B3 - 2

1) $r_A = -kC_A$

$$\tau = \frac{V}{v_0} = \frac{2}{3.0\times10^{-3}} = \frac{C_{A0}x_A}{kC_A} = \frac{C_{A0}x_A}{kC_{A0}(1-x_A)} = \frac{1}{k}$$

よって $k = 1.5\times10^{-3}$ min^{-1}

$$\tau = \int_{C_{A0}}^{C_A} \frac{dC_A}{r_A} = -\frac{1}{k}\ln[C_A]_{C_{A0}}^{C_A} = \frac{1}{k}\ln\frac{C_{A0}}{C_A} = \frac{1}{k}\ln\left(\frac{1}{1-x_A}\right)$$

よって $1-x_A = \frac{1}{e^{k\tau}}$ $x_A = 1-\frac{1}{e^{k\tau}} = 0.632$

2) $C_{Af} = C_{A0}(1-x_{Af})$

$v_t = v_0 + v_R = v_0 + \gamma v_0 = (1+\gamma)v_0$

$$C_{Ain} = \frac{F_{Ain}}{v_t} = \frac{v_0C_{A0} + v_RC_{Af}}{v_0+v_R} = \frac{v_0C_{A0} + v_0\gamma C_{A0}(1-x_{Af})}{v_0(1+\gamma)}$$

$$= \frac{C_{A0}(1+\gamma)}{1+\gamma} - \frac{\gamma}{1+\gamma}C_{A0}x_{Af}$$

$$= C_{A0}\left(1-\frac{\gamma}{1+\gamma}x_{Af}\right) \quad -①$$

単通転化率 x' を求めると 1) より $x = 1-\frac{1}{e^{k\tau}}$。今流量の $\frac{1}{2}$ 倍になっているので

$$x' = 1-\frac{1}{e^{\frac{k\tau}{2}}} = 0.394$$

$C_{Af} = C_{Ain}(1-x)$ より

$$C_{Ain} = \frac{C_{Af}}{1-x} = \frac{1-x_{Af}}{1-x'}C_{A0} \quad -②$$

①と②を代入

$$\frac{1-x_{Af}}{1-x'} = 1-\frac{\gamma}{1+\gamma}x_{Af} = 1-\frac{1}{2}x_{Af}$$

これを解くと

$x_{Af} = 0.566$