

# Physics 10310 — General Physics I

## Hour Exam 1 – Fall 2009

**There are 5 problems. Please do all problems.  
Please show all work.**

1. There are 100cm in a m, 1000 kg in a metric ton and 1000 g in 1 kg.
  - (a) How many metric tons are in 1 g?
  - (b) How many cubic meters are in 1 cm<sup>3</sup>?
2. A water balloon is dropped from the top of a tower, 200m off the ground. An alert archer at the base of the tower sees the balloon and shoots an arrow straight up toward the balloon 5 s after the balloon was dropped. The arrow's initial velocity is 40 m/s.
  - (a) When does the collision occur?
  - (b) Where does the arrow intercept the balloon?
3. A rock is thrown from the top of a tower with an upward angle of 60° and a speed  $v_0$ . The rock is in flight for 6.5 seconds and hits the ground 15 meters from the base of the tower. Ignore air resistance.
  - (a) What is the speed  $v_0$ ?
  - (b) How high off the ground is the top of the tower?

- (c) What is the speed of the rock just before it hits the ground?
4. An object of mass 43 g is at rest at the origin of an xy coordinate system at time  $t=0$ . Constant forces,  $\vec{F}_1 = (0.071, 0.0)$  N and  $\vec{F}_2 = (0.0, 0.081)$  N act on the object. Motion is only in the xy plane.
- Draw the free body diagram for the object.
  - State the initial conditions, that is the position and velocity vectors at time  $t=0$  s.
  - What is the position and velocity of the object at time  $t=1.200$  s?
  - What is the position and velocity of the object at time  $t=3.600$  s?
5. A parachutist experiences two forces: One is the force of gravity which is of the form  $\vec{F}_G = -mg\hat{j}$ . Here,  $m$  is the mass of the parachutist and  $g$  is the acceleration due to gravity. The other force is a drag force. It has the form  $\vec{F}_d = Av^2\hat{j}$ , where the velocity of the parachutist is given by  $-v\hat{j}$ .
- What are the dimensions and units of  $A$ ?
  - Complete the equation  $\frac{dv}{dt} = \dots$
  - At some point the parachutist reaches a constant terminal velocity. What is the terminal velocity?