HW2-5 Soln)

The effective volume of <u>one</u> particle is $\pi d^2 l$, with *l* the MFP. If there are N particles in the container, then V = NV₀. So,

$$PV = nRT$$
$$\frac{PNV_o}{n} = RT$$
$$PN_A \pi d^2 l = RT$$
$$l = \frac{4RT}{PN_A \pi d^2}$$

For He, the table has $d = 2.4 \times 10^{-10}$ m, so

$$l = \frac{(8.3)300}{10^5 (6.023 \times 10^{23}) \pi (2.4 \times 10^{-10})^2} = \frac{2.3 \times 10^{-8} \text{m}}{2.3 \times 10^{-8} \text{m}}$$

For Xe, the table has $d = 5.3 \times 10^{-10}$ m, so

$$l = \frac{(8.3)300}{10^5 (6.023 \times 10^{23}) \pi (5.3 \times 10^{-10})^2} = 4.7 \times 10^{-8} \text{m}$$

Remember that we made some approximations during this discussion.