

**Answer on** Question #66465, 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  $5 \times 10^{-26}$  kg and  $k_B = 1.38 \times 10^{-23}$  JK<sup>-1</sup>

**Find:**  $v_{m.p.} = ?$   $v_a = ?$   $v_{r.m.s.} = ?$

**Given:**

$$T = 300 \text{ K}$$

$$m_0 = 5 \times 10^{-26} \text{ kg}$$

$$k = 1.38 \times 10^{-23} \text{ J} \times \text{K}^{-1}$$

**Solution:**

$$\text{The most probable speed: } v_{m.p.} = \sqrt{\frac{2kT}{m_0}} \quad (1)$$

$$\text{Of (1)} \Rightarrow v_{m.p.} = 406.9 \text{ m/s}$$

$$\text{Average speed: } v_a = \sqrt{\frac{8kT}{\pi m_0}} \quad (2)$$

$$\text{Of (2)} \Rightarrow v_a = 459.3 \text{ m/s}$$

The root mean square speed:

$$v_{r.m.s.} = \sqrt{\frac{3kT}{m_0}} \quad (3)$$

$$\text{Of (3)} \Rightarrow v_{r.m.s.} = 498.4 \text{ m/s}$$

**Answer:**

$$v_{m.p.} = 406.9 \text{ m/s}$$

$$v_a = 459.3 \text{ m/s}$$

$$v_{r.m.s.} = 498.4 \text{ m/s}$$