

# Midterm Exam No. 02 (2015 Fall)

## PHYS 205A: University Physics

Date: 2015 Oct 14

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### Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
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 train travels due South at 30 m/s relative to the ground in a rain that is blown toward the South by the wind. The path of each raindrop makes an angle of  $70^\circ$  with the vertical, as measured by an observer stationary on the ground. An observer on the train, however, sees the drops fall perfectly vertically. Determine the speed of the raindrops relative to the ground.

2. (10 points.) A block slides down a frictionless plane having an inclination of  $\theta = 30.0^\circ$  with respect to horizontal. The block starts from rest at the top, and the length of the incline is 3.00 m.

- (a) Find the acceleration of the block.
- (b) Find the speed when it reaches the bottom of the incline?

3. (10 points.) A car is traveling at 30.0 m/s on a horizontal highway. What is the stopping distance when the surface is dry and the coefficient of kinetic friction  $\mu_k$  between road and tires is 0.60?

4. (10 points.) A bag of cement weighing  $mg = 450\text{ N}$  hangs in equilibrium from three wires as suggested by the forces shown in Figure 1. Two of the forces make angles  $\theta_1 = 30.0^\circ$  and  $\theta_2 = 60.0^\circ$  with the horizontal. Assuming the system is in equilibrium, find the magnitude of the tensions  $T_1$  and  $T_2$ .

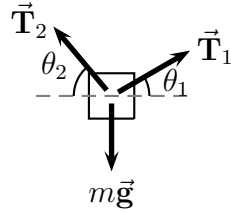


Figure 1: Problem 4

5. (10 points.) A trunk with a weight of 220 N rests on the floor. The coefficient of static friction between the trunk and the floor is 0.40, and the coefficient of kinetic friction is 0.30.
- (a) What is the magnitude of the minimum horizontal force with which a person must push on the trunk to start it moving?
  - (b) Once the trunk is moving, what magnitude of horizontal force must the person apply to keep it moving with constant velocity?
  - (c) If the person continued to push with the force used to start the motion, what would be the magnitude of the trunk's acceleration?

6. (**10 points.**) Your mass is 85 kg. How much will you weigh on a bathroom scale inside an elevator when the elevator, originally moving upward at 15 m/s, is brought to rest with constant acceleration in 3.0 s.  
(Hint: Determine acceleration using kinematic equations.)

7. (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  $R = 250$  m. See Figure 2. What is the greatest speed at which he can drive without the car leaving the road at the top of the hill?

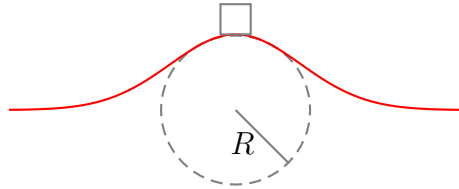


Figure 2: Problem 7



8. (10 points.) A bicyclist travels in a circle of radius 25.0 m at a constant speed of 9.00 m/s. The bicycle-rider mass is 85.0 kg. Calculate the magnitude of the force of friction on the bicycle from the road.