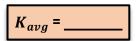
CONCEPT: AVERAGE KINETIC ENERGY OF IDEAL GASES

- Kinetic-Molecular Theory: Equations connecting P,V,T (Macroscopic) to v, K (Microscopic)
 - Recall: **Temperature** is related to the *Average Kinetic Energy*



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

<u>EXAMPLE</u>: 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 <u>TYPE</u> of gas.

<u>PROBLEM</u>: 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

$$PV = nRT = Nk_BT$$

$$K_{avg} = \frac{3}{2}k_BT$$

$$R = 8.314 \frac{J}{mol \cdot K} = 0.08206 \frac{L \cdot atm}{mol \cdot K}$$

$$k_B = 1.38 \times 10^{-23} \frac{J}{K}$$

$$N_A = 6.02 \times 10^{23} \frac{\text{particles}}{\text{mol}}$$

<u>PROBLEM</u>: A spherical balloon of volume 4×10^{-3} m³ 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

1L = 0.001 m³ 1 atm = 1.01×10⁵ Pa