241205-problem-5.52

December 5, 2024

1 Problem 5.52

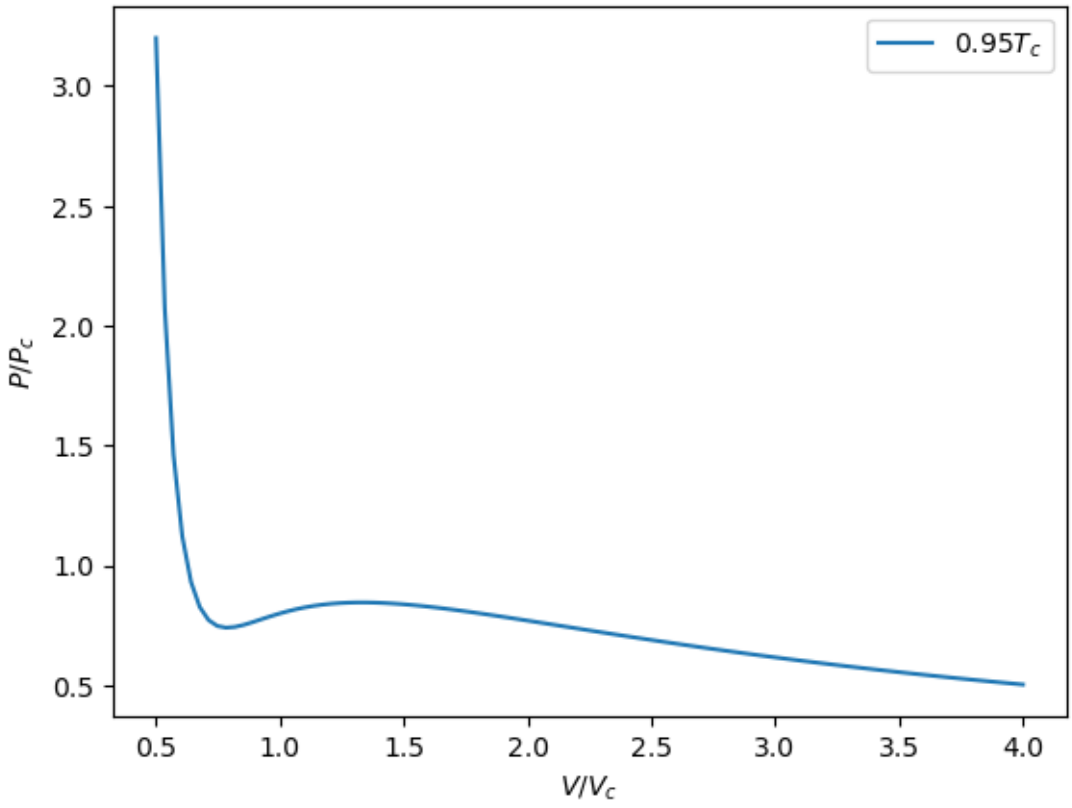
This problem is very similar to what we did in the text, but with an extension that I want to do.

[2]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

[3]:
```
def p(v,t):
    return 8*t/(3*v-1)-3/v**2
```

[4]:
```
v = np.linspace(0.5, 4, 100)

fig0 = plt.figure()
ax0 = fig0.add_subplot(111)

## THIS IS THE ONE CHANGE FROM WHAT WE DID ##
ax0.plot(v, p(v,0.95), label=r'$0.95T_c$')

ax0.legend()

ax0.set_ylabel(r'$P/P_c$')
ax0.set_xlabel(r'$V/V_c$')
```

[4]:
```
Text(0.5, 0, '$V/V_c$')
```



OK, so I'm going to make a dataframe with that information in it first.

[5]:
```
df = pd.DataFrame({'v/vc':v,
                   '0.95Tc p/pc':p(v,0.95),
                  })
```

And nown I'm going to add the Gibbs Free Energy at 0.95 Tc.

[6]:
```
df['0.95Tc G'] = -0.95*np.log(3*df['v/vc']-1)+.95/(3*df['v/vc']-1)-9/4/df['v/
↪vc']
```

And now let's look at what we have.

