Quiz 4 (45 mins)

Quiz Rules

1. You are expected to abide by highest standards of academic honesty. You have been apprised of it during the first lecture.
2. State the assumptions made very clearly.
3. You are allowed to carry calculator and pen.
4. *Above all, read the question carefully.*

1. [100 points] The following reversible, first-order reaction takes place in a CSTR.

$$A \underset{k_2}{\overset{k_1}{\rightleftharpoons}} B \tag{1}$$

You are given the following data:
Rate constant, $k_1 = 10^3 \exp(-2500/T)$ s^{-1}, T is in K
Heat of reaction, $\Delta H_{\text{rxn}} = -10$ kcal/mol
Equilibrium constant, $K = 7.8$ at 280 K
Specific heat of the reaction mixture, $c_p = 1$ kcal/kg-K
Density, $\rho = 1$ kg/L

(a) For a reactor space time of 10 min, what is the conversion for a 280 K operating temperature? What is the conversion at 480 K?

(b) If the feed temperature is 320 K and the feed concentration is 5 M, what is the necessary heat-removal rate per liter of reactor volume to maintain a 280 K operating temperature?