

Exercise walk-through

1.4

Introductory organic chemistry and alkanes (Topic 4)

Pearson Edexcel · International A-Level · Chemistry

Count pairs before naming shape

- 1** NH_4^+ and CH_4 : four bonding regions, tetrahedral, 109.5° .
- 2** NH_3 : three bonds and one lone pair, pyramidal, about 107° . H_2O : two bonds and two lone pairs, bent, about 104.5° .
- 3** Lone pairs repel more strongly; the angle reduction is not a fixed amount per pair.

Compare fuels using their whole pathway

- 1** Cracking makes smaller hydrocarbons including alkenes; balance atoms in proposed products.
- 2** CO reduces oxygen transport; nitrogen/sulfur oxides can contribute to acid pollution.
- 3** Bioethanol growth can absorb CO₂, but processing and transport still emit. Hydrogen production also matters.

Choose reagents and conditions

- 1 **1** H_2/Ni adds hydrogen; steam/acid catalyst adds water; Br_2 adds bromine across $\text{C}=\text{C}$.
- 2 **2** Cold dilute acidified manganate(VII) gives a diol. Bromine decolourisation supports unsaturation, not a unique identity.
- 3 **3** Addition polymerisation opens $\text{C}=\text{C}$, retains side groups and loses no small molecule.

Exercises 2.1·2.3

2.1 Give the IUPAC name for the alkane $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_3$. [1]

2.2 State the energy source that starts radical substitution of methane by chlorine, and explain its role. [2]

2.3 Write the equation for the complete combustion of dodecane, $\text{C}_{12}\text{H}_{26}$. [2]

Exercises 2.1·2.3

2.1 Give the IUPAC name for the alkane $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_3$. [1]

2.1 2-methylpentane.

2.2 State the energy source that starts radical substitution of methane by chlorine, and explain its role. [2]

2.2 Ultraviolet light provides energy for homolytic cleavage of the Cl–Cl bond, producing chlorine radicals. Heating is not a second required condition for this stated UV route.

2.3 Write the equation for the complete combustion of dodecane, $\text{C}_{12}\text{H}_{26}$. [2]

2.3 $\text{C}_{12}\text{H}_{26} + 18.5 \text{ O}_2 \rightarrow 12 \text{ CO}_2 + 13 \text{ H}_2\text{O}$.

Exercises 3.1·3.2

3.1 A single molecule of $\text{C}_{12}\text{H}_{26}$ is cracked. The products are two molecules of ethene, one molecule of propene and one molecule of an alkane. Deduce the molecular formula and give a possible structure of the alkane. [3]

3.2 Give the equations for the initiation step and the TWO propagation steps in the reaction between chlorine and ethane, and explain why a trace of butane appears in the products. [5]

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3.1 Subtract the atoms in two ethene molecules and one propene molecule: $\text{C} = 12 - 4 - 3 = 5$; $\text{H} = 26 - 8 - 6 = 12$. The alkane is C_5H_{12} , for example $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$.

3.2 Give the equations for the initiation step and the TWO propagation steps in the reaction between chlorine and ethane, and explain why a trace of butane appears in the products. [5]

3.2 Initiation: $\text{Cl}_2 \rightarrow 2\text{Cl} \cdot$. Propagation: $\text{Cl} \cdot + \text{C}_2\text{H}_6 \rightarrow \text{HCl} + \text{C}_2\text{H}_5 \cdot$; $\text{C}_2\text{H}_5 \cdot + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{Cl} \cdot$. Butane: a termination step $\text{C}_2\text{H}_5 \cdot + \text{C}_2\text{H}_5 \cdot \rightarrow \text{C}_4\text{H}_{10}$ – two ethyl radicals combining.

Exercise 3.3

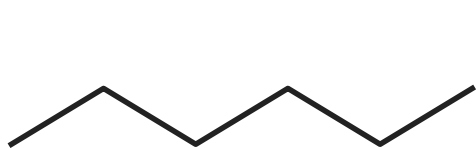
3.3 How many structural isomers have the formula C_6H_{14} ? Draw skeletal formulas for any three of them. [4]

Exercise 3.3

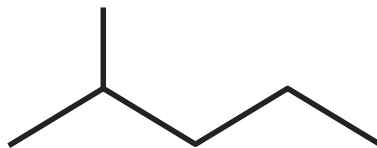
3.3 How many structural isomers have the formula C_6H_{14} ? Draw skeletal formulas for any three of them. [4]

3.3 Five: n-hexane, 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane, 2,3-dimethylbutane – any three skeletal formulas.

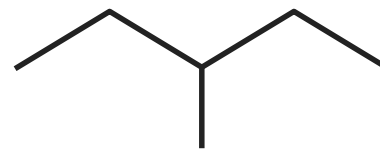
Every end and corner is a carbon; add H to make four bonds.



hexane



2-methylpentane



3-methylpentane