Midterm Exam No. 03 (2017 Fall)

PHYS 205A-002: University Physics

Date: 2017 Nov 13

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
2. Total time = 50 minutes.
3. There are 7 questions in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to show your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (**10 points.**) The force acting on a particle varies as shown in the figure below. Find the work done by the force on the particle as it moves from $x = 10\,\text{m}$ to $x = 30\,\text{m}$.

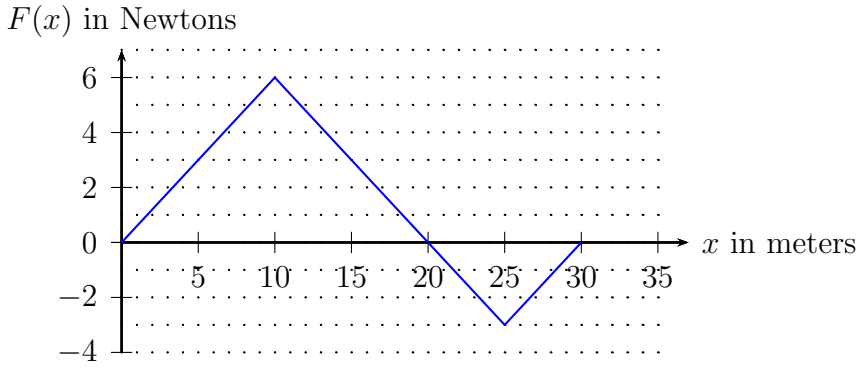

Figure 1: Problem 1.

2. (**10 points.**) A mass $m = 25\,\text{kg}$ slides down a frictionless incline, starting from rest at point A at height h. After sliding down the incline it moves horizontally on a frictionless surface before coming to rest by compressing a spring of spring constant $k = 4.0\times10^4\,\text{N/m}$ by a length $x = 15\,\text{cm}$. See Figure 2. Ignore friction.

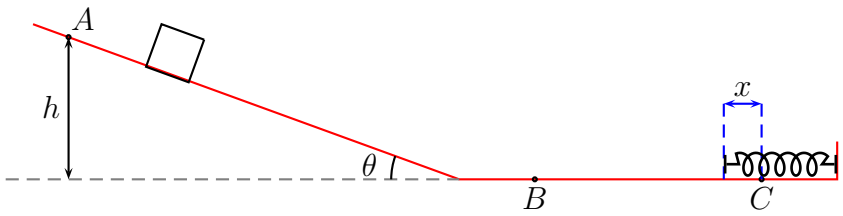

Figure 2: Lecture-Example 2.

(a) Determine the the work done (including sign) by the normal force on the mass while the mass moves from point A to point C.

(b) Determine the the work done by force of spring (including sign) on the mass while the mass moves from point A to point C.

(c) Determine the change in kinetic energy of the mass while the mass moves from point A to point C.

(d) Determine the the work done by gravity (including sign) on the mass while the mass moves from point A to point C.

3. (**10 points.**) Consider the potential energy curve shown in the figure below.

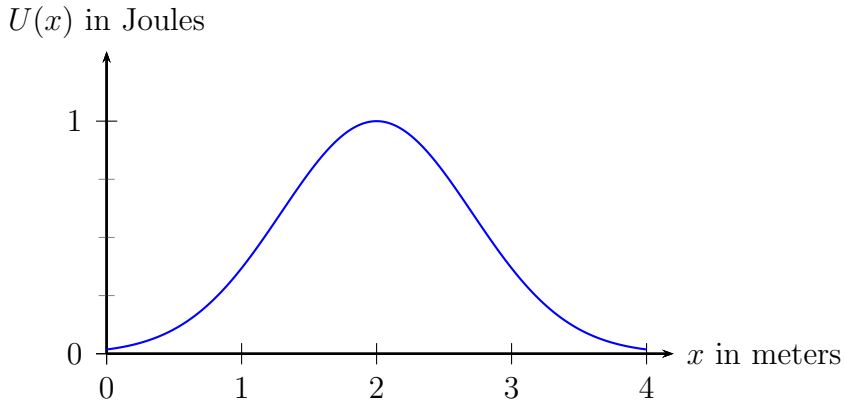

Figure 3: Problem 3.

(a) Determine whether the component of force F_x is positive, negative, or zero, at $x = 3\,\text{m}$.

(b) Sketch the curve for F_x versus x from $x = 0\,\text{m}$ to $x = 4\,\text{m}$.

4. (**10 points.**) A block of mass $m = 3.00\,\text{kg}$ is released from rest from point Ⓐ and slides on the frictionless track shown in Figure 4. (Let $h_a = 7.00\,\text{m}$.) Determine the block's speed at point Ⓑ.

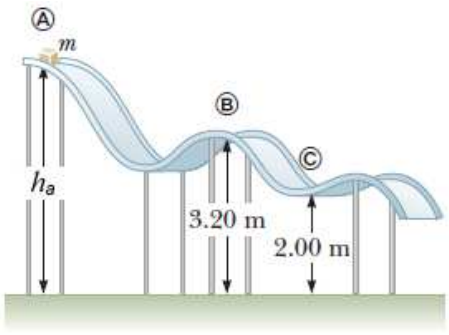

Figure 4: Problem 4.

5. (**10 points.**) An object has a kinetic energy of 60.5 J and a momentum of magnitude 11 kg·m/s. Find the speed and the mass of the object.

6. (**10 points.**) A railroad car of mass m is moving with a speed of 4.00 m/s. It collides and couples with three other coupled railroad cars, each of the same mass as the single car and moving in the same direction with an initial speed of 2.00 m/s.

   (a) What is the speed of the four cars after the collision?

   (b) Determine the ratio of the final to initial kinetic energy.

7. (**10 points.**) A wheel with a radius of 1.00 m lies in a vertical plane and rotates about its central axis with a constant angular acceleration of $4.00\,\mathrm{rad/s^2}$. The wheel starts at rest at $t = 0$, and the radius vector of a certain point P on the rim makes an angle of one radian with the horizontal at this time. Find the angular position of point P at $t = 2.00\,\mathrm{s}$, modulo multiples of 2π radians.