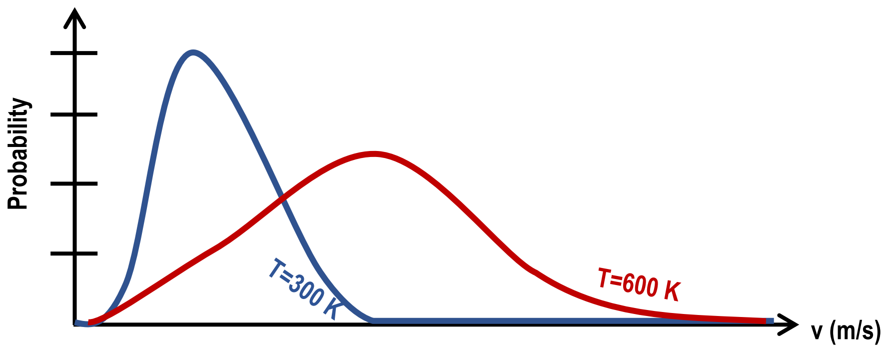
CONCEPT: SPEED DISTRIBUTION OF IDEAL GASES

● Gas particles do *not* all travel at the same speed. As they collide, particles speed up and slow down randomly.

- If you plotted the # of particles vs. the speeds, you get a ______________ (a.k.a **Maxwell-Boltzmann Distribution**)

EXAMPLE: The speed distributions for an ideal gas at different temperatures is shown below. The ideal gas particles have a molar mass of 28 g/mol. **a)** Calculate the most probable, average, and RMS speeds of gas particles in a sample at 300K. **b)** If you picked a particle from the 600K gas sample at random, what is the speed you'd most likely measure?



● There are 3 special speeds you need to know:

Most Probable (Likely) Speed	Average Speed	RMS Speed
$v_{MP} = \sqrt{\_\_\_\_} = \sqrt{\_\_\_\_}$	$v_{avg} = \sqrt{\_\_\_\_} = \sqrt{\_\_\_\_}$	$v_{rms} = \sqrt{\frac{3k_BT}{m}} = \sqrt{\frac{3RT}{M}}$
● Highest probability = _______ of the curve	● True average	● Type of average skewed to higher v

● For any given temperature, v_{MP} __ v_{avg} __ v_{rms}

- In general, all 3 speeds increase as T increases, and the curve gets flatter.

PROBLEM: The escape velocity from the Earth is approximately 11.2 km/s. If the mass of helium atoms is 6.64 $\times 10^{-27}$ kg, at what temperature would the average speed of helium atoms be equal to the escape velocity?

A) 2361 K
B) 2.11 K
C) 4.5×10^{-42} K
D) 3.9×10^{-20} K

IDEAL GAS EQs & Constants

$PV = nRT = Nk_BT$

$v_{MP} = \sqrt{\frac{2k_BT}{m}} = \sqrt{\frac{2RT}{M}}$

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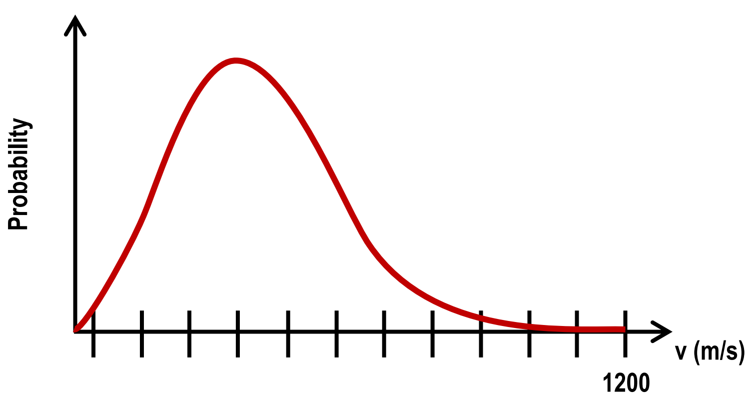
$R = 8.314 \frac{J}{mol\ K}$

$k_B = 1.38\times10^{-23} \frac{J}{K}$

$N_A = 6.02\times10^{23}$

PROBLEM: The graph below plots the probability distribution for oxygen, which has a molar mass of 32 g/mol. The farthest tick on the x-axis is set to 1200 m/s. What is the temperature of this sample of oxygen gas?



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