HW1_2

January 20, 2022

1 Problem 2

Problem 2.1 Given relationships:

$$M_A = 3M_B \tag{1}$$

and

$$x_A = \frac{z}{3} \text{ for } z = [0, 1] \tag{2}$$

$$\omega_A = \frac{m_A}{m_A + m_B} \tag{3}$$

$$m = Mn \tag{4}$$

$$x_A = \frac{n_A}{n_A + n_B} \tag{5}$$

find ω_A as a function of z: combining (3) and (4) gives

$$\omega_A = \frac{M_A n_A}{M_A n_A + M_B n_B}$$

and substituting (1) into M_A gives

$$\omega_A = \frac{3M_B n_A}{3M_B n_A + M_B n_B}$$

which can be simplified as

$$\omega_A = \frac{3n_A}{3n_A + n_B} \tag{6}$$

Next, by combining (2) and (5) and solving for n_B we get

$$x_A = \frac{z}{3} = \frac{n_A}{n_A + n_B}$$

$$n_B = \frac{3n_A}{z} - n_A \tag{7}$$

Now (7) can be substituted into (6) and simplified to get

$$\omega_A = \frac{3n_A}{3n_A + \frac{3n_A}{z} - n_A} = \frac{3}{3 + \frac{3}{z} - 1}$$

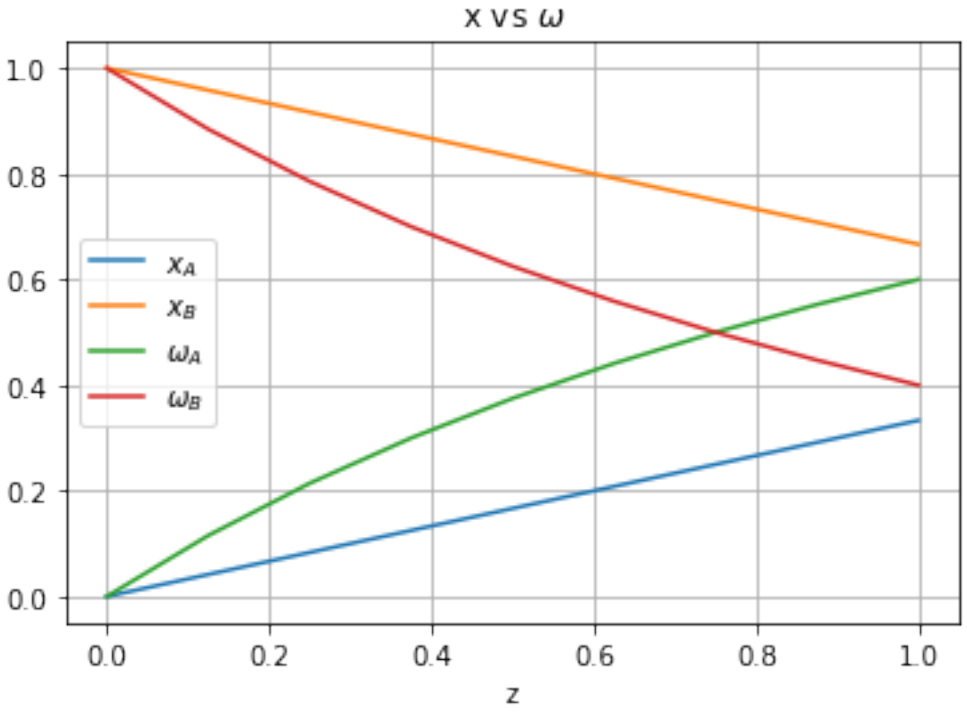
Problem 2.2 following is a plot of x and ω

[ ]:
```
import matplotlib.pyplot as plt
import numpy as np

z = np.linspace(0,1,9)
xa = z/3
xb = 1-xa
wa = 3/(3+3/z-1)
wb = 1-wa
plt.plot(z,xa,label='$x_A$')
plt.plot(z,xb,label='$x_B$')
plt.plot(z,wa,label='$\omega_A$')
plt.plot(z,wb,label='$\omega_B$')
plt.grid()
plt.legend()
plt.title('x vs $\omega$')
plt.xlabel('z')
;
```

```
<ipython-input-1-e4f059850846>:7: RuntimeWarning: divide by zero encountered in
true_divide
  wa = 3/(3+3/z-1)
```

[ ]:
```
''
```



While the molar fraction is a linear profile, it's interesting that the profile for mass fraction is not linear. The mass fraction increases as the molar fraction increases.