Physics 1114 - General Physics I
Final Exam - 2013.07.25

Name: _____

---

1. A rocket sits on a launch pad 3 meters off the ground. The rocket is fired off with an initial speed of 400 m/s at an angle of 55° with the horizon.
(a) How long is the rocket in the air?
(b) How far from the launch site does the rocket travel horizontally?
(c) What is the maximum height achieved by the rocket.
(d) What is the rocket's speed right before it hits the ground?
(e) What angle with the horizontal does the rocket make right before impact?

2. (a) A block sits at rest on a frictionless surface. Sketch a free body diagram which includes all the forces acting on the block. Label them!
(b) Assume the block from (a) is now moving with a constant velocity to the right. Sketch a free body diagram which includes all the forces acting on the block.
(c) Assume the block from (a) is now moving with constant velocity to the right on a surface which does have friction. Sketch a free body diagram which includes all the forces acting on the block.
(d) Assume the block from (a) is now accelerating to the right on a surface which does have friction. Sketch a free body diagram which includes all the forces acting on the block.

3. Two cars are approaching a perpendicular intersection without a stop sign. Car 1 has a mass 700 kg and is heading north and car 2 has mass 900 kg and is heading west. The two cars collide at the intersection, and stick together as a result of the collision. After the collision, the two cars were moving in a direction 40° west of north. If car 1 had an initial velocity of 45 meters per second, what was the initial speed of car 2?

4. A solid sphere of mass 5 kg and diameter 35 cm sits at the top of a ramp 30 meters long whose angle of incline is 25°. The solid sphere is released and it rolls down the ramp without slipping.
(a) How much work does gravity do on the sphere during its trip down the ramp?
(b) What is the total kinetic energy of the sphere when it reaches the base of the ramp? (The moment of inertia of a solid sphere is $\frac{2}{5}MR^2$).
(c) What is the velocity of the sphere when it reaches the base of the ramp?

5. A pendulum with a string of length 10 m has a sphere of mass 3 kg attached to the end. The mass is pulled to one side so that the string forms an angle of 10° from its equilibrium position.
(a) Sketch a free body diagram which includes all the forces acting on the mass at the end of the string.
(b) If the sphere is released, how long will it take for the pendulum to complete one full period of motion?
(c) What happens to the period of motion if the 3 kg sphere is replaced with a 1 kg sphere instead?
(d) What happens to the period of motion if the 5 kg sphere is pulled back to form an angle of 10° from its equilibrium position?

6. A 15 kg chunk of unobtanium is suspended by a wire, completely submerged in salt water. The buoyant force the water exerts on the chunk of unobtanium is $F_B = 12320$ N.
(a) What is the density of unobtanium? (The density of salt water is 1.03×10^3 kg/m^3)
(b) If the unobtanium is removed from the water, what is the tension in the wire suspending the unobtanium?

7. A block of mass 0.4 kg slides on a horizontal frictionless table toward a spring with a force constant 180 N/m. The block hits the spring at speed 1.2 m/s. How far does the block slide from the time it contacts the spring to the time it stops momentarily?

8. A copper pot with a mass of 0.500 kg contains 0.170 kg of water, and both are at a temperature of 20°C. A 25.0 kg block of unobtainium at 85°C is dropped into the pot. Find the final temperature of the system, assuming no heat loss to the surroundings. You may assume that the specific heat capacity of unobtainium is $c_u = 3660$ J / kg·k. Similarly, for copper $c_c = 390$ J / kg·k and $c_w = 4190$ J / kg·k.