2.25 Alcohols, Carboxylic Acids and Polymers: 30-minute Pack

AQA 8464 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

Bioethanol as a transport fuel

Revision Library resource team

In the UK, most standard unleaded petrol sold at the pump (called E10) is a blend containing up to 10% bioethanol. Bioethanol is produced by fermenting sugars from crops such as sugar beet or wheat using yeast, then distilling the mixture to increase the ethanol concentration. Blending bioethanol with petrol reduces the amount of crude oil needed to make each litre of fuel. However, growing crops specifically for bioethanol production uses agricultural land and water that could otherwise grow food crops, and processing the crops into fuel itself requires energy.

1 Esters are used in a variety of everyday products.

(a) State two properties of esters that make them useful in perfumes. **(2)**

(b) State one other everyday use of esters, other than in perfumes. **(1)**

(Total for Question 1 is 3 marks)

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2 Ethanol and propan-1-ol are both members of the alcohol homologous series.

(a) Draw the displayed structural formula of ethanol, showing all atoms and all covalent bonds. **(2)**

(b) Give the molecular formula of propan-1-ol. **(1)**

(c) State the number of carbon atoms in a molecule of butan-1-ol and, using the general formula for alcohols, deduce its molecular formula. **(2)**

(Total for Question 2 is 5 marks)

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3 Read the source text 'Bioethanol as a transport fuel' before answering this question.

(a) State two everyday uses of ethanol, other than as a fuel. **(2)**

(b) Using the information in the source text, suggest one advantage and one disadvantage of using bioethanol as a transport fuel. **(2)**

(c) Explain why ethanol is often described as a 'carbon neutral' fuel in principle, but why bioethanol production is not always truly carbon neutral in practice. **(3)**

(Total for Question 3 is 7 marks)

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4 Carboxylic acids are a homologous series of organic compounds.

(a) State the general formula for the carboxylic acids. **(1)**

(b) The table shows the first four carboxylic acids. Complete the table. **(3)**

Carbon atoms (inc. COOH carbon)	Name	Molecular formula
1	methanoic acid	HCOOH
2	(i)	CH_3COOH
3	propanoic acid	(ii)
4	butanoic acid	C_3H_7COOH

(c) Name the functional group found in carboxylic acids, and give its formula. **(2)**

(Total for Question 4 is 6 marks)

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5 A small piece of sodium is added to a test tube of ethanol.

(a) By analogy with the reaction of sodium with water, describe what you would observe. **(2)**

(b) Name the gas produced in this reaction. **(1)**

(c) Write a balanced symbol equation for the reaction between sodium and ethanol. **(2)**

(Total for Question 5 is 5 marks)

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Mark scheme · 2.25 Alcohols, Carboxylic Acids and Polymers: 30-minute Pack

Question 1

(a) volatile (evaporate easily) **B1**

(a) have a strong, pleasant (often fruity/sweet) smell **B1**

(a) Answer: Esters are volatile (evaporate easily) and have strong, pleasant (often fruity) smells.

(b) as flavourings in food, or as a solvent (e.g. in nail varnish/nail varnish remover), oe **B1**

(b) Answer: As flavourings in food (or as a solvent, e.g. in nail varnish remover).

Question 2

(a) correct skeleton showing two carbon atoms singly bonded to each other, with the second carbon also singly bonded to the oxygen atom **M1**

(a) all five hydrogen atoms correctly placed (three on the first carbon, two on the second carbon) and the O-H bond shown **A1**

(a) Answer: A chain of two carbon atoms joined by a single C-C bond; the first carbon carries three hydrogen atoms, the second carbon carries two hydrogen atoms and is bonded to the oxygen atom, and the oxygen atom carries one hydrogen atom ($H_3C\text{-}CH_2\text{-}O\text{-}H$).

(b) C_3H_7OH cao (accept C_3H_8O) **B1**

(b) Answer: C_3H_7OH

(c) 4 carbon atoms **M1**

(c) C_4H_9OH cao **A1**

(c) Answer: 4 carbon atoms; C_4H_9OH

Question 3

(a) any one of: solvent (e.g. in perfumes, inks, cosmetics, hand sanitiser) **B1**

(a) any other one of: in alcoholic drinks; as methylated spirits (a cleaning solvent/fuel for camping stoves) **B1**

(a) Answer: E.g. as a solvent (in perfumes, inks or hand sanitiser); in alcoholic drinks.

(b) advantage, e.g. made from renewable plant material, so does not use up finite crude oil reserves, oe **B1**

(b) disadvantage, e.g. land and water used to grow fuel crops could instead grow food, which may reduce food supply/raise food prices, oe **B1**

(b) Answer: Advantage: made from a renewable resource (plant crops), so does not deplete finite crude oil reserves. Disadvantage: land and water used to grow fuel crops could instead be used to grow food, which could reduce food supply or raise food prices.

(c) the crop plants absorb carbon dioxide from the atmosphere by photosynthesis as they grow, oe **B1**

(c) this can balance/cancel out the carbon dioxide released when the bioethanol is later burned, giving no net increase in atmospheric CO_2 in theory, oe **B1**

(c) in practice, energy is used (e.g. farm machinery, fertiliser production, transport and processing, as suggested by the source text) which releases additional CO_2, so bioethanol production is not perfectly carbon neutral, oe **B1**

(c) Answer: Growing plants absorb carbon dioxide by photosynthesis, which in theory balances the CO_2 released when the bioethanol is burned, giving no net increase in atmospheric CO_2. In practice, energy is used for farming, fertiliser production, transport and processing, which releases additional CO_2, so it is not truly carbon neutral.

Question 4

(a) $C_nH_{2n+1}COOH$ **B1**

(a) Answer: $C_nH_{2n+1}COOH$

(b) (i) ethanoic acid **B1**

(b) (ii) C_2H_5COOH cao **B1**

(b) both rows fully correct and consistent, oe **B1**

(b) Answer: (i) ethanoic acid; (ii) C_2H_5COOH

(c) carboxyl group (carboxylic acid group) **B1**

(c) -COOH cao **B1**

(c) Answer: Carboxyl group, -COOH.

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Question 5

(a) effervescence/fizzing, as bubbles of gas are produced, oe **B1**

(a) the sodium gradually gets smaller until it disappears; the reaction is less vigorous than with water, oe **B1**

(a) Answer: Fizzing (effervescence) is seen as a gas is produced, and the piece of sodium gradually gets smaller until it disappears. The reaction is less vigorous than the reaction of sodium with water.

(b) hydrogen **B1**

(b) Answer: Hydrogen.

(c) correct formula for sodium ethoxide, CH_3CH_2ONa, as a product **M1**

(c) fully balanced: $2CH_3CH_2OH + 2Na \rightarrow 2CH_3CH_2ONa + H_2$ cao **A1**

(c) Answer: $2CH_3CH_2OH + 2Na \rightarrow 2CH_3CH_2ONa + H_2$

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