Name:_____ ID:_____ Lab (day/time)_____

Physics 201

Midterm Exam 2

7/9/2014

Collaboration is not allowed. Allowed on your desk are: up to ten 8.5 x 11 inch doubled sided sheets of notes that are bound together, non-communicating/graphing scientific calculator, 1 page of scratch paper, writing utensils, and the exam. You will have 60 minutes to complete this exam.

1. (4 points) A witness during a trial recalls this story: "I remember we were playing tug o' war with all 20 of us. Half of us on one end of the rope and half on the other end. We must have been very evenly matched because it ended in a tie. Later that evening the defendant got his truck really stuck in the mud. We tied that same rope we had been using for the tug o' war to the truck and all 20 of us pulled on it. Before the truck began to move the rope broke." Is this statement plausible? Explain.

2. (4 points) A 15.0-kg package is dropped from a high tower and is "tracked" by a radar system. At one point the radar tracking indicates that its acceleration is 6.90 m/s^2 downward. Determine the force of air resistance on the package at this point.

For questions 3 through 6 circle all correct answers, a given problem may have more than one correct answer. Each correctly circled answer will receive two points. There are **5** correct answers in this section and only the first **5** circled answers will be graded. There is no partial credit.

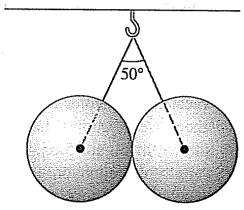
3. Consider a small insect, flying a couple of feet above the highway, whose life is abruptly ended on the windshield of a car that hits the bug at 65 mph. In this collision, how does the force of the bug against the windshield compare to the force of the windshield against the bug?
   (a) The force on the bug much larger.
   (b) The force on the windshield is slightly smaller.
   (c) The forces are exactly the same.
   (d) The forces are equal in magnitude and opposite in direction.
   (e) It depends on how fast and in which direction the bug was flying.

4. A spaceship is moving in the galactic eastward direction at constant speed. A net force directed southward acts on the object for a year. At the end of the year, the net force drops to zero. Which of the following statements are *necessarily* true?
   (a) The object will be moving due south when the force drops to zero.
   (b) The final velocity of the object will be directed south of east.
   (c) The change in the velocity of the object will be directed south.
   (d) The direction of the acceleration depends on how fast the object was initially moving.
   (e) The magnitude of the acceleration depends on how fast the object was initially moving.

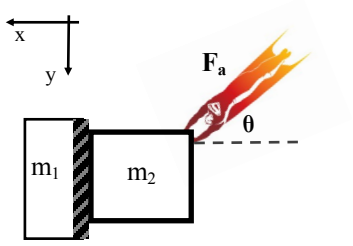
5. A large unidentified flying object (UFO) climbs with a constant velocity of 175 m/s at an angle of 32° with respect to the horizontal. Which of the following statements are true concerning the magnitude of the *net force* on the UFO?
   (a) It is equal to the weight of the plane.
   (b) It is equal to the magnitude of the force of air resistance.
   (c) It is less than the weight of the plane but greater than zero.
   (d) It is equal to the component of the weight of the plane in the direction of motion.
   (e) It is zero.

6. A person who normally weighs 200 pounds is standing on a scale inside an elevator. The elevator is moving upwards with a constant speed of 7 m/s when it begins to slow down at a rate of 5 m/s^2. Before the elevator begins to slow down, the reading of the scale is _____, and while the elevator is slowing down, the reading of the scale is _____.
   (a) 200 pounds, less than 200 pounds
   (b) 200 pounds, greater than 200 pounds
   (c) greater than 200 pounds, less than 200 pounds
   (d) greater than 200 pounds, 200 pounds
   (e) less than 200 pounds, greater than 200 pounds

7. (10 points) Two identical, perfectly smooth 76.2-N bowling balls, 22.4 cm in diameter are hung together from the same hook in the ceiling by means of two thin, light wires, as show in the figure. Find (a) the tension in each wire and (b) the force the balls exert on each other.



8. (15 points) Two masses, $\mathbf{m_1}$ and $\mathbf{m_2}$, are falling but not freely. In addition to gravity, there is also a force $\mathbf{F_a}$ pushing on $\mathbf{m_2}$ at an angle $\boldsymbol{\theta}$, down from the horizontal in the direction that pushes $\mathbf{m_2}$ against $\mathbf{m_1}$. Friction ($\boldsymbol{\mu_s}$) is present between the two masses and the force is applied such that the masses do not rotate. The force $\mathbf{F_a}$ is as large as it can be and not have $\mathbf{m_1}$ slide relative to $\mathbf{m_2}$. Use the coordinate system given in the diagram and find (a) an expression for the acceleration of the center of mass of the $\mathbf{m_1} + \mathbf{m_2}$ system in terms of $\mathbf{m_1}$, $\mathbf{m_2}$, $\mathbf{F_a}$, $\boldsymbol{\theta}$, and $\mathbf{g}$? (b) Draw a FBD for each mass separately. Identify motion constraints and Newton's 3rd law force pairs. (c) Write down Newton's 2nd law applied to each mass separately in terms of the variables given. *Extra credit*: If both masses are each 200 kg, the coefficient of static friction between the surface is $\boldsymbol{\mu_s} = 1/2$, and $\boldsymbol{\theta} = 45°$, what is the value of $\mathbf{F_a}$?



Scores:

Problems

1	2	3-6	7	8

Exam Total
