Midterm Exam No. 02 (2014 Fall)

PHYS 205A: University Physics

Date: 2014 Oct 8

(Name) (Signature)

Instructions

1. Total time = 50 minutes.
2. There are 8 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.

1. (**10 points.**) You have a toy hanging down from the rear-view mirror in your car. At a certain moment of time if the cord makes an angle of $\theta = 15.0^\circ$ with the vertical, what is the acceleration of the car at that moment?

2. (**10 points.**) A block is projected up a frictionless inclined plane with initial speed $v_0 = 3.50\,\mathrm{m/s}$. The angle of incline is $\theta = 30.0°$.

   (a) How far up the plane does it go?

   (b) What is its speed when it gets back to the bottom?

3. (**10 points.**) A bag of cement weighing $mg = 500\,\mathrm{N}$ hangs in equilibrium from three wires as described in Fig. 1. Two of the wires make equal angles $\theta_1 = \theta_2 = 30.0^\circ$ with the horizontal. Assuming the system is in equilibrium, find the tensions T_1, T_2, and T_3 in the wires.

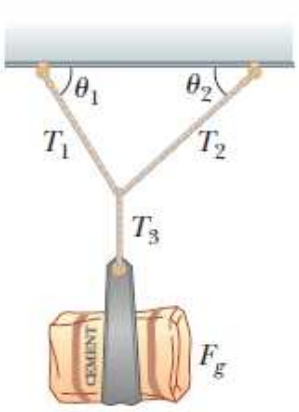

Figure 1: Problem 3.

4. (**10 points.**) In the Atwood machine shown in Fig. 2, the masses m_1 and m_2 are connected by a string that goes around a pulley. The masses of the pulley and string are negligible by comparison. The pulley turns without friction and the string does not stretch.

   (a) Using Newton's laws, show that the acceleration of the masses is given by the expression

   $$a = \left(\frac{m_2 - m_1}{m_2 + m_1} \right) g. \tag{1}$$

   (b) Determine the acceleration for $m_2 \gg m_1$ and describe the motion?

   (c) Determine the acceleration for $m_2 \ll m_1$ and describe the motion?

   (d) Plot a as a function of m_2 for fixed m_1.

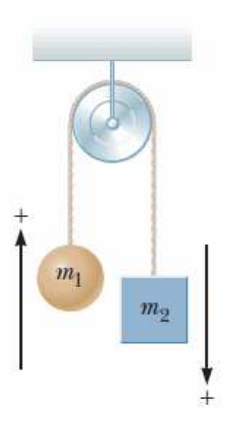

Figure 2: Problem 4.

5. (**10 points.**) A car is traveling at 70.0 miles/hour (= 31.3 m/s) on a horizontal highway.

   (a) What is the stopping distance when the surface is dry and the coefficient of static friction μ_s between road and tires is 0.60?

   (b) If the coefficient of static friction between road and tires on a rainy day is 0.40, what is the minimum distance in which the car will stop?

6. (**10 points.**) When a small 2.0 g coin is placed at a radius of 5.0 cm on a horizontal turntable that makes three full revolutions in 3.14 s, the coin does not slip.

   (a) What is the coin's speed?

   (b) What is the magnitude and direction of the coin's acceleration?

   (c) What is the magnitude and direction of the frictional force on the coin?

   (d) If you learn that the coin is on the verge of slipping when it is placed at a radius of 10 cm. What is the coefficient of static friction between coin and turntable?

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 $R = 250\,\mathrm{m}$. What is the greatest speed at which he can drive without the car leaving the road at the top of the hill?

8. (**10 points.**) What is the terminal speed of a 6.00 kg spherical ball that has a radius of 3.00 cm and a drag coefficient of 1.60? The density of the air through which the ball falls is 1.20 kg/m^3