Name _____

Physics 160 Lab Time _____

Exam 1 – Force and Motion

October 15, 2010

- This is a closed book examination.
- You may use a 3x5 index card that you have made with any information on it that you would like. You must have your name, lab section and the date on your index card.
- There is extra scratch paper available.
- Please fill out the Scantron sheet completely
  - Include your test code.
  - Include your Dragon ID
  - Include your name
- Mark your exam and include explanations where needed. This will help you learn from your exam as well as provide any verification of your scantron sheet.
- Please make sure to fill out each "Problem Solving Sheet" completely
  - Include your test code
  - Include your Dragon ID
  - Include your name
  - Include your lab time
- Your explanation/work for the worked problems is worth ¾ of the points. You must use a separate "Problem Solving Sheet" for each problem.

A general reminder about problem solving:

1. Visualize - draw a picture
2. Pick a coordinate frame
3. Create a simplified picture – schematic with vectors describing motion
   a. 2D Motion: separate vectors into components
   b. Force Problem: create a simplified free body diagram
   c. Energy Problem: create energy level diagram(s)
4. Write down what you know – create separate columns for different directions
5. Write down what you don't know and/or what you want to know
6. List mathematical relationships
7. Combine mathematical formulas, Simplify and Solve
8. Check your answer – Is it reasonable? Are the units correct?

- Show all work!

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The next three questions refer to a planet of mass M_p and radius R_p. In all cases the gravitational force is determined for you standing on the surface of the planet.

1. [2 PTS] What would happen if the mass of a planet were to suddenly double (but the radius stayed the same)?
   a) The gravitational force would decrease $F_{new} = ¼ F_{old}$
   b) The gravitational force would decrease $F_{new} = ½ F_{old}$
   c) The gravitational force would not change $F_{new} = F_{old}$
   d) The gravitational force would increase $F_{new} = 2 F_{old}$
   e) The gravitational force would increase $F_{new} = 4 F_{old}$

2. [2 PTS] What would happen if the radius of a planet were to suddenly double (but the mass stayed the same)?
   a) The gravitational force would decrease $F_{new} = ¼ F_{old}$
   b) The gravitational force would decrease $F_{new} = ½ F_{old}$
   c) The gravitational force would not change $F_{new} = F_{old}$
   d) The gravitational force would increase $F_{new} = 2 F_{old}$
   e) The gravitational force would increase $F_{new} = 4 F_{old}$

3. [2 PTS] What would happen if the mass of a planet were to suddenly double and the radius also doubled?
   a) The gravitational force would decrease $F_{new} = ¼ F_{old}$
   b) The gravitational force would decrease $F_{new} = ½ F_{old}$
   c) The gravitational force would not change $F_{new} = F_{old}$
   d) The gravitational force would increase $F_{new} = 2 F_{old}$
   e) The gravitational force would increase $F_{new} = 4 F_{old}$

The next two questions refer to a heavy white ball you throw as fast as you can straight up into the air. Use a coordinate system where up is in the positive y-direction. Do not ignore air drag.

4. [2 PTS] Given $|a_1|$ is the magnitude of the ball's acceleration after it has left your hand but just before it reaches the top and $|a_2|$ is the magnitude of the ball's acceleration just after the top but before you catch it.
   a) $|a_1|$ is always greater than $|a_2|$
   b) $|a_1|$ always equals $|a_2|$
   c) $|a_1|$ is always less than $|a_2|$
   d) $|a_1| = |a_2| = 0$ only at the top.
   e) Not enough information is given to determine relative magnitudes.

5. [2 PTS] The magnitude of the ball's acceleration at the top (where $v_y = 0 \frac{m}{s}$) of your throw is
   a) greater than 9.81 m/s^2.
   b) equal to 0 m/s^2.
   c) equal to 9.81 m/s^2.
   d) less than 9.81 m/s^2.
   e) Not enough information is given.

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6. [2 PTS] A mosquito traveling at 1 m/s collides with the windshield of a car traveling at 25 m/s. The force the mosquito exerts on the car
   a) is less than the force the car exerts on the mosquito.
   b) is the same as the force the car exerts on the mosquito.
   c) is greater than the force the car exerts on the mosquito.
   d) is proportional to the ratio of the masses.
   e) is not possible to determine.

7. [2 PTS] Two identical spring-loaded dart guns are fired straight down at the same time. One fires a regular dart while the other a dart with extra mass. Which dart hits the ground first?
   a) The regular dart.
   b) The dart with extra mass.
   c) Both darts hit the ground at the same time.
   d) Not enough information given.

8. [2 PTS] A sky diver that is falling through the air experiences quite a bit of air drag (proportional to their velocity squared). As a sky diver falls through the air their velocity increases until they reach terminal velocity. Hence, as a sky diver falls faster and faster through the air, their acceleration
   a) increases.
   b) decreases.
   c) remains the same.
   d) is always greater than their velocity.
   e) is not possible to determine.

9. [2 PTS] You roll two carts down the same incline. The mass of cart 1 is twice the mass of cart 2 ($m_1 = 2m_2$). Which cart has a greater velocity?
   a) Cart 1 is traveling faster: $v_1 = 2v_2$
   b) Cart 1 is traveling faster: $v_1 = \sqrt{2}v_2$
   c) Both carts have the same velocity. $v_1 = v_2$
   d) Cart 2 is traveling faster: $v_1 = \frac{1}{\sqrt{2}}v_2$
   e) Cart 2 is traveling faster: $v_1 = \frac{1}{2}v_2$

10. [2 PTS] The area under the angular velocity vs time graph is the change in angle.
   a) TRUE
   b) FALSE

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Do the next two problems using separate problem solving sheets. There are extra problems solving sheets available if you need one.

11. [10 PTS] A turntable is started rotating from rest with a constant angular acceleration. If it takes 8 seconds for the turntable to make 2 revolutions what is the angular velocity at 4 seconds?

12. [10 PTS] You are at the carnival and decide to experience a ride called the "Anti-Grav Cylinder of Death". The ride consists of a tall cylinder of radius 2 m that you enter. The walls of the cylinder are carpeted and you are instructed to stand with your back to the wall. The floor of the cylinder is a grate below which you can see water where several hungry sharks are waiting expectantly. The ride operator starts the cylinder rotating about its vertical axis and you are pressed against the wall. The just happen to know the coefficient of static friction, μ_s=0.82, and the coefficient of kinetic friction, μ_k=0.75, between the carpet and your clothes. What is the minimum angular velocity that you would feel comfortable with the ride operator removing the floor?