Final Exam (2016 Spring)

PHYS 203A: College Physics

Date: 2016 May 9

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on odd-numbered seats.
2. Total time = 120 minutes.
3. There are 10 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 golfer takes two strokes to putt a golf ball into a hole. On the first stroke, the ball moves 5.0 m at an angle 60° East of North. On the second, it moves 4.33 m West. If the golfer had instead hit the ball directly into the hole on the first stroke, what would have been the magnitude and direction of the ball's displacement?

2. (**10 points.**) A speeder passes a parked police car at 40.0 m/s and keeps moving with uniform speed. The police car starts from rest, immediately after the speeder passes, and proceeds with a uniform acceleration of 2.0 m/s^2. How far does the speeder get before being overtaken by the police car?

3. (**10 points.**) A block is projected up a frictionless inclined plane with initial speed $v_0 = 5.0$ m/s. The angle of incline is $\theta = 30.0°$. How much time does it take for the block to come to stop?

4. (**10 points.**) A stuntman drives a car over the top of a hill, the cross section of which can be approximated by a circle of radius $R = 25\,\mathrm{m}$. What is the greatest speed at which he can drive without the car leaving the road at the top of the hill?

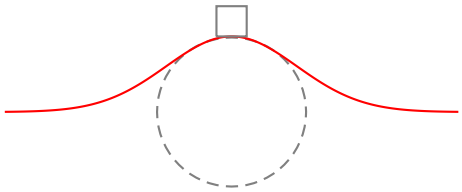

Figure 1: Problem 4

5. (**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 $\theta = 30.0°$ and gains velocity when it reaches $\theta = 0$. Determine the velocity of the mass when $\theta = 0$.

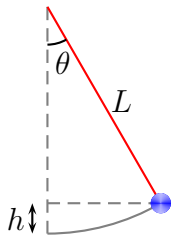

Figure 2: Problem 5.

6. (**10 points.**) A shooter of mass $m_2 = 90.0\,\text{kg}$ shoots a bullet of mass $m_1 = 3.00\,\text{g}$ horizontally, standing on a frictionless surface at rest. If the muzzle velocity of the bullet is $v_{1f} = 700.0\,\text{m/s}$, what is the recoil speed of the shooter?

7. (**10 points.**) The 0.300 m radius tires of a car has an angular acceleration of 15 $\mathrm{rad/s^2}$. Assume perfect rolling (no slipping or sliding.) How many revolutions do the tires make in 2.00 s after they start from rest?

8. (**10 points.**) The center of mass of a person may be determined by an arrangement shown in Figure 3 below. A light (massless) plank rests on two scales separated by a distance equal to the height $h = 1.80\,\text{m}$ of the person. The scales that measure the normal forces read $N_1 = F_{g1} = 500.0\,\text{N}$ and $N_2 = F_{g2} = 300.0\,\text{N}$. Determine the distance of the girl's center of mass from her feet.

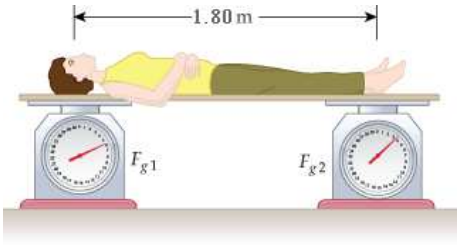

Figure 3: Problem 8.

9. (**10 points.**) A hollow spherical shell ($I = \frac{2}{3}MR^2$) rolls perfectly (without sliding or slipping) on an inclined plane. If the sphere started from rest at the top, vertical height of 1.20 m, what is the velocity of the sphere when it reaches the bottom of the incline?

10. (**10 points.**) A merry-go-round, in the shape of a uniform solid disc, is free to rotate (without friction) about its symmetry axis. It has mass $M = 100.0$,kg, radius $R = 2.00\,\mathrm{m}$, and moment of inertia $I = \frac{1}{2}MR^2$. A kid (mass $m = 30.0\,\mathrm{kg}$) walks from the outer edge of the disc halfway to the center of the disc. If the angular speed of the merry-go-round was $2.10\,\mathrm{rad/s}$ when the kid was at the outer edge, what is the angular speed of the merry-go-round when the kid is halfway to the center?