P 12-6

$$A + B \longrightarrow 2C$$

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

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

Energy balance:

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

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

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

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

substituting in ① we get ②

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

$$-W_s = 63525 \text{ Btu/hr} \qquad \text{1 hp = 2544.43 Btu/hr}$$

$$T = 199 \, ^\circ F$$