

1.6 A second order reaction is conducted under constant pressure at a temperature of 325 °C. Estimate the time required to achieve 60 % conversion of A. The feed contains A at a concentration of 1 mol/L. Use $\varepsilon = -0.5$. The reaction rate constant is given as

- Estimate the overall order of the reaction.
- $k = 4.7 \times 10^7 e^{\frac{-25300}{RT}}$

1.6 Solution:

- Conversion, $X_A = 0.6$
- Fractional volume change, $\varepsilon = -0.5$
- Concentration of A in the feed, $C_{A_0} = 1 \text{ mol/L}$
- Temperature, $T = 598.15 \text{ }^\circ\text{K}$
- $k = 4.7 \times 10^7 e^{\frac{-25300}{1.987(598.15)}} = 0.0268 \text{ L}/(\text{mol}\cdot\text{K})$

- $kt_b C_{A0} = \int_0^x \frac{(1+\varepsilon x)}{(1-x)^2} dx = \int_0^{0.6} \frac{(1-0.5x)}{(1-x)^2} dx = 1.208$
- Reaction time, $t_b = 1.208 / (0.0268(1)) = 45 \text{ s.}$