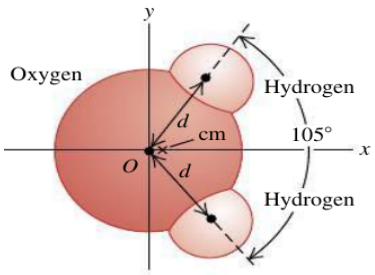
Tutorial 8

PHY 101 Monsoon 2024

Q1. The figure shows a simple model of a water molecule. The oxygen–hydrogen separation is d=9.57× 10^{-11} m. Each hydrogen atom has mass 1.0 u, and the oxygen atom has mass 16.0 u. Find the position of the centre of mass. Nearly all the mass of each atom is concentrated in its nucleus, whose radius is only about 10^{-5} times the overall radius of the atom. Hence we can safely represent each atom as a point particle. We can choose our coordinate system such that the x-axis lie along the molecule's symmetry axis as shown in the figure.



Q2. Two cars are moving towards each other on a straight road. Car A has a mass of 1500 kg and is moving at a speed of 20 m/s, while Car B has a mass of 1000 kg and is moving at a speed of 15 m/s. The two cars collide head-on and come to a complete stop after the collision. Assume the collision is perfectly inelastic (they stick together after the collision). Calculate the velocity of the combined mass immediately after the collision (before they come to rest).

Q3. A shell flying with a velocity u (mass '3m') bursts into three identical fragments (mass 'm') so that the kinetic energy of the system increases k times. What maximum velocity can one of the fragments attain?

Q4. A lighter particle moving with a speed of 10 m s^{-1} collides with an object of double its mass moving in the same direction with half its speed. Assume that the collision is a one dimensional elastic collision. What will be the speed of both particles after the collision?

Q5. A bullet of mass 50 g is fired from below into a suspended object of mass 450 g. The object rises through a height of 1.8 m with bullet remaining inside the object. Find the speed of the bullet. Take g = 10 ms^{-2}.