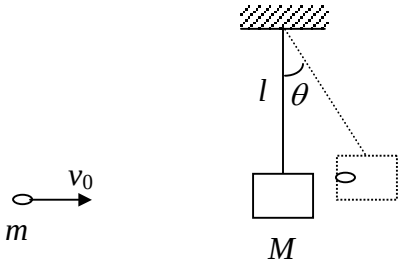
The University of Alabama at Birmingham (UAB)
Department of Physics

PH 462/562 – Classical Mechanics II – Spring 2006

Assignment # 1 Due: **Tuesday, Jan. 10**
(Turn in for credit!)

1. Read Chapter 3 in the textbook and write a 1-page summary including the key physical principles discussed.

2. A ballistic pendulum used to measure the speed of a bullet is built by suspending a block of wood of mass M by a string of length l. The pendulum is initially at rest in the vertical position. A bullet of mass m is shot at the block and becomes embedded in it. The pendulum starts swinging and rises up to a height such that the string makes a maximum angle θ with the vertical direction as illustrated in the figure below.



   a. From the point of view of the conservation laws (e.g., conservation of linear momentum, conservation of energy, etc.), divide the problem in a suitable number of parts and state which conservation laws may be applied to each part.

   b. Determine the initial speed v_0 of the bullet in terms of M, m, l, and θ.

3. Consider a rocket with initial mass m_0 taking off vertically (from rest) in a constant gravitational field g. The rocket ejects spent fuel at a constant rate $\dot{m} = -k$ with an exhaust speed u relative to the rocket (k is a positive constant).

   a. Assuming that gravity is the only external force acting on the rocket, derive the differential equation for its motion.

   b. Solve the differential equation and determine how the height of the rocket changes as a function of time.