The second term vanishes because of the lack of correlation.
(b) The average of the second term is

$$\left\langle \frac{1}{2}\sum_n m_n(\boldsymbol{v}'_n)^2 \right\rangle = \frac{3}{2}MU^2 \tag{17-A26}$$

18 Viscosity

18.1 (a) In a unit volume, the ideal gas law tells us that the number of moles is p/RT, and since there is N_A molecules in a mole, the result follows. For $T = 300$ K and $p = 1$ bar, we get $n \approx 2.4 \times 10^{25}$ m^{-3}.
(b) A single molecule of diameter d will collide with a molecule of the same size if it gets inside a circle of radius d centered at the target molecule. In a cylinder with radius d and length equal to the mean-free-path λ, there must be exactly one molecule, or $n\lambda\pi d^2 = 1$, where n is the density of molecules. For air this becomes $\lambda \approx 147$ nm.
(c) For air the speed of sound is $c \approx 330$ m/s and the viscosity estimate becomes $\eta \approx \rho\lambda^2/\tau \approx \rho\lambda c \approx 5 \times 10^{-5}$ Pas, which is a factor 2 too large.

18.2 In an isentropic gas we have $p \sim \rho^\gamma$ and $p \sim \rho T$, so that $\rho \sim T^{1/(\gamma-1)}$ and $\nu \sim T^{1/2-1/(\gamma-1)}$. For monatomic gases $\gamma = 5/3$ and $\nu \sim T^{-1}$, for diatomic $\gamma = 7/5$ and $\nu \sim T^{-2}$, and for multiatomic $\gamma = 4/3$ and $\nu \sim T^{-5/2}$.

18.3 One finds $d \approx 3$ μm and $t_0 \approx 11$ s. The layer seems a bit thin compared to, for example curling (example 18.2.1). The tire pattern probably influences the "ice grip" considerably.

18.4 (a) The total flux is

$$Q(t) = \int_{-\infty}^{\infty} v_x(y,t)\,dy\ . \tag{18-A1}$$

From (18-5) we get by integrating over y

$$\frac{dQ}{dt} = \nu \int_{-\infty}^{\infty} \frac{\partial^2 v_x}{\partial y^2}\,dy = 0\ , \tag{18-A2}$$

because $\partial v_x/\partial y$ vanishes at infinity.
(b) The total momentum per unit of length is

$$\mathcal{P} = \int_{-\infty}^{\infty} \rho_0 v_x(y,t)\,dy = \rho_0 Q \tag{18-A3}$$

and is constant because Q is.
(c) The kinetic energy per unit of length is

$$\mathcal{T} = \frac{1}{2}\rho_0 \int_{-\infty}^{\infty} v_x(y,t)^2\,dy \tag{18-A4}$$

In the Gaussian case this becomes

$$\mathcal{T} = \frac{1}{2}\rho_0 \frac{a^2}{a^2+2\nu t}\int_{-\infty}^{\infty} \exp\left(-\frac{y^2}{a^2+2\nu t}\right)\,dy \tag{18-A5}$$

$$= \frac{1}{2}\rho_0\sqrt{\pi}\frac{a^2}{\sqrt{a^2+2\nu t}} \tag{18-A6}$$

