

PARAGRAPH 1

Thermal decomposition of gaseous X_2 to gaseous X at 298 K takes place according to the following equation:



The standard reaction Gibbs energy, $\Delta_r G^\circ$, of this reaction is positive. At the start of the reaction, there is one mole of X_2 and no X . As the reaction proceeds, the number of moles of X formed is given by β . Thus, $\beta_{\text{equilibrium}}$ is the number of moles of X formed at equilibrium. The reaction is carried out at a constant total pressure of 2 bar. Consider the gases to behave ideally. (Given: $R = 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$)

*33. The equilibrium constant K_p for this reaction at 298 K, in terms of $\beta_{\text{equilibrium}}$, is

- | | |
|--|--|
| (A) $\frac{8\beta_{\text{equilibrium}}^2}{2 - \beta_{\text{equilibrium}}}$ | (B) $\frac{8\beta_{\text{equilibrium}}^2}{4 - \beta_{\text{equilibrium}}^2}$ |
| (C) $\frac{4\beta_{\text{equilibrium}}^2}{2 - \beta_{\text{equilibrium}}}$ | (D) $\frac{4\beta_{\text{equilibrium}}^2}{4 - \beta_{\text{equilibrium}}^2}$ |

Sol. (B)



$$\begin{array}{ccc} 1 & & \\ 1 - \frac{\beta_e}{2} & & \beta_e \end{array}$$

Total number of moles at equilibrium.

$$\Rightarrow 1 - \frac{\beta_e}{2} + \beta_e$$

$$\Rightarrow 1 + \frac{\beta_e}{2}$$

$$K_p = \frac{(p_x)^2}{p_{x_2}}$$

$$= \frac{\left(\frac{\beta_e \times 2}{1 + \frac{\beta_e}{2}} \right)^2}{\left(1 - \frac{\beta_e}{2} \right) \times 2}$$

$$= \frac{2\beta_e^2}{1 - \frac{\beta_e^2}{4}}$$

$$K_p = \frac{8\beta_e^2}{4 - \beta_e^2}$$

- *34. The **INCORRECT** statement among the following, for this reaction is
- (A) Decrease in the total pressure will result in formation of more moles of gaseous X
 - (B) At the start of the reaction, dissociation of gaseous X_2 takes place spontaneously
 - (C) $\beta_{\text{equilibrium}} = 0.7$
 - (D) $K_c < 1$

Sol. (C)

There is no data given to find the $\beta_{\text{equilibrium}}$ exact value.

$$\Delta G_c^\circ = -2.303RT \log K_c$$

$$\log K_c = -1$$

$$K_c < 1$$