

Exercise walk-through

1.5.1

Alkene conditions, polymers and disposal

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 molecular formula of cyclohexene and explain why it differs from hex-1-ene. [2]

2.2 State reagents/conditions and the organic product for hydrogenation, hydration and mild oxidation of ethene. [6]

2.3 Two pure liquids each have formula C_5H_{10} . One rapidly decolourises bromine water in the dark; the other does not. Give a possible compound for each and explain why the formula alone was insufficient. [3]

Exercises 2.1·2.3

2.1 Give the molecular formula of cyclohexene and explain why it differs from hex-1-ene. [2]

2.1 C_6H_{10} . One ring removes two hydrogens relative to acyclic hexene C_6H_{12} , while both already contain a double bond.

2.2 State reagents/conditions and the organic product for hydrogenation, hydration and mild oxidation of ethene. [6]

2.2 Hydrogen with nickel catalyst gives ethane. Steam with an acid catalyst gives ethanol. Cold dilute acidified potassium manganate(VII) gives ethane-1,2-diol. Strong hot oxidation is not the specified diol-producing method.

2.3 Two pure liquids each have formula C_5H_{10} . One rapidly decolourises bromine water in the dark; the other does not. Give a possible compound for each and explain why the formula alone was insufficient. [3]

2.3 Pent-1-ene can be the decolourising liquid, cyclopentane the other. Both have C_5H_{10} , but one has $C=C$ and the other a saturated ring; the formula does not reveal connectivity. The test supports unsaturation rather than uniquely proving pent-1-ene.

Exercises 3.1·3.2

3.1 Name the alkene monomer corresponding to the repeat unit $[-\text{CH}_2-\text{CH}(\text{CH}_2\text{CH}_3)-]_n$, giving its structural formula. Explain why the pendant ethyl group is not inserted into the main polymer backbone. [3]

3.2 A student says that any alkene with different groups attached to its $\text{C}=\text{C}$ shows E/Z isomerism. Use 2-methylpropene and pent-2-ene to evaluate the statement, stating the condition separately for each double-bond carbon. [4]

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3.1 But-1-ene, $\text{CH}_2=\text{CHCH}_2\text{CH}_3$. The two original double-bond carbons become adjacent backbone carbons; the attached ethyl group remains a side group.

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3.2 Each double-bond carbon must have two different groups. In 2-methylpropene, $\text{CH}_2=\text{C}(\text{CH}_3)_2$, one carbon has two H and the other two methyl groups, so it cannot show E/Z isomerism. In pent-2-ene, $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$, each has H plus a different carbon group, so E and Z forms are possible. Restricted rotation about $\text{C}=\text{C}$ allows these forms to remain distinct; different groups somewhere in the molecule is insufficient.

Exercise 3.3

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3.3 Recycling can conserve feedstock but needs collection/sorting and suitable clean material. Incineration can recover energy, but relevant toxic gases must be removed and carbon emissions remain. Biodegradable alternatives may reduce persistence, but breakdown needs suitable conditions, organisms, time and often industrial composting. They do not automatically degrade rapidly in a cold sea or landfill, and must not be treated as permission to litter. Accept other linked scientific tradeoffs.