

## Honors Physics Rotation HW, $T=I\alpha$ (Homework)

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1.

Four masses are held in position at the corners of a rectangle by light rods as shown in Figure P8.25. The mass values are given below.

$M_1$ (kg)	$M_2$ (kg)	$M_3$ (kg)	$M_4$ (kg)
2.90	2.30	4.30	2.50

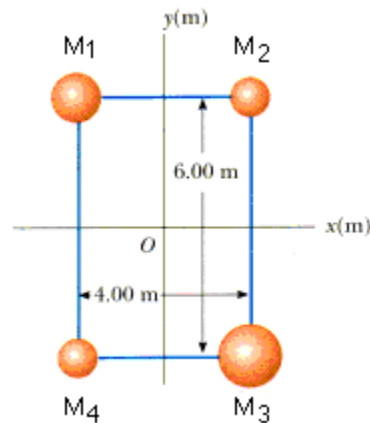


Figure P8.25.

- Find the moment of inertia of the system about the  $x$  axis.
- Find the moment of inertia of the system about the  $y$  axis.
- Find the moment of inertia of the system about an axis through  $O$  and perpendicular to the page.

2.

A potter's wheel having a radius 0.47 m and a moment of inertia  $11.2 \text{ kg}\cdot\text{m}^2$  is rotating freely at 47 rev/min. The potter can stop the wheel in 7.0 s by pressing a wet rag against the rim and exerting a radially inward force of 68 N. Find the effective coefficient of kinetic friction between the wheel and the wet rag.

3.

A 250 kg merry-go-round in the shape of a uniform, solid, horizontal disk of radius 1.50 m is set in motion by wrapping a rope about the rim of the disk and pulling on the rope. What constant force would have to be exerted on the rope to bring the merry-go-round from rest to an angular speed of 0.700 rev/s in 2.00 s?

4.

A cylindrical **6.00 kg** pulley with a radius of **0.600 m** is used to lower a **4.00 kg** bucket into a well (Fig. 8.31). The bucket starts from rest and falls for **4.00 s**.

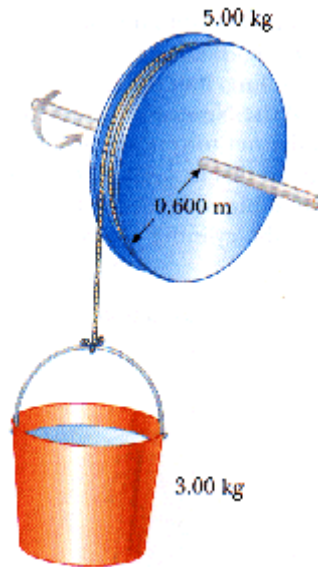


Figure P8.31

- (a) What is the linear acceleration of the falling bucket?
- (b) How far does it drop?
- (c) What is the angular acceleration of the cylinder?

5.

A light string is wrapped around a solid cylindrical spool of radius **0.500 m** and mass **0.500 kg**. A **5.00 kg** mass is hung from the string, causing the spool to rotate and the string to unwind (Fig. P8.33). Assume that the system starts from rest and no slippage takes place between the string and the spool. By direct application of Newton's second law, determine the angular speed of the spool after the mass has dropped **4.00 m**

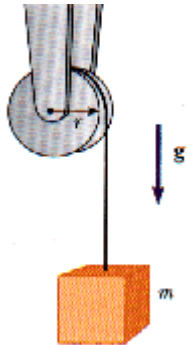


Figure P8.33.

6.

A **9.0 kg** cylinder rolls without slipping on a rough surface. At the instant its center of mass has a speed of **12.0 m/s**, determine

- (a) the translational kinetic energy of its center of mass,
- (b) the rotational kinetic energy about its center of mass, and
- (c) its total kinetic energy.

7.

A horizontal 810-N merry-go-round of radius 1.3 m is started from rest by a constant horizontal force of 50 N applied tangentially to the merry-go-round. Find the kinetic energy of the merry-go-round after 3.0 s. (Assume it is a solid cylinder.)

8.

A 260 N sphere 0.20 m in radius rolls, without slipping, 6.0 m down a ramp that is inclined at  $31^\circ$  with the horizontal. What is the angular speed of the sphere at the bottom of the hill if it starts from rest?

9.

Use conservation of energy to determine the angular speed of the spool show in Figure P8.33 after the mass  $m$  has fallen 3.90 m, starting from rest. The light string attached to this mass is wrapped around the spool and does not slip as it unwinds. Assume that the spool is a solid cylinder of radius 0.400 m and mass 0.500 kg, and that  $m = 5.00$  kg.



Figure P8.33.

10.

The system of point masses shown in Figure P8.45 is rotating at an angular speed of 9.0 rev/s. The masses are connected by light, flexible spokes that can be lengthened or shortened. What is the new angular speed if the spokes are shortened to 0.70 m? (An effect similar to that illustrated in this problem occurred in the early stages of the formation of our Galaxy. As the massive cloud of dust and gas that was the source of the stars and planets contracted, an initially small rotation increased with time.)

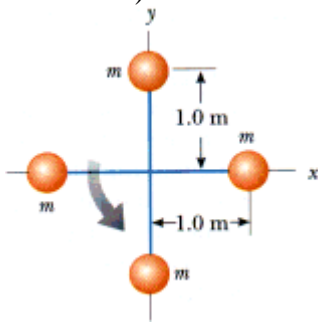


Figure P8.45.

11.

A student sits on a rotating stool holding two 3.0 kg masses. When his arms are extended horizontally, the masses are 1 m from the axis of rotation, and he rotates with an angular speed of 0.75 rad/s. The moment of inertia of the student plus stool is  $3.0 \text{ kg}\cdot\text{m}^2$  and is assumed to be constant. The student then pulls the masses horizontally to 0.30 m from the rotation axis.

(a) Find the new angular speed of the student.

(b) Find the kinetic energy of the student before and after the masses are pulled in.

12.

A merry-go-round rotates at the rate of 0.20 rev/s with an 85-kg man standing at a point 2.0 m from the axis of rotation.

(a) What is the new angular speed when the man walks to a point 0.7 m from the center? Assume that the merry-go-round is a solid 25-kg cylinder of radius 2.0 m.

(b) Calculate the change in kinetic energy due to this movement.

How do you account for this change in kinetic energy?