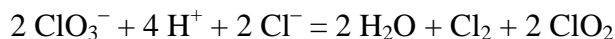


Problem 1-02 Reaction rate expressed by the rate of change of mole number

The time change of the mole number of chloride ions in the course of the reaction



is $dn_{\text{Cl}^-}/d\tau = -0.025 \text{ mol s}^{-1}$. Calculate

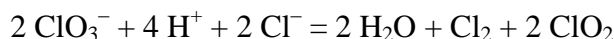
(a) reaction rate J , corresponding to the stoichiometry given above,

(b) rate of change of mole number of (i) H^+ , (ii) H_2O ,

(c) rate of change of total mole number.

$$\left[\begin{array}{l} \text{(a) } J = +0.0125 \text{ mol s}^{-1}, \text{ (b)(i) } dn_{\text{H}^+}/d\tau = +0.05 \text{ mol s}^{-1}, \text{ (ii) } dn_{\text{H}_2\text{O}}/d\tau = +0.025 \text{ mol s}^{-1}, \\ \text{(c) } dn/d\tau = +0.0375 \text{ mol s}^{-1} \end{array} \right]$$

Solution:



$$dn_{\text{Cl}^-}/d\tau = -0.025 \text{ mol s}^{-1}$$

$$\nu_{\text{Cl}^-} = -2$$

$$\text{(a) } J = \frac{1}{\nu_{\text{Cl}^-}} \cdot \frac{dn_{\text{Cl}^-}}{d\tau} = \frac{1}{(-2)} \cdot (-0.025) = \underline{+0.0125 \text{ mol s}^{-1}}$$

$$\text{(b) } J = \frac{1}{\nu_i} \cdot \frac{dn_i}{d\tau} \Rightarrow \frac{dn_i}{d\tau} = \nu_i \cdot J$$

$$\text{(i) } \nu_{\text{H}^+} = -4, \frac{dn_{\text{H}^+}}{d\tau} = \nu_{\text{H}^+} \cdot J = (-4) \cdot 0.0125 = \underline{+0.05 \text{ mol s}^{-1}}$$

$$\text{(ii) } \nu_{\text{H}_2\text{O}} = +2, \frac{dn_{\text{H}_2\text{O}}}{d\tau} = \nu_{\text{H}_2\text{O}} \cdot J = (+2) \cdot 0.0125 = \underline{+0.025 \text{ mol s}^{-1}}$$

$$\text{(c) } \frac{dn}{d\tau} = \frac{dn_i}{\sum \nu_i} = \frac{dn_i}{\nu_i} \cdot \frac{\sum \nu_i}{\nu_i} = \frac{\sum \nu_i}{\nu_i} \cdot \frac{dn_i}{d\tau} = \frac{(-3)}{(-2)} \cdot (-0.025) = \underline{+0.0375 \text{ mol s}^{-1}}$$