

ChE 344
Chemical Reaction Engineering
Winter 1999
Exam I
Part 2 (20%)

Open Book, Notes, and Disk
Closed Web

Name _____

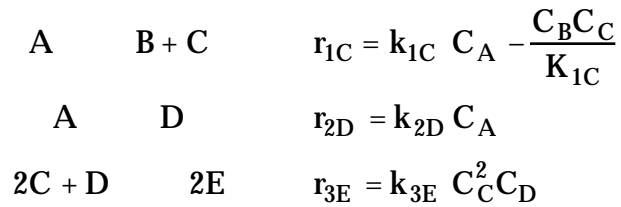
I have neither given nor received aid on this examination nor have I spent more than one hour working on Part 2 of this exam.

Signed _____

Start Time _____

Finish Time _____

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min



Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

- (a) the concentration of B is a maximum at $W =$ _____
- (b) the concentration of C is a maximum at $W =$ _____
- (c) Explain why the curves look the way they do.
- (d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 1.0 \text{ dm}^3/\text{kg cat} \cdot \text{min}$

$$k_{1C} = 2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

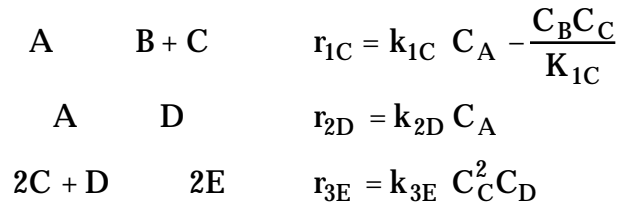
$$k_{2D} = 0.4 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$k_{3E} = 5 \text{ dm}^9/\text{mol}^2 \cdot \text{kg cat} \cdot \text{min}$$

$$W_f = 100 \text{ kg}$$

A

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min



Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

- (a) the concentration of B is a maximum at $W =$ _____
- (b) the concentration of C is a maximum at $W =$ _____
- (c) Explain why the curves look the way they do.
- (d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 0.2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$

$$k_{1C} = 2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

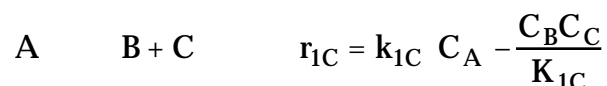
$$k_{2D} = 0.4 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

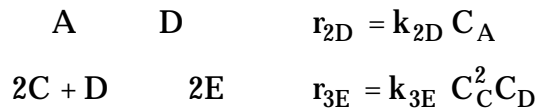
$$k_{3E} = 5 \text{ dm}^9/\text{mol}^2 \cdot \text{kg cat} \cdot \text{min}$$

$$W_f = 100 \text{ kg}$$

B

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min





Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

- (a) the concentration of B is a maximum at $W =$ _____
- (b) the concentration of C is a maximum at $W =$ _____
- (c) Explain why the curves look the way they do.
- (d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 5.0 \text{ dm}^3/\text{kg cat} \cdot \text{min}$

$$k_{1C} = 2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

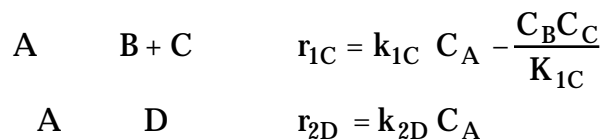
$$k_{2D} = 0.4 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$k_{3E} = 5 \text{ dm}^9/\text{mol}^2 \cdot \text{kg cat} \cdot \text{min}$$

$$W_f = 100 \text{ kg}$$

C

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min





Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

(a) the concentration of B is a maximum at $W =$ _____

(b) the concentration of C is a maximum at $W =$ _____

(c) Explain why the curves look the way they do.

(d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 1.0 \text{ dm}^3/\text{kg cat} \cdot \text{min}$

$$k_{1C} = 0.2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

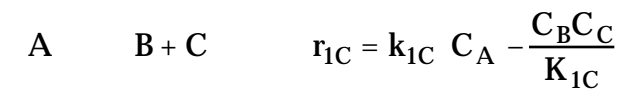
$$k_{2D} = 0.4 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$k_{3E} = 5 \text{ dm}^9/\text{mol}^2 \cdot \text{kg cat} \cdot \text{min}$$

$$W_f = 100 \text{ kg}$$

D

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min



Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

- (a) the concentration of B is a maximum at $W =$ _____
- (b) the concentration of C is a maximum at $W =$ _____
- (c) Explain why the curves look the way they do.
- (d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 1.0 \text{ dm}^3/\text{kg cat}\cdot\text{min}$

$$k_{1C} = 10 \text{ dm}^3/\text{kg cat}\cdot\text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

