2.24 Alkanes, Alkenes and Crude Oil: 30-minute Pack

AQA 8464 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Alkanes are a homologous series of saturated hydrocarbons. Complete the table by giving the missing name or molecular formula for each alkane.

Carbon atoms	Name	Molecular formula
1	methane	CH_4
2	ethane	(a)
3	(b)	C_3H_8
4	butane	(c)
5	(d)	C_5H_{12}

(a) Give the molecular formula of ethane. **(1)**

(b) Name the alkane with molecular formula C_3H_8. **(1)**

(c) Give the molecular formula of butane. **(1)**

(d) Name the alkane with molecular formula C_5H_{12}. **(1)**

(Total for Question 1 is 4 marks)

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2 Testing for alkenes: bromine water decolourises in the presence of an alkene.

(a) State the observable change when bromine water is shaken with ethene. **(1)**

(b) Explain why bromine water decolourises in this test. **(1)**

(Total for Question 2 is 2 marks)

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3 Crude oil is separated into fractions, such as refinery gases, petrol, diesel and bitumen, which contain hydrocarbons of different chain lengths.

(a) Describe the trend in (i) boiling point and (ii) viscosity as the chain length of the hydrocarbons in a fraction increases. **(2)**

(b) Explain why fractions with shorter carbon chains are generally easier to ignite (more flammable) than fractions with longer carbon chains. **(2)**

(Total for Question 3 is 4 marks)

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4 This question is about the complete combustion of 2-methylpropane and its effect on the environment.

(a) Write the balanced symbol equation for the complete combustion of 2-methylpropane (C_4H_{10}). **(2)**

(b) State one environmental concern associated with large-scale hydrocarbon combustion, and give its effect. **(2)**

(Total for Question 4 is 4 marks)

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5 Combustion of hexane, C_6H_{14}, in excess oxygen gives carbon dioxide and water.

(a) Write the balanced symbol equation for the complete combustion of hexane. **(2)**

(b) Calculate the number of moles of CO_2 produced when 1.00 mol of hexane undergoes complete combustion. Show substitution. **(1)**

(Total for Question 5 is 3 marks)

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6 Incomplete combustion can produce carbon monoxide as well as carbon dioxide.

(a) Explain why a flame supplied with insufficient oxygen can produce carbon monoxide. **(2)**

(b) State one danger to humans from inhaling carbon monoxide. **(1)**

(Total for Question 6 is 3 marks)

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7 The table shows the boiling points of four hydrocarbons.

Hydrocarbon	Carbon atoms	Boiling point (°C)
Methane	1	-162
Butane	4	-1
Octane	8	126
Hexadecane	16	287

(a) Describe the trend shown in the table between the number of carbon atoms in a hydrocarbon and its boiling point. **(1)**

(b) Using the trend shown in the table, predict whether a hydrocarbon with 12 carbon atoms would be a gas, a liquid or a solid at room temperature (approximately 20°C). Justify your answer. **(2)**

(Total for Question 7 is 3 marks)

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Mark scheme · 2.24 Alkanes, Alkenes and Crude Oil: 30-minute Pack

Question 1

(a) C_2H_6 cao **B1**

(a) Answer: C_2H_6

(b) propane **B1**

(b) Answer: Propane.

(c) C_4H_{10} cao **B1**

(c) Answer: C_4H_{10}

(d) pentane **B1**

(d) Answer: Pentane.

Question 2

(a) orange/brown bromine water becomes colourless cao **B1**

(a) Answer: Orange bromine water becomes colourless

(b) ethene reacts with bromine by electrophilic addition, forming a colourless dibromoalkane, removing coloured bromine, oe **B1**

(b) Answer: Ethene reacts with bromine by electrophilic addition to form a colourless dibromoalkane, removing the coloured bromine.

Question 3

(a) boiling point increases as chain length increases, oe **B1**

(a) viscosity increases as chain length increases, oe **B1**

(a) Answer: Both boiling point and viscosity increase as chain length increases.

(b) shorter-chain molecules have weaker intermolecular forces, so are more volatile, evaporating more easily, oe **M1**

(b) this means they vaporise and mix with oxygen/air more readily, so they ignite more easily, oe **A1**

(b) Answer: Shorter-chain molecules have weaker intermolecular forces so evaporate more easily, mixing readily with air/oxygen and igniting more easily.

Question 4

(a) shows correct stoichiometry for C_4H_{10} combustion **M1**

(a) $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$, or any correct multiple (e.g. $C_4H_{10} + 6.5O2 \rightarrow 4CO_2 + 5H_2O$) **A1**

(a) Answer: $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

(b) names one concern, e.g. carbon dioxide released; particulates (soot); oxides of nitrogen; sulfur dioxide; carbon monoxide from incomplete combustion **B1**

(b) gives the effect of that concern, e.g. CO_2: enhanced greenhouse effect and climate change; particulates: global dimming or breathing problems; NOx or SO_2: acid rain or breathing problems; CO: toxic, oe **B1**

(b) Answer: Increased CO_2 emissions, which enhance the greenhouse effect and cause climate change (or another concern with its effect).

Question 5

(a) shows correct carbon and hydrogen balance in partial form or correct coefficients for C_6H_{14} and H_2O and CO_2, oe **M1**

(a) $2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$ cao **A1**

(a) Answer: $2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$

(b) 6.00 mol CO_2 cao (from 1 mol $C_6H_{14} \rightarrow$ 6 mol CO_2 in balanced equation) **B1**

(b) Answer: 6.00 mol CO_2

Question 6

(a) states that less oxygen is available so carbon cannot be fully oxidised to CO_2, oe **M1**

(a) explains that carbon is partially oxidised to CO (which has lower oxygen content) instead of CO_2, oe **A1**

(a) Answer: With insufficient oxygen carbon cannot be fully oxidised to CO_2, so partial oxidation produces CO which contains less oxygen per carbon atom.

(b) carbon monoxide binds to haemoglobin, reducing oxygen transport, leading to fainting, unconsciousness or death, oe **B1**

(b) Answer: CO binds to haemoglobin, reducing oxygen transport and causing fainting or death.

Question 7

(a) as the number of carbon atoms increases, the boiling point increases, oe **B1**

(a) Answer: As the number of carbon atoms increases, the boiling point increases.

(b) liquid **B1**

(b) justification, e.g. its boiling point would be expected to lie between that of octane (126°C) and hexadecane (287°C), well above room temperature, so it is not a gas; nothing in the trend suggests it would be a solid at room temperature, oe (accept other reasoned justification consistent with the trend) **B1**

(b) Answer: Liquid - its predicted boiling point (between octane's 126°C and hexadecane's 287°C) is well above room temperature, so it is not a gas, but the trend gives no reason to expect it is a solid.

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