Answer on Question #63868, Physics / Mechanics | Relativity

Consider an O_2 rotating in x, y plane about the z-axis the rotation passes through the center of molecule perpendicular to its length the mass of each O_2 is 2.26 x 10^{-26} kg and at room temperature the average separation between the 2 atoms.
a) Find the moment of inertia of the molecule about the z-axis.
b) If the angular Speed of the molecule about the z-axis is 4.6pi x 10^{12} rad/s. What is its rotational kinetic energy?

Solution:

a) The moment of inertia of the molecule:

$$J = m\left(\frac{d}{2}\right)^2 + m\left(\frac{d}{2}\right)^2 = \frac{1}{2}md^2$$

Radius of an atom of oxygen r = 48 x 10^{-12} m
d = 4 x 48 x 10^{-12} m = 1.92 10^{-10} m
Then

$$J = \frac{1}{2} \times 2.26 \cdot 10^{-26} \times (1.92 \cdot 10^{-10})^2 = 4.17 \cdot 10^{-46}\ kgm^2$$

b) The kinetic energy of rotational motion of molecules:

$$KE = \frac{1}{2}I\omega^2$$

Then

$$KE = \frac{1}{2}4.17 \cdot 10^{-46} \times (4.6\pi \cdot 10^{12})^2 = 4.32 \cdot 10^{-20}J$$

Answer: a) $\mathbf{4.17 \cdot 10^{-46}\ kgm^2}$; b) $\mathbf{4.32 \cdot 10^{-20}J}$

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