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} = _____

- k_B (Boltzmann Constant) **=** $1.38\times10^{-23}\ \frac{J}{K}$

- ***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

$PV = nRT = Nk_BT$

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

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

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

$N_A = 6.02\times10^{23}\ \frac{\text{particles}}{\text{mol}}$

PROBLEM: A spherical balloon of volume 4×10^{-3} 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

1L = 0.001 m^3

1 atm = 1.01×10^5 Pa