Physics 101 February 11, 1999
Final Exam Time: 2 hours

NAME:_____

I.D. No.:_____

Encircle your section:

Section 1	9MTTF	S. Isber
Section 2	10MTTF	T. Zableet
Section 3	11MTTF	T. Zableet
Section 5	12MTWF	B. Bodakian

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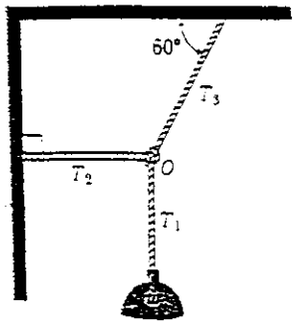
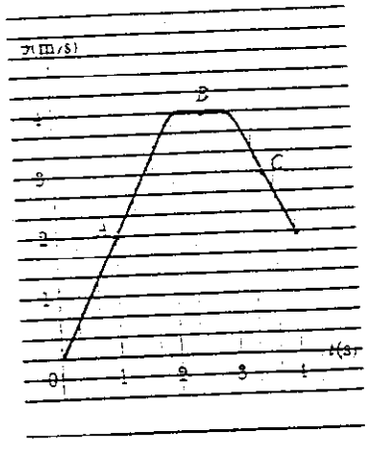
I The angular velocity of a bicycle is 4.0 rad/s at time t=0, and its angular acceleration is constant and equal to 2.0 rad/s^2.A spoke OP on the wheel is horizontal at time t=0.
What angle does this spoke make with the horizontal at time t= 3.0s?
What is the wheel's angular velocity at this time?

II In the adjacent figure a hanging lamp of weight w hangs from a cord, which is knotted at point O to two other cords, one fastened to the ceiling, the other to the wall. We wish to find the tensions in these three cords, assuming the weights of the cords to be negligible.



III. A baseball player moves in a straight-line path in order to catch a fly ball. His velocity as a function of time is shown in the adjacent graph.
Find his instantaneous acceleration at points A,B,and C on the curve.



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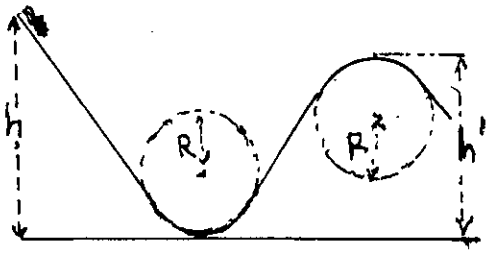
I. A stone is thrown straight upward from the top of a building with an initial velocity of 20m/s. The building is 50.0m height, and the stone just misses the edge of the roof on its way down.
Calculate the time needed for the stone to reach its maximum height?
Find the maximum height?
Find the velocity of the ball just before it hits the ground?

II. You are to design a roller coaster in which cars start from rest at a height h=30m, roll down into a valley, and then up a mountain.(see adjacent figure)
What is the speed of the cars at the bottom of the valley?
If the passengers are to feel an apparent weight eight times their weight at the bottom of the valley, what must be the radius R of the arc of circle that fits the bottom of the valley?
The top of the next mountain is an arc of circle of the same radius R. If the passengers are to feel weightless at the top of this mountain, what must be its height h'?



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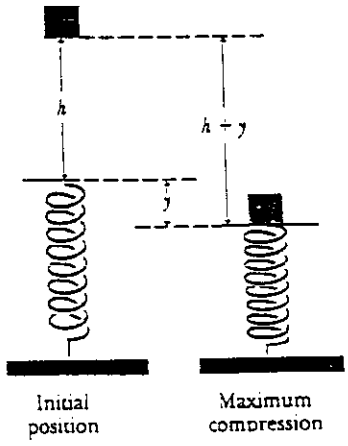
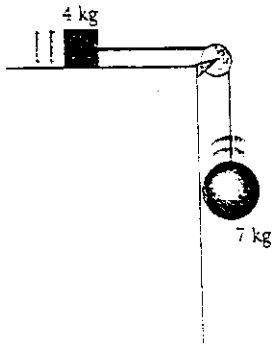
I. A brick of mass m_1 initially at rest, is dropped from a height h onto a spring whose force constant is k. Find the maximum distance y that The spring will be compressed.



