

Combustion and Fuels

Answers to Exercises

- A.**
- (a) Combustion
(b) A supporter of combustion
(c) A fuel
 - The temperature to which a substance must be heated before combustion takes place is known as its ignition temperature.
 - When placed over a flame, a paper cup containing water does not burn because the water takes away the heat from the cup and does not allow it to reach its ignition temperature.
 - The amount of heat given out by a unit mass of a fuel on complete combustion in air or oxygen is known as the calorific value of the fuel.
 - In order of increasing boiling range, petrol, diesel and kerosene may be arranged as petrol < kerosene < diesel.
 - Natural gas, liquid petroleum gas (LPG) and biogas are three gaseous fuels. Natural gas collects over petroleum found inside the earth. Wells are sunk to extract it. LPG is obtained by the liquefaction of petroleum gas, and biogas is obtained from the anaerobic fermentation of cattle dung and domestic sewage.
 - The ignition point of a fuel should not be lower than room temperature. Otherwise, it would catch fire at room temperature.
- B.**
- Coal contains compounds of nitrogen and sulphur as impurities, which also burn to form the oxides of these elements. These oxides are poisonous and pollute the atmosphere. In an insufficient supply of air, coal burns to form carbon monoxide, which, too, is poisonous and pollutes the air. A lot of soot is formed when coal is burnt.
 - Biogas is obtained by the anaerobic fermentation (fermentation in the absence of air) of cattle dung and domestic sewage. A mixture of methane (CH_4), carbon dioxide (CO_2), hydrogen (H_2), and hydrogen sulphide (H_2S) is thus obtained, methane being the main constituent. Methane burns completely to give carbon dioxide and water vapour. No soot and carbon monoxide are formed.
- $$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} + \text{heat}$$
- Refer to Figure 7.6 on page 72.
- C.**
- Light a candle and wait for a while. Some wax near the wick melts, trickles down and resolidifies. Place a glass tube bent at right angles at a distance of 10–12 cm. One arm of the tube should be smaller than the other. Place the mouth of the shorter arm just over the wick and introduce the longer arm into a transparent bottle. Now raise the shorter arm such that its mouth is just above the flame. Test the gases coming out of the longer arm as follows.
 - Pass the gas over anhydrous copper (II) sulphate (white) kept in a watch glass. The anhydrous copper (II) sulphate turns blue, indicating that the gases contain water vapour.
 - Insert the longer arm of the tube into a test tube containing limewater. Place another tube in the same test tube. Suck through tube B. [See Figure 7.10 (c)]. The limewater will turn milky as gases get drawn in through tube A. This indicates that the gases contain carbon dioxide.
 - Hold a stainless-steel dish above the flame for a while. A black solid deposits on the underside. This solid is soot.
 - A candle flame consists of the following four regions.
 - A bright blue region near the wick, where the wax burns completely
 - The dark inner cone containing unburnt vapours of wax
 - The luminous region containing unburnt carbon particles
 - An outer mantle (not prominently visible) surrounding the entire flame
 - A good fuel should have the following characteristics.
 - It should have a high calorific value.
 - It should have a low ignition point, but not lower than room temperature (so that it does not catch fire at room temperature).
 - It should not burn too fast or too slowly.
 - The combustion of the substance should not produce harmful substances like soot and poisonous gases.
 - No residues should be left on combustion.
 - It should be safe to store, handle and transport.
- D.**
- slower
 - spacecraft
 - A – unsuitable, B – best, C – better, D – good
 - neither, nor
 - better
- E.**
- (c)
 - (d)
 - (d)
 - (a)
 - (a)
- F.**
- (a) (iv)
 - (b) (iii)
 - (c) (ii)
 - (d) (i)