

## Answer Question #68096 – Physics – Mechanics – Relativity

The temperature in interstellar space is 2.7 K. Find the rms speed of hydrogen molecules at this temperature.

### Solution.

Root-mean-square speed is the measure of the speed of particles in a gas which is most convenient for problem solving within the kinetic theory of gases. It is defined as the square root of the average velocity-squared of the molecules in a gas. It is given by the formula

$$v_{rms} = \sqrt{\frac{3RT}{M_m}}$$

where  $v_{rms}$  is the root mean square of the speed in the meters per second,  $M_m$  is the molar mass of the gas in kilogram per mole,  $R = 8.31 \frac{J}{mol \cdot K}$  and  $T$  is the temperature in kelvins. [1]

According to the condition of the problem  $T = 2.7K$ ,  $M_m = 0.002 \frac{kg}{mol}$  (the molecular mass of hydrogen),  $T = 2.7K$ . Hence

$$v_{rms} = \sqrt{\frac{3 \cdot 8.31 \cdot 2.7}{0.002}} \approx 183.5 \frac{m}{s}$$

**Answer.**  $183.5 \frac{m}{s}$

1. [https://en.wikipedia.org/wiki/Root-mean-square\\_speed](https://en.wikipedia.org/wiki/Root-mean-square_speed)

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