P12-6

$$A + B \rightarrow 2C$$

	A	B	C
$F_{i0} \left(\frac{lb\ mol}{hr} \right)$	10	10	0
$T_{i0}\ (°F)$	80	80	—
$C_{pi0} \left(\frac{Btu}{lb\ mol\ °F} \right)$	51	44	47.5
$MW \left(\frac{lb}{lb\ mol} \right)$	128	94	222
$\rho_i \left(\frac{lb}{ft^3} \right)$	63	67.2	65

$$\Delta H_R = 20000 \quad \frac{Btu}{lb\ mol\ A}$$

Energy balance:

$$UA\,(T_s - T) - \dot{W}_s - F_{A0}\,\Delta H_{Rx}\,X_{AF} = F_{A0}\,(C_{PA} + C_{PB})[T - T_0]$$
$$\llcorner ②$$

$$\frac{\dot{Q} - \dot{W}_s}{F_{A0}} - X_A\,\Delta H_R = \sum \theta_i\,C_{pi}\,[T - T_0] \quad —①$$

$$\theta_A = 1 \ ; \ \theta_B = \frac{F_B}{F_A} = 1 \ ; \ \theta_C = 0 \ ; \ X_{AF} = 1$$

$$\dot{Q} = UA\,(T_s - T)$$

substituting in ① we get ②

$$\rightarrow \quad T = T_0 + \frac{U_A(T_s - T) - W_s - F_{A0}\,\Delta H_{Rx}}{F_{A0}(C_{P_A} + C_{P_B}) + UA}$$

$$-W_s = 63525 \; Btu/hr$$

$$T = 199 \; °F$$