

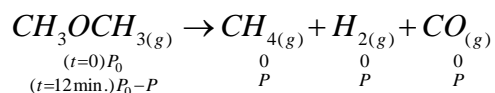
The gas phase decomposition of dimethyl ether follows first order kinetics,



The reaction is carried out in a constant volume container at  $500^\circ C$  and has a half-life of 14.5 minutes. Initially, only dimethyl ether is present at a pressure of 0.40 atm. Which of the following is the total pressure of the system after 12 minutes? Assume ideal gas behaviour.

- (A) 0.575 atm                      (B) 0.75 atm                      (C) 0.925 atm                      (D) 0.225 atm

*Solution*



[  $P \propto n$  at constant V, T and therefore pressure has been used like moles in the above equation.]

$$\text{For 1}^{\text{st}} \text{ order reaction, } k = \frac{2.303}{t} \log \frac{a}{a-x} = \frac{2.303}{t} \log \frac{P_0}{P_0-P}$$

$$\therefore \frac{0.693}{14.5} = \frac{2.303}{12} \log \frac{0.40}{0.40-P}$$

$$\Rightarrow \frac{18}{14.5 \times 5} \approx \log \frac{0.40}{0.40-P} \left[ \because \frac{2.303}{0.693} \approx \frac{10}{3} \right]$$

$$\therefore P \approx 0.175 \text{ atm}$$

$$\text{Total pressure after 12 min.} = P_0 - P + P + P + P = P_0 + 2P = 0.40 + 2 \times 0.175 = 0.75 \text{ atm}$$

Hence, (B)