10.19 a) $2T \rightarrow B + X$

conversion - time in batch reactor

Mole balance

$$\frac{dX}{dt} = \frac{-r_T' W}{N_{T0}} \quad -①$$

rate law

$$-r_T' = k_T P_T a \quad -②$$

decay law

$$-\frac{da}{dt} = k_d a^2 \quad -③$$

Stoichiometry

$$P_T = P_{T0}(1-X) \quad -④ \qquad \varepsilon = y_{A0}\delta \qquad \delta = 0$$

⇒ solve eq. ① to ④ numerically to get conc. vs time

b) Moving bed:

Mole balance:

$$\frac{dX}{dW} = \frac{-r'_T}{F_{A0}}$$

decay law

$$-\frac{da}{dW} = \frac{k_d a^2}{U_s}$$

$\Rightarrow$ other equations are same.

c) Increasing U_s will increase conversion

d) For second order decay

$$t = \frac{1 - \exp\left[\frac{E_T - 2E_T + E_d}{R}\left(\frac{1}{T} - \frac{1}{T_0}\right)\right]}{k_{d0}\left(1 - 2 + \frac{E_D}{E_T}\right)}$$

$$= \frac{1 - \exp\left[\frac{E_D - E_T}{R}\left(\frac{1}{T} - \frac{1}{T_0}\right)\right]}{k_{d0}\left(E_D/E_T - 1\right)}$$

For $E_T = 25$ kcal/mol $E_d = 10$ kcal/mol

$$t = -0.96\left[1 - \exp\left[-7549\left(\frac{1}{T} - \frac{1}{735}\right)\right]\right]$$

For $E_f = 10$ kcal/mol $\quad E_b = 25$ kcal/mol