Midterm Exam 03 (2016 Spring)

PHYS 203A: College Physics

Date: 2016 Apr 22

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on odd-numbered seats.
2. Total time = 50 minutes.
3. There are 8 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.**) A skier speeds down a smooth ski slope which is at an angle of $\theta = 23^\circ$ with the horizontal. Neglect friction. The mass of the skier is 75 kg.

   (a) Using Newton's laws deduce the equation governing the forces parallel to the slope.

   (b) Using Newton's laws deduce the equation governing the forces normal to the slope.

   (c) What is the magnitude of the acceleration experienced by the skier?

2. (**10 points.**) A book of mass 6.0 kg rests on a plank. You tilt one end of the plank and slowly increase the angle of the tilt. The coefficient of static friction between the book and the plank is 0.40.

   (a) Using Newton's laws deduce the equation governing the forces parallel to the plank.

   (b) Using Newton's laws deduce the equation governing the forces normal to the plank.

   (c) What is the maximum angle of tilt for which the book will remain stationary and not slide down the plank?

3. (**10 points.**) A 23.0 kg child is riding a playground merry-go-round that is rotating at 5.0 radians per second. What is her centripetal acceleration if she is 6.00 m from its center?

4. (**10 points.**) Figure 1 shows a pendulum of length $L = 3.0\,\text{m}$ and mass $m = 5.0\,\text{kg}$. It starts from rest at angle $\theta = 30.0°$ and gains velocity when it reaches $\theta = 0$. Determine the work done by the force of tension in the string during this part of motion.

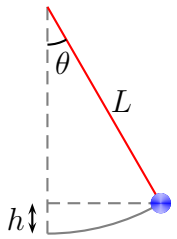

Figure 1: Problem 4.

5. (**10 points.**) A roller coaster of mass $m = 300.0\,\text{kg}$ moves on the curve described in Figure 2. Assume frictionless surface. It starts with velocity $v_A = 5.0\,\text{m/s}$ at point A height $h_A = 50.0\,\text{m}$. Determine the velocity of the mass at points C, when its height is $h_C = 40.0\,\text{m}$,

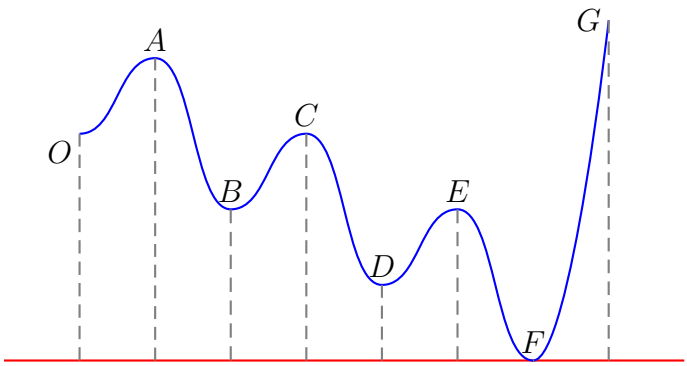

Figure 2: Problem 5.

6. (**10 points.**) A mass $m = 30.0\,\text{kg}$ 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 $k = 4.0 \times 10^4\,\text{N/m}$ by a length x. See Figure 3. Determine the maximum compression x in the spring.

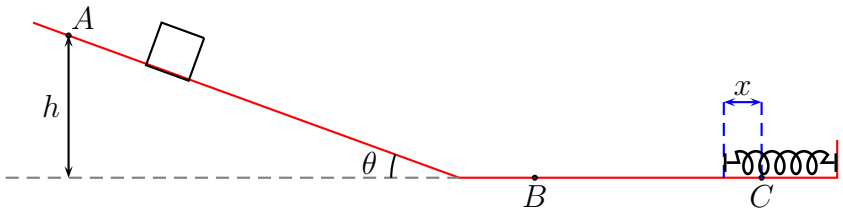

Figure 3: Problem 6.

7. (**10 points.**) Two ice skaters stand facing each other at rest on a frozen pond. They push off against one another and the 48 kg skater acquires a speed of 0.60 m/s. If the other skater acquires a speed of 0.90 m/s, what is her mass?

8. (**10 points.**) A shooter of mass $m_2 = 110.0\,\text{kg}$ shoots a bullet of mass $m_1 = 3.00\,\text{g}$ in a direction $\theta = 60.0^\circ$ with respect to the horizontal, standing on a frictionless surface at rest. If the muzzle velocity of the bullet is $v_{1f} = 600.0\,\text{m/s}$, what is the recoil speed of the shooter?