, ...

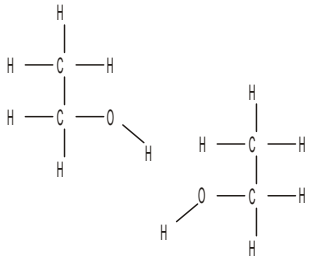
.....

intermolecular bonds .....

.....

[2]

(ii) On the ethanol molecules below, label any relevant dipoles, show the intermolecular bond formed and state the type of intermolecular bond.



type of intermolecular bond .....

[3]

(iii) Glycerol forms the same type of intermolecular bonds as ethanol. Predict, with a reason, whether the boiling point of glycerol will be higher or lower than that of ethanol.

The boiling point of glycerol will be ..... than that of ethanol because

.....

.....

[1]

[Total 6 marks]

2. Ethanol can be formed by fermentation of glucose, $C_6H_{12}O_6$.

(i) Write a balanced equation, including state symbols, for the formation of ethanol by fermentation.

.....

[2]

(ii) Fermentation only occurs in the presence of yeast. State **two** other essential conditions.

.....

.....

[2]

(iii) How would you know when fermentation of glucose is complete?

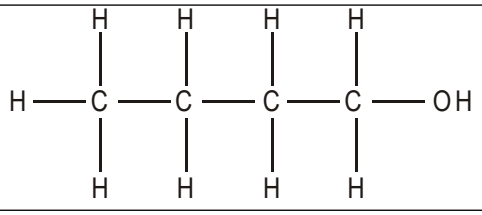
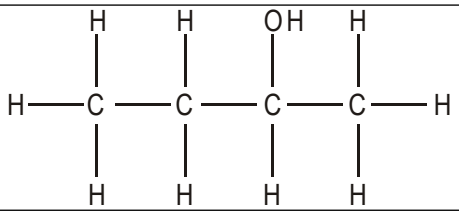
.....

.....

[1]

[Total 5 marks]

3. Four possible structural isomers of $C_4H_{10}O$ are alcohols. Two are shown below.

	
butan-1-ol	butan-2-ol

(i) Draw the other two structural isomers of $C_4H_{10}O$ that are alcohols

isomer 1	isomer 2

[2]

(ii) Name isomer 1. .....

[1]

[Total 3 marks]

4. Butan-2-ol can be dehydrated to produce a mixture of three alkenes each with a molecular formula C_4H_8.

Draw the displayed formula for each of the three alkenes.

[Total 3 marks]

5. A student reacted 8.72 g of bromobutane with an excess of OH^-. The student produced 4.28 g of butan-1-ol.

In this reaction the hydroxide ion acts as a nucleophile.

(i) What name is given to this type of reaction?

.....

[1]

(ii) Explain the term *nucleophile*.

.....

[1]

(iii) Outline the mechanism for this reaction.

Show curly arrows and relevant dipoles.

[4]

(iv) Calculate the amount, in mol, of $CH_3CH_2CH_2CH_2Br$ reacted.

$CH_3CH_2CH_2CH_2Br$, *M*r = 136.9

..... mol

[1]

(v) Calculate the amount, in mol, of $CH_3CH_2CH_2CH_2OH$ produced.

..... mol

[2]

(vi) Calculate the percentage yield.

Quote your answer to **three** significant figures.

..... %

[1]

[Total 10 marks]

7. In this question, one mark is available for the quality of spelling, punctuation and grammar.

The rates of hydrolysis of chloroethane, bromoethane and iodoethane are different.

- Describe how you would monitor the reaction rates.
- Explain why chloroethane, bromoethane and iodoethane react at different rates.

Use suitable equations in your answer.

.....

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.....

[Total 6 marks]

8. In 1930, an American engineer, Thomas Midgley, demonstrated a new refrigerant. As part of his demonstration, he inhaled a lung full of dichlorodifluoromethane, CCl_2F_2, and used it to blow out a candle.

