

Exercise walk-through

1.4.2

Structural isomers: chains and saturated rings

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.

Exercise 2.1

2.1 Name $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$ and explain why the name 2-ethylbutane does not use the correct parent chain. [3]

Exercise 2.1

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2.1 3-methylpentane. The longest continuous chain has five carbons; selecting a four-carbon chain incorrectly treats part of that chain as an ethyl substituent.

Exercise 2.2

2.2 Draw and name all three acyclic structural isomers of C_5H_{12} .

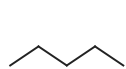
[6]

Exercise 2.2

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[6]

2.2



pentane



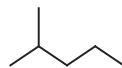
2-methylbutane



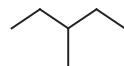
2,2-dimethylpropane



hexane



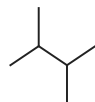
2-methylpentane



3-methylpentane



2,2-dimethylbutane



2,3-dimethylbutane

C_5H_{12} : 3 structures
 C_6H_{14} : 5 structures
 Hydrogen atoms fill
 each carbon valency to 4.

Top row only: three correct structures and three correct names, 6 marks. The lower rows show the distinct C_6H_{14} structures used in 2.3.

Exercise 2.3

2.3 An alkane has a four-carbon parent chain and two methyl substituents. Give the two distinct lowest-locant names that produce C_6H_{14} , and explain why 3,3-dimethylbutane is not a third structure. [3]

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2.3 2,2-dimethylbutane and 2,3-dimethylbutane. Reversing the numbering turns 3,3 into 2,2 without changing connectivity.

Exercise 3.1

3.1 Draw and name all saturated single-ring structural isomers containing three or four total carbon atoms. Give the molecular formula of each. [6]

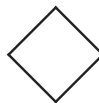
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3.1



cyclopropane



cyclobutane



methylcyclopropane



cyclopentane



methylcyclobutane



ethylcyclopropane

Full solution 3.1

3.1



cyclopropane



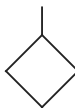
cyclobutane



methylcyclopropane



cyclopentane



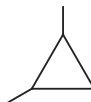
methylcyclobutane



ethylcyclopropane



1,1-dimethylcyclopropane



1,2-dimethylcyclopropane

C₃H₆: 1 structure
C₄H₈: 2 structures
C₅H₁₀: 5 structures

Single saturated rings;
end/corner = carbon.

First row: cyclopropane C₃H₆; cyclobutane C₄H₈; methylcyclopropane C₄H₈. Award one mark per correct structure and one per name with formula, 6 marks.

Exercise 3.2

3.2 Draw and name all five saturated single-ring structural isomers of C_5H_{10} . Do not count separate cis/trans arrangements as structural isomers. [10]

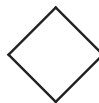
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3.2



cyclopropane



cyclobutane



methylcyclopropane



cyclopentane



methylcyclobutane



ethylcyclopropane

Full solution 3.2 (1/2)

3.2



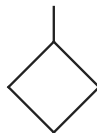
cyclopropane



cyclobutane



methylcyclopropane

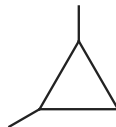


Full solution 3.2 (2/2)

cyclopentane



methylcyclobutane



ethylcyclopropane

C_3H_6 : 1 structure
 C_4H_8 : 2 structures
 C_5H_{10} : 5 structures

Single saturated rings;
end/corner = carbon.

1,1-dimethylcyclopropane

1,2-dimethylcyclopropane

Five correct structures and names: cyclopentane, methylcyclobutane, ethylcyclopropane, 1,1-dimethylcyclopropane and 1,2-dimethylcyclopropane. Award one mark per correct structure and one per name, 10 marks. Cis/trans forms of the last name do not add another connectivity.

Exercise 3.3

3.3 A student claims that C_6H_{12} has just one cycloalkane structure because it must be a six-carbon ring. Give three counterexample names containing different ring sizes, and explain why changing the ring size can preserve the molecular formula. [4]

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3.3 Cyclohexane, methylcyclopentane and ethylcyclobutane are examples with six-, five- and four-carbon rings. Moving carbons from the ring into saturated side chains retains one ring and six total carbons, so each has C_6H_{12} . Accept a correct three-carbon-ring example in place of another ring size.