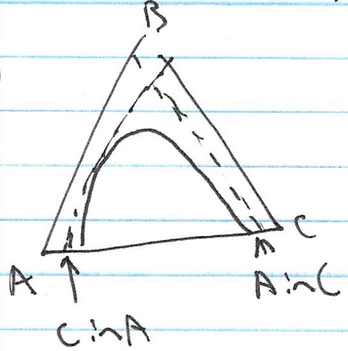
Josh Whitehead
Ch En 2800

HW 7

1.) a.)



$$\boxed{\begin{array}{l} \text{max Solubility A in C} : \approx 7\% \\ \text{max Solubility C in A} : \approx 5\% \end{array}}$$

b.) A-Rich: $x_A \simeq 0.78$, $x_B \simeq 0.19$, $x_C \simeq 0.03$

C-Rich: $x_A \simeq 0.26$, $x_B \simeq 0.47$, $x_C \simeq 0.28$

$\boxed{\text{More C-rich Phase}}$

2.) MIBK: 35% A, 7% H_2O, 58% MIBK

H_2O: 25% A, 70% H_2O, 5% MIBK

$m_A = \cancel{1.2 \cdot 0.2 = 0.24}\ 1.2 \cdot 0.33 = 0.396$

$m_{H_2O} = 0.24$

$m_M = 0.564$

$0.35x + 0.25y = 0.396$

$0.07x + 0.7y = 0.24$

$y = 1.584 - 1.4x$

$x = 3.429 - 10y$

$y = 1.584 - 1.4(3.429 - 10y)$

$y = 1.584 - 4.8 + 14y$

$-13y = -3.216$

$y = 0.247$ $\therefore$ $x = 1.2 - 0.247 = 0.953$

$$\boxed{\begin{array}{l} \therefore m_{MIBK} = 0.953 \text{ kg} \\ m_{H_2O} = 0.247 \text{ kg} \end{array}}$$

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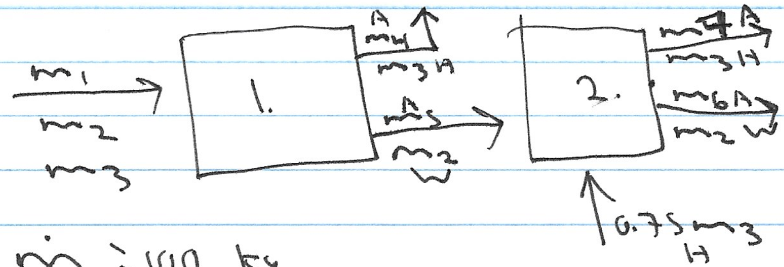
3.)



$m_1 = 40$ kg A
$m_2 = 60$ kg W
$m_3 = 100$ kg H

$\dot{m} = 100 \frac{kg}{s}$

1.) $0.343 = \dfrac{\frac{m_4}{100 + m_4}}{\frac{m_5}{60 + m_5}} \rightarrow \dfrac{0.343 m_5}{60 + m_5} = \dfrac{m_4}{100 + m_4}$ $\quad m_4 + m_5 = 40$

$0.343 m_5 (100 + 40 - m_5) = (60 + m_5)(40 - m_5)$

$\rightarrow 48.02 m_5 - 0.343 m_5^2 = -m_5^2 - 20 m_5 + 2400$

$0.657 m_5^2 + 68.02 m_5 - 2400 = 0$

$m_5 = \dfrac{-68.02 \pm \sqrt{68.02^2 - 4(0.657)(-2400)}}{2(0.657)} = 27.812$

2.) $0.343 = \dfrac{\frac{m_7}{75 + m_7}}{\frac{m_6}{60 + m_6}} \rightarrow \dfrac{0.343 m_6}{60 + m_6} = \dfrac{m_7}{75 + m_7}$ $\quad m_6 + m_7 = 27.812$

$\dfrac{0.343 m_6}{60 + m_6} = \dfrac{27.812 - m_6}{75 + 27.812 - m_6}$

$-m_6^2 - 32.19 m_6 + 1668.7 = 35.265 m_6 - 0.343 m_6^2$

$0.657 m_6^2 + 67.45 m_6 - 166.7 = 0$

$m_6 = \dfrac{-67.45 \pm \sqrt{67.45^2 - 4 \cdot 0.657 \cdot 1668.7}}{2(0.657)} = 20.6$

$\dfrac{20.6 \text{ kg A}}{40 \text{ kg A}} = 0.515 \rightarrow \boxed{51.5\% \text{ A}}$

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4) $\Delta P = 0$, $P = 1\,atm$ $\quad 60\ \frac{J}{s}$

$$Q = \Delta H + \cancel{\Delta E_K} + \cancel{\Delta E_P} \quad \therefore Q = \Delta H$$

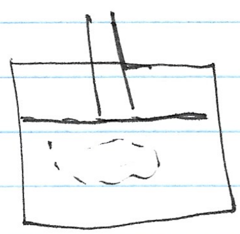
$\frac{J}{s} \cdot \frac{g}{J}$

$$\Delta H = \hat{H}_{evap} = 2256.9\ \frac{kJ}{kg} = 2256.9\ \frac{J}{g}$$

$\therefore$ time $=$

$$2256.9\ \frac{J}{g} \cdot \frac{1\,s}{60\,J} = 37.615\ \frac{s}{g} \cdot 1\,g = \boxed{37.6\ sec}$$

5.) a) 4L gas @ 30°C $\quad P_1 = 5\,bar \quad P_2 = 8\,bar$



$$\Delta U + \cancel{\Delta E_K} + \cancel{\Delta E_P} = Q + W$$

$$\boxed{\Delta U = Q + W}$$

b.) if $\Delta T = 0 \rightarrow \cancel{\Delta U} + \cancel{\Delta E_K} + \cancel{\Delta E_P} = Q + W$

$\therefore W = -Q \qquad W = 7.65\ L\,bar \cdot \frac{8.314\ J}{0.08314\ L\,bar} = 765\ J$

$$\therefore \boxed{Q = -765\ J}$$

c.) if $Q = 0 \rightarrow \Delta U = W$ $\quad$ ~~if $\hat{U}$ is dependent on T, and $W = 765\ J$,~~

if $\hat{U}$ is dependent on T, then $U_f - U_i$ has to be positive because W is positive. $\therefore U_f$ would have to be greater than U_i which means $T_f > 30°C$