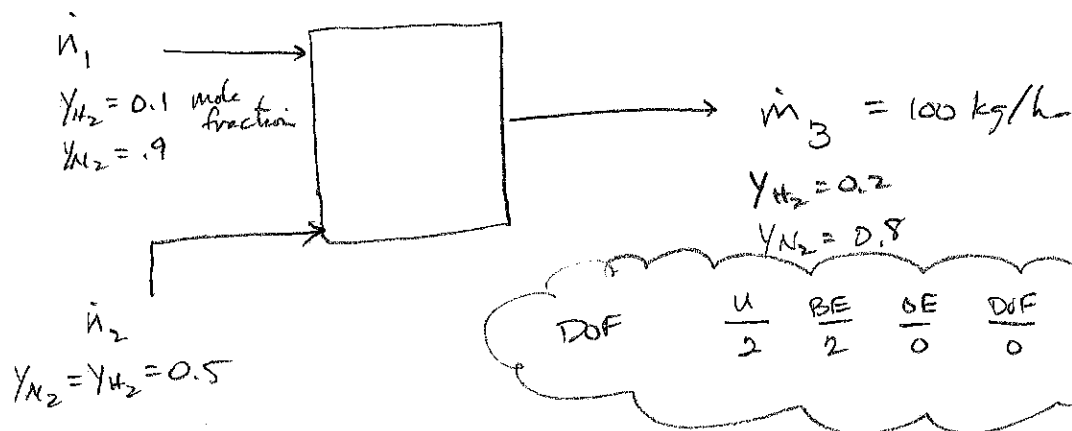


4.22



(a) First convert to moles

$$\begin{aligned}\overline{MW}_3 &= Y_{H_2,3} \overline{MW}_{H_2} + Y_{N_2,3} \overline{MW}_{N_2} \\ &= .2(2) + .8(28) = 22.8 \frac{\text{gmix}}{\text{mole}_3}\end{aligned}$$

$$\dot{n}_3 = \frac{100 \text{ kg/hr}}{22.8 \text{ kg/mole}} = 4.39 \text{ kg.mole/hr}$$

$$\dot{n}_{H_2,3} = 0.877 \text{ kg.mole } H_2/\text{hr}$$

total moles

$$\dot{n}_1 + \dot{n}_2 = \dot{n}_3$$

H_2 moles

$$Y_{H_2,1} \dot{n}_1 + Y_{H_2,2} \dot{n}_2 = Y_{H_2,3} \dot{n}_3$$

$$\dot{n}_1 + \dot{n}_2 = 4.39$$

$$.1\dot{n}_1 + .5\dot{n}_2 = 0.877$$

multiply (1) by 0.1

$$.1\dot{n}_1 + .1\dot{n}_2 = .439$$

$$.4\dot{n}_2 = .438$$

$$\dot{n}_2 = 1.09 \text{ kmole/hr}$$

$$\dot{n}_1 = 4.39 - 1.09$$

$$\dot{n}_1 = 3.29 \text{ kmole/hr}$$

$$(b) Y_{H_2,1} \dot{n}_1 + Y_{H_2,2} \dot{n}_2 = Y_{H_2,3} \dot{n}_3 \leftarrow \text{total mole balance multiplied by } Y_{H_2,1}$$

$$Y_{H_2,1} \dot{n}_1 + Y_{H_2,2} \dot{n}_2 = Y_{H_2,3} \dot{n}_3$$

$$(Y_{H_2,2} - Y_{H_2,1}) \dot{n}_2 = (Y_{H_2,3} - Y_{H_2,1}) \dot{n}_3$$

$$\dot{n}_2 = \frac{(Y_{H_2,3} - Y_{H_2,1})}{(Y_{H_2,2} - Y_{H_2,1})} \dot{n}_3$$

$$\dot{n}_1 = \dot{n}_3 - \dot{n}_2$$

$$\dot{n}_3 = \frac{\dot{n}_3}{\overline{MW}_3}$$

(c) see spreadsheet!