

NAME :



Massachusetts Institute of Technology

16.07 Dynamics

Final Exam

Date: December 17, 2007

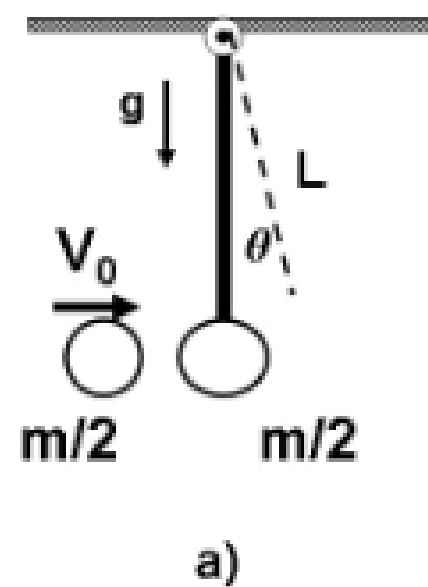
	Points
Problem 1	25
Problem 2	15
Problem 3	30
Problem 4	15
Problem 5	15

Problem 1 (25 points)

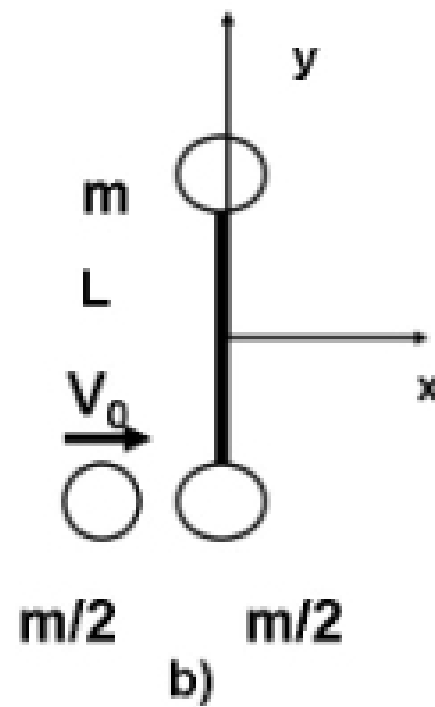
1.1) Consider a pendulum of mass $m/2$ at rest suspended by a massless rod of length L from a frictionless pivot in the presence of gravity, shown in a). Use small angle approximation for the subsequent motion of the pendulum, $\theta \ll 1$.

a) A mass $m/2$ with velocity V_0 collides **inelastically** (In an inelastic collision, the bodies do not rebound, but stick together.). What is the velocity of the two masses immediately after the collision? What is the instantaneous reaction force in the pivot? Show that these initial conditions follow from the conservation of linear and angular momentum. Is energy conserved in the collision?

b) What is the subsequent motion of the pendulum?



1.2) Now consider a dumbbell at rest on a horizontal frictionless plane, as shown in b). It has 2 masses connected by a massless rigid rod; one of m , one of $m/2$. Another mass of $m/2$ and velocity V_0 impacts the lower mass and an inelastic collision occurs.



a) What is the initial velocity of the two dumbbell masses immediately after the collision? Show that these initial conditions follow from the conservation of linear and angular momentum.

b) Is the initial motion the same as that of 1.1?

c) What is the position of the center of mass with time? Is momentum conserved with time? Is angular momentum conserved with time? What is the force in the rod?

d) Solve for the position of the masses as a function of time in a coordinate system moving with the center of mass.