Announcements

- Homework 10 not due the coming Monday, but the Monday after
- I am ONE QUESTION from having the Midterms all graded. Should be done by this evening.
- CompDay on Monday will be on computing inertial tensors with Python and Sympy
- Don't forget to start thinking/reading through your Final Chapter!
- Responses: `rembold-class.ddns.net`

Today's Objectives

- Understand why principal axes are useful
- Be able to compute moments of inertia about a primary axis
- Be able to determine the principal axis of some given mass distribution
- Understand how to use principal axes to reason about the the spinning motion of a mass distribution.

Q1

Consider a mass distribution that when rotated about its center of mass yields the following inertial tensor:

$$\vec{\mathbf{I}} = \begin{bmatrix} 4 & 0 & 2 \\ 0 & 4 & 0 \\ 2 & 0 & 4 \end{bmatrix}$$

in the standard Cartesian coordinate basis. Which axis would be a principal axis?

A) The x axis
B) The y axis
C) The z axis
D) None of the above

Q2

Taking the same inertial tensor as the last question, all of the following values are the moment of inertia about a principal axis *except one*. Which of the following is NOT a moment of inertia about a principal axis?

$$\vec{\mathbf{I}} = \begin{bmatrix} 4 & 0 & 2 \\ 0 & 4 & 0 \\ 2 & 0 & 4 \end{bmatrix}$$

A) 2
B) 4
C) 6
D) 8

Q3

We already know that the moment of inertia about the $\hat{\boldsymbol{y}}$ principal axis is 4. But which principal axis corresponds to the moment of inertia of 6?

$$\vec{\mathbf{I}} = \begin{bmatrix} 4 & 0 & 2 \\ 0 & 4 & 0 \\ 2 & 0 & 4 \end{bmatrix}$$

A) $\frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$

B) $\frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}$

C) $\frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$

D) $\frac{1}{\sqrt{2}} \begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix}$

Q4

We know have two different ways we could represent the mass distribution about some center of mass. Either in the standard Cartesian coordinates or in some set of principal axes coordinates. For the example we have been looking at, suppose it was rotating about the x-axis in the Cartesian coordinates. How would the magnitude of the angular momentum compare as seen in that coordinates system versus as seen in the principal axes coordinate system?

A) It would be larger
B) It would be smaller
C) It would be the same
D) It will depend on the rate of rotation

Q5

For a rigid body moving through space at a constant non-zero speed and rotating about its center of mass at a constant non-zero rate about a constant axis, is the principal axes coordinate system an inertial coordinate system?

A) Yes!
B) No!
C) Sometimes!
D) I have no clue what is happening!