Final Exam (2017 Fall)

PHYS 203A-002: College Physics

Date: 2017 Dec 12

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat numbers divisible by 3.
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.**) Vector $\vec{\mathbf{A}}$ has a magnitude of 5.0 units and points 30° North of East. Vector $\vec{\mathbf{B}}$ has a magnitude of 6.0 units and points due North. What is the magnitude and direction of vector $\vec{\mathbf{C}} = \vec{\mathbf{A}} - \vec{\mathbf{B}}$?

2. (**10 points.**) A small fish is dropped by a pelican that is rising steadily at 4.0 m/s. Determine the time taken for the fish to reach the water 15.0 m below.

3. (**10 points.**) Two skaters, a man and a woman, are standing on ice. Neglect any friction between the skate blades and the ice. The mass of the man is 99 kg, and the mass of the woman is 66 kg. The woman pushes on the man with a force of 65 N due East. Determine the magnitude and direction of the acceleration of the woman as a consequence.

4. (**10 points.**) A stuntman whose mass is 75 kg drives a car at a uniform speed of 25 m/s through the bottom of a valley, the cross section of which can be approximated by a circle of radius $R = 150$ m. What is the normal force acting on the stuntman while crossing the deepest part of the valley?

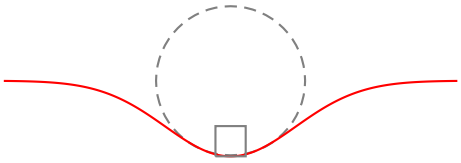

Figure 1: Problem 4

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 height $h = 0.50\,\text{m}$ and gains velocity when it reaches $\theta = 0$. Determine the velocity of the bob when $\theta = 0$.

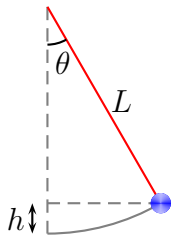

Figure 2: Problem 5.

6. (**10 points.**) John's mass is 90 kg, and Barbara's is 45 kg. He is standing on the x axis at $x_J = +10.0\,\text{m}$, while she is standing on the x axis at $x_B = 0.0\,\text{m}$. Find the position of their center of mass.

7. (**10 points.**) A car is traveling with a speed of 25 m/s along a straight horizontal road. The wheels have a radius of 0.30 m. If the car speeds up with a linear acceleration of 2.0 m/s^2 for 7.0 s, find the angular displacement of a point on the outer edge of each wheel during this period.

8. (**10 points.**) A solid sphere ($I = \frac{2}{5}MR^2$) is (perfectly) rolling on a surface. What fraction of its total kinetic energy is in the form of rotational kinetic energy about the center of mass?

9. (**10 points.**) A cylinder ($I = \frac{1}{2}MR^2$) rolls perfectly (without sliding or slipping) on an inclined plane. If the cylinder started from rest at the top, vertical height of 1.20 m, what is the velocity of the cylinder when it reaches the bottom of the incline?

10. (**10 points.**) A playground carousel is free to rotate about its center on frictionless bearings, and air resistance is negligible. The carousel itself (without riders) has a moment of inertia of $125\,\mathrm{kg\,m^2}$. When one person is standing on the carousel at a distance of $1.5\,\mathrm{m}$ from the center, the carousel has an angular velocity of $0.6\,\mathrm{rad/s}$. However, as this person moves inward to a point located $0.75\,\mathrm{m}$ from the center, the angular velocity increases to $0.9\,\mathrm{rad/s}$. What is the person's mass?