Reltek, Øving 2 Vegard G. Jervell

Oppg. 1a) $2N_2O \rightarrow 2N_2 + O_2$

$k_{N_2O} = 0,977 \ l/mol \cdot s$

$X = 0,9$

I) $r_{N_2O} = k_{N_2O} C_{N_2O}^2$

II) $-r_{N_2O} = \frac{dC_{N_2O}}{dt} = \frac{d}{dt}\left(C_0^{N_2O}(1-x)\right) = -C_0^{N_2O}\frac{dx}{dt}$

I = II)

$k_{N_2O} C_{N_2O}^2 dt = C_0^{N_2O} dx$

$k_{N_2O} dt = \frac{C_0^{N_2O}}{\left(C_0^{N_2O}(1-x)\right)^2} dx$

$k_{N_2O} t = \frac{1}{C_0^{N_2O}} \int_0^{0,9} \frac{dx}{(1-x)^2} = \frac{-1}{C_0^{N_2O}} \int_1^{0,1} \frac{du}{u^2} = \frac{-1}{C_0^{N_2O}}\left(1 - \frac{1}{0,1}\right)$

$t = \frac{9}{k_{N_2O} C_0^{N_2O}}$, $C_0^{N_2O} = \frac{P_0}{RT_0} = 0,01 \frac{mol}{l}$

$t = 15 \ min$

Oppg. 7 b)

I) $r_{N_2O} = k_{N_2O} C_{N_2O}^2$

II) $C_{N_2O} = \frac{n_{N_2O}}{V_T}$

$n_T = C_T V_T$, $n_{T0} = C_{T0} V_{T0}$, $C = \frac{P}{RT}$

III) $V_T = V_{T0} \frac{n_T T P_0}{n_{T0} T_0 P} = V_{T0} \frac{n_T}{n_{T0}}$

IV) $n_T = n_A + n_B + n_C = n_{T0} + n_{A0}\left(-1 + 1 + \frac{1}{2}\right) X_A$, $A = N_2O$

IV → III : V) $V_T = V_{T0}\left(1 + \frac{n_{A0} X_A}{n_{T0} \cdot 2}\right)$, $\frac{n_{A0}}{n_{T0}} = 1$

V → II : VI) $C_{N_2O} = \frac{n_{N_2O}}{V_{T0}\left(1 + \frac{1}{2} X_{N_2O}\right)} = \frac{n_0^{N_2O}(1 - X_{N_2O})}{V_{T0}\left(1 + \frac{1}{2} X_{N_2O}\right)}$

VI) $C_{N_2O} = C_0^{N_2O} \frac{1 - X_{N_2O}}{1 + \frac{1}{2} X_{N_2O}}$

VII) $-r_{N_2O} = \frac{dC_{N_2O}}{dt} = -C_0^{N_2O} \frac{dX}{dt}$

VII = I) $\frac{k_{N_2O}}{C_0^{N_2O}} dt = \frac{dX}{C_{N_2O}^2}$

$$\frac{k_{N_2O}}{C_0^{N_2O}} t = \frac{1}{C_0^2} \int_0^{2,9} \left(\frac{1 + \frac{1}{2} X_{N_2O}}{1 - X_{N_2O}}\right)^2 dX = \frac{3}{2} \ln(1 - X) + \frac{1}{4} X + \frac{\frac{9}{4} X}{1 - X} \Big|_{X=0}^{X=2,9}$$

$$\frac{k_{N_2O}}{C_0^{N_2O}} t = 17 \frac{1}{C_0^{N_2O}}$$

$$t = \frac{17}{k_{N_2O} C_0^{N_2O}} = 29 \text{ min}$$

Oppg. 1c)

I) $r_A = F_{A0} \frac{dx}{dV}$

II) $r_A = k_A C_A^2$, $C_A = C_{A0} \frac{1 - x_A}{1 + \frac{1}{2} x_A}$

I = II) $k_A C_A^2 dV = F_{A0} dx$

$$dV = \frac{F_{A0}}{k_A C_{A0}^2} \left(\frac{1 + \frac{1}{2} x_A}{1 - x_A} \right)^2 dx$$

$$V = \frac{F_{A0}}{k_A C_{A0}^2} \left[\frac{3}{2} \ln(1-x) + \frac{1}{4} x + \frac{9x}{4(1-x)} \right]_{x=0,9}$$

$$V = 2900 l = 2,9 m^3$$

Oppg. 1d)

I) $-r_A = \frac{F_A - F_{A0}}{V} = \frac{-F_{A0} x_A}{V}$

II) $r_A = k_A C_A^2$, $C_A = C_{A0} \frac{1 - x_A}{1 + \frac{1}{2} x_A}$

I = II) $k_A C_A^2 = \frac{F_{A0} x_A}{V}$

$$V = \frac{F_{A0} x_A}{k_A C_{A0}^2} \left(\frac{1 + \frac{1}{2} x_A}{1 - x_A} \right)^2$$

$$V = 32280 l \approx 32,3 m^3$$