Midterm Exam No. 02 (2017 Fall)

PHYS 205A-002: University Physics

Date: 2017 Oct 13

_____   _____
(Name)   (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.

2. Total time = 50 minutes.

3. There are 7 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 ball is tossed from an upper-story window of a building. The ball is given an initial velocity of $9.00\,\mathrm{m/s}$ at an angle of $25.0°$ above the horizontal. It strikes the ground 3.00 s later. Find the height from which the ball was thrown.

2. (**10 points.**) A car travels due east with a speed of 46.0 km/h. Raindrops are falling at a constant speed vertically with respect to the Earth. The traces of the rain on the side windows of the car make an angle of 58.0° with the vertical.

   (a) Find the magnitude and direction of the velocity of rain with respect to the car.

   (b) Find the magnitude and direction of the velocity of rain with respect to the Earth.

3. (**10 points.**) Your mass is 95 kg. How much will you weigh on a bathroom scale (designed to measure the Normal force) inside an elevator that is slowing down at $1.0\,\mathrm{m/s^2}$ while moving upward?

4. (**10 points.**) A block slides down an incline plane having an inclination of 30.0°. The coefficient of kinetic friction between the block and the plane is 0.30. Find the acceleration of the block.

5. (**10 points.**) A bag of cement weighing $mg = 500.0\,\mathrm{N}$ hangs in equilibrium from three wires as suggested in Fig 1. Two of the wires make equal angles $\theta_1 = \theta_2 = 30.0°$ with the horizontal. Assuming the system is in equilibrium, find the tensions T_1, T_2, and T_3 in the wires.
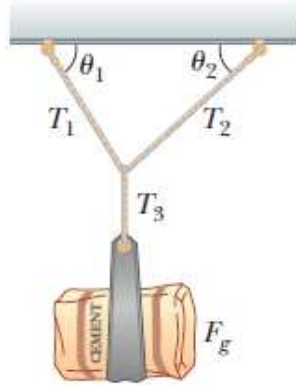

Figure 1: Problem 5

6. (**10 points.**) A curve in a road forms part of a horizontal circle of radius $250\,\text{m}$. A car of mass $2500\,\text{kg}$ goes around it at constant speed $14.0\,\text{m/s}$.

(a) Identify the individual forces acting on the car.

(b) Determine the magnitude and direction of the total force acting on the car.

7. (**10 points.**) A skier of mass m is skiing down a frictionless hill that makes an angle θ with the horizontal, as shown in the diagram. The skier starts from rest at time $t = 0$ and is subject to a velocity-dependent drag force due to air resistance of the form $F = -bv$, where v is the velocity of the skier and b is a positive constant. Determine an expression for the terminal velocity of the skier. Express all algebraic answers in terms of m, g b, θ, and fundamental constants.