

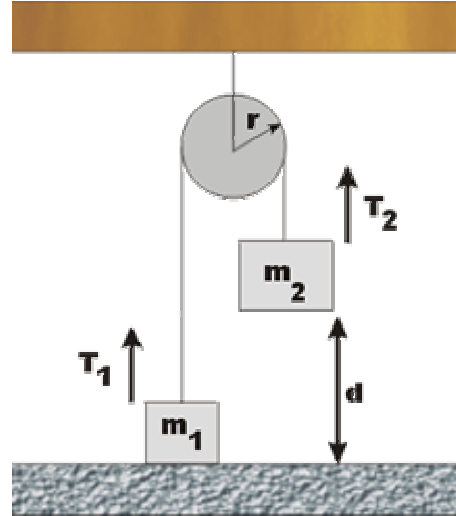
Problem (28 marks)

Solve this problem in the supplied test booklet. Show your work, since some part marks will be awarded. Be sure to clearly indicate which parts of the problem are being solved.

Two masses m_1 and m_2 are suspended by a massless rope over a pulley of radius r , as shown.

Assume that we are close to the Earth's surface, so the acceleration due to gravity is constant. Assume that the rope does not slip on the pulley.

At time $t = 0$ the masses are stationary and are released.



The mass m_2 is 10 kg. The radius r of the pulley is 3.5m. The distance d is 17 m.

All answers must have correct units stated!

Part A (10 Marks Total): Assume that the pulley has no mass, so that T_1 and T_2 have equal magnitudes. Assume that m_1 is constant and equal to 5 kg.

1. What is the speed of mass m_2 when it strikes the ground? (3 marks)
2. How long does it take m_2 to strike the ground? (3 marks)
3. While m_2 is falling what is the tension T_1 in the string? (2 marks)
4. What is the angular speed ω of the pulley when m_2 strikes the ground? (2 marks)

Part B (8 Marks Total): Assume that the pulley has no mass. Now the mass m_1 is a container filled with sand, which is leaking out at a rate of 1.5 kg/sec. At some time t , m_1 is equal to 4.2 kg and it is moving at a speed of 3 m/sec.

1. At this time what is the acceleration of the masses? (3 marks)
1. At this time what is the tension T_1 in the string? (3 marks)
2. At this time, what is the angular acceleration α of the pulley? (2 marks)

Part C (10 Marks Total): Assume that m_1 is constant and equal to 5 kg. Assume that the pulley has a mass of 6 kg, so its moment of inertia I is 63 kg m^2 .

1. What is the speed of mass m_2 when it strikes the ground? (3 marks)
2. While m_2 is falling, what is its acceleration? (3 marks)
3. While m_2 is falling what is the total torque τ exerted on the pulley? (2 marks)
4. Treat the masses m_1 and m_2 as point particles. When m_2 strikes the ground, what is the total angular momentum of the system about the axis of revolution of the pulley? (2 marks)