FINAL EXAM

PHYS 201 (Fall 2006), 12/13/06

Name:

Signature:

Duration: 120 minutes
Show all your work for full/partial credit!
Include the correct units in your final answers for full credit!
Unless otherwise stated, quote your results in SI units!

1.) *Short Answer* *(18 pts.)*

For each question below, provide a short answer. For each statement, circle the correct answer (no reasoning required for the TRUE/FALSE problems).

(a) The work done by a conservative force is equal to the negative value of the change in potential energy.
TRUE FALSE

(b) You walk into an elevator, step on a scale, and push the "down" button. The scale will read MORE LESS than your actual weight. (Circle one.)

(c) If a car travels around a banked curve, what two forces contribute to the car's centripetal acceleration?

(d) The pressure in a fluid is measured at two depths. The pressure is LOWER HIGHER at the deeper of the two points.
Why?

(e) If a longitudinal sound wave is traveling through a tube, then the particles (the air molecules) move perpendicular to the direction of the propagating wave.
TRUE FALSE

(f) Assume that four uniform objects have the same mass and diameter and are released simultaneously from rest at different heights above the bottom of a hill and roll down without slipping. All four objects have the same speed when they reach the bottom of the hill. Which of these was released from the highest point above the bottom of the hill?
A) solid sphere
B) solid cylinder
C) hollow cylinder
D) thin-walled hollow cylinder

2.) *Energy of a Spring* *(10 pts.)*

A mass m is oscillating with amplitude A at the end of a spring with spring constant k.

(a) At what point x in its motion is the elastic potential energy maximum?

(b) At what point x in its motion is the kinetic energy of the system maximum?

(c) What is the total mechanical energy of the system at any point during its motion, in terms of k, m, and A?

(d) How far, in terms of A, is the mass from the equilibrium position of the spring when the elastic potential energy equals the kinetic energy?

3.) *Rotational Motion* *(10 pts.)*

A light string is wrapped around the outer rim of a solid uniform cylinder of radius 0.350 m that can rotate without friction about an axle through its center. A 3.00 kg stone is tied to the free end of the string. When the system is released from rest, you determine that the stone reaches a speed of 3.50 m/s after having fallen 2.50 m. What is the mass of the cylinder?

4.) *Dynamics of Rotational Motion* *(10 pts.)*

While exploring a castle, Exena the Exterminator is spotted by a dragon who chases her down a hallway. Exena runs into a room and attempts to swing the heavy door shut before the dragon gets her. The door is initially perpendicular to the wall, so it must be turned through 90° to close. The door is 3.00 m tall and 1.25 m wide, and it weighs 750 N. You can ignore the friction at the hinges. If Exena applies a force of 220 N at the edge of the door and perpendicular to it, how much time does it take her to close the door?

5.) *Inelastic Collision* *(10 pts.)*

A 5.00 kg ornament is hanging by a 1.50 m wire when it is suddenly hit by a 3.00 kg missile traveling horizontally at 12.0 m/s. The missile embeds itself in the ornament during the collision.

(a) What is the speed of the ornament (with the embedded missile) immediately after the collision?

(b) What is the tension in the wire immediately after the collision?

6.) *Archimedes Principle* *(12 pts.)*

A piece of wood is 0.600 m long, 0.250 m wide, and 0.080 m thick. Its density is 600 kg/m^3. The wood is placed in calm fresh water ($\rho = 1000$ kg/m^3).

(a) What is the height (thickness) of the piece of wood that lies above the surface of the water?

(b) What volume of lead must be fastened underneath it to sink the wood to the point at which its top is just even with the water level? (The density of lead is $\rho_{lead} = 11300$ kg/m^3.)

(c) What is the mass of the lead, the wood, and the two combined?

(d) Now assume that twice the volume found in **(b)** is attached to the wood (instead of just 1$\times$ the volume). What is the acceleration of the combined wood and lead as it sinks to the bottom?

7.) *Heat Engine* *(10 pts.)*

The pV diagram shown below is of a heat engine operating on 1 mole of ideal He gas. Segment ca is isothermal.

(a) Calculate the heat gain or loss in each segment. (1 atm = 1.013 $\times 10^5 Pa$)

(b) Calculate the work done by the system.

(b) Find the thermal efficiency of the heat engine.

8.) *Inclined Plane* *(12 pts.)*

While a roofer is working on a roof that slants at 36° above the horizontal, he accidentally nudges his 85.0 N toolbox, causing it to start sliding downward, starting from rest. The kinetic friction force is 22.0 N. The toolbox starts from a distance along the incline of 4.25 m from the lower edge of the roof.

(a) At the point at which the toolbox reaches the the lower edge of the roof, calculate the work done by gravity?

(b) At the point at which the toolbox reaches the the lower edge of the roof, calculate the work done by friction?

(c) Using the net work calculated in **(a)**+**(b)**, calculate the speed of the toolbox as it reaches the lower edge of the roof?

(d) Assuming the lower edge of the roof has a height of 3.00 m, calculate the horizontal distance from the lower edge of the roof at which the toolbox lands on the ground.

9.) *Waves on a String and Sound Waves* *(8 pts.)*

A 75 cm wire of mass 5.625 g is tied at both ends and adjusted to a tension of 35.0 N. Assume it is vibrating in its third harmonic.

(a) Find the frequency and wavelength at which the string is vibrating.

(b) Find the frequency and wavelength of the sound waves it is producing.

Name:

Final Exam - Version 1

No.	Points
1	
2	
3	
4	
5	
6	
7	
8	
9	
Sum	