Name: _____

Chemical Reaction Engineering
ChEE 420
The University of Arizona
Prof. Suchol Savagatrup

Midterm Exam 1

September 29th, 2020

Problem 1 _____ (/30)

Problem 2 _____ (/35)

Problem 3 _____ (/35)

Total _____ (/100)

Exam Rules:

1. This exam is open book and open notes.
2. You may use a calculator, no other electronic devices.
3. You will have 75 minutes to work on the exam.
4. **Write only on one side of the papers. Extra paper is available.**
5. **Box your final answers.**
6. **Write you name on every page that you wish to be graded**
7. Must show work to receive full credit.
8. Turn off cell phones and any device that makes noise.
9. All work must be your own. No talking during the exam.

DO NOT OPEN THE EXAM UNTIL YOU ARE INSTRUCTED TO DO SO.

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Potentially Useful Equations, Constants, Integrals

Constants

$$R = 8.314 \frac{J}{mol \cdot K} \qquad R = 0.082 \frac{atm \cdot L}{mol \cdot K}$$

Equations

$$k(T) = Aexp\left(-\frac{E}{RT}\right)$$

$$k(T) = k(T_1) \exp\left[\frac{E}{R}\left(\frac{1}{T_1} - \frac{1}{T}\right)\right]$$

$$P_i = C_i RT$$

$$P_{Total} V = N_{Total} RT$$

$$C_i = \frac{N_i}{V} = \frac{F_i}{\upsilon}$$

$$K_C = \frac{k_f}{k_r}$$

Useful Integrals in Reactor Designs

$$\int_0^x \frac{dx}{1-x} = \ln\frac{1}{1-x}$$

$$\int_{x_1}^{x_2} \frac{dx}{(1-x)^2} = \frac{1}{1-x_2} - \frac{1}{1-x_1}$$

$$\int_0^x \frac{dx}{(1-x)^2} = \frac{x}{1-x}$$

$$\int_0^x \frac{dx}{1+\varepsilon x} = \frac{1}{\varepsilon}\ln(1+\varepsilon x)$$

$$\int_0^x \frac{(1+\varepsilon x)dx}{1-x} = (1+\varepsilon)\ln\frac{1}{1-x} - \varepsilon x$$

$$\int_0^x \frac{(1+\varepsilon x)dx}{(1-x)^2} = \frac{(1+\varepsilon)x}{1-x} - \varepsilon \ln\frac{1}{1-x}$$

$$\int_0^x \frac{(1+\varepsilon x)^2 dx}{(1-x)^2} = 2\varepsilon(1+\varepsilon)\ln(1-x) + \varepsilon^2 x + \frac{(1+\varepsilon)^2 x}{1-x}$$

$$\int_0^x \frac{dx}{(1-x)(\Theta_B - x)} = \frac{1}{\Theta_B - 1}\ln\frac{\Theta_B - x}{\Theta_B(1-x)} \qquad \Theta_B \neq 1$$

$$\int_0^W (1-\alpha W)^{\frac{1}{2}}\, dW = \frac{2}{3\alpha}\left[1 - (1-\alpha W)^{\frac{3}{2}}\right]$$

$$\int_0^x \frac{dx}{ax^2+bx+c} = -\frac{2}{2ax+b} + \frac{2}{b} \qquad for\ b^2 = 4ac$$

$$\int_0^x \frac{dx}{ax^2+bx+c} = \frac{1}{a(p-q)}\ln\left(\frac{q}{p}\cdot\frac{x-p}{x-q}\right) \quad for\ b^2 > 4ac$$

Where p and q are the roots of the equation.

$$ax^2 + bx + c = 0 \quad \text{i.e.,} \; p, q = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\int_0^x \frac{a+bx}{c+gx}dx = \frac{bx}{g} + \frac{ag-bc}{g^2}\ln\frac{c+gx}{c}$$