Question#47243 – Chemistry – Organic Chemistry

Question:

The chemical formula of petrol is $C_{12}H_{26}$. If we want to burn completely 1 liter in air, find out mass of oxygen, moles of oxygen, volume of oxygen, volume of air (hint:O_2 21% of air mixture). How much CO_2 is produce by mass, volume. Suppose 1 liter=1000g.

Answer:

The equation of reaction:

$2\ C_{12}H_{26} + 37\ O_2 \rightarrow 24\ CO_2 + 26\ H_2O$

According to this equation, to burn 2 liters of hydrocarbon $C_{12}H_{26}$, 37 liters of oxygen O_2 are required. If we have 1 liter of hydrocarbon $C_{12}H_{26}$, than **$V(O_2)$ = 37/2 = 18.5 liters** of oxygen O_2 are necessary.

The amount of moles of O_2 can be estimated:

$n(O_2) = \dfrac{V(O_2)}{V_m}$, where V_m = 22.4 L/mol is the volume of one mole of gaseous compound at STP.

Therefore, the amount of moles of oxygen O_2:

$$n(O_2) = \frac{V(O_2)}{V_m} = \frac{18.5L}{22.4L/mol} = 0.826mol$$

The mass of oxygen O_2 is defined as:

$m(O_2) = n(O_2) \times M(O_2) = 0.826mol \times 31.999g/mol = 26.4g$, where $M(O_2)$ is the mass of one mole of oxygen O_2.

The volume of air required is greater than the volume of Oxygen:

$$V(air) = \frac{100\% \times V(O_2)}{21\%} = \frac{100\% \times 18.5L}{21\%} = 88L$$

The volume of CO_2 produced is twelve times greater than the volume of hydrocarbon $C_{12}H_{26}$ burnt, **$V(CO_2)$ = 1L × 12 = 12 L.**

The mass of CO_2:

$$m(CO_2) = n(CO_2) \times M(CO_2) = \frac{V(CO_2)}{V_m} \times M(CO_2) = \frac{12L}{22.4L/mol} \times 44g/mol = 23.6g$$