Homework No. 07 (Spring 2021)

PHYS 205A: University Physics

Due date: Wednesday, 2021 Mar 24, 11:55 AM, 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 (under Assesments → Assignments).

Problems

1. (**10 points.**) A mass of $m = 25.0\,\text{kg}$ slides down a frictionless incline that makes an angle of $\theta = 30.0°$ 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.

   (a) Determine the work done by the force of gravity.

   (b) Determine the work done by the normal force.

   (c) Determine the change in the gravitational potential energy of the mass.

   (d) Determine the change in the kinetic energy of the mass.

2. (**10 points.**) A roller coaster of mass $m = 500.0\,\text{kg}$ moves on the curve described in Figure 1. Assume frictionless surface. It starts from rest, $v_A = 0\,\text{m/s}$ at point A height at $h_A = 40.0\,\text{m}$.

   (a) What is the work done by the normal force?

   (b) Determine the velocity of the mass at point E, given $h_E = 20.0\,\text{m}$.

   (c) How does your result depend on the mass.

3. (**10 points.**) Figure 2 shows a pendulum of length $L = 3.0\,\text{m}$ and mass $m = 5.0\,\text{kg}$. It starts from rest at angle $\theta = 30.0°$. Determine the velocity of the mass when $\theta = 0$.

4. (**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 3.

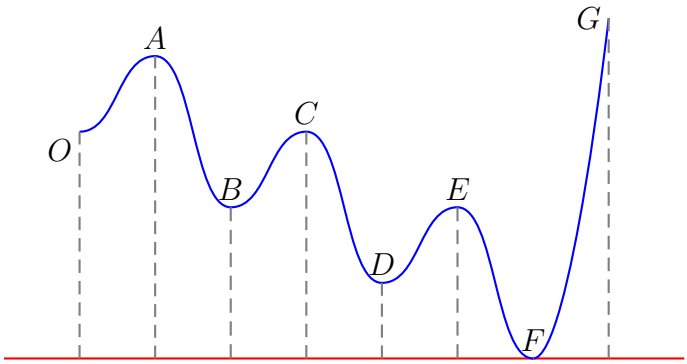

Figure 1: Problem 2.

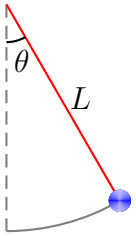

Figure 2: Problem 3.

(a) Determine the velocity of the mass at point B.

(b) Determine the maximum compression x in the spring.

5. (**10 points.**) A $3.0 \times 10^2\,\text{kg}$ mass slides down a frictionless incline, starting from rest at point A. The incline makes an angle of $30°$ with respect to the horizontal. After sliding down a distance $L = 2.0\,\text{m}$ (along the incline) it hits a spring of spring constant $4.0 \times 10^4\,\text{N/m}$ at point B. The mass is brought to rest at point C when the spring is compressed by length x. See Figure 4. Determine the compression x.

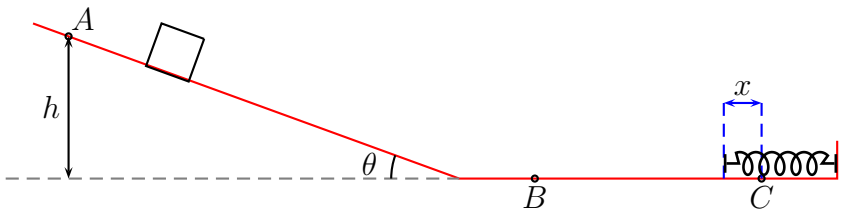

Figure 3: Problem 4.

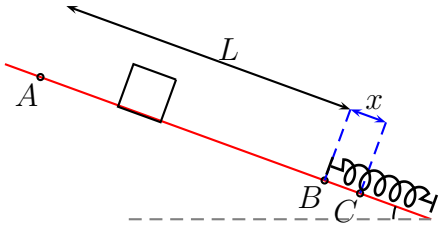

Figure 4: Problem 5.