# Notebook

February 17, 2020

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

<- Introduction | Water Contents | References | Low-Dimensional Fittings ->

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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`:

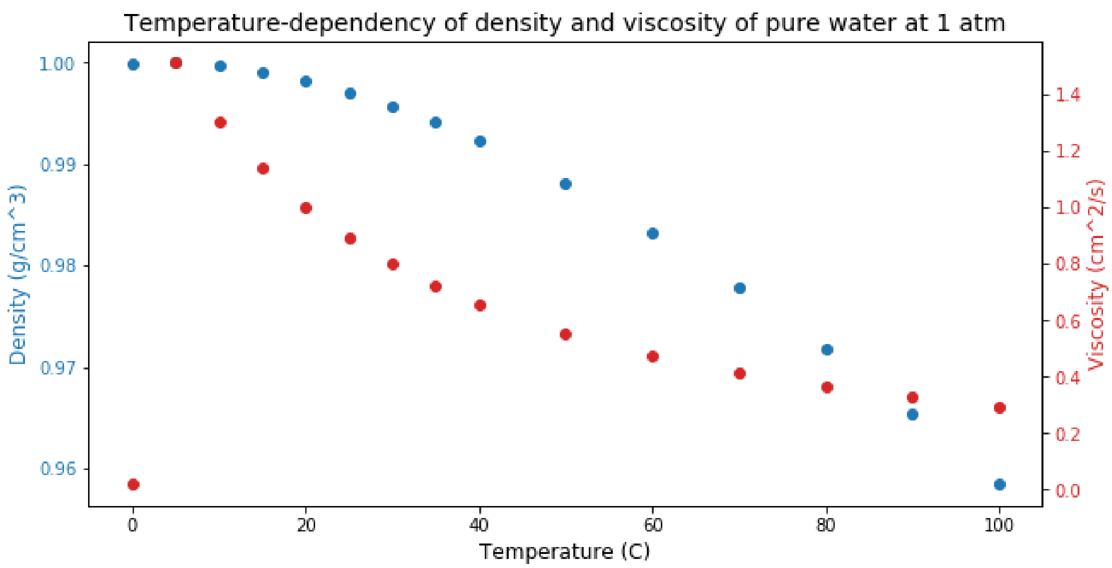
[4]:
```
fig, ax1 = plt.subplots(figsize=(10,5))

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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<- Introduction | Water Contents | References | Low-Dimensional Fittings ->