

Homework No. 06 (Fall 2021)

PHYS 203A: COLLEGE PHYSICS

Department of Physics, Southern Illinois University–Carbondale

Due date: Tuesday, 2021 Oct 19, 12.30pm, on D2L

Instructions

- Describe your thought process in detail and organize it clearly. Make sure your answer has the correct units and the right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (Assessments → Assignments).

1. **(10 points.)** Consider a mass $m = 25$ kg being pulled by a force $F_{\text{pull}} = 80.0$ N, exerted horizontally, such that the mass moves, on a horizontal surface with coefficient of kinetic friction $\mu_k = 0.30$. See Figure 1. Assume that the mass starts from rest. We would like to determine the final velocity v_f after the mass has moved a horizontal distance $d = 10.0$ m.



Figure 1: Problem 1.

- (a) Identify the forces acting on the mass and write Newton's equations of motion for the configuration.
 - (b) Compute the work done by each of the individual force. In particular, what is the work done by the force of pull, and the force of friction?
 - (c) Determine the total work done by the sum of all the forces acting on the mass.
 - (d) Using the work-energy theorem determine the final velocity.
2. **(10 points.)** A mass $m = 25$ kg slides down an inclined plane with angle $\theta = 30.0^\circ$. Assume coefficient of kinetic friction $\mu_k = 0.30$. Assume that the mass starts from rest. Determine the final velocity v_f after the mass has moved a distance $d = 10.0$ m along the incline.

3. (10 points.) A mass of $m = 25.0\text{ kg}$ slides down a frictionless incline that makes an angle of $\theta = 30.0^\circ$ with the horizontal. Assume that the mass starts from rest. The two forces acting on the mass during the slide are the normal force and the force of gravity. The mass slides $d = 10.0\text{ m}$ along the incline.
- Determine the work done by the force of gravity.
 - Determine the change in the gravitational potential energy of the mass.
 - Determine the change in the kinetic energy of the mass.
4. (10 points.) A roller coaster of mass $m = 500.0\text{ kg}$ moves on the curve described in Figure 2. Assume frictionless surface. It starts from rest, $v_A = 0\text{ m/s}$ at point A height at $h_A = 40.0\text{ m}$.

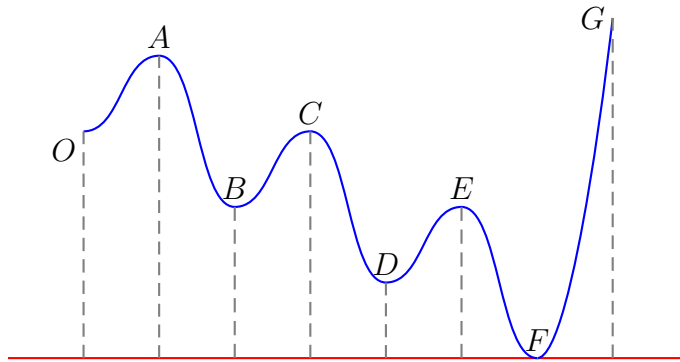


Figure 2: Problem 4.

- What is the work done by the normal force?
 - Determine the velocity of the mass at point E , given $h_E = 20.0\text{ m}$.
 - How does your result depend on the mass.
5. (10 points.) Figure 3 shows a pendulum of length $L = 3.0\text{ m}$ and mass $m = 5.0\text{ kg}$. It starts from rest at angle $\theta = 30.0^\circ$. Determine the velocity of the mass when $\theta = 0$.

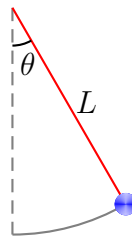


Figure 3: Problem 5.

6. (10 points.) A mass $m = 20.0\text{ kg}$ slides down a frictionless incline, starting from rest at point A at height $h = 1.0\text{ m}$. After sliding down the incline it moves horizontally on a frictionless surface before coming to rest by compressing a spring of spring constant $k = 2.0 \times 10^4\text{ N/m}$ by a length x . See Figure 4.

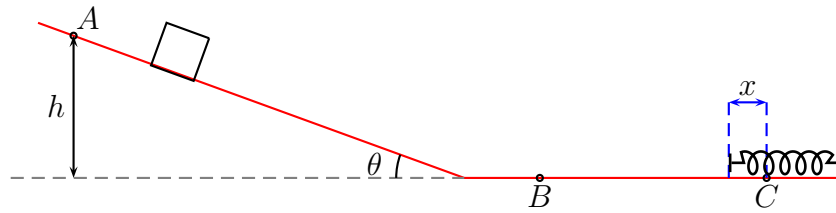


Figure 4: Problem 6.

- (a) Determine the velocity of the mass at point B .
- (b) Determine the maximum compression x in the spring.