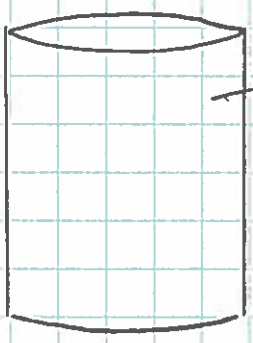

air at $T = 20°C = 293\,K$

a.) $p = 1\,atm = 1.013 \times 10^5\,Pa$

Use physicist form of IGL:

$$p = \left(\frac{N}{V}\right) k_B T$$

$$\left(\frac{N}{V}\right) = \frac{p}{k_B T} = \underline{2.505 \times 10^{25}\,m^{-3}}$$

and,

$$\lambda = \frac{1}{4\sqrt{2}\,\pi \left(\frac{N}{V}\right) r^2}$$

$\underline{r = 1 \times 10^{-10}\,m}$ (diatomic)

$$\underline{\lambda = 2.246 \times 10^{-7}\,m}$$

b.) $p = 10^{-10}\,mm\,Hg \left(\frac{1.013 \times 10^5\,Pa}{760\,mm\,Hg}\right) = 1.333 \times 10^{-8}\,Pa$

So: $\left(\frac{N}{V}\right) = \frac{p}{k_B T} = \underline{3.297 \times 10^{12}\,m^{-3}}$

and

$$\lambda = \frac{1}{4\sqrt{2}\,\pi \left(\frac{N}{V}\right) r^2}$$

$$= \underline{1.707 \times 10^6\,m} = \underline{1707\,km}$$

essentially a collisionless gas.