Final Exam (2015 Summer)

PHYS 203A: College Physics

Date: 2015 Aug 7

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(Name)   (Signature)

Instructions

1. Total time = 110 minutes.

2. There are 12 questions in this exam.

3. Equation sheet is provided separately.

4. To obtain partial credit for your work you need to show your work in detail and organize it clearly.

5. A simple calculator (with trigonometric functions) is allowed.

6. Use of mobile phones is strictly prohibited.

1. (**10 points.**) A jogger runs 250.0 m in a direction 30.0° West of North and then 400.0 m in a direction 45.0° North of East. Determine the magnitude and direction of the total displacement of the jogger.

2. (**10 points.**) A small fish is dropped by a pelican that is descending steadily at $4.00\,\mathrm{m/s}$ when it is $50.0\,\mathrm{m}$ above the ground. How much time later does the fish hit the water?

3. (**10 points.**) A rifle is aimed horizontally at a target 30.0 m away. The bullet hits the target 1.90 cm below the aiming point. What is the bullet's speed as it emerges from the rifle?

4. (**10 points.**) Your mass is 75.0 kg. How much will you weigh on a bathroom scale (designed to measure the Normal force) inside an elevator that is

   (a) slowing down at 2.00 m/s² while moving upward?

   (b) speeding up at 2.00 m/s² while moving downward?

   (c) moving downward at constant speed?

5. (**10 points.**) A block is projected up a frictionless inclined plane with initial speed $v_i = 3.50$ m/s. The angle of incline is $\theta = 30.0°$. How far up the plane does the block go?

6. (**10 points.**) A roller coaster of mass $m = 400.0\,\text{kg}$ moves on the curve described in Figure 1. Assume frictionless surface. It starts from rest at point A at height $h_A = 50.0\,\text{m}$. Determine the velocity of the mass at point E, given height $h_E = 20.0\,\text{m}$.
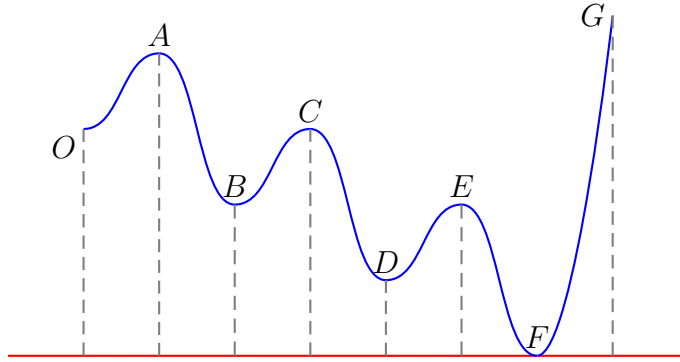

Figure 1: Problem 6.

7. (**10 points.**) A car of mass $m_1 = 2500.0\,\text{kg}$ is moving at speed $v_{1i} = 20.0\,\text{m/s}$ towards East. A truck of mass $m_2 = 6000.0\,\text{kg}$ is moving at speed $v_{2i} = 25.0\,\text{m/s}$ towards North. They collide at an intersection and get entangled (complete inelastic collision). What is the magnitude and direction of the final velocity of the entangled automobiles?

8. (**10 points.**) A wind turbine is initially spinning at a constant angular speed. As the wind's strength gradually increases, the turbine experiences a constant angular acceleration of $0.170\,\mathrm{rad/s^2}$. After making 2839 revolutions, its angular speed is $132\,\mathrm{rad/s}$. What is the initial angular speed of the turbine?

9. (**10 points.**) A hiker, who weighs $875\,\mathrm{N}$, is strolling through the woods and crosses a small horizontal bridge. The bridge is uniform, weighs $3585\,\mathrm{N}$, and rests on two concrete supports, one at each end. He stops one-fifth of the way along the bridge. What is the magnitude of the force that a concrete support exerts on the bridge at each end?

10. (**10 points.**) A solid-sphere ($I = \frac{2}{5}MR^2$) rolls perfectly (without sliding or slipping) on an inclined plane. If the sphere started from rest at the top, vertical height of $2.00\,\mathrm{m}$, what is the velocity of the solid-sphere when it reaches the bottom of the incline?

11. (**10 points.**) A merry-go-round, in the shape of a disc, is free to rotate (without friction) about its symmetry axis. It has mass $M = 100.0$,kg, radius $R = 2.00\,\text{m}$, and moment of inertia $I = \frac{1}{2}MR^2$. A kid (mass $m = 25.0\,\text{kg}$) walks from the outer edge of the disc to the center. If the angular speed of the merry-go-round was $2.10\,\text{rad/s}$ when the kid was at the outer edge, what is the angular speed of the merry-go-round when the kid is at the center?

12. (**10 points.**) A mass $m = 1.00\,\mathrm{kg}$ slides down a frictionless incline starting from rest at the top, vertical height of $2.0\,\mathrm{m}$. It hits a spring of spring-constant $k = 2000.0\,\mathrm{N/m}$ at the bottom and comes to rest after compressing it. Determine the final compression in the spring.