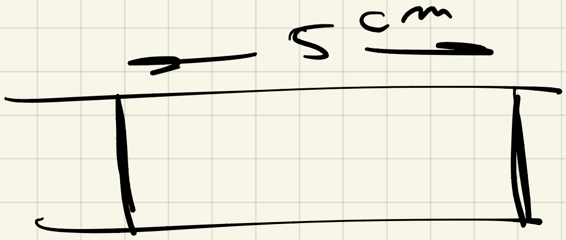
60546

1)

a



$$V = 5\,cm \; \frac{\pi (1)^2}{4} = 3.9\,cm^3$$

$$\frac{dC}{d\tau} = kC$$

$$\frac{C}{C_0} = \exp(-k\tau)$$

$$\frac{1}{\tau} \ln\frac{C}{C_0} = -k$$

$$k = \ln\left(\frac{.006}{.01}\right) \frac{1.5\,cm^3/s}{3.9\,cm^3}$$

a $\quad k = .196/s$ $\quad$ 10 POINTS

b) $\quad k = \cancel{A_0} \exp\left(-\frac{E_A}{RT}\right)$

	k	$1/T$	$\ln k$
505	.196	.00198	−1.63
515	.27	.00194	−1.32
525	.49	.00190	−.71

b) $k = \cancel{A_0}\, \exp\left(-\frac{E_A}{RT}\right)$

	k	$1/T$	$\ln k$
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515	.27	.00194	−1.32
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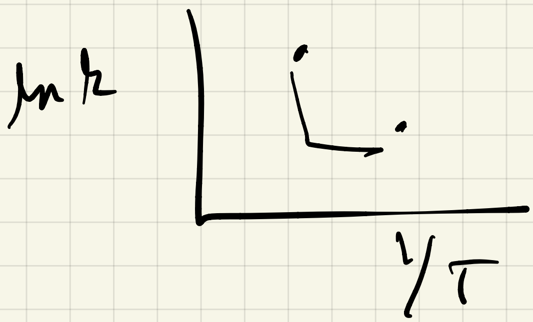


$$\frac{(-1.63 - 1.32)}{.00198 - .00194} = \frac{E_A}{R}$$

$$= 7750$$

$$E_a \sim 7750 \;\; 8.314$$

$$= 64.4 \text{ KJ/MOLE}$$

$$E_a = 120\,789$$

$\sim 80 \frac{\text{KJ}}{\text{MOLE}}$?

