

# Notebook

February 16, 2020

*NBBinder test on a collection of notebooks about some thermodynamic properperties of water*

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## 1 Reading the Data

A table with the variation of density and viscosity in terms of the temperature, at a fixed pressure of 1 atmosphere, is available in [Batchelor \(2000\)](#). The data has been digitized and saved into a local `csv` file. Here we load the table from the file and view and plot the data.

### 1.1 Importing the libraries

First we import the libraries used in this particular notebook.

```
[1]: import pandas as pd
import matplotlib.pyplot as plt
```

### 1.2 Using pandas

The data has been digitized to the local file `water.csv`. An easy way to retrieve it is with the `pandas.read_csv()` function of the `pandas` library:

```
[2]: water_pd = pd.read_csv('water.csv', header=[0,1])
```

#### 1.2.1 Viewing the data with pandas

The data is diplayed nicely with pandas:

```
[3]: water_pd
```

```
[3]:      temp      density      viscosity
      Temperature (C) Density (g/cm^3) Viscosity (cm^2/s)
```

0	0	0.9999	0.01787
1	5	1.0000	1.51400
2	10	0.9997	1.30400
3	15	0.9991	1.13800
4	20	0.9982	1.00400
5	25	0.9971	0.89400
6	30	0.9957	0.80200
7	35	0.9941	0.72500
8	40	0.9923	0.65900
9	50	0.9881	0.55400
10	60	0.9832	0.47500
11	70	0.9778	0.41400
12	80	0.9718	0.36600
13	90	0.9653	0.32700
14	100	0.9584	0.29500

### 1.2.2 Plotting the data

We may also visualize both variations of density and viscosity using `matplotlib.pyplot`:

```
[4]: fig, ax1 = plt.subplots(figsize=(10,5))

color = 'tab:blue'
ax1.set_xlabel(water_pd['temp'].columns[0], fontsize=12)
ax1.set_ylabel(water_pd['density'].columns[0], color=color, fontsize=12)
ax1.plot(water_pd['temp'], water_pd['density'], 'o', color=color)
ax1.tick_params(axis='y', labelcolor=color)

ax2 = ax1.twinx()

color = 'tab:red'
ax2.set_ylabel(water_pd['viscosity'].columns[0], color=color, fontsize=12)
ax2.plot(water_pd['temp'], water_pd['viscosity'], 'o', color=color)
ax2.tick_params(axis='y', labelcolor=color)

plt.title('Temperature-dependency of density and viscosity of pure water at 1_
→atm',
         fontsize=14)
plt.show()
```



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