

CONCEPT: AVERAGE KINETIC ENERGY OF IDEAL GASES

- Kinetic-Molecular Theory: Equations connecting P,V,T (Macroscopic) to v, K (Microscopic)

- Recall: **Temperature** is related to the Average Kinetic Energy _____:

$$K_{avg} = \underline{\hspace{2cm}}$$

- k_B (Boltzmann Constant) = $1.38 \times 10^{-23} \frac{J}{K}$
- T *MUST* be in Kelvin (K)

EXAMPLE: **a)** Calculate the average kinetic energy of Oxygen molecules at 27°C. **b)** Would the answer be any different if the molecules were Nitrogen?

- Average Kinetic Energy depends *ONLY* on the _____ of the gas, not the TYPE of gas.

PROBLEM: In a sample of gas, you pick a particle at random. The mass of the particle is 1.67×10^{-27} kg and you measure its speed to be 1600 m/s. If that particle's kinetic energy is equal to the average kinetic energy of the gas particles, what is the temperature of the sample of gas?

- A) 232 K
- B) 0.065 K
- C) 103.3 K
- D) 206.5 K

IDEAL GAS EQs & Constants	
$PV = nRT = Nk_B T$	
$K_{avg} = \frac{3}{2} k_B T$	
$R = 8.314 \frac{J}{mol \cdot K}$	$= 0.08206 \frac{L \cdot atm}{mol \cdot K}$
$k_B = 1.38 \times 10^{-23} \frac{J}{K}$	
$N_A = 6.02 \times 10^{23} \frac{particles}{mol}$	

PROBLEM: A spherical balloon of volume $4 \times 10^{-3} \text{ m}^3$ contains an ideal gas at a pressure of 1.2 atm. If the average kinetic energy of the gas particles is 7.2×10^{-21} J, how many moles of gas are inside the balloon?

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CONVERSIONS
1 L = 0.001 m ³
1 atm = 1.01 × 10 ⁵ Pa