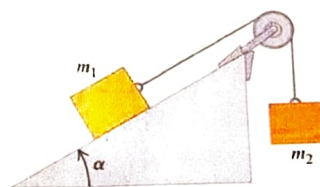




PHYS-C0110 Mechanics
Exam 13.10.2025

Remember: For full points it is important to justify your answers. Just giving the correct answer/number/formula might not be enough. Add short explanations for what you are doing so that grader can be sure you understand the actual physical concepts. No calculators or other materials are allowed.

One mass of m_1 is on an incline and another one of mass m_2 hangs from the rope that goes over a (rotating) massless pulley and is then attached to the first mass, see figure. The masses are moving with constant velocities so that m_1 slides upwards along the incline. Gravity acts downwards with a constant acceleration of g and there is no friction.



1.
 - a) Draw forces acting on both masses (i.e. free body diagram for both masses) (2p.)
 - b) Solve the forces acting on the masses. What should the mass m_2 be expressed in terms of m_1 and angle α ? (3p.)
 - c) If the mass on the incline does experience kinetic friction with coefficient μ_k , how will the expression for m_2 in part b) change (1p.)

2. a) An object of mass of m slides downwards on a frictionless incline with an angle α (from horizontal direction). The object is initially at rest. What is the object's acceleration along the incline in terms of the gravitational acceleration g ? What is its speed after sliding a distance of d along the incline? (Friction can be ignored.) (3p.)

b) An object can now roll (without slipping) on the incline. The object is a uniform sphere of radius R and it therefore has a moment of inertia $I = 2mR^2/5$. Compute the speed of the sphere's center of mass after the sphere has rolled a distance of d along the incline? Explain the difference to part a)? Will the speed be larger or smaller than in a)? (2p.)

c) If the object is a uniform cylinder with a moment of inertia $I = mR^2/2$ (R is the cylinder radius), after rolling a distance d along the incline as in part b), will its speed be larger or smaller than that of the sphere? Explain. (1p.)

3. a) An atomic nucleus (at rest) fissions into two pieces with masses m_A and m_B . What is the ratio of the pieces kinetic energies? Why? (2p.)

a) Balls of masses m and $2m$ collide head-on elastically. Initially, the ball with mass $2m$ is stationary and another moves at a velocity v in the positive direction along the x-axis. Determine the balls velocities after the collision. (4p.)