Constants and conversions that may or may not be helpful:

- Boltzmann constant: k = 1.38×10^{-16} erg K^{-1}
- 1 Joule (J) = 10^7 erg
- sound speed: $c_s = \sqrt{\frac{\gamma P}{\rho}}$; $\gamma = \frac{5}{3}$
- ideal gas law: $P = nkT = \frac{\rho kT}{m_u \mu}$

(a) **2 points:** In one or two sentences, explain qualitatively what the scale height is.

Answer: The scale height is the distance over which a quantity decreases by a factor of $1/e$.

(*1 point for something about a quantity changing over a distance, 1 point for knowing the dropoff is exponential.*)

(b) **3 points:** § 2.1 gives the pressure scale height as $H_P = c^2/(\gamma g)$. Show that this is equal to $H = kT/m_u g$.

Answer: Using the sound speed $c_s = \sqrt{\frac{\gamma P}{p}}$,

$$\begin{aligned} H &= \frac{c_s^2}{\gamma g} \\ &= \frac{(\gamma P/\rho)}{\gamma g} \\ &= \frac{P}{\rho g} \\ &= \frac{\rho kT}{m_u \rho g} \\ &= \frac{kT}{m_u g} \end{aligned}$$

(*2 points for using correct equations (if math errors led to wrong expression), 1 more for deriving correct expression.*)