Physics 341 Sage Assignment 1

S1. In this exercise, we will show that as the mass in a disk gets progressively more and more concentrated towards the edge, the moment of inertia approaches that of a ring.

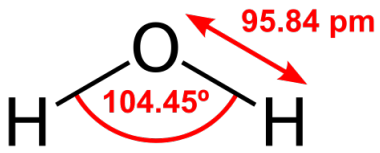
The disk has a radius R, and a density σ given by

$$\sigma(r, \sigma_0, R, n) = \sigma_0 \left(\frac{r}{R}\right)^n$$

where $n > 0$.

Calculate the moment of inertia as a function of n, $I(n)$, and the mass as function of n, $M(n)$. Then divide $I(n)$ by $M(n)$ and take the limit $n \to \infty$, to verify that I tends to that of a ring.

S2. The figure shows the geometry of a water molecule.



Take the masses of the H atoms as 1 u, and the mass of the O atom as 16 u. Work in a coordinate system with the O atom at the origin, and with the symmetry axis of the molecule as the y axis, so that the molecule is in the (x, y) plane.

(a) Calculate the position vectors of the two H atoms. (Bear in mind that the arguments of the trig functions in Sage need to be in radians).

(b) Calculate the position vector of the centre of mass of the molecule.

(c) Calculate the moments of inertia of the molecule about each of the coordinate axes.