Use Midgley's demonstration to suggest **two** properties of CCl_2F_2. Explain, with a reason, **two** other uses of chemicals such as CCl_2F_2, other than as a refrigerant.

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[Total 4 marks]

9. (a) When ethanol is heated with acidified potassium dichromate(VI) solution, it can be oxidised to form either ethanal, CH_3CHO (Fig. 1), or ethanoic acid, CH_3COOH (Fig. 2).

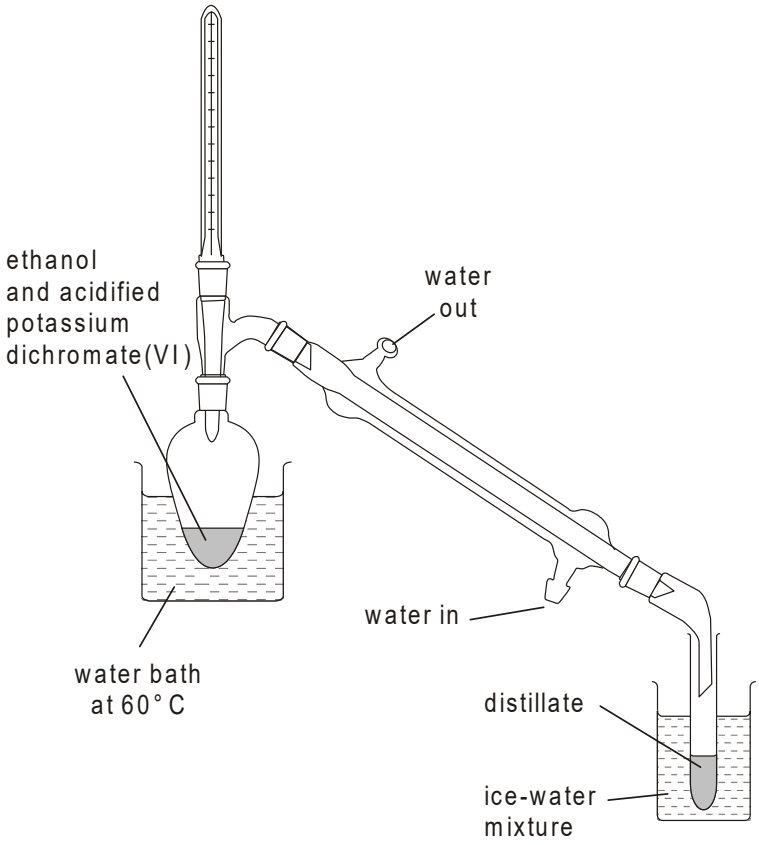


Fig. 1

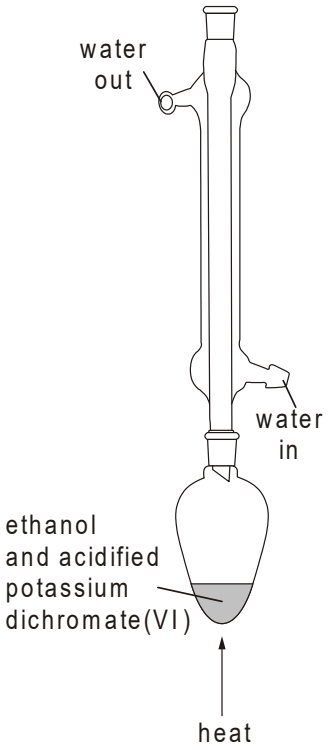


Fig. 2

The boiling points of ethanol, ethanal and ethanoic acid are given in the table below.

	CH_3CH_2OH	CH_3CHO	CH_3COOH
boiling point/ °C	78	21	118

Use this table of boiling points to explain

(i) why the organic product is likely to be ethanal if the apparatus shown in Fig. 1 is used,

.....

.....

[2]

(ii) why the organic product is likely to be ethanoic acid if the apparatus shown in Fig. 2 is used.

