Classical Mechanics, Homework #6

PHY 6/75101 **Due November 12, 2007**

Student _____

Which of the following statements are true? Keep in mind that several (or none, or all) of these statements may be valid. (Fill-in for true; leave blank for false.)

◯ Finding the principal moments of inertia is an example of a broader class of problem — finding the eigenvalues of a matrix operator.

◯ The principal axes of inertia are examples of eigenvectors such as arise in Quantum Mechanics.

◯ The inertia ellipsoid (see textbook p. 197) is an ellipsoid with the same inertia tensor as the rigid body in question.

◯ If our rigid body is an ellipsoid, the inertia ellipsoid is identical to the body itself.

◯ The purpose of "spin-balancing" an automobile wheel is to cancel asymmetries that cause the center of gravity (i.e., center of mass) of the wheel to not coincide exactly with the center of the axis of rotation.

◯ It is possible for two equal-mass rigid bodies that look very different to have the same inertia tensor about their centers of mass.

◯ After diagonalizing an inertia tensor, the origin of the coordinate system will coincide with the center of mass of the rigid body.

◯ An inertia tensor is always defined in terms of a Cartesian coordinate system.

◯ The process of diagonalizing an inertia tensor is equivalent changing the distribution of mass in the body without changing the relationship between applied torque and angular acceleration.

◯ An inertia tensor with $I_{11} = I_{22} = I_{33}$ could be the inertia tensor for a sphere or for a cube.

◯ A piece of machinery initially rotates about a principal axis through its center of mass, and then the axis of rotation is moved slightly, although it still passes through the center of mass. We expect vibration or stress on the bearings, or both, to increase.

◯ The principal moments of a rigid body have no intrinsic ordering (with regard to which one is first, *etc.*), but it is customary to number them in order of increasing size.

◯ For any rigid body, the principal axis aligned with its longest dimension must be the first principal axis.

◯ For any homogeneous rigid body, the principal axis aligned with its shortest dimension must be the first principal axis.

◯ The principal moments can be positive or negative.

◯ The diagonal components of an inertia tensor can be positive or negative.

◯ The off-diagonal components of an inertia tensor can be positive or negative.

◯ All three principal axes must pass through the center of mass.

◯ All three principal axes must pass through the origin of the coordinate system being used.

◯ Suppose the inertia tensor for a certain body about a certain point is not known. It is frequently possible to identify the principal axes by inspection. Then the inertia tensor can be calculated using those axes. This tensor does not need to be diagonalized because it should be diagonal already.