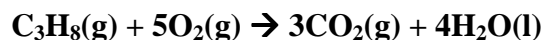


- The complete combustion of propane, C₃H₈, in air gives water and carbon dioxide as the products? Write a balanced equation for this reaction.

Marks
7



What mass of oxygen is required for the complete combustion of 454 g of propane and what masses of CO₂ and H₂O are produced?

The molar mass of propane is $(3 \times 12.01 \text{ (C)}) + (8 \times 1.008 \text{ (H)}) = 44.094$. Therefore, 454 g corresponds to:

$$\text{number of moles} = \frac{\text{mass}}{\text{molar mass}} = \frac{454}{44.094} = 10.3 \text{ mol}$$

5 mol of O₂(g) is required for every 1 mol of propane. Therefore, $5 \times 10.3 = 51.5$ mol of O₂ is required. The molar mass of O₂ is $(2 \times 16.00) = 32.00$ so the mass of O₂ required is:

$$\text{mass} = \text{number of moles} \times \text{molar mass} = 51.5 \times 32.00 = 1650 \text{ g} = 1.65 \text{ kg}$$

3 mol of CO₂ and 4 mol of H₂O are produced for every 1 mol of propane. Therefore, $3 \times 10.3 = 30.9$ mol of CO₂ and $4 \times 10.3 = 41.2$ mol of H₂O are produced.

The molar mass of CO₂ is $(12.01 \text{ (C)}) + (2 \times 16.00 \text{ (O)}) = 44.01$ and the molar mass of H₂O is $(2 \times 1.008 \text{ (H)}) + (16.00 \text{ (O)}) = 18.016$.

The masses of CO₂ and H₂O produced are therefore:

$$\begin{aligned} \text{mass of CO}_2 &= 30.9 \times 44.01 = 1360 \text{ g} = 1.36 \text{ kg} \\ \text{mass of H}_2\text{O} &= 41.2 \times 18.016 = 742 \text{ g} = 0.742 \text{ kg} \end{aligned}$$

(Note that the mass of propane is given to three significant figures in the question and this is reflected in each answer).

Explain the "law of conservation of mass". Show whether or not the above combustion conforms to this law.

The law of conservation of mass states that mass may neither be created nor destroyed. In this reaction:

$$\begin{aligned} \text{mass of reactants} &= 0.454 \text{ kg (C}_3\text{H}_8) + 1.65 \text{ kg (O}_2) = 2.10 \text{ kg} \\ \text{mass of products} &= 1.36 \text{ kg (CO}_2) + 0.742 \text{ kg (H}_2\text{O)} = 2.10 \text{ kg} \end{aligned}$$

This combustion obeys the law (to 3 significant figures).