Solutions

Each answer shows the steps, then the **result**.

2.1

- the alkene functional group is the **C=C** double bond

2.2

- cracking **breaks large alkanes into smaller, more useful molecules** (alkanes and alkenes)

2.3

- remaining fragment: $14 - 8 = 6$ carbons, $30 - 18 = 12$ hydrogens
- $\mathbf{C_{14}H_{30} \rightarrow C_8H_{18} + C_6H_{12}}$

2.4

- reagent: **steam**
- catalyst: **phosphoric acid**, at high pressure

2.5

- ethene has a C=C that can **open** so bromine **adds**
- ethane is **saturated**, so bromine cannot add

3.1 B

- the alkene **turns bromine water colourless**
- A is an alkane; C and D are other tests

3.2

(a)

- the other product is an **alkene**

(b)

- $10 - 8 = 2$ carbons, $22 - 18 = 4$ hydrogens
- $\mathbf{C_2H_4}$

3.3

- add **bromine water** and shake
- alkene: **colourless**; alkane: stays **orange**

3.4

(a)

- high temperature, about 600–700 **°C**
- a catalyst, e.g. **aluminium oxide** or silica

(b)

- long-chain fractions are in surplus and make **poor fuels**
- cracking makes **petrol** and **alkenes** for polymers

(c)

- $\mathbf{C_{10}H_{22} \rightarrow C_8H_{18} + C_2H_4}$
- the second product is **ethene**

(d)

- shake with **orange bromine water**
- ethene **decolourises** it; octane leaves it **orange**

(e)

- product: **ethanol**
- catalyst: **phosphoric acid**
- type: **addition / hydration**

(f)

- the alkene has a C=C that can **open**, so atoms add with nothing lost
- octane is **saturated**, so it can only react by **substitution**