

Answer on Question #65325, Physics Molecular Physics Thermodynamics

Calculate the most probable speed, average speed and the root mean square speed for gas molecules at 300 K. The mass of gas molecule is 5×10^{-26} kg and $k_B = 1.38 \times 10^{-23}$ J/K

Solution:

Data:

$$T = 300^\circ K$$

$$m = 5 \times 10^{-26} \text{ kg}$$

$$k = 1.38 \times 10^{-23} \frac{\text{J}}{^\circ K}$$

$$\langle v \rangle = \sqrt{\frac{8kT}{\pi m}} = \sqrt{\frac{8 \times 1.38 \times 10^{-23} \times 300}{3.1415 \times 5 \times 10^{-26}}} = 459.19 \frac{m}{s}$$

$$v_{\text{most probable}} = \sqrt{\frac{2kT}{m}} = \sqrt{\frac{2 \times 1.38 \times 10^{-23} \times 300}{5 \times 10^{-26}}} = 406.94 \frac{m}{s}$$

$$\sqrt{\langle v^2 \rangle} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3 \times 1.38 \times 10^{-23} \times 300}{5 \times 10^{-26}}} = 498.4 \frac{m}{s}$$

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