II. Two objects are connected by a light string that passes over a frictionless and massless pulley (see figure). The coefficient of kinetic friction between the 4.00 kg object and the surface is 0.300. Find:

a) the acceleration of the two objects.
b) The tension in the string.



III. In an experiment on a frictionless air track two masses collide elastically. The moving mass is 60g and the initially stationary mass is 120 g. The initial velocity of the moving mass is 0.80 m/s.

a) What is the velocity of each mass after the collision?
b) Show wether the kinetic energy is conserved or not?

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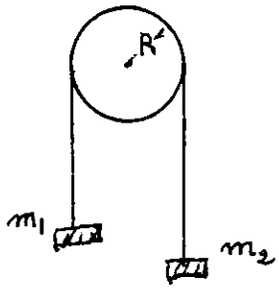
I. Two masses m_1 and m_2 are suspended from a string which runs, without sliding, over a pulley (see adjacent figure). The pulley has a radius R, a rotational inertia I about its axle and rotates without friction. Find the acceleration of the masses if $m_1 > m_2$.



II. A moving particle collides elastically with another particle of the same mass that is initially at rest. Show that the angle between the tracks of the two particles after the collision is 90°; assume that the collision is not a head-on.

III. An automobile, of total mass 1300-kg, has wheels 76.2 cm in diameter of mass 27.2 kg each.

a) What is the total kinetic energy of the automobile when traveling at 81-km/h?
b) What percentage of the kinetic energy belongs to the rotational motion of the wheels about their axles?
Assume that each wheel can be considered as a uniform disk of diameter 76.2 cm,

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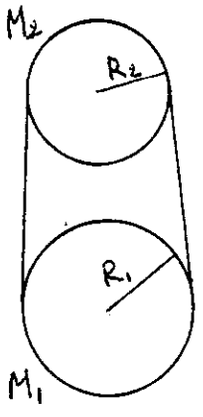
I. A ballistic pendulum consists of a block of wood of mass M = 4.0 kg suspended from thin wires. Initially it is at rest. A bullet of mass m = 10 g strikes the block horizontally and remains stuck to it. The impact of the bullet puts the block in motion causing it to swing upward to a height h = 20 cm. What was the speed of the bullet before the impact?

II. A disk rotating freely on a shaft is suddenly coupled by means of a drive belt to a second disk sitting on a parallel shaft (see figure). The initial angular velocity of the first disk is ω, that of the second is zero. The disks are uniform of masses M_1 and M_2 and of radii R_1 and R_2 respectively. The drive belt is massless and the shafts are frictionless.

Calculate the final angular velocity of each disk?



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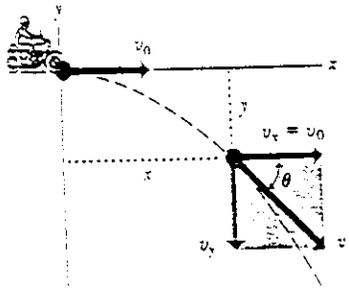
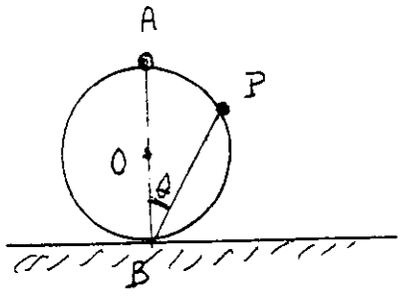
I. A 3.94kg block extends a spring 15.7 cm from its unstretched position. The block is removed and a 0.520 kg object is hung from the same spring. The system is put into oscillation. Find the period of its oscillation?

II. A motorcycle stunt rider rides off the edge of a cliff with a horizontal velocity of magnitude 5 m/s. Find the rider's position and velocity after 0.25 s.



III. A particle sits on top of a large smooth sphere of radius R. (see adjacent figure). The particle begins to slide down the sphere without friction. At what angular position will the particle loose contact with the surface of the sphere?



