Homework 11, Kansas State University PHYS522, Mechanics Due: Tuesday April 24, 2007 at beginning of class

Instructions

1. Read the book before starting the homework and before the lecture.
2. Start the homework early. Ask questions early.
3. Make sure you know how to do all the problems. Never surrender, giving up is not an option!
4. You only need to do 5 problems for full credit, total of 100 points.

Trajectory in a non-inertial reference frame

1. Problem 10-9

Dynamics of Rigid Bodies (do one of asterisk * problems, the other one will be counted for extra credit)

2. *Consider a circular disk of mass *m*, radius, *R* and thickness *d*. Let the disc's center of mass be at the origin and circular portion of the disc be parallel to the *xy* plane.
   a) Find all elements of the moment of inertial tensor **I** for the disc.
   b) Is this coordinate system the principle axes of the disc?

3. Problem 11-5 Part (a)
   Also:
   Show that the edge (cushion) of a billiard table should be at a height 7/10 of the diameter of the billiard ball in order that no reaction occurs between the table surface and the ball when the ball strikes the cushion.

4. *Problem 11-7

5. Eigenvalue and Eigenvector problem :Consider a matrices **A** and **B** and vector **x** where

$$\mathbf{A} = \begin{pmatrix} 4 & 0 & 1 \\ -2 & 1 & 0 \\ -2 & 0 & 1 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} -1 & 2 & 0 \\ 3 & -1 & 1 \\ 0 & 2 & 1 \end{pmatrix}, \text{ and } \mathbf{x} = \begin{pmatrix} 4 \\ -2 \\ 3 \end{pmatrix}$$

   a) Find the product **Ax** by hand.
   b) Find the product **AB** by hand.
   c) Find the eigenvalues of **A** by hand.
   d) Find the eigenvectors of **A** by hand.
   e) Check your answers for a) thru d) using *Mathematica.*

6. A rigid body consists of three masses fastened at points (*x*,*y*,*z*) as follows: *m* at (*a*,0,0), 2*m* at (0,*a*,*a*), and 3*m* at (0,*a*,-*a*).
   a) Find the moment of inertial tensor **I** .
   b) Find the principal moments and a set of orthogonal principal axes.