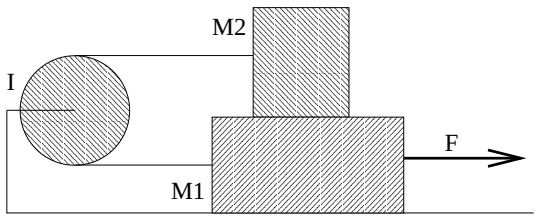
PHY6938 Proficiency Exam Spring 2002
April 5 , 2002
Mechaincs

1. As shown in the diagram, two blocks with masses M_1 and M_2 are attached by an unstretchable rope around a frictionless pulley with radius r and moment of inertia I. There is no slipping between the rope and the pulley. The coefficient of kinetic friction between the blocks is the same as between block 1 and the surface, μ. A horizontal force F is applied to M_1. Find the acceleration of M_1.



2. The asteroid Toro was discovered in 1964. Its radius is about 5 km. Acceleration due to gravity on earth is g $= 9.81 m/s^2$, the earth's radius is 6378 km, and the gravitational constant $G = 6.67 \times 10^{-11} \frac{m^3}{kg\, s^2}$.

(a) Assuming the density of Toro is the same as that of Earth, find its total mass and the acceleration due to gravity at its surface.

(b) Suppose a body is placed in a circular orbit around Toro, with radius just slightly larger than the asteroid's radius. What is the speed of the body ?

(c) If a rock is thrown into a circular orbit around Toro at a height of 200 m above the surface, what is its period of revolution ?

3. Consider the off-center elastic collision of two objects of equal mass when one is initially at rest.

(a) Show that the final velocity vectors of the two objects are perpendicular to each other.

(b) Show that the incoming object cannot have a backward scattered component.