Problem 1.18 v_{rms} for N_2 at room temperature

$$v_{rms} = \sqrt{\frac{3kT}{m}}$$

Take $T = 300\,K$

$m = ?$

N_2 gas: $m = 2 \cdot m_N = 2 \cdot 14.0$ g/mole

$m = 28$ g/mole

but our formula is per molecule

$$\therefore m = \frac{28g}{mole} \times \frac{1\,mole}{6.02\times10^{23}\,mol} \times \frac{1kg}{1000g}$$

$m = 4.65\times10^{-26}$ kg.

$$v_{rms} = \sqrt{\frac{3\cdot(1.381\times10^{-23}\,J/K)(300K)}{4.65\times10^{-26}\,kg}} \simeq 517\,m/s$$

alternatively

$$v_{RMS} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3R}{N_A m}T} = \sqrt{\frac{3(8.314\,J/mol\text{-}K)(300K)}{0.028\,kg/mol}}$$

≈ 517 m/s

OR...

$$v_{RMS} = \sqrt{\frac{3kT\,c^2}{mc^2}} = \sqrt{\frac{3\left(\frac{1}{40}eV\right)}{(28\cdot931.5\times10^6\,eV)}}\cdot(3\times10^8\,m/s)$$

≈ 509 m/s

(due to round-off in that $1/40$ eV).