.....

.....

[2]

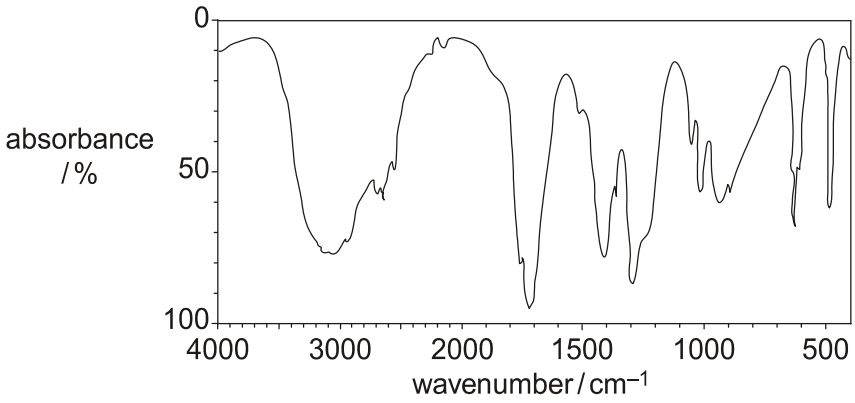
(b) Write a balanced equation for the oxidation of ethanol to ethanoic acid. Use (O) to represent the oxidising agent.

.....

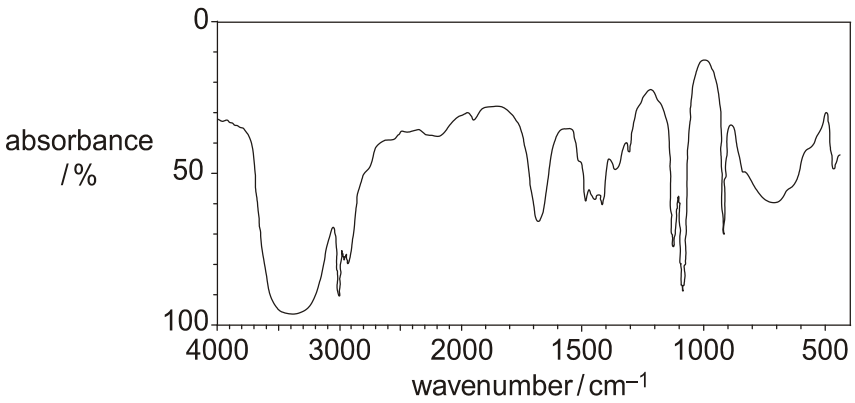
[2]

(c) The ethanal collected using the apparatus shown in Fig. 1 was analysed by infra-red spectroscopy. Use your *Data Sheet* to justify which of the three spectra shown below is most likely to be that of ethanal.

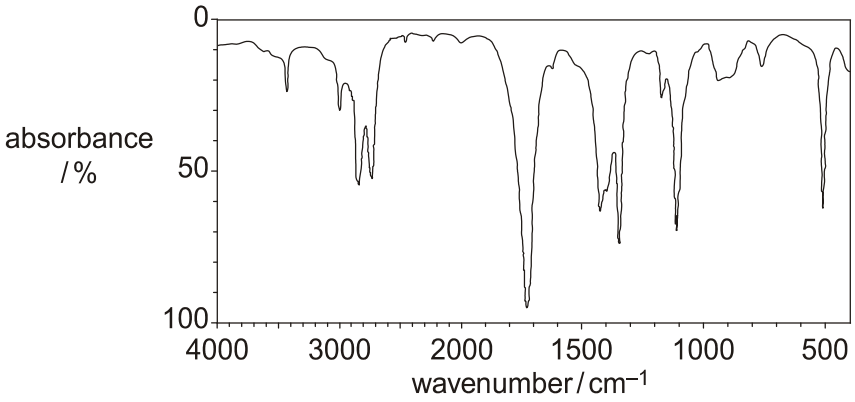
spectrum **A**



spectrum **B**



spectrum **C**



The organic product collected when using the apparatus shown in Fig. 1 is most likely to be that shown by spectrum ..... because.....

