Josh Whitehead 14 Jan 2022

HW #0

1.) a.) $2Sb + 3I_2 \rightarrow 2SbI_3$

have
1.2 mol Sb
2.4 mol I_2

Limiting reagent:

$1.2\ Sb \cdot \frac{\cancel{2}\ SbI_3}{\cancel{2}\ Sb} = 1.2 \text{ mol } SbI_3$ → smaller

$2.4\ I_2 \cdot \frac{2\ SbI_3}{3\ I_2} = 1.6 \text{ mol } SbI_3$

$\boxed{\text{Sb is limiting reagent}}$

$\boxed{\text{Theoretical yield} = 1.2 \text{ mol } SbI_3}$

In excess

$1.2\ Sb \cdot \frac{3\ I_2}{2\ Sb} = 1.8$ mol needed ~~excess~~ I_2

$M_{I_2} = 253.8 \frac{g}{mol}$ → ~~$m_{excess}\ I\ 1.8\ mol \cdot 253.8 \frac{g}{mol}$~~

→ $2.4 - 1.8 = 0.6$ mol excess I_2

$m_{excess} = 0.6 \cancel{mol} \cdot 253.8 \frac{g}{\cancel{mol}}$ $\boxed{= 152.\ g\ I_2 \text{ in excess}}$

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1) b) $m_{I_2} = 2.4\ g$ $m_{Sb} = 1.2\ g$

$n_{I_2} = 2.4\ g \cdot \frac{1\ mol}{253.8\ g} = 0.00946\ mol\ I_2$

$n_{Sb} = 1.2\ g \cdot \frac{1\ mol}{121.76\ g} = 0.00986\ mol\ Sb$

Limiting Reagent

$0.00986\ Sb \cdot \frac{2\ SbI_3}{2\ Sb} = 0.00986$

$0.00946\ I_2 \cdot \frac{2\ SbI_3}{3\ I_2} = 0.006304$ smaller Limiting reagent

I_2 is limiting reagent

Theoretical yield is $6.304 \times 10^{-3}\ mol\ SbI_3$

$0.00946\ I_2 \cdot \frac{2\ Sb}{3\ I_2} = 0.006304$ moles needed Sb

$0.006304\ \cancel{mol} \cdot \frac{121.76\ g}{\cancel{mol}} = 0.7676\ g$ needed

$\therefore$ ~~0.7676~~ $(1.2 - 0.7676)\ g\ Sb = 0.432$

$\therefore$ 0.432 g Sb excess

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HW#0

2) $3\,NaOH + Fe(NO_3)_3 \longrightarrow Fe(OH)_3 + 3\,NaNO_3$

$n_{NaOH} = 0.05\,\cancel{L} \cdot 0.2\,\frac{mol}{\cancel{L}} = 0.01\ mol\ NaOH$

$n_{Fe(NO_3)_3} = 0.03\ L \cdot 0.125\ \frac{mol}{L} = 0.00375\ mol\ Fe(NO_3)_3$

Limiting reagent

$0.01\ mol\ NaOH \cdot \frac{1\ Fe(OH)_3}{3\ NaOH} = 0.0033\ mol\ Fe(OH)_3$

$0.00375\ Fe(NO_3)_3 \cdot \frac{1\ Fe(OH)_3}{1\ Fe(NO_3)_3} = 0.00375\ mol\ Fe(OH)_3$

$\therefore$ NaOH = limiting reagent

Theoretical yield $= 3.33 \times 10^{-3}\ mol\ Fe(OH)_3$

$M_{Fe(OH)_3} = M_{Fe} + 3M_O + 3M_H = 55.8 + 3(16.0 + 1.008)$

$= 106.8\ \frac{g}{mol}$

$\therefore m_{yield} = 3.33 \times 10^{-3}\ mol \cdot 106.8\ \frac{g}{mol}$

$\boxed{= 0.356\ g\ Fe(OH)_{3(s)}}$

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HW #0

3) Assume Ideal gas: $P_1V_1 = n_1RT_1$

$P_2V_2 = n_2RT_2$

$\cancel{R}$ $\frac{V_1}{R} = \frac{n_1T_1}{P_1} = \frac{V_2}{R} = \frac{n_2T_2}{P_2}$

$\rightarrow \frac{n_1T_1}{P_1} = \frac{n_2T_2}{P_2}$

$n_1 = 3$ mol
$T_1 = 298$ K
$P_1 = 0.95$ atm
$T_2 = 398$ K

$n_2 = 0.88 \cdot 2 + (1-0.88) \cdot 1 + (1-0.88) \cdot 2 = 2.12$ mol

$\therefore P_2 = \frac{n_2T_2P_1}{n_1T_1} = \frac{2.12 \cdot 398 \cdot 0.95}{3 \cdot 298}$

$= \boxed{P_2 = 0.897 \text{ atm}}$

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HW #0

4) $2N_2 + 5O_2 \longrightarrow 2N_2O_5$

$\cancel{2}^{4}\,\cancel{HNO_3} \longrightarrow \cancel{1}^{2}\,\cancel{H_2O} + \cancel{1}^{2}\,N_2O_5$ $\quad\Delta H \quad (+73.7)(2)$

