Notebook

February 15, 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

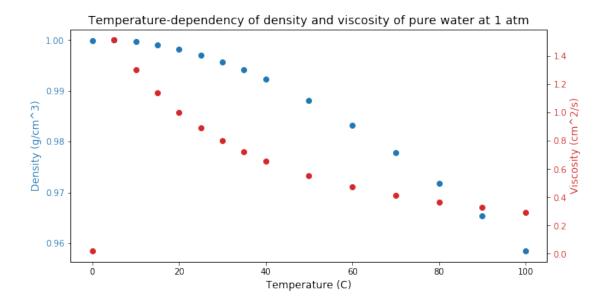The data is diplayed nicely with pandas:

```
[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`:

```python
[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()
```

Temperature-dependency of density and viscosity of pure water at 1 atm

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