

Total points: 40. Total time: 1.5 hr. Show all your work.

You must write down your answers with units in the **Ans.** boxes

1. (5 pt) The angular position of a point on a wheel is given by the function $\theta(t) = 7.0t^3 - 3.0t + 2.0$. Determine the average velocity during the interval (0, 2)s.

Ans. _____

2. (5 pt) What is the angular speed of the Earth as it orbits the Sun.

Ans. _____

3. (5 pt) A large solid sphere with mass $2M$ is glued to a smaller sphere with a mass $4M$. They are being rotated about an axis through the center of the $4M$ sphere as shown in Fig. 1. Determine the moment of inertia of the system.

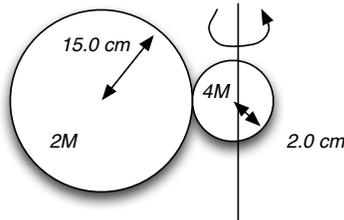


Figure 1: Moment of Inertia (Problem 3)

Ans. _____

4. (5 pt) A force $\vec{F} = (7.0\hat{i} - 2.0\hat{k})$ N is applied at a location given by the radius vector $\vec{r} = (3.0\hat{i} + 2.0\hat{k})$ m. Determine the torque about the origin of the coordinate system.

Ans.

5. (5 pt) Estimate the rotational kinetic energy of the earth as it rotates about the Sun. Assume the Earth is a uniform sphere of mass $m = 6.0 \times 10^{24}$ kg, radius 6.4×10^3 km, and distance to the Sun equal to 150 million km.

Ans.

6. (5 pt) A hoop ($I = mR^2$) of radius 0.40 m and mass 0.6 kg is rolling without slipping at a speed of 15 m/s toward an incline of slope 30° . How far up the incline will the hoop roll, assuming that it rolls without slipping?

Ans.

7. (6 pt) A 120-N board with length of $L = 10$ m rests on two supports as shown in Fig. 2. A 24-kg block is placed on the board $x = 3.0$ m from the left end. Find the force exerted by the left support on the board.

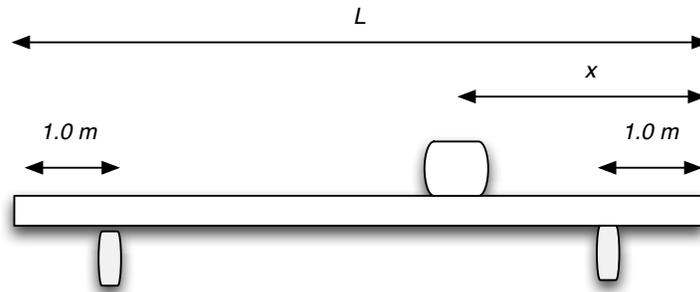


Figure 2: Board (Problem 7)

Ans.

8. (8 pt) A uniform, 400-N beam is supported by a rope and a hinge as shown in Fig. 3. If $\theta = 50^\circ$, write down the net torque about the hinged (left) end of the beam.

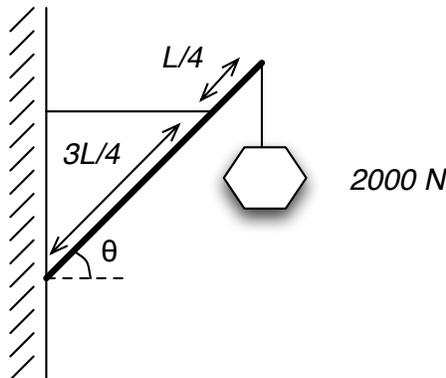


Figure 3: Beam (Problem 8)

Ans.