

**5072 CHEMISTRY (NEW PAPERS WITH SPA)
TOPIC 11: ORGANIC CHEMISTRY**

**5067 CHEMISTRY (NEW PAPERS WITH PRACTICAL EXAM)
TOPIC 11: ORGANIC CHEMISTRY**

SUB-TOPIC 11.1
FUELS AND CRUDE OIL

LEARNING OUTCOMES

- a) Name natural gas, mainly methane, and petroleum as sources of energy
- b) Describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation
- c) Name the following fractions and state their uses
 - i. petrol (gasoline) as a fuel in cars
 - ii. Naphtha as feedstock for the chemical industry
 - iii. Paraffin (kerosene) as a fuel for heating and cooking and for aircraft engines
 - iv. Diesel as a fuel for diesel engines
 - v. Lubricating oils as lubricants and as a sources of polishes and waxes
 - vi. Bitumen for making road surfaces
- d) State that the naphtha fraction from crude oil is the main source of hydrocarbons used as the feedstock for the production of a wide range of organic compounds
- e) Describe the issues relating to the competing uses of oil as an energy source and as a chemical feedstock

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A Introduction

- Petroleum, coal and natural gas are fossil fuels. They are the residue left behind from the decomposition of ancient plant life over millions of years ago. Fossil fuels are non-renewable resources.
- We burn these fuels to provide energy for heating, electricity generation and transport. But we have been careless in our use of fossil fuels. Precious reserves of these fuels are dug up and consumed extremely quickly. They are burned away with little thought for the future. Scientists predict that most of the Earth's oil reserves will be depleted over the next 100 years if used at this rate.
- At the same time fossil fuels are the raw materials that supply the feedstock for the chemical industry. Chemical compounds from fossil fuels are made into polymers, medicines, solvents, adhesives, detergents, fertilisers and many other useful products. Hence, burning the fossil fuels burn away the feedstock needed by the chemical industry.
- For the sake of our future generations, we need to learn to treat fossil fuels as valuable resources to be cherished, used carefully and recycled.
 - Reduce the use of fossil fuels. Use fossil fuels more carefully and avoid wastage. Alternatives to fossil fuels must be developed, e.g. bio fuels, nuclear fuels, solar energy, geothermal energy, hydrogen fuel and energy from wind, waves or tides.
 - Reuse instead of causing a litter problem. Disposing of waste in landfills spoils the environment.
 - Recycle plastics to save huge amounts of natural resources.
- We have to manage our oil resources efficiently by finding sustainable use of resources and recovering of these resources so that we can have enough oil to burn and also to provide the feedstock for the chemical industry.

B Natural Gas

- Natural gas is formed together with petroleum in the ground. Over a period of millions of years, the action of high pressure and temperature converted fossil remains of marine animals and plants into petroleum and natural gas.
- The main constituent in natural gas is methane.
- Methane burns with a blue, non-luminous and non-smoky flame to liberate a lot of heat energy.
- Hence, methane represents an important source of energy.
$$\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}); \Delta H = -882\text{kJmol}^{-1}$$
- Methane is also obtained from another fossil fuel, coal, by a process called coal gasification.
- Coal is treated with Oxygen and steam at very high temperatures to break the Carbon-Carbon bonds in Large Hydrocarbon molecules in coal into smaller gaseous Hydrocarbons.
- Coal Gasification produces Syngas (Carbon Dioxide and Hydrogen) and Methane.
$$\text{C}(\text{s}) + 2\text{H}_2(\text{g}) \rightarrow \text{CH}_4(\text{g}); \quad \text{C}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{CO}(\text{g}) + \text{H}_2(\text{g}); \quad \text{C}(\text{s}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g})$$
- Syngas can be used directly as a fuel – burning Carbon Monoxide and Hydrogen are exothermic processes.
- Syngas is a valuable raw material to produce useful chemicals, e.g. Methanol
$$\text{CO}(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{CH}_3\text{OH}(\text{l})$$

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C Petroleum

- Petroleum is a complex mixture of Hydrocarbons such as alkanes, alkenes and aromatic hydrocarbons.
- Petroleum is another important source of energy.
- More than 90% of the petroleum is used as fuel for heating and transportation.
- Petroleum is also an important source of petrochemicals – feedstocks for the chemistry industry.
- A process called fractional distillation is used to separate petroleum into useful fractions.