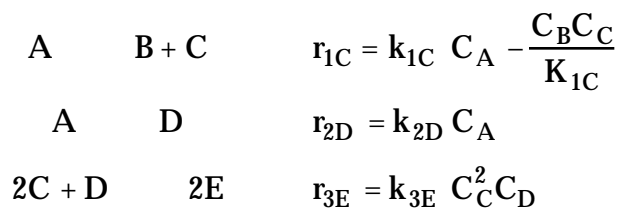
$$k_{2D} = 0.4 \text{ dm}^3/\text{kg cat}\cdot\text{min}$$

$$k_{3E} = 5 \text{ dm}^9/\text{mol}^2\cdot\text{kg cat}\cdot\text{min}$$

$$W_f = 100 \text{ kg}$$

E

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min



Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

- (a) the concentration of B is a maximum at $W =$ _____
- (b) the concentration of C is a maximum at $W =$ _____
- (c) Explain why the curves look the way they do.
- (d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 1.0 \text{ dm}^3/\text{kg cat} \cdot \text{min}$

$$k_{1C} = 2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

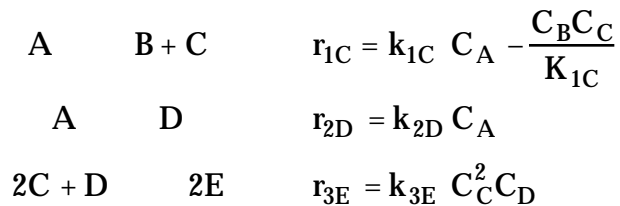
$$k_{2D} = 0.4 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$k_{3E} = 20 \text{ dm}^9/\text{mol}^2 \cdot \text{kg cat} \cdot \text{min}$$

$$W_f = 100 \text{ kg}$$

F

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min



Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

- (a) the concentration of B is a maximum at $W =$ _____
- (b) the concentration of C is a maximum at $W =$ _____

- (c) Explain why the curves look the way they do.
- (d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 1.0 \text{ dm}^3/\text{kg cat} \cdot \text{min}$

$$k_{1C} = 2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

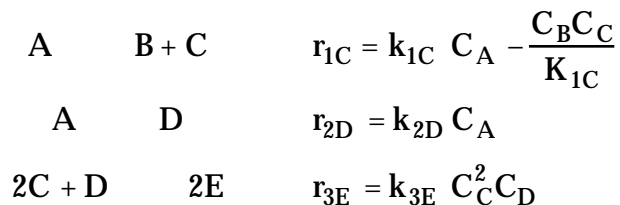
$$k_{2D} = 0.4 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$k_{3E} = 10 \text{ dm}^9/\text{mol}^2 \cdot \text{kg cat} \cdot \text{min}$$

$$W_f = 100 \text{ kg}$$

G

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min



Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

- (a) the concentration of B is a maximum at $W =$ _____
- (b) the concentration of C is a maximum at $W =$ _____
- (c) Explain why the curves look the way they do.

- (d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 15 \text{ dm}^3/\text{kg cat} \cdot \text{min}$

$$k_{1C} = 2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

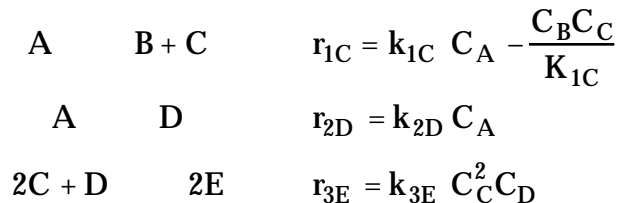
$$k_{2D} = 0.4 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$k_{3E} = 5 \text{ dm}^9/\text{mol}^2 \cdot \text{kg cat} \cdot \text{min}$$

$$W_f = 100 \text{ kg}$$

H

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min



Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

- (a) the concentration of B is a maximum at $W =$ _____
- (b) the concentration of C is a maximum at $W =$ _____
- (c) Explain why the curves look the way they do.
- (d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 1.0 \text{ dm}^3/\text{kg cat}\cdot\text{min}$

$$k_{1C} = 2 \text{ dm}^3/\text{kg cat}\cdot\text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

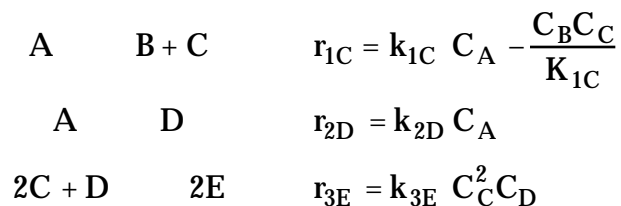
$$k_{2D} = 0.8 \text{ dm}^3/\text{kg cat}\cdot\text{min}$$

$$k_{3E} = 5 \text{ dm}^9/\text{mol}^2\cdot\text{kg cat}\cdot\text{min}$$

$$W_f = 100 \text{ kg}$$

I

The gas phase reactions take place isothermally in a membrane reactor packed with catalyst. Pure A enters the reactor at 24.6 atm and 500K and a flow rate of A of 10 mol/min



Only species B diffuses out of the reactor through the membrane. At what point in the reactor is the

- (a) the concentration of B is a maximum at W = _____
- (b) the concentration of C is a maximum at W = _____
- (c) Explain why the curves look the way they do.
- (d) Vary k_{1C} (.1 to 1000) and write a paragraph describing what you observe. Explain whether or not what you observe is reasonable.

Additional Information

Overall mass transfer coefficient $k_B = 1.0 \text{ dm}^3/\text{kg cat} \cdot \text{min}$

$$k_{1C} = 2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$K_{1C} = 0.2 \text{ mol}/\text{dm}^3$$

$$k_{2D} = 2 \text{ dm}^3/\text{kg cat} \cdot \text{min}$$

$$k_{3E} = 5 \text{ dm}^9/\text{mol}^2 \cdot \text{kg cat} \cdot \text{min}$$

$$W_f = 100 \text{ kg}$$