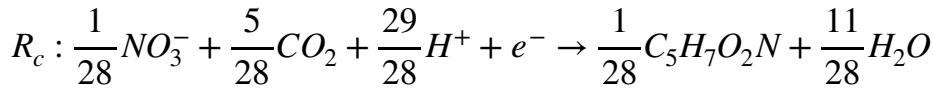
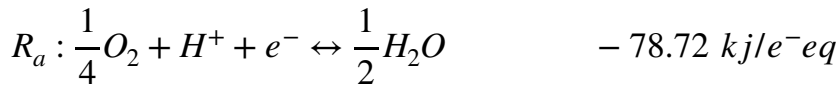
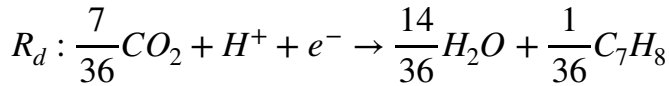


1.



$$f_s = 0.3 \quad f_e = 0.7$$

$$R = f_e^0 \times (R_a - R_d) + f_s^0 \times (R_c - R_d)$$

2.

The information given from Question 4.24, the removal is 96%

Where

$$S = S^0 \times \text{removal efficiency} = (1 - 0.96) \times 50 = 2 \text{ mg/L}$$

When bulk liquid concentration of benzoate is 2 mg/L

$$J_{ss} = 0.15 \frac{\text{mg}}{\text{cm}^2 \cdot d} \text{ and } a = 3 \text{ cm}^{-1}$$

the numerical values are substituted into Equation 4.42

$$S = S^0 - \frac{J_{ss}aV}{Q}$$

Solving the Volume equation to

$$V = \frac{Q(S^0 - S)}{J_{ss}a} = \frac{100 \frac{\text{m}^3}{d} \times \frac{1000L}{\text{m}^3} \times 48 \frac{\text{mg}}{L}}{0.15 \frac{\text{mg}}{\text{cm}^2 \cdot d} \times 3 \text{ cm}^{-1}} = 10.67 \text{ m}^3$$

3.

In the first CSTR

$$\theta_x = \frac{1}{Y\hat{q} - b}$$

$$S = K \frac{1 + b\theta_x}{\theta_x(Y\hat{q} - b) - 1}$$

4.

$$[\theta_x]_{lim} = \frac{1}{Y\hat{q} - b}$$

$$\theta_x = SF[\theta_x]_{lim}$$

$$\theta = \theta_x \left[\frac{X_i^0}{X_v} + \frac{Y(S^0 - S)(1 + (1 - f_d)b\theta_x)}{X_v(1 + b\theta_x)} \right]$$

$$V = Q \times \theta =$$