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Physics 2C, Winter 2020

Reading Assignment due Tuesday 2/11: Submit via Gradescope by 11:30am

1. In a room full of air, the air is mainly composed of Nitrogen and Oxygen molecules (both at room temperature). Find (to two significant figures) the values of v_{rms} for both molecules. (Eq. (20.26) relates v_{rms} to absolute temperature.)
2. Describe whether the following equations apply to monoatomic atoms, diatomic molecules, both, or neither:
 - (a) $E_{\text{th}} = (3/2)Nk_{\text{B}}T$
 - (b) $(\text{KE}) = (3/2)Nk_{\text{B}}T$

Note this is the energy of all of the molecules. If you want the average energy per molecule, you would exclude the “N” from these equations.

3. An equation for the average thermal energy per gas molecule (monoatomic or diatomic) is given by

$$E_{\text{th}} = \frac{f}{2}k_{\text{B}}T$$

where f is the number of degrees of freedom accessible to the gas molecules.

- (a) How many degrees of freedom does a diatomic molecule have at low temperatures, medium temperatures, and high temperatures (consult Figure 20.11).
- (b) Describe what degrees of freedom are accessible (e.g., “translational but nothing else,” “translational + vibrational but nothing else,” etc.) to the gas molecules in each of three temperature regions (low, medium and high). Again, the discussion surrounding Figure 20.11 is useful.
- (c) Is room temperature considered low, medium, or high temperature? Remember, the horizontal scale in Figure 20.11 is logarithmic.

For extra practice (not due): From Chapter 20 of Knight, 4th edition: Conceptual Questions: 7-8. Exercises: 20, 24, 27, 29, 33-36.