A6

1) 反応式より S の増加量は A の消費量。

よって $C_P = C_{S0} + (C_{A0} - C_A)$

2) $r_A = -kC_A C_P = -kC_A(C_{S0} + C_{A0} - C_A) = -kC_A^2 - kC_A(C_{S0} + C_{A0})$

$\frac{dr_A}{dC_A} = 2kC_A - k(C_{S0} + C_{A0})$

$\frac{dr_A}{dC_A} = 0$ となる時、$C_{Aex} = \frac{C_{S0} + C_{A0}}{2}$

3) $\tau = \frac{V_T}{q} = \int_{C_{Aex}}^{C_{A0}} \frac{dC_A}{-r_A} = \frac{C_{A0} - C_{Aex}}{-r_A} = \frac{C_{Aex} - C_{A0}}{-kC_{Aex}^2 + kC_{Aex}(C_{S0} + C_{A0})} = 0.985$ s

よって $V_T = 9.85$ L

4) $\tau = \frac{V_P}{q} = \int_{C_{Aex}}^{C_{A0}} \frac{dC_A}{-r_A} = -\frac{1}{k}\int_{C_{Aex}}^{C_{A0}} \frac{dC_A}{C_A^2 - C_A(C_{S0} + C_{A0})}$

$= -\frac{1}{k} \cdot \frac{1}{C_{S0} + C_{A0}} \int_{C_{Aex}}^{C_{A0}} \left\{ \frac{1}{C_A - (C_{S0} + C_{A0})} - \frac{1}{C_A} \right\} dC_A$

$= -\frac{1}{k} \cdot \frac{1}{C_{S0} + C_{A0}} \int_{C_{Aex}}^{C_{A0}} \left\{ -\frac{1}{C_{S0} + C_{A0} - C_A} - \frac{1}{C_A} \right\} dC_A$

$= -\frac{1}{k} \frac{1}{C_{S0} + C_{A0}} \left[\{ \ln(C_{S0} + C_{A0}) - C_A \} - \ln C_A \right]_{C_{Aex}}^{C_{A0}}$

$= -\frac{1}{k} \cdot \frac{1}{C_{S0} + C_{A0}} \left[\ln\left(\frac{C_{S0} + C_{A0} - C_A}{C_A} \right) \right]_{C_{Aex}}^{C_{A0}} = 2.635$ s

よって $V_P = 26.3$ L

5) ④ が正解

⑤ は、CSTR, PFR 両方とも C_{Aex} まで反応速度は上昇するので ×