Midterm Exam 02 (2015 Summer)

PHYS 203A: College Physics

Date: 2015 Jul 10

(Name) (Signature)

Instructions

1. Total time = 60 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.
5. A simple calculator (with trignometric functions) is allowed.

1. (**10 points.**) An airplane flying horizontally at a constant speed of 350 km/h over level ground releases a bundle of food supplies. Ignore the effect of air on the bundle.

   (a) What is the bundle's initial vertical and horizontal component of velocity?

   (b) What is the bundle's horizontal component of velocity just before hitting the ground?

2. (**10 points.**) A rifle is aimed horizontally at a target 30 m away. The bullet hits the target 1.9 cm below the aiming point. What is the bullet's speed as it emerges from the rifle?

3. (**10 points.**) Rain is falling vertically at a constant speed of 8.0 m/s (relative to the ground). At what angle from the vertical does the rain appear to be falling as viewed by the driver of a car traveling on a straight, level road with a speed of 54 km/h (~ 15 m/s) (relative to the ground)?

4. (**10 points.**) Three particles have their positions on a straight line, far away from any other objects. See Fig. 1. The masses of these particles are $m_1 = 300\,\text{kg}$, $m_2 = 500\,\text{kg}$, and $m_3 = 200\,\text{kg}$. The distances are $r_{12} = 50\,\text{m}$ and $r_{23} = 25\,\text{m}$ Find the magnitude and direction of the net gravitational force acting on mass 2.

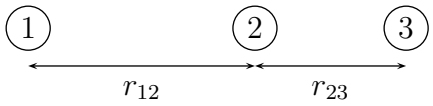

Figure 1: Problem 4

5. (**10 points.**) Your mass is 75 kg. How much will you weigh on a bathroom scale (designed to measure the Normal force) inside an elevator that is

   (a) slowing down at 2 m/s^2 while moving downward?

   (b) speeding up at 2 m/s^2 while moving upward?

   (c) moving downward at constant speed?

6. (**10 points.**) A block is projected up a frictionless inclined plane with initial speed $v_0 = 3.5$ m/s. The angle of incline is $\theta = 32.0°$. How far up the plane does the block go?

7. (**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 0.41, and the coefficient of kinetic friction is 0.32.

   (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?

8. (**10 points.**) One mass (m_a) and another mass ($m_b > m_a$) are attached to a massless cord that passes over a frictionless pulley. The hanging masses are free to move. The acceleration of the masses is

$$a = \left(\frac{m_b - m_a}{m_b + m_a}\right) g, \tag{1}$$

and the tension in the string is

$$T = \left(\frac{m_b}{m_b + m_a}\right) 2m_a g, \tag{2}$$

(a) What is the acceleration of the masses if $m_b = 3m_a$?

(b) What is the tension in the cord if $m_b = 3m_a$? Express the answer in terms of $m_a g$.

(c) You know that the maximum tension the cord can withstand is $2m_a g$. Will the cord break when the second mass is $m_b = 100m_a$? (Hint: If you prefer to work with actual numbers, you can set $m_a = 1$ kg for analysis.)

(d) Let $m_b = Nm_a$. For what N will the cord break?