Crude oil and hydrocarbons

Edexcel GCSE Chemistry (1CH0) · Foundation and Higher

Show your working where needed. Check the worked answers when you finish.

Name _____ Date _____

1. What counts as a hydrocarbon

Which of these formulae represent hydrocarbons? CH_4, CH_3OH, C_3H_8, CO_2. Explain how you decided.

2. The next member of a series

Write the general formula of the alkanes. Use it to find the molecular formula of an alkane with five carbon atoms. Explain what makes it saturated.

3. Two refinery fuels

Kerosene and bitumen are collected at different parts of a crude-oil fractionating column. State one use for each fraction. Identify which is collected higher in the column and explain why.

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4. Propane in excess oxygen

Propane has the molecular formula C_3H_8. Write a balanced symbol equation for its complete combustion in oxygen.

5. Faulty fuel burning

A gas flame leaves black deposits on a pan. State the substance in the deposit and explain what a limited oxygen supply can do to the products of combustion.

6. A refinery reaction

A refinery cracks one molecule of a hydrocarbon with formula $C_{12}H_{26}$ to form one molecule of C_8H_{18} and one other molecule. Work out the other formula. Explain how cracking can meet the demand for two different kinds of product.

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7. Use bromine water

Bromine water stays orange with sample A and becomes colourless with sample B. The samples are propane and propene. Identify both. Draw the product of B reacting with bromine, showing all its bonds.

8. A surplus of heavy fractions

A refinery has surplus long-chain hydrocarbons and needs more petrol-range fuel and more feedstock for making polymers. An operator proposes distilling the surplus a second time. Explain why that will not achieve both aims. Suggest a process that could.

9. Extra challenge · Check two refinery products

A refinery breaks one molecule of $C_{13}H_{28}$ into one molecule of C_9H_{20} and one other molecule. Calculate its formula. A sample of the other product reacts with bromine water.

The refinery confirms it is but-2-ene. Draw the product formed with bromine, showing all its bonds. State one reason the refinery may need to break the larger molecules.

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Worked answers

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1. What counts as a hydrocarbon

CH_4 and C_3H_8. Both contain only carbon and hydrogen. CH_3OH and CO_2 also contain oxygen.

2. The next member of a series

The general formula is C_nH_{2n+2}. For n = 5, 2 × 5 + 2 = 12, so the molecular formula is C_5H_{12}. The molecule has only single bonds between its carbon atoms.

3. Two refinery fuels

Kerosene is used as an aircraft fuel. Bitumen is used to surface roads or roofs. Kerosene contains smaller molecules with lower boiling points, so its vapour rises higher before condensing.

4. Propane in excess oxygen

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$. Complete combustion gives carbon dioxide and water. The three carbon atoms give $3CO_2$ and the eight hydrogen atoms give $4H_2O$. The products contain ten oxygen atoms.

5. Faulty fuel burning

The black deposit is carbon (soot). With limited oxygen the fuel can burn incompletely, giving carbon and/or carbon monoxide instead of converting all the carbon to carbon dioxide. Water is also formed.

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Worked answers

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6. A refinery reaction

The other molecule contains 12 − 8 = 4 carbon atoms and 26 − 18 = 8 hydrogen atoms, giving C_4H_8.

Cracking can supply shorter-chain molecules used as fuels and alkenes used as feedstock for making polymers.

7. Use bromine water

A is propane and B is propene. The propene reacts by addition and uses up the bromine. The product is $CH_3CHBrCH_2Br$.

Show a three-carbon chain with single C-C bonds, one Br bond on carbon 1 and one on carbon 2. Add H atoms so that each carbon makes four bonds.

8. A surplus of heavy fractions

Distillation separates molecules already present by their boiling ranges, so it cannot make useful shorter molecules from long ones. Cracking breaks long molecules into shorter ones. It can supply short-chain fuel molecules and alkenes for making polymers.

9. Extra challenge · Check two refinery products

The second product contains 13 − 9 = 4 carbon atoms and 28 − 20 = 8 hydrogen atoms, so its formula is C_4H_8.

Draw CH_3-CHBr-CHBr-CH_3 with all C-H bonds and both C-Br bonds. The original double bond in the middle becomes a single bond. Cracking supplies smaller fuels and alkenes needed to make products such as polymers.

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