Alcohols – AS 2022 Chemistry P2

1. June/2022/Paper_7404/2/No.7

0 7 In Europe, some of the glucose from crops is fermented to produce ethanol.

Use of a carbon-neutral fuel leads to no net emissions of carbon dioxide to the atmosphere.

0 7 . 1 The ethanol produced by fermentation of glucose may be regarded as a carbon-neutral fuel.

Justify this statement. Include the relevant chemical equations in your answer.

[4 marks]

Coffee beans from South America are exported to Europe in an outer layer called silverskin.

The waste silverskin can be fermented to produce a solution containing propanone, ethanol and butan-1-ol.

0 7 . 2 Suggest why ethanol produced in Europe using silverskin from South America is less likely to be carbon-neutral than ethanol produced from crops grown in Europe.

[1 mark]

0 7 . 3 **Table 2** shows the enthalpies of combustion of the three fuels from the fermentation of silverskin.

Table 2

Fuel	**Standard enthalpy of combustion / kJ mol^{-1}**	**Energy released per mole of CO_2 produced / kJ**
ethanol, $C_2H_5OH(l)$	–1371	
butan-1-ol, $C_4H_9OH(l)$	–2673	
propanone, $C_3H_6O(l)$	–1786	

One way to measure a fuel's environmental impact is to measure the amount of energy released per mole of CO_2 produced.

Complete **Table 2**.

Use your answers to deduce the fuel with the lowest environmental impact by this measure.

[2 marks]

0 7 . 4 A student investigated the combustion of propanone (C_3H_6O) using calorimetry.

A copper calorimeter containing water was heated by the complete combustion of some propanone. The student did not record the final temperature of the water.

Table 3 shows the student's results.

Table 3

Mass of propanone burned / g	1.18
Mass of water / g	260
Initial temperature of water / °C	22.3
Final temperature of water / °C	Not recorded

Use the results in **Table 3** to calculate a value for final temperature of the water in the experiment.

Assume that no heat was lost in the experiment and that the heat capacity of the calorimeter is negligible.

For propanone, enthalpy of combustion = –1786 kJ mol^{-1}

For water, specific heat capacity = 4.18 J g^{-1} K^{-1}

[4 marks]

Final temperature of water _____ °C

0 7 . 5 Butan-1-ol can be added to petrol for cars.

An equation for the complete combustion of gaseous butan-1-ol is shown.

$$C_4H_9OH(g) + 6\,O_2(g) \rightarrow 4\,CO_2(g) + 5\,H_2O(g) \quad \Delta H = -2504 \text{ kJ mol}^{-1}$$

Table 4 shows some mean bond enthalpy data.

Table 4

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

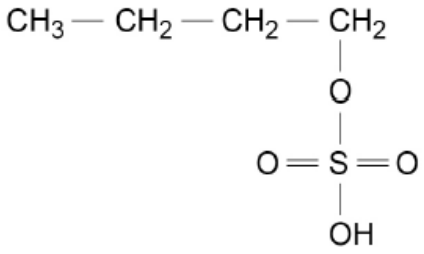
Use these data to calculate a value for the mean C–C bond enthalpy in gaseous butan-1-ol.

[3 marks]

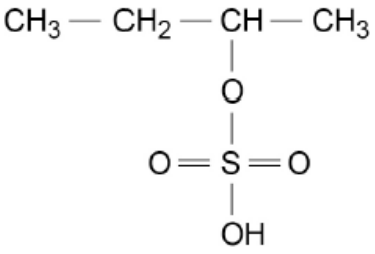
C–C bond enthalpy _____ kJ mol^{-1}

Butan-1-ol can be manufactured by reacting steam with but-1-ene in the presence of the catalyst, concentrated sulfuric acid.

In the first part of this process, but-1-ene reacts with concentrated sulfuric acid to form compounds **W** and **X**.



Compound **W**



Compound **X**

Butan-1-ol is then made from compound **W**.

0 7 . 6 Name and outline a mechanism to show the conversion of but-1-ene into compound **W** in the first part of this process.

[5 marks]

Name of mechanism _____

Outline of mechanism

0 7 . 7 There is a very low yield of butan-1-ol from but-1-ene in this manufacturing process.

Explain why.

[2 marks]

_____

_____

_____

_____

2. June/2022/Paper_7404/2/No.15

Which compound produces $(CH_3)_2CHCOCH_3$ when oxidised?

[1 mark]

A 2-methylpropan-1-ol ⬭

B 2,2-dimethylpropanol ⬭

C 2-methylbutan-2-ol ⬭

D 3-methylbutan-2-ol ⬭