Assignment II, HONS 157 (Honors Physics I)
Fall 2015
Due 9/4/15 at start of class

As always, please put your answers on separate paper.

1. A right circular cylindrical container (e.g. a tube) is measured to have a *diameter* of 4 inches and a height of 15 inches. What is its volume *in cubic centimeters*? (1 cubic centimeter, also sometimes called a cc for short, is a volume that is 1 cm x 1 cm x 1 cm).

2. How many square inches are in a square meter?