A FIT OF 3 POINTS

$\frac{E}{R} = 11{,}500$

$$k = A_0 \exp\left(-\frac{E_A}{RT}\right)$$

$$\ln k = \ln A_0 - \frac{E_A}{RT}$$

$$= 21 - 11434\left(\frac{1}{T}\right)$$

15 $E_A = 95,000$ J/MOLE

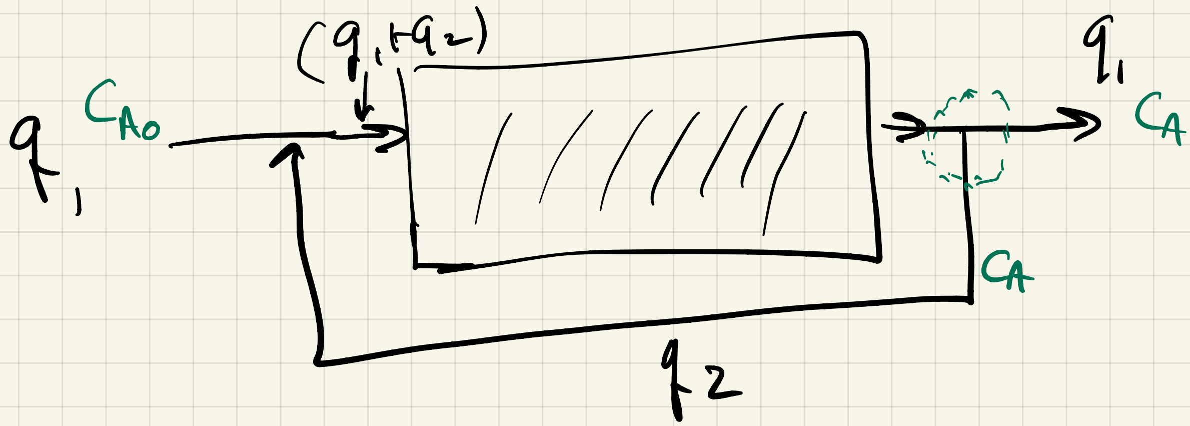
c) RECYCLE HIGH ENOUGH FOR CSTR

$$0 = qC_{A_0} - qC_A - kC_A V$$

$$\frac{C_A}{C_{A_0}} = \frac{1}{1 + k\,V/q}$$

$$= .66$$

10 $C_A = .0066$ mol/L



$$q_2 = R\,q_1$$

$$C_A = C_{Ai}\exp(-k\tau)$$

$$\tau = \frac{V}{(R+1)q_1}$$

$$C_{Ai} = q_1 C_{A0} + R q_1 C_A$$

$$C_A = \frac{q_1 C_{A0} + R q_1 C_A}{q_1(R+1)}\exp\left(-k\frac{V}{R+1\,q_1}\right)$$

$$\text{HEAT REMOVAL} = \sum F_i \cancel{C_{p_i} \Delta T}^{\,0} - \frac{F_{A_0} \Delta H_R}{V}(f_{A_{0}} - f_{A_0})$$

$$= \Delta H \, F_{A_0} \left(1 - \frac{.006}{.01}\right)$$

$$F_{A_0} = \frac{1.5 \text{ cm}^3/\text{s}}{24.5 \text{ l/MOLE}} = .00006 \frac{\text{mole}}{\text{s}}$$

$$= \left(.00006 \frac{\text{MOLE}}{\text{S}}\right)(.4)\left(800 \text{ KJ/MOL}\right)(.01)$$

d) 10 $= .0002 \text{ KJ/s} = .2 \text{ W}$

e) $$\frac{\Delta H}{\sum C_p} = \frac{(.01 \text{ MOLE})(800 \text{ KJ/MOLE})}{(.31)(29 \frac{\text{J}}{\text{MOL K}}) + (.69 \; 21 \frac{\text{J}}{\text{MOL-K}})}$$

10

$$= 340 \text{ K}$$

f CSTR $= \Delta H \; r$

$\frac{\text{KJ}}{\text{MO}} \quad \frac{\text{MOL}}{\text{S}}$

10

$$= 800 \left(\frac{.196}{\text{S}}\right)\left(\frac{.0066}{245000 \frac{\text{cm}^3}{\text{MOL}}}\right) V \quad 4 \text{ cm}^3$$

$$= .17 \text{ J/s}$$

5 g) MASS + HEAT TRANSFER RESISTANCE

10 j) $1 \Rightarrow -1$

5 k)

l) $d_p = .1\ cm$, $D = .002\ cm^2/s$

$$\phi = \sqrt{\frac{(.1\ cm)^2\ (19.6)/s}{.002\ cm^2/s}}$$

$= .16$

$\sim$ JUST KINETIC

$\eta_p = .15$

$\eta = .9$ 10% DROP

$$Re = \frac{d_p \, U \, \rho_f}{\mu_f}$$

$$= \frac{(1\,cm) \dfrac{1.5\,cm^3/s}{(\pi \, 1/4)} \left(\dfrac{.0012\,g}{cm^3} \right)}{(.01/50)}$$

$$= 1$$

$$f_f = \frac{150\,(.63)}{1}$$

$$= 94.5$$

$$\frac{\Delta P}{L} = \frac{(94.5)(.0012)\left(\dfrac{1.5}{\pi/4}\right)^2}{.1\,cm}$$

$$= 41 \text{ PASCAL}/m$$

VERY LOW.