[7]:
```
df
```

[7]:

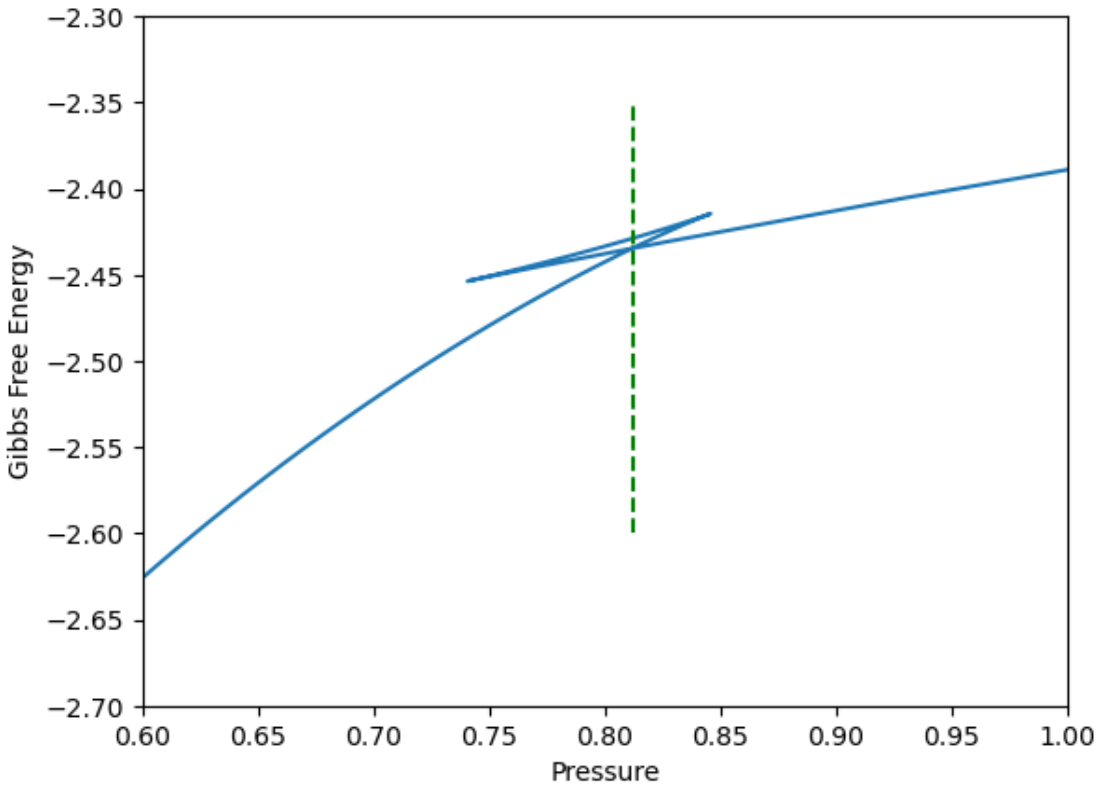
	v/vc	0.95Tc p/pc	0.95Tc G
0	0.500000	3.200000	-1.941510
1	0.535354	2.072574	-2.159594
2	0.570707	1.461596	-2.285904
3	0.606061	1.121389	-2.360752
4	0.641414	0.930992	-2.405163
..	…	…	…

```
95  3.858586     0.517129 -2.733923
96  3.893939     0.513636 -2.739001
97  3.929293     0.510186 -2.744062
98  3.964646     0.506777 -2.749108
99  4.000000     0.503409 -2.754137

[100 rows x 3 columns]
```

Now, let's plot G vs p like he did in the textbook (Figure 5.21 in my book and the notes)

[14]:
```
fig1, ax1 = plt.subplots()

ax1.plot(df['0.95Tc p/pc'], df['0.95Tc G'])
ax1.set_xlim(0.6, 1)
ax1.set_ylim(-2.7, -2.3)
ax1.set_xlabel('Pressure')
ax1.set_ylabel('Gibbs Free Energy')

ax1.vlines(0.812, -2.60, -2.35, 'green', 'dashed')
```

[14]:
```
<matplotlib.collections.LineCollection at 0x7463e0890200>
```



So that looks like it happens at about 0.812 or somewhere thereabouts.

Let's plot the Pressure vs. Volume and then put that pressure on and see how it looks:

[16]:
```
fig2, ax2 = plt.subplots()

ax2.plot(df['v/vc'],df['0.95Tc p/pc'])
ax2.set_ylabel('Pressure')
ax2.set_xlabel('Volume')

ax2.hlines(0.812, 0.5, 2.5, 'green', 'dashed')
```

[16]:
```
<matplotlib.collections.LineCollection at 0x7463e0788200>
```