

## 1. Carbon compounds as fuels and feedstock

|                         |   |
|-------------------------|---|
| Hydrocarbon             | A chemical made of only carbon and hydrogen   |
| Crude oil               | A mixture of hydrocarbons found in rock   |
| Alkanes                 | Saturated hydrocarbons (without double bond)  |
| Alkene                  | Unsaturated hydrocarbon (with double bond). They turn bromine water from brown to colourless. |
| Fractional distillation | A process of separating crude oil using the different boiling points of fractions             |
| Viscosity               | How thick a liquid is   |
| Flammability            | How easily a fraction catches fire  |
| Boiling point           | The temperature at which a substance turns from a liquid to a gas                             |
| Combustion              | A reaction where a fuel is oxidised releasing heat energy                                     |
| Cracking                | Breaking less useful long-chain alkanes into useful short-chain alkanes and alkenes           |

## 4. Properties of hydrocarbons

|               |                                    |
|---------------|------------------------------------|
| Property      | Change as carbon chain gets longer |
| Boiling point | Increases                          |
| Viscosity     | Increases (less runny)             |
| Flammability  | Decreases                          |

## 2. Alkanes

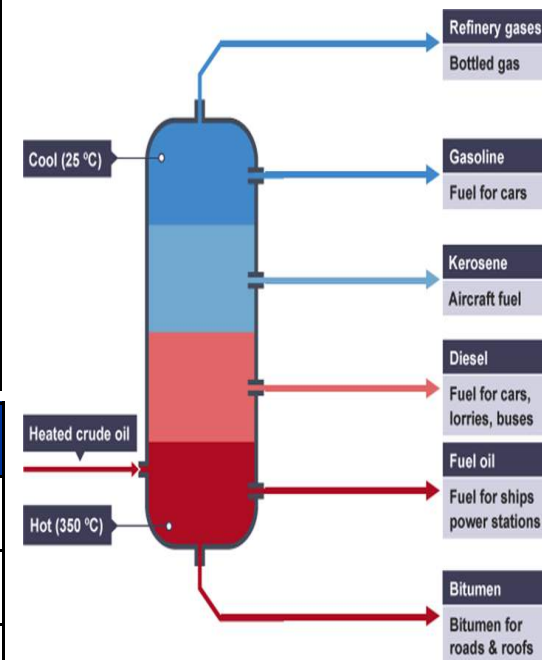
|                 |                                |   |
|-----------------|--------------------------------|---|
| General formula | $C_nH_{2n+2}$                  |   |
| Name            | Molecular formula              | Displayed formula   |
| Methane         | CH <sub>4</sub>                | $\begin{array}{c} H \\   \\ H-C-H \\   \\ H \end{array}$  |
| Ethane          | C <sub>2</sub> H <sub>6</sub>  | $\begin{array}{c} H & H \\   &   \\ H-C & -C-H \\   &   \\ H & H \end{array}$   |
| Propane         | C <sub>3</sub> H <sub>8</sub>  | $\begin{array}{c} H & H & H \\   &   &   \\ H-C & -C & -C-H \\   &   &   \\ H & H & H \end{array}$                      |
| Butane          | C <sub>4</sub> H <sub>10</sub> | $\begin{array}{c} H & H & H & H \\   &   &   &   \\ H-C & -C & -C & -C-H \\   &   &   &   \\ H & H & H & H \end{array}$ |

## 5. Cracking

|                         |                          |
|-------------------------|--------------------------|
| Type of cracking        | Conditions               |
| Catalytic               | Hot (500°C) + catalyst   |
| Steam                   | Very hot (850°C) + Steam |
| Short chain = desirable | Long chain = undesirable |

## 3. Fractional distillation

|    |   |
|----|---|
| 1. | The column is cooler at the top than the bottom                             |
| 2. | The crude oil is heated   |
| 3. | The fractions evaporate and rise up the column                              |
| 4. | The fractions condense at different points according to their boiling point |
| 5. | The liquid fractions run off and are collected                              |



## 6. Alkenes (TRIPLE ONLY)

| General formula | $C_nH_{2n}$       |  |
|-----------------|-------------------|--|
| Name            | Molecular formula | Displayed formula  |
| Ethene          | $C_2H_4$          | <pre>       H   H                   C = C                   H   H           </pre>   |
| Propene         | $C_3H_6$          | <pre>       H   H   H                       H - C - C = C                           H   H           </pre>   |
| Butene          | $C_4H_8$          | <pre>       H   H   H   H                           H - C - C - C = C                               H   H   H           </pre>                     |
| Pentene         | $C_5H_{10}$       | <pre>       H   H   H   H   H                               H - C - C - C - C = C                                   H   H   H   H           </pre> |