$\cancel{2H_2O} \longrightarrow \cancel{O_2} + \cancel{2H_2}$ $\quad +571.6$

$\cancel{0.5}^{2}\,N_2 + \cancel{1.5}^{\cancel{6}\,5}\,O_2 + \cancel{0.5}^{2}\,\cancel{H_2} \longrightarrow \cancel{4HNO_3}$ $\quad (-174.1)(4)$

$\therefore \Delta H_f = [2(73.7) + 571.6 - 4(174.1)]$ kJ

$\boxed{= +22.6 \text{ kJ}}$

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HW # 0

5) $N_2O_4 \rightleftharpoons 2NO_2$

$$K_p = \frac{(P_{NO_2})^2}{(P_{N_2O_4})} = 11$$

	N_2O_4	$2NO_2$
i	1	0
c	$-x$	$+2x$
e	$1-x$	$2x$

$$\rightarrow 11 = \frac{(2x)^2}{1-x}$$

$$\downarrow$$

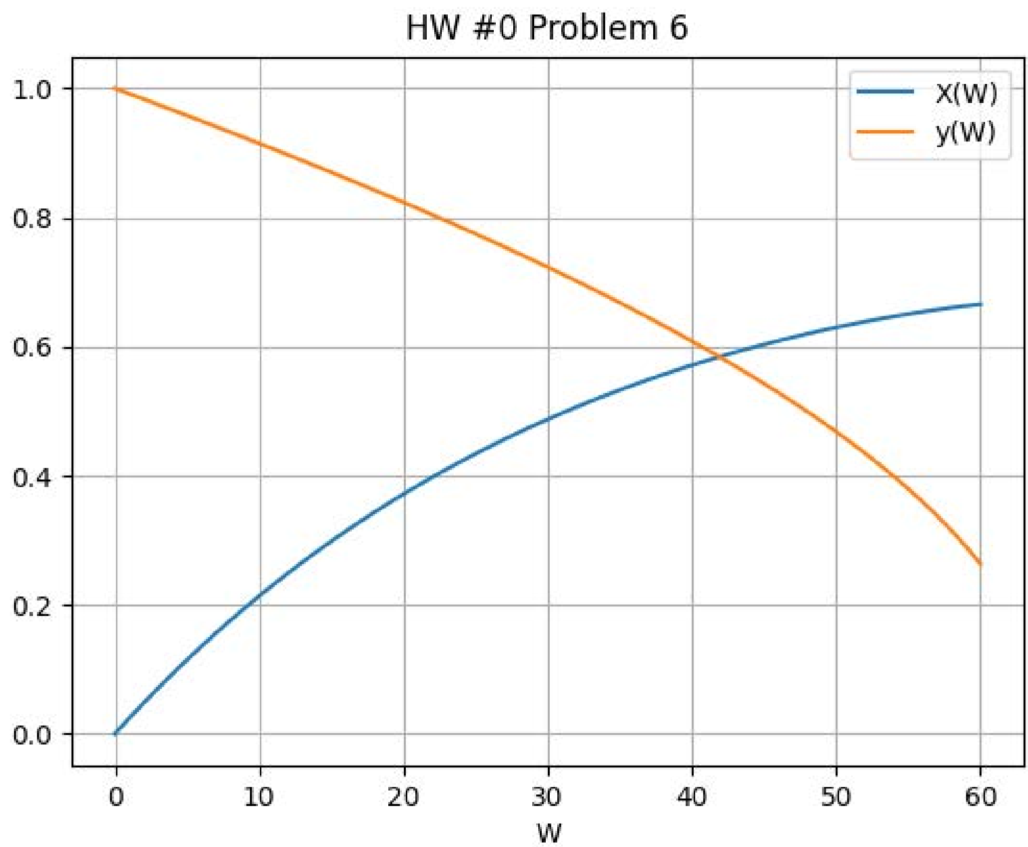
$$4x^2 + 11x - 11 = 0$$

$$x = \frac{b \pm \sqrt{-b \pm 4ac}}{2a}$$

$$\downarrow$$

$$x = 0.779,\ \cancel{-3.529}$$

$$\boxed{\begin{aligned} P_{N_2O_4} &= 1 - 0.779 = 0.221 \text{ atm} \\ P_{NO_2} &= 2(0.779) = 1.56 \text{ atm} \end{aligned}}$$


HW #0 Problem 6
x(W)
y(W)
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
W

```python
"""Josh Whitehead
14Jan2022
This code is to solve the system of
equations in HW0 problem 6 in ChEn3353"""

import scipy.integrate as sc
import matplotlib.pyplot as plt
import numpy as np
k = .0266                                                       # define constants
f = 1.08
a = .0166
e = -.15
y0 = 1
x0 = 0
tend = 61
t = np.arange(0,tend)


def rhs(xy,t):                                                  # define function that
returns diff eq
    x = xy[0]
    y = xy[1]
    dxdw = k*y/f*((1-x)/(1+e*x))
    dydw = -a*(1+e*x)/2/y
    return [dxdw,dydw]


xy0 = [x0,y0]

sol = sc.odeint(rhs,xy0,t)                                      # vector of x(w),y(w)

x = sol[:,0]                                                    #separate x(w),y(w)
y = sol[:,1]

plt.plot(t,x,label='X(W)')                                      # plot x(w), y(w)
plt.plot(t,y,label='y(W)')
plt.title('HW #0 Problem 6')
plt.legend()
plt.grid()
plt.xlabel('W')
plt.savefig('HW0_6')
```