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

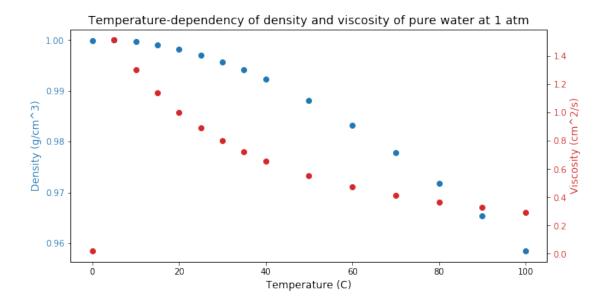The data is diplayed nicely with pandas:

```
[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`:

```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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