

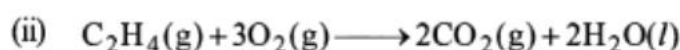
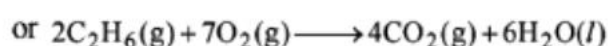
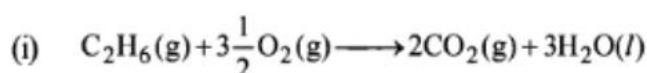
Question 15

A mixture of ethane (C_2H_6) and ethene (C_2H_4) occupies 40 litres at 1.00 atm and at 400 K. The mixture reacts completely with 130 g of O_2 to produce CO_2 and H_2O . Assuming ideal gas behaviour, calculate the mole fractions of C_2H_4 and C_2H_6 in the mixture. (1995 - 4 Marks)

Let the volume of ethane in mixture = x litre

\therefore Volume of ethene = $(40 - x)$ litre

Combustion reactions of ethane and ethene are :



Volume of O_2 required for complete combustion of ethane

$$= \frac{7x}{2} \quad [\text{For } x \text{ litres}]$$

Volume of O_2 required for complete combustion of ethene

$$= (40-x) \times 3 \quad [\text{For } (40-x) \text{ L}]$$

$$\therefore \text{Total volume of } O_2 \text{ required} = \frac{7x}{2} + (40-x)3 \text{ l}$$

Calculation of number of moles (n)

$$P = 1 \text{ atm}, V = \frac{7x}{2} + (40-x)3 \text{ l}; R = 0.082 \text{ l atm K}^{-1} \text{ mol}^{-1};$$

$$T = 400 \text{ K}$$

$$\text{Since } n = \frac{PV}{RT} = \frac{1 \times \left[\frac{7x}{2} + (40-x)3 \right]}{0.082 \times 400} = \frac{7x + (40-x)6}{2 \times 0.082 \times 400}$$

$$\text{Mass of } n \text{ moles of } O_2 = \left[\frac{7x + (40-x)6}{2 \times 0.082 \times 400} \right] \times 32 = 130$$

$$\text{or } 130 = \left[\frac{7x + 240 - 6x}{65.6} \right] \times 32$$

$$\Rightarrow 8528 = 32x + 240 \times 32 \Rightarrow 32x = 848 \Rightarrow \text{or } x = \frac{848}{32} = 26.5$$

$$\text{Hence mole fraction (\%)} \text{ of ethane} = \frac{26.5}{40} \times 100 = \mathbf{66.25\%}$$