Reading 2/11

(1) $m_{N_2} = (28.0)(1.67 \times 10^{-27} \text{ kg}) = 4.68 \times 10^{-26}$ kg

$m_{O_2} = \cancel{\ \ } \; 5.34 \times 10^{-26}$ kg

$$\boxed{v_{rms,N_2}} = \sqrt{\frac{3(1.38 \times 10^{-23})(293)}{4.68 \times 10^{-26}}} \text{ m/s} = \boxed{510 \text{ m/s}}$$

$$\boxed{v_{rms,O_2} = 480 \text{ m/s}}$$

N_2 molecules move faster because they're lighter than O_2

(2) (b) $(KE)_{trans} = \frac{3}{2} N k_B T$ applies to both monoatomic and diatomic gases at all temperatures (see pg. 559)

3 "quadratic" d.o.f.'s $(x, y, z) \Rightarrow \frac{3}{2} k_B T$ per molecule

(Equipartition thm)

(a) $E_{th} = (KE)_{trans}$ applies to monatomic gases and diatomic gases at low temp.

At medium temp $E_{th} = \frac{5}{2} N k_B T$, high temp $E_{th} = \frac{7}{2} N k_B T$ because rotational and vibrational d.of.s become available.

(3) (a) & (b) low: 3 (translational KE)

medium: 5 (trans. KE and rotational KE)

high: 7. (trans. KE + rotational KE + vibrational KE & PE)

(c) C_v @ 300K is $\frac{5}{2} R \Rightarrow$ medium temp

(Fig. 20.11)