**Assignment II, FYSE 130**
**Fall 2014**
**Due 8/29/14 at start of class**

1. Usain Bolt has set the world record for the 100 meter dash at 9.58 seconds.

   a) What was Usain's average speed for this race (in m/s)?

   b) What was Usain's average speed for this race (in mi/hr)?

   c) How far (in meters) could a NASCAR vehicle traveling at 210 miles per hour travel in the time it would take Usain bolt to complete a lap around a track (400 meters)? (Assume Usain somehow could average the same speed for a full 400 meter lap as he did in his world-record 100 meter dash).

2. The world record for the 400 meter dash was set by Michael Johnson at 43.18 seconds. (This involves going all the way around a track once).

   a) What was Michael Johnson's average speed (in m/s)?

   b) What was Michael Johnson's average speed (in mi/hr)?

   c) What was Michael Johnson's average velocity (in m/s)?

3. Adam and Bob run in a straight line. Adam runs at a steady speed of 8 m/s. Bob runs at 6 m/s for 10 minutes, then starts to run at a speed of 10 m/s.

   a) After 15 minutes, who has run further? (How much further has that person run?)

   b) After 20 minutes, who has run further? (How much further has that person run?)

   c) Charlie and Adam are in a 1000 meter race. Charlie runs the first 500 meters at a speed of 5 m/s and runs the second 500 meters at 11 m/s. Steady Adam still runs the race at a steady speed of 8 m/s. Who finishes the race first?

   d) Why didn't Charlie and Adam tie in part (c)? After all, 8 m/s is halfway between 5 m/s and 11 m/s. What's the flaw in this logic?

4. Does a speedometer in a car measure speed or velocity? Explain.

5. If the velocity of an object is zero, does its acceleration have to be zero? Explain.

More on back!

6. A baseball leaves a pitcher's hand at 90 miles per hour. The ball is hit by the batter and heads straight back to the pitcher at a speed of about 110 miles per hour. The only time the ball's speed changed was while the bat was hitting the ball, which only lasts for about a millisecond (0.001 seconds).

    a) What is the acceleration (in meters/second/second) of the baseball during the collision with the bat?

    b) The acceleration due to gravity is about 9.81 meters/second/second. This amount of acceleration is known as 1 "g". How many "g"s would the acceleration you calculated in part (a) correspond to?

7. A baseball is popped up directly at home plate (assume the ball was moving purely horizontally when it was hit). Once the ball reaches its highest point, it accelerates downwards at a constant acceleration of 9.81 meters/second/second. (In reality, this isn't exactly true – air resistance changes this a bit, but it isn't a horrible approximation). You notice that it takes the ball 2.300 seconds to fall from rest at its highest point to being caught by the catcher 1.23 meters above the ground.

    a) How high was the baseball above the ground (not above the catcher!) at its highest point?

    b) How fast was the baseball moving when the catcher caught it?

    c) Due to the high altitude, in Denver gravity causes a slightly lower acceleration – about 9.79 meters/second/second. It turns out, the difference is way too small to detect for a popup like this one. At the top of Mount Everest, however, the acceleration drops to about 9.60 meters/second/second. If – somehow – you could play baseball at the top of Mount Everest, how long would it take a baseball to fall from its highest point into the catcher's mitt if it was hit the same distance above home plate that you calculated in part (a) above?