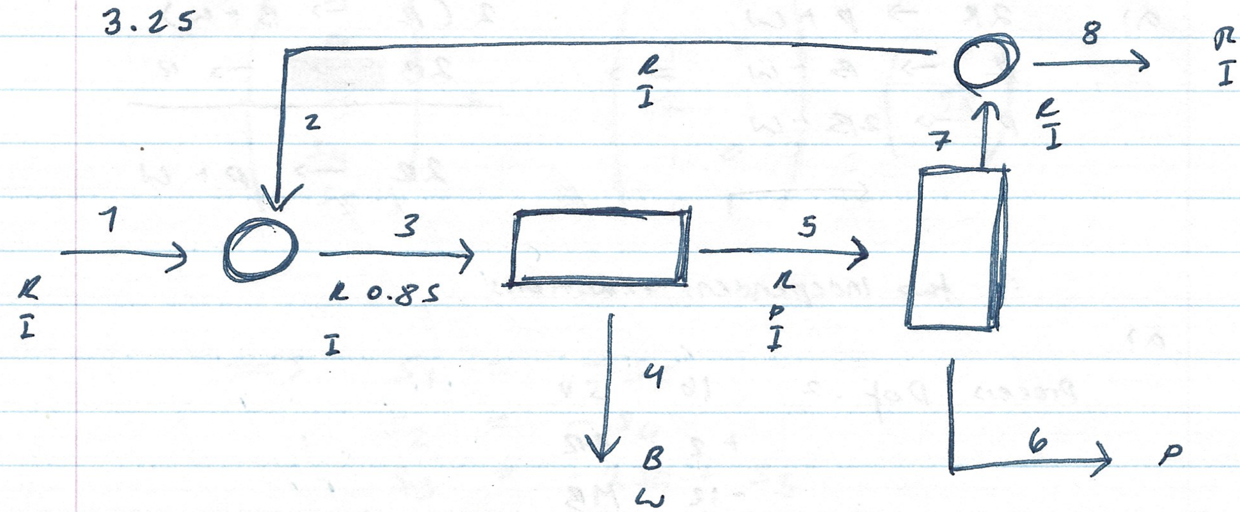
3.25



(SR1) $\frac{n_I^1}{n_R^1} = \frac{1}{11}$

(SR2) 50% conversion

$n_R^8 = 0.5 n_R^1$

(SR3) 80% yield

$0.8 = \frac{n_P^6}{R_{PR}^{max}}$

→ when all reacted R is allocated to P

→ amount converted = 50%

2R for 1P

$0.8 = \frac{n_P^6}{\frac{1}{4} n_R^1}$

(SR4) splitter ratio, $w_R^8 = w_R^7$

a) $2R \rightarrow P + W$

$R \rightarrow B + W$

$P \rightarrow 2B + W$

$\Rightarrow$

$2(R \rightarrow B + W)$

$2B + W \rightarrow P$

$2R \rightarrow P + W$

$\therefore$ two independent reactions

a)

Process DOF $=$

$$
\begin{array}{rl}
16 & SV \\
+2 & RR \\
-12 & MB \\
-1 & SSU \\
-4 & SR \\
\hline
1 & \\
-1 & \text{(basis)} \\
\hline
0 &
\end{array}
$$

$\rightarrow$ process is correctly specified if we prescribe a basis

· let $N' = 100$ mol/h

b) · does not change DOF of process

$\rightarrow$ only two independent reactions so the absence of the third reaction would not have given us more information c)

	Mixer	Reactor	Seperator	Splitter	OB
SV	6	7	6	6	7
RR	—	+2	—	—	+2
MB	-2	-5	-3	-2	-5
SSV	-1	-1	-0	-0	-0
SR	-1	-0	-0	-1	-3
DOF	2	3	3	3	1
				(basis)	-1
					0

- solving the OB
  - we get n_W^4; n_B^4, N^8 (r_1, r_2, N^4, N^6)
  - can solve reactor

Mixer	Reactor	Seperator	Splitter	OB
2	1	2	1	0

- can combine reactor + seperator + splitter into one CV

	Reactor + Seperator + Splitter
SV	9
RR	+2
MB	-5
SSV	-4
SR	-2
DOF	0

- solve reactor + seperator + splitter

- get N^3, N^2

Mixer	Reactor	Seperator	Splitter	OB
0	0	0	0	0

- solve for N^7, N^5

d) • let $N^1 = 100$ mol/h

(SR1) $\frac{n_I^1}{n_R^1} = \frac{1}{11}$

$N^1 = n_R^1 + n_I^1$

$100 = 12 n_I^1$

$n_I^1 = 8.33$ mol/h $= n_I^8$

(SR2) $n_R^1 = 91.67$ mol/h $= \frac{1}{2} n_R^8$

$\Rightarrow n_R^8 = 45.83$

(SR3) $0.80 = \frac{n_P^6}{\frac{1}{4} n_R^1}$

$n_P^6 = 18.33$ mol/h $= r_1$

$= N^6$

• total balances

$n_W^4 = r_1 + r_2 \Rightarrow r_2 = n_W^4 - r_1$

$n_B^4 = r_2$

$n_R^1 - n_R^8 - 2r_1 - r_2 = 0$

$45.833 = 2r_1 + r_2$

$45.833 = 2r_1 + n_W^4 - r_1$

$n_W^4 = 27.503$

$r_2 = 9.17$ mol/h $= n_B^4$

$N^4 = n_W^4 + n_B^4$

$= 36.676$ mol/h

Reactor + Seperator + Splitter

· stream 8

$$w_R^8 = \frac{n_R^8}{n_R^8 + n_1}$$

$$= 0.846 = w_R^7 = w_R^2$$

$$w_1^8 = 0.154 = w_1^7 = w_1^2$$

· total balance

$$0.85N^3 - 0.846N^2 = n_R^8 + 2r_1 + r_2$$

$$0.15N^3 - 0.156N^2 = n_1^8$$

$\Downarrow$ MATLAB

$$N^2 = 1733.33 \text{ mol/h}$$

$$N^3 = 1833.33 \text{ mol/h}$$

$$\Rightarrow 0.15N^3 = 0.156N^7$$

$$N^7 = 1787.30 \text{ mol/h}$$

$$= N^3 + N^6$$

$$\Rightarrow N^3 = 1769.17 \text{ mol/h}$$