

41. (a) From $\rho_H = 0.35\rho = n_p m_p$, we get the proton number density n_p :

$$n_p = \frac{0.35\rho}{m_p} = \frac{(0.35)(1.5 \times 10^5 \text{ kg/m}^3)}{1.67 \times 10^{-27} \text{ kg}} = 3.14 \times 10^{31} \text{ m}^{-3} .$$

- (b) From Chapter 20 (see Eq. 20-9), we have

$$\frac{N}{V} = \frac{p}{kT} = \frac{1.01 \times 10^5 \text{ Pa}}{(1.38 \times 10^{-23} \text{ J/K})(273 \text{ K})} = 2.68 \times 10^{25} \text{ m}^{-3}$$

for an ideal gas under “standard conditions.” Thus,

$$\frac{n_p}{(N/V)} = \frac{3.14 \times 10^{31} \text{ m}^{-3}}{2.44 \times 10^{25} \text{ m}^{-3}} = 1.2 \times 10^6 .$$