84. Using the ideal gas law, one mole occupies a volume equal to

$$V = \frac{nRT}{p} = \frac{(1)(8.31)(50)}{1 \times 10^{-8}} = 4.2 \times 10^{10} \text{ m}^3 \ .$$

Therefore, the number of molecules per unit volume is

$$\frac{N}{V} = \frac{nN_\text{A}}{V} = \frac{(1)\left(6.02 \times 10^{23}\right)}{4.2 \times 10^{10}} = 1.4 \times 10^{13} \ \frac{\text{molecules}}{\text{m}^3} \ .$$

Using $d = 20.0 \times 10^{-9}$ m, Eq. 20-25 yields

$$\lambda = \frac{1}{\sqrt{2}\,\pi d^2 \left(\frac{N}{V}\right)} = 39 \text{ m} \ .$$