18.23. Solve: **(a)** The average kinetic energy of a proton at the center of the sun is

$$\varepsilon_{\text{avg}} = \tfrac{3}{2}k_{\text{B}}T \approx \tfrac{3}{2}\left(1.38\times10^{-23}\ \text{J/K}\right)\left(2\times10^{7}\ \text{K}\right) = 4\times10^{-16}\ \text{J}$$

(b) The root-mean-square speed of the proton is

$$v_{\text{rms}} = \sqrt{\frac{3k_{\text{B}}T}{m}} \approx \sqrt{\frac{3\left(1.38\times10^{-23}\ \text{J/K}\right)\left(2\times10^{7}\ \text{K}\right)}{1.67\times10^{-27}\ \text{kg}}} = 7\times10^{5}\ \text{m/s}$$