

# Midterm Exam 03 (2017 Fall)

## PHYS 203A-002: College Physics

Date: 2017 Nov 14

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(Name)

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### Instructions

1. Seating direction: Please be seated on seats with seat numbers divisible by 3.
2. Total time = 75 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 person pushes a 15 kg shopping cart at a constant velocity for a distance of 25 m. She pushes in a direction  $30^\circ$  below the horizontal. A 45 N frictional force opposes the motion of the cart.
- (a) Determine the change in kinetic energy.
  - (b) Determine the work done by the normal force.
  - (c) Determine the work done by the gravitational force.
  - (d) Determine the work done by the frictional force.
  - (e) Determine the work done by the pushing force.

2. (**10 points.**) A 0.60 kg basketball is dropped out of the window that is 6.5 m above the ground. The ball is caught by a person whose hands are 1.5 m above the ground.
- (a) Identify the forces acting on the basketball during the drop.
  - (b) Determine the work done by the gravitational force.
  - (c) Determine the change in gravitational potential energy.
  - (d) Determine the change in kinetic energy.

3. (10 points.) Figure 1 shows a pendulum of length  $L = 3.0$  m and mass  $m = 5.0$  kg. It starts from rest at height  $h = 0.50$  m and gains velocity when it reaches  $\theta = 0$ .

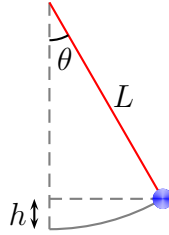


Figure 1: Problem 3.

- (a) Identify the forces acting on the mass.
- (b) Determine the work done by the force of tension.
- (c) Determine the work done by the gravitational force.
- (d) Determine the change in gravitational potential energy.
- (e) Determine the change in kinetic energy.

4. (**10 points.**) Adolf and Ed are wearing harnesses and are hanging at rest from the ceiling by means of ropes attached to them. Face to face, they push off against one another. Adolf has a mass of 99 kg, and Ed has a mass of 66 kg. Following the push, Adolf swings upward to a height of 0.60 m above his starting point. To what height above his own starting point does Ed rise?

5. **(10 points.)** A bullet with mass  $m_1 = 3.00\text{ g}$  is fired into a wooden block of mass  $m_2 = 1.00\text{ kg}$ , that hangs like a pendulum. The bullet is embedded in the block (complete inelastic collision). The block (with the bullet embedded in it) goes  $h = 30.0\text{ cm}$  high after collision. Calculate the speed of the bullet before it hit the block.

6. **(10 points.)** John's mass is 75 kg, and Barbara's is 50 kg. He is standing on the  $x$  axis at  $x_J = +10.0$  m, while she is standing on the  $x$  axis at  $x_B = 0.0$  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  $2.0 \text{ m/s}^2$  for 7.0 s, find the angular displacement of a point on the outer edge of each wheel during this period.

8. **(10 points.)** Two people start at the same place and walk around a circular lake in opposite directions. One walks with an angular speed of  $1.0 \times 10^{-3} \text{ rad/s}$ , while the other has an angular speed of  $3.0 \times 10^{-3} \text{ rad/s}$ . Where do they meet again, in reference to their initial position?