.....

.....

[3]

[Total 9 marks]

10. Acrolein, CH_2=CHCHO, and acrylic acid, CH_2=CHCOOH, are both used in industry for the manufacture of plastic resins and polymers. Both acrolein and acrylic acid can be made from prop-2-en-1-ol, CH_2=$CHCH_2OH$.

(a) (i) Draw the structures of prop-2-en-1-ol and acrolein. Clearly display the functional groups in each compound.

prop-2-en-1-ol	**acrolein**

[2]

(ii) Name the functional group common to **both** prop-2-en-1-ol and acrolein.

.....

[1]

(b) Prop-2-en-1-ol can be oxidised to form either acrolein or acrylic acid.

(i) Identify a suitable oxidising mixture.

.....

[2]

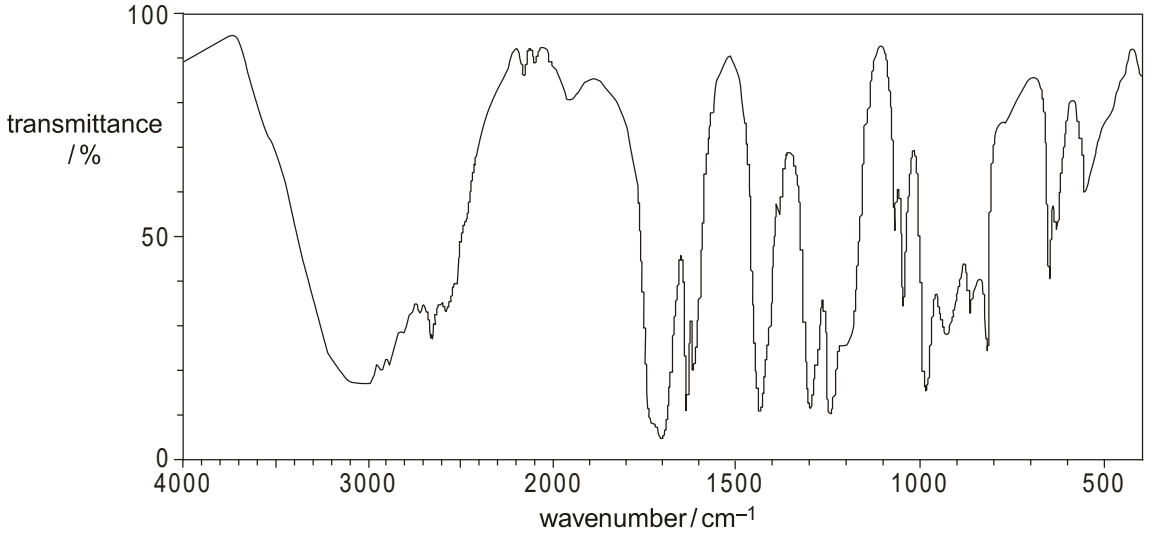
(ii) Write a balanced equation for the oxidation of prop-2-en-1-ol into acrolein. Use (O) to represent the oxidising agent.

.....

[1]

[Total 6 marks]

11. A sample of prop-2-en-1-ol was oxidised and an infra-red spectrum of the organic product was obtained.



By referring to your Data Sheet, decide whether acrolein, CH_2=CHCHO, or acrylic acid, CH_2=CHCOOH, was formed.

The infra-red spectrum above is of .....

because .....

.....

.....

.....

.....

[Total 3 marks]

12. Acrylic acid reacts with prop-2-en-1-ol to produce an ester.

(i) Complete the balanced equation for this reaction.

CH_2=CHCOOH + CH_2=CHCH$_2$OH → ..... + ...

[2]

(ii) Draw the structure of the ester. Clearly display **all** of the functional groups.

[2]

[Total 4 marks]