Module 5 Problems

Exercise 1

A solid disk with mass $m = 4kg$ and radius $r = 0.5m$ is mounted on a frictionless axle.($I_{disk} = \frac{1}{2}mr^2$)

(a) Calculate the moment of inerta of the disk about it's central axis.

(b) A force of $8N$ us applied tangentially at the rim of the disk counterclockwise. Find the resulting torque.

(c) Determine the angular acceleration of the disk.

(d) Using the Right-Hand Rule, determine whether the torque vector points into or out of the page.

Exercise 2

A hollow cylinder(a thin-walled hoop) with a mass $2kg$ and radius $0.4m$ is initially at rest. A force of $5N$ is applied tangentially to the rim for $3.0s$($I_{hoop} = mr^2$)

(a) Find the moment of inertia of the hoop about it's central axis.

(b) Determine the angular acceleration of the hoop.

(c) Calculate the final angular velocity after 3 seconds.

(d) Find the rotational kinetic energy of the hoop at 3 seconds.

Exercise 3

An ice skater is spinning with an initial angular velocity of $2rad/s$ and a moment of inertia of $I_1 = 3kg \cdot m^2$. They pull their arms in reducing their moment of inertia to $I_2 = 1.2kg \cdot m^2$. (Angular momentum: $L = I\omega$)

(a) What happens to the skaters angular speed after pulling their arms in? Why?

(b) Find the skaters new angular velocity.

(c) Calculate the initial and final rotational kinetic energy.

(d) Use the right-hand rule to determine the direction of the skaters angular momentum vector when spinning counterclockwise when viewed from above.

Exercise 2

A $6kg$ bowling ball with radius $r = 0.3m$ starts from rest and rolls down a $1.5m$ tall incline without slipping.

(a) Find the moment of inertia of the bowling ball.

(b) Determine the final rotational kinetic energy at the bottom of the incline.

(c) what is the final velocity and angular velocity of the sphere.