CAIE IGCSE Chemistry

11.3 Fuels

Notes

Name the fossil fuels

- The fossil fuels are coal, natural gas and petroleum (crude oil).

Name the main constituent of natural gas…

- The main constituent of natural gas is methane, CH_4.

State that hydrocarbons are…

- Hydrocarbons are compounds that only contain hydrogen and carbon.
- E.g. alkanes are hydrocarbons.

State that petroleum is a mixture of hydrocarbons

- Petroleum is a mixture of hydrocarbons
- Crude oil is another term used interchangeably with petroleum, crude oil is the raw form of petroleum before it is refined and processed.
- Petroleum is a finite resource found in rocks and formed from the remains of an ancient biomass consisting mainly of plankton that was buried in mud.

Describe the separation of petroleum into useful fractions by fractional distillation

- Petroleum can be separated into its constituent fractions by a separating process known as fractional distillation
- Fractional distillation separates compounds into its constituent substances based on their differences in boiling points
- Crude oil is heated in a furnace until it is vaporised and is added to a fractionating column, that has divisions at different levels to collect the various constituents (fractions)
- Fractions will separate into its constituent levels based on their properties: different boiling points, chain length, volatility and viscosity.
- Typical fractions collected include:
    - Refinery gases (e.g., propane, butane) at the top.
    - Gasoline (petrol) slightly lower.
    - Kerosene (jet fuel) mid-level.
    - Diesel below kerosene.
    - Heavy fuel oil near the bottom.
    - Residue (e.g., bitumen) at the very bottom.

Describe how the properties of fractions obtained from petroleum change from the bottom to the top of the fractionating column, limited to:

(a) Decreasing chain length

- Fractions with shorter carbon chains, such as propane, will be tapped from the top of the fractionating column.
- Fractions with longer chain lengths will collect at the bottom of the fractionating column.

(b) Higher volatility

- Fractions with higher volatility will separate off at the top of the fractionating column
- Fractions with lower volatility will collect at the bottom of the fractionating column

(c) Lower boiling points

- Fractions with lower boiling points condense at higher levels (top of the column).
- Fractions with higher boiling points condense at lower levels (bottom of the column).

(d) Lower viscosity

- Viscosity refers to how thick and sticky and substance is
- Hydrocarbons with lower viscosity, such as refinery gases, will separate off at the top of the column
- Hydrocarbons with higher viscosity, such as bitumen will collect at the bottom of the fractionating column

Name the uses of the fractions as:

Petroleum is separated into fractions since its individual constituents have various utility functions such as:

(a) Refinery gas fraction

- Gas used in heating and cooking

(b) Gasoline /petrol fraction

- Fuel used in cars

(c) Naphtha fraction

- Used as a chemical feedstock

(d) Kerosene /paraffin fraction

- Used for jet fuel

(e) Diesel oil/ gas oil fraction

- Fuel used in diesel engines

(f) Fuel oil fraction
- Fuel used in ships
- Fuel for home heating systems

(g) Lubricating oil fraction
- Used for lubricants, waxes and polishes

(h) Bitumen fraction
- Used for making roads