

Alcohols and Carboxylic Acid

Q1. (2018) – 4b, 4c (i, ii)

4 Ethanol can be used as a liquid fuel.

A student investigates how much heat energy is released when a known mass of ethanol is burned.

The apparatus is set up as shown in Figure 3.

A known volume of water is placed in a metal can.

The temperature of the water is measured.

The ethanol is ignited and placed under the beaker so that the flame is touching the beaker.

The water is heated by the flame.

The flame is extinguished.

The final temperature of the water is measured.

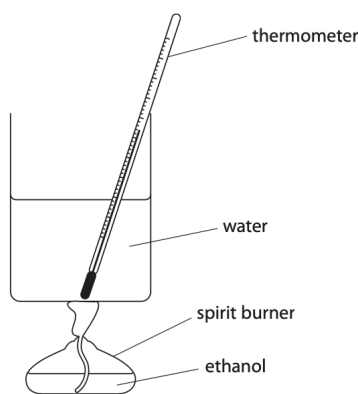
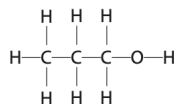


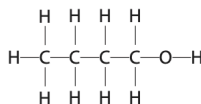
Figure 3

A)

(b) Propanol and butanol are both members of the same homologous series as ethanol.



propanol



butanol

Propanol and butanol can also be burned in the apparatus shown in Figure 3.

Give **three** reasons why ethanol, propanol and butanol are members of the same homologous series.

(3)

reason 1

.....

reason 2

.....

reason 3

.....

B)

(c) Ethanol can oxidise when exposed to air to produce ethanoic acid and water.

Propanol can also oxidise in a similar reaction when it is exposed to air.

(i) Write the word equation for the reaction when **propanol** oxidises when it is exposed to air.

(2)

C)

(ii) What is the formula of the functional group in carboxylic acids?

(1)

- ☐ A $-\text{OH}$
- ☐ B $-\text{CH}_3$
- ☐ C $-\text{COOH}$
- ☐ D $-\text{CO}_2$

Q2. (2019)

- 4 (a) Ethanol is made by fermentation of a carbohydrate dissolved in water, in the presence of yeast.

The reaction is carried out at 30°C .

Explain why the reaction is carried out at a temperature of 30°C rather than at a temperature of 80°C .

(2)

Q3. (2019) – 4b

A)

- (b) Ethanol, $\text{C}_2\text{H}_5\text{OH}$, can be converted into ethanoic acid, CH_3COOH .

(i) In this reaction ethanol is

(1)

- ☐ A hydrated
- ☐ B oxidised
- ☐ C polymerised
- ☐ D reduced

B)

(ii) Draw the structure of a molecule of ethanoic acid, CH_3COOH , showing all covalent bonds.

(2)

Q4. (2020)

- 5 (a) Figure 3 shows the structure of two monomers.

monomer A	monomer B
$\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$	$\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{COOH}$

Figure 3

- (i) Monomer B contains a carboxylic acid group.

Describe what you would see when a small amount of solid sodium carbonate is added to a solution of monomer B.

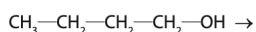
(2)

Q5. (2020) – 5c

- (c) Alcohols can be dehydrated.

Complete the balanced equation for the dehydration of butan-1-ol by drawing the structures of the two products in the boxes. Name the two products.

(3)



Q6. (2020)

- 10 (a) Figure 10 shows a flask fitted with a cotton wool plug.
The flask contains an aqueous solution of a carbohydrate.

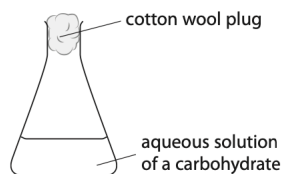


Figure 10

A)

- (i) State **two** steps that need to be taken to turn the solution of the carbohydrate in the flask into a solution of ethanol.

(2)

1

.....

2

.....

B)

- (ii) The apparatus in Figure 11 is used to increase the concentration of the dilute solution of ethanol.

