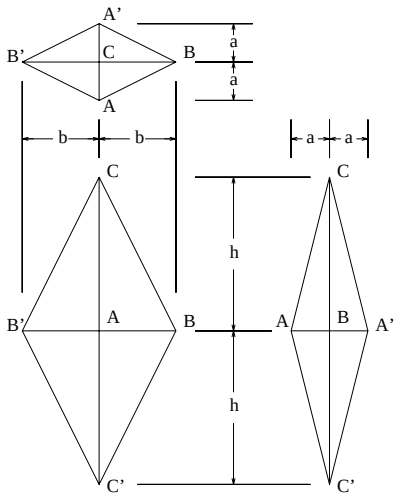
Physics 507 Homework #6
Due: Thursday, Oct. 14, 2010

6.1 A diamond shaped object is shown in top, front, and side views. It is an octahedron, with 8 triangular flat faces.



It is made of solid aluminum of uniform density, with a total mass M. The dimensions, as shown, satisfy $h > b > a$.
(a) Find the moment of inertia tensor about the center of mass, clearly specifying the coordinate system chosen.
(b) About which lines can a stable spinning motion, with fixed $\vec{\omega}$, take place, assuming no external forces act on the body?

6.2 We defined the general rotation as $A = R_z(\psi) \cdot R_y(\theta) \cdot R_z(\phi)$. Work out the full expression for $A(\phi, \theta, \psi)$, and verify the last expression in (4.31). [For this and exercise 6.3, you might want to use a computer algebra program such as mathematica or maple, if one is available.]

6.3 Find the expression for $\vec{\omega}$ in terms of $\phi, \theta, \psi, \dot{\phi}, \dot{\theta}, \dot{\psi}$. [This can be done simply with computer algebra programs. If you want to do this by hand, you might find it easier to use the product form $A = R_3 R_2 R_1$, and the rather simpler expressions for $R\dot{R}^T$. You will still need to bring the result (for $R_1 \dot{R}_1^T$, for example) through the other rotations, which is somewhat messy.]