18.20. Solve: (a) The average translational kinetic energy per molecule is

$$\varepsilon_{avg} = \tfrac{1}{2}mv_{rms}^2 = \tfrac{3}{2}k_B T$$

This means ε_{avg} doubles if the temperature T doubles.

(b) The root-mean-square speed v_{rms} increases by a factor of $\sqrt{2}$ as the temperature doubles.

(c) The mean free path is

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

Because N/V and r do not depend on T, doubling temperature has no effect on λ.