Cracking: shorter molecules and demand

Student activity • observation and reasoning

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The question

How can breaking a long molecule produce useful shorter ones?

Build a balanced cracking model and use an invented refinery supply/demand comparison. Distinguish a chemical conversion from fractional distillation.

Equipment

• Booklet, pencil, periodic table and optional molecular model kit

Desk activity only; keep small model pieces away from mouths.

Course coverage: Shared core: 4.17–4.18. Catalytic cracking model using silica/alumina at the syllabus range 600–700 °C; no classroom heating procedure.

Plan, model or apparatus sketch

Draw a labelled structure or model to explain your reasoning for this lesson.

Method and reasoning

Read the whole sequence before starting

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1. Construct a $C_{10}H_{22}$ model or atom inventory. Split it into C_8H_{18} and a second hydrocarbon, conserving every atom.

2. Identify which product is an alkane and which is an alkene, and show the C=C bond needed in the shorter product.

3. Label the industrial conditions: vapour, hot catalyst (silica or alumina) and 600–700 °C for the specified model.

4. Use an invented refinery scenario: supply 30 units of heavy fractions and demand 10; supply 20 units of lighter fuel fractions and demand 40. Explain the incentive for conversion without treating the units as a balanced chemical yield.

5. Compare cracking with distillation: state whether molecules change and whether covalent bonds are broken.

6. Explain how alkene formation could be supported by a controlled bromine-water observation without carrying out the test here.

Cleanup

- Return shared equipment and retain corrected reasoning.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Invented supply/demand units are illustrative, not a refinery dataset or mass balance. Complete $C_{10}H_{22} \rightarrow C_8H_{18}$ + ____. Actual cracking produces a mixture, not one guaranteed pair of products. Syllabus catalytic conditions: silica/alumina, 600–700 °C. This model is not a bench demonstration instruction.

Task	My structure / working	Reason / correction
Balanced cracking model		
Conditions		
Supply / demand reasoning		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Complete and balance the supplied cracking equation.

2. Identify the alkene product and its functional group.

3. State the specified catalyst and temperature range.

4. Why can demand make cracking useful?

5. How does cracking differ from fractional distillation?

6. Why does a decolourised bromine test not establish the exact identity of every cracking product?