Boğaziçi University
Department of Physics

Phys 101 Fall 2009

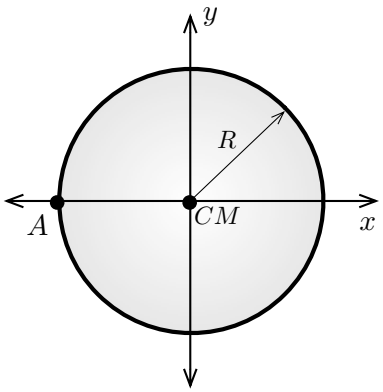
Midterm 2

15 December 2009

50-minute exam. Closed book/notes. No calculators are allowed.
Solve each problem on a separate page in the correct order.

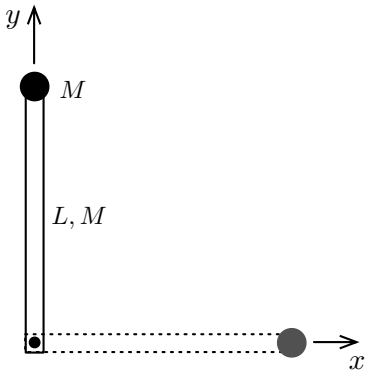
Question 1:

The areal mass density of a disk of radius R is nonuniform, such that $\sigma = ar$, where a is some constant. **(a)** Find the total mass of the disk as a function of a and R. .Find the moment of inertia with respect to an axis which is perpendicular to the disk, **(b)** that passes through the center of mass, **(c)** that passes through the point A.



Question 2:

A long uniform rod of length L and mass M is pivoted about a horizontal, frictionless pin through one end. Another small mass of M is attached to the other end of the rod. The rod is released from rest in a vertical position, as shown in the figure. **(a)** Find the moment of inertia, I, of the system with respect to the pivot. At the instant the rod is horizontal **(b)** find the center of mass of the system, **(c)** the magnitude of its angular acceleration α, **(d)** the x and y components of the acceleration of its center of mass $\vec{a}_{\rm cm}$, and **(e)** the components of the reaction force at the pivot, $\vec{F}_{\rm pivot}$. $[I_{\rm rod,cm} = \frac{1}{12}ML^2]$



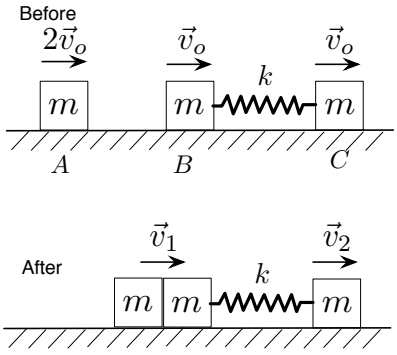
Question 3:

The collision between the masses is perfectly inelastic (they stick each other.) The massless spring of force constant k is initially unstretched. There is no friction.

a) Find the speeds v_1 and v_2 just after the collision.

b) Find the impulse on B at the instant of the collision.

c) Find the maximum compression of the spring.



Question 4:

A girl of mass m is standing on a plank that has a mass of $3m$. The plank, originally at rest, is free to slide on a frozen lake, which is a flat, frictionless supporting surface. The girl begins to walk along the plank at a constant speed of v relative to the plank. **(a)** What is the speed of the plank relative to the ice surface? **(b)** What is her speed relative to the ice surface?