Ministry of Higher Education and Scientific Research

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Department of Computer Science

Mechanics of a Particle (Physics 1)

Problems & Exercises (of Chap 2)

Dynamics

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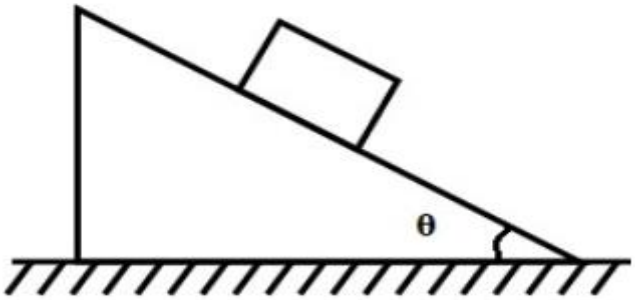
Exercise 1

A body with a weight equal to 8N is placed on a rough inclined plane with an angle $\theta = 35°$. The coefficient of kinetic friction is 0.40. We take $g = 10m/s^2$.

1. Find the angle of inclination for the body to slide with a constant velocity.
2. What is the normal force for an angle of inclination of $\theta = 35°$?
3. What is the frictional force for an angle of inclination of $\theta = 35°$?
4. What is the acceleration for an angle of inclination of $\theta = 35°$?"

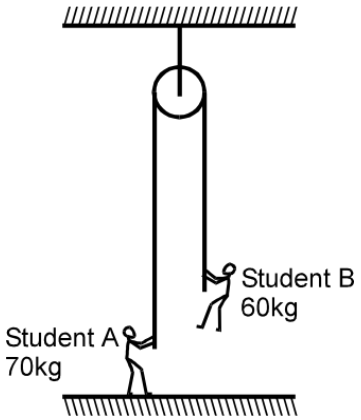


Exercise 2: A rope of negligible mass passes over a pulley of negligible mass attached to the ceiling, as shown in the figure. One end of the rope is held by Student **A** of mass **70 kg**, who is at rest on the floor. The opposite end of the rope is held by Student **B** of mass **60 kg**, who is suspended at rest above the floor. Use ***g = 10 m/s²***

1) Draw and label free-body diagrams showing the forces on Student **A** and on Student **B**.
2) Calculate the magnitude of the force exerted by the floor on Student **A**.

Student **B** now climbs up the rope at a constant acceleration of ***0.25 m/s²*** with respect to the floor.

3) Calculate the tension in the rope while Student **B** is accelerating.
4) As Student **B** is accelerating, is Student **A** pulled upward off the floor? Justify your answer.
5) With what minimum acceleration must Student **B** climb up the rope to lift Student **A** upward off the floor?

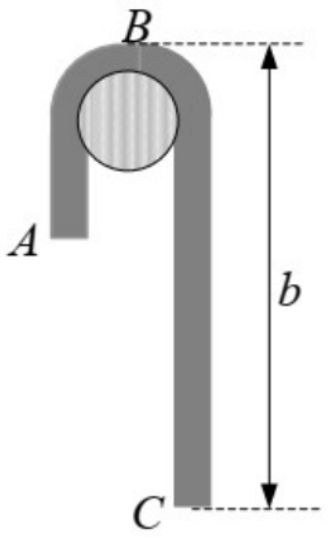


Exercise 3

A rope with mass ***M*** uniformly distributed along its length ***L*** (figure below) can slide frictionlessly along the groove of a fixed pulley with a very small radius. When the movement begins **BC = b**.

Show that when $\mathbf{BC} = \frac{2}{3}\mathbf{L}$:

- The acceleration is $\boldsymbol{a} = \frac{g}{3}$; and
- The velocity $\boldsymbol{v} = \sqrt{\frac{2g}{L}\left(b\,L - b^2 - \frac{2}{9}\,L^2\right)}$



Numerical application: ***L =12 m, and b = 7 m.***

Exercise 4

A material point of mass **m** is launched with an initial velocity v_0 at an angle **θ** with the horizontal. It is subjected to the Earth's gravitational field. The launch takes place in a vacuum:

Isolate the material point and apply the fundamental principle of dynamics to it.

Establish the literal expressions of:

1. The acceleration ***a(t).***
2. The two time equations ***x(t)*** and ***z(t).***
3. The trajectory equation. ***z = x(t).***
4. The velocity ***v(t).***
5. The position $\overrightarrow{OM}$***(t).***
6. The distance $OA = x_{max.}$
7. The maximum altitude $\mathbf{z_{max}}$ reached by this projectile.
8. What is the magnitude of the velocity with which the projectile hits the ground?