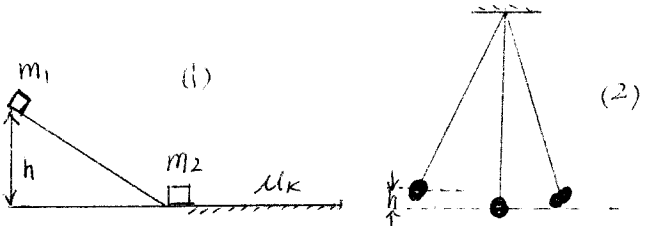
Chapter 9: Momentum and Center of Mass



1. Block 1 of mass m_1 slides from rest along a frictionless ramp from height h and then collides with stationary Block 2, which has mass $m_2 = 2m_1$. After the collision, they stick together and slide into a region where the coefficient of kinetic friction is μk and come to a stop in distance d within the region. What is the value of distance d?

2. Two identical pendulum bobs are suspended from strings of equal length, and the first one is released from rest at height h as shown. When the first bob hits the second initially at rest, the two bobs stick together and swing up. Find (a) the maximum height to which the combined masses rise (in term of the initial height h). (b) Percentage of the energy loss?

3. A bullet of mass m and speed v passes completely through a pendulum bob of mass M. The bullet emerges with a speed of v/2. The pendulum bob is suspended by a stiff rod of length L and negligible mass. What is the minimum value of v such that the bob will barely swing through a complete vertical circle?

4. A small block of mass m_1 is released from rest at the top of a curved wedge of mass m_2, which sits on a horizontal frictionless surface. When the block leaves the wedge, its velocity is measured to be v_1 to the right. (a) What is the velocity of the wedge after the block reaches the horizontal surface? (b) What is the height h of the wedge?

5. A mass of m_1 with initial velocity V_1 approaches another mass of m_2 initially at rest to make a head-on collision. Mass m_2 is attached by a spring of stiffness k that is initially relaxed. During their collision, find the maximum compression of the spring (assuming there are no energy losses because of the spring).

6. An 8.0-kg ball, hanging from the ceiling by a light wire 135 cm long, is struck in an elastic collision by a 2.0-kg ball moving horizontally at 5.0 m/s just before collision. Find the tension in the wire just after collision.

7. A block of mass m slides along a frictionless track with speed v. It collides with a stationary block of mass M. Find an expression for the minimum value of v that will allowed the second block to circle the loop-the-loop of radius R without falling off if the collision is (a) perfectly inelastic or (b) perfectly elastic.

8. A rope of length L and mass M lies coiled on a table. Starting at t = 0, one end of the rope is lifted from the table with a force F such that it moves with a constant velocity V. (a) Find the height of the center of mass of the rope as a function of time. (b) Assuming that the force exerted by the table equals the weight of the rope still there, find the force F you exert on the top of the rope.