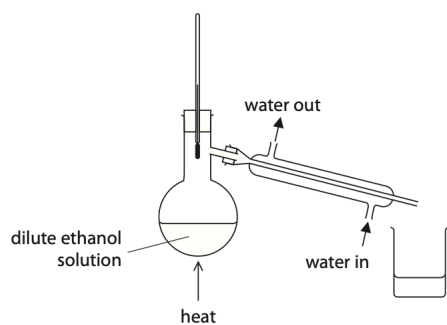


Figure 11

This apparatus did not produce a very concentrated solution of ethanol.

Describe how the apparatus can be altered to produce a more concentrated solution of ethanol.

(2)

Q7. (2020) – 10c

*(c) Figure 12 shows information about some compounds in the same homologous series.

name	structural formula	formula mass	density in g cm ⁻³	boiling point in °C	does it react with an alcohol?	does it react with sodium hydroxide solution?
butanoic acid	CH ₃ CH ₂ CH ₂ COOH	88	0.96	164	yes	yes
ethanoic acid	CH ₃ COOH	60	1.05	118	yes	yes
hexanoic acid	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ COOH	116	0.93	205	yes	yes
pentanoic acid	CH ₃ CH ₂ CH ₂ CH ₂ COOH	102	0.94	186	yes	yes
propanoic acid	CH ₃ CH ₂ COOH	74	0.99	141	yes	yes

Figure 12

Explain, using the data in Figure 12, why these compounds belong together in the same homologous series.

(6)

Q8. (2021) – 10a (i, iii, iv)

10 (a) Propanol, C₃H₇OH, can undergo reactions to form compounds Y and Z shown in Figure 14.

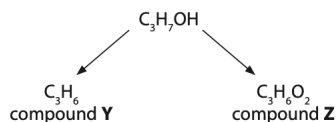


Figure 14

A)

(i) What happens to propanol when it forms compound Y?

(1)

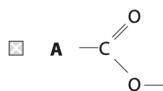
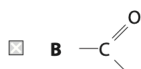
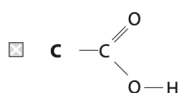
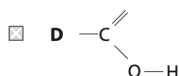
- ☐ A propanol undergoes an addition reaction
- ☐ B propanol is dehydrated
- ☐ C propanol is hydrated
- ☐ D propanol is oxidised

B)

(iii) Compound Z is a carboxylic acid.

Which of the following shows the functional group of a carboxylic acid?

(1)



C)

- (iv) Compound **Z** is an acid and turns litmus and universal indicator papers red.
Compound **Z** also shows other acidic properties.

Devise an experiment that would show another acidic property of compound **Z**.
(2)

Q9. (2022) – 10b

- (b) Figure 15 shows the arrangement of atoms in a molecule of an alcohol.

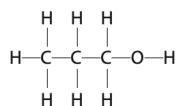


Figure 15

A)

- (i) Give the name of the carbon-containing product formed when the alcohol in Figure 15 undergoes dehydration.

(1)

B)

- (ii) Give the formula of the functional group of the product formed when the alcohol in Figure 15 undergoes oxidation.

(1)

Q10. (2023) – 7a (iii), 7b

- 7 Figure 12 shows the structure of the molecules of three organic compounds.

propene	propanoic acid	ethanol
$ \begin{array}{c} \text{H} \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{H} \end{array} $	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad // \\ \text{H} - \text{C} - \text{C} - \text{C} \\ \quad \quad \backslash \\ \text{H} \quad \text{H} \quad \text{O} - \text{H} \end{array} $	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{O} - \text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $

Figure 12

A)

- (iii) Propanoic acid reacts with calcium carbonate, CaCO_3 , to form calcium propanoate, $\text{Ca}(\text{C}_2\text{H}_5\text{COO})_2$, and two other products.

Name the **two** other products.

(2)

product 1

product 2

B)

- *(b) Glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, is a carbohydrate.

A dilute solution of ethanol can be produced from glucose by fermentation.

The dilute solution of ethanol can then be processed to form a concentrated solution of ethanol.

Describe how the fermentation of glucose is carried out and how the dilute solution of ethanol produced can then be processed to form a concentrated solution of ethanol.

You may include diagrams in your answer.

(6)