CH341 - Exercises Week 1

1.1 The total interaction energy of two molecules (or atoms) is described by the Lennard-Jones potential:

$$V(r) = \frac{C_1}{r^{12}} - \frac{C_2}{r^6} = 4\varepsilon\left[\left(\frac{\sigma}{r}\right)^{12} - \left(\frac{\sigma}{r}\right)^{6}\right]$$

- What is the relation between parameters C_1, C_2 and parameters ε, σ ?
  Calculate the minimum potential energy between two molecules (or atoms) and the distance that corresponds to this minimum.
- For argon the parameters are as following: $\sigma = 3.4 \cdot 10^{-10}\ \mathrm{m}$ et $\varepsilon = 1.65 \cdot 10^{-21}\ \mathrm{J}$.
  Calculate the value of the potential energy at the minimum and the corresponding distance between argon atoms.

1.2 Calculate the surface tension work done when spherical droplets with an average radius of 1.0x10^{-3} mm agglomerate to form a sphere of 1 litre of water at 20°C.
The surface tension of water is 72.8x10^{-3} J/m^2 at 20°C.

1.3 Droplets of mercury are deposited on a glass plate. What is the pressure difference between the inside and the outside of a droplet (supposed to be spherical) if its diameter is 1 mm or 0.1 mm? ($\gamma_{Hg} = 484\ \mathrm{mNm^{-1}}$ at $T = 20°\mathrm{C}$). What fraction of an atmosphere does this difference in pressure represent?