

**PHYS 306: HOMEWORK ASSIGNMENT No. 6:  
ROTATING RIGID BODIES**

(March 12th, 2017)

**HOMEWORK DUE: Monday, MARCH 20th, 2017**  
**To be handed in during class- Late Homework will not be accepted**

**QUESTION (1) MOMENTS of INERTIA:**

**1(a)** Derive the moment of inertia of a solid cylinder of radius  $R$ , density  $\rho$ , and length  $z_o$ , about its central axis. Having done this, suppose I have a hollow solid cylinder of outer radius  $R_2$  and inner radius  $R_1$ . Assume the material of the cylinder has density  $\rho$ , and the cylinder has length  $z_o$ . Find the moment of inertia of the cylinder about its central axis.

**1(b)** Consider a tennis racquet, which has 3 different moments of inertia  $I_1, I_2, I_3$  along its principal axes. The racquet head (the part which hits the ball) is made from a circle of wood, of diameter 20 cm, and mass 200 g, attached at its edge to a solid cylinder (the handle) of wood, of length 40 cm and mass 200 g, oriented so that its extension along its axis would pass through the centre of the circular plate. Draw the bat, and then calculate the position of the centre of mass. Then, find the 3 different moments of inertia about the centre of mass; you can assume that the radius of the cylindrical handle and the thickness of the racquet head are negligible.

**QUESTION (2) ROTATING CYLINDERS:**

**2(a)** Consider a problem in which we have a truck with 10 wheels, each of mass 100 kg and diameter 1 metre and assumed to be of uniform density, which are fixed to a truck body of mass 4 tons. If the truck is moving along at a velocity of 30 ms<sup>-1</sup>, then what are (i) its total kinetic energy, and (ii) its momentum?

**2(b)** The truck crashes into a car of mass 1 ton, whose wheels have negligible mass, and sticks to it. What is the final velocity of the pair of objects, assuming they remain stuck to each other? And how much kinetic energy is dissipated in the collision?

**END of 6th HOMEWORK ASSIGNMENT**