34. (a) We set up a ratio using Eq. 20-25:

$$\frac{\lambda_{\rm Ar}}{\lambda_{\rm N_2}} = \frac{1/\left(\pi\sqrt{2}d_{\rm Ar}^2(N/V)\right)}{1/\left(\pi\sqrt{2}d_{\rm N_2}^2(N/V)\right)} = \left(\frac{d_{\rm N_2}}{d_{\rm Ar}}\right)^2 .$$

Therefore, we obtain

$$\frac{d_{\rm Ar}}{d_{\rm N_2}} = \sqrt{\frac{\lambda_{\rm N_2}}{\lambda_{\rm Ar}}} = \sqrt{\frac{27.5}{9.9}} = 1.7 .$$

(b) Using Eq. 20-2 and the ideal gas law, we substitute $N/V = N_{\rm A}n/V = N_{\rm A}p/RT$ into Eq. 20-25 and find

$$\lambda = \frac{RT}{\pi\sqrt{2}d^2 p N_{\rm A}} .$$

Comparing (for the same species of molecule) at two different pressures and temperatures, this leads to

$$\frac{\lambda_2}{\lambda_1} = \left(\frac{T_2}{T_1}\right)\left(\frac{p_1}{p_2}\right) .$$

With $\lambda_1 = 9.9 \times 10^{-6}$ cm, $T_1 = 293$ K (the same as T_2 in this part), $p_1 = 750$ torr and $p_2 = 150$ torr, we find $\lambda_2 = 5.0 \times 10^{-5}$ cm.

(c) The ratio set up in part (b), using the same values for quantities with subscript 1, leads to $\lambda_2 = 7.9 \times 10^{-6}$ cm for $T_2 = 233$ K and $p_2 = 750$ torr.