## 7. Reactions of Alkenes (TRIPLE ONLY)

| Reaction                          | Observation  |
|-----------------------------------|--|
| Oxidation (incomplete combustion) | Burn in air to produce smoky flames  |
| Addition                          | Double bond opens to form single bonds. Reacts with hydrogen, water and halogens |

## 6. Alcohols (TRIPLE ONLY)

| Functional group | -OH               |  |
|------------------|-------------------|--|
| Name             | Molecular formula | Displayed formula  |
| Methanol         | $CH_3OH$          | <pre>       H               H - C - O - H               H           </pre>   |
| Ethanol          | $C_2H_5OH$        | <pre>       H   H                   H - C - C - O - H                           H   H           </pre>   |
| Propanol         | $C_3H_7OH$        | <pre>       H   H   H                       H - C - C - C - O - H                               H   H   H           </pre>                     |
| Butanol          | $C_4H_9OH$        | <pre>       H   H   H   H                           H - C - C - C - C - O - H                                   H   H   H   H           </pre> |

## 7. Fermentation of alcohols (TRIPLE ONLY)



## 8. Reactions of alcohol (TRIPLE ONLY)

|             |   |                          |
|-------------|---|--------------------------|
| Combustion  | Burns with a clean flame                                | Spirit burners, biofuels |
| With sodium | Hydrogen bubbles given off. Metal skates around surface | N/A                      |
| Oxidation   | Oxidising agent changes colour                          | Making carboxylic acids  |

## 10. Synthetic and naturally occurring polymers (TRIPLE ONLY)

|           |   |
|-----------|---|
| Monomer   | A small unit that joins together to make a polymer  |
| Polymer   | A long chain molecule made of many polymers   |
| Synthetic | Man made  |
| DNA       | Deoxyribonucleic acid. Natural polymer that codes genetic instructions. Formed of nucleotides in a double helix |
| Cellulose | Natural polymer made from glucose. Use in plant cell walls  |
| Starch    | Natural polymer made from glucose. Use in plant cells as a food store   |
| Protein   | Natural polymer made of amino acids. Used for growth and repair in cells. Also called a polypeptide.            |

## 11. Addition polymerisation (TRIPLE ONLY)

| Monomer(s)  | Polymer   |
|---|---|
| Alkenes   | Long-chain alkane   |
| $  \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  n \text{ C} = \text{C} - \\    \quad   \\  \text{H} \quad \text{H} \\  \text{ethene}  \end{array}  $ | $  \begin{array}{c}  \left( \begin{array}{cc}  \text{H} & \text{H} \\    &   \\  \text{C} & - & \text{C} \\    &   \\  \text{H} & \text{H}  \end{array} \right)_n \\  \text{poly(ethene)}  \end{array}  $ |

## 11. Condensation polymerisation (TRIPLE HT ONLY)

| Monomer(s)   | Polymer   |
|--|---|
| Diol (2 alcohol)<br>Dicarboxylic acid  | Polyester (+ water)   |
| $  \begin{array}{c}  \text{HO} - \square - \text{OH} \\  \text{HOOC} - \square - \text{COOH}  \end{array}  $ | $  \left( \square - \text{OOC} - \square - \text{COO} \right)_n + 2n\text{H}_2\text{O}  $ |

## 12. Amino acids (TRIPLE HT ONLY)

| Monomer(s)   | Polymer   |
|--|---|
| Amino acid   | Polypeptide (+ water)   |
| $  \begin{array}{c}  \text{H} \quad \text{O} \quad \text{H} \quad \text{H} \\    \quad    \quad   \quad   \\  \text{H}_2\text{N} - \text{C} - \text{C} - \text{OH} \quad \text{H} - \text{N} - \text{C} - \text{COOH} \\    \quad \quad \quad   \\  \text{R} \quad \quad \quad \text{R}  \end{array}  $ <p style="text-align: center;"> </p> | $  \begin{array}{c}  \text{H} \quad \text{O} \quad \text{H} \quad \text{H} \\    \quad    \quad   \quad   \\  \text{H}_2\text{N} - \text{C} - \text{C} - \text{N} - \text{C} - \text{COOH} \\    \quad \quad \quad   \\  \text{R} \quad \quad \quad \text{R}  \end{array}  $ <p style="text-align: center;"> </p> |