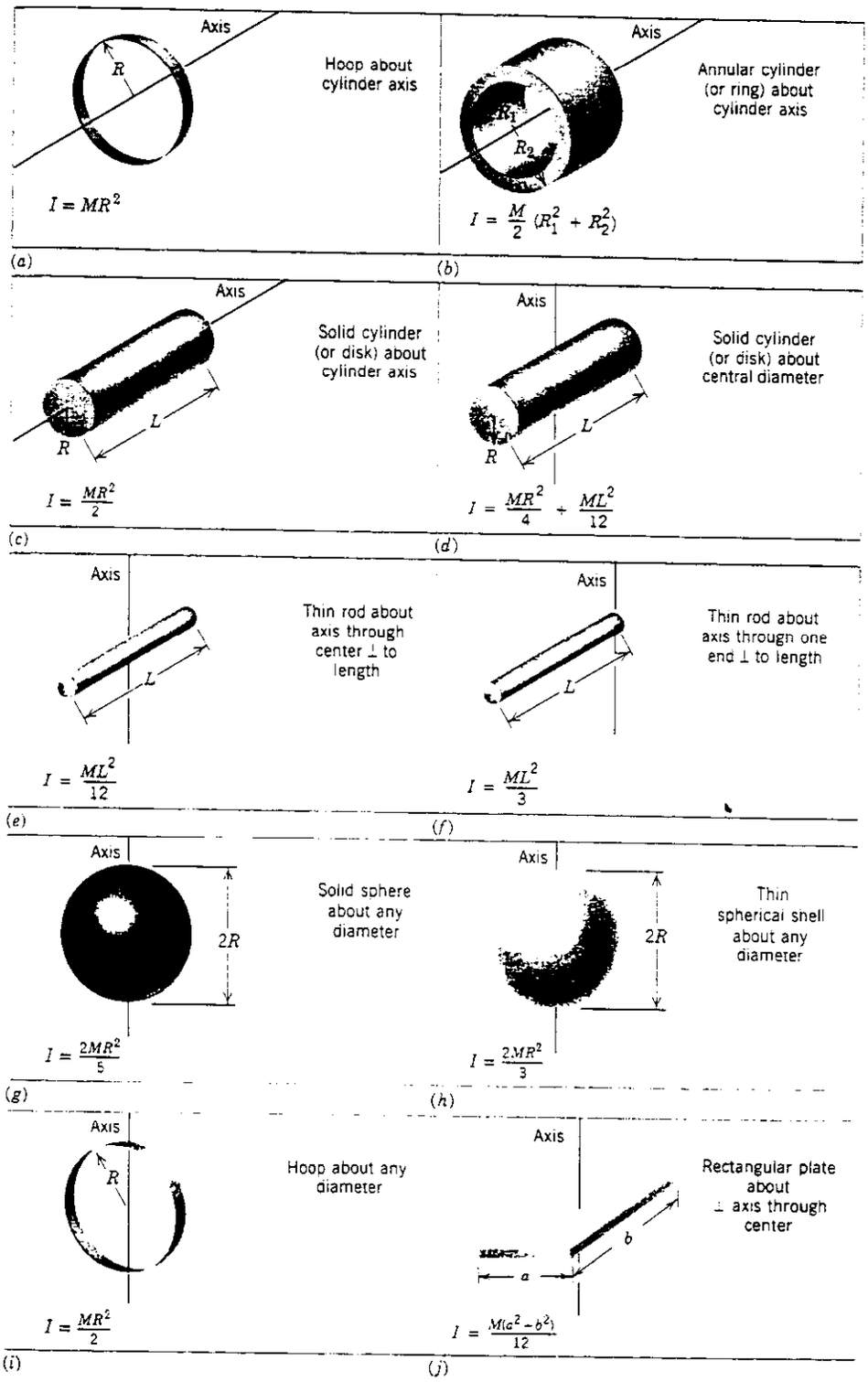


Figure 9 The rotational inertia of various solids about selected axes.

12-4 TORQUE ACTING ON A PARTICLE

Experience with a heavy door teaches us that a given force can produce various angular accelerations depending on where the force is applied to the door and how it is directed (see Fig. 10). A force (such as F_1) applied at the edge and directed along the door cannot produce an angular acceleration, nor can a force (such as F_2) applied to the hinge line along the door; but a force (such as F_3) applied at right angles to the door at its outer edge produces the largest angular acceleration.

The rotational analogue of force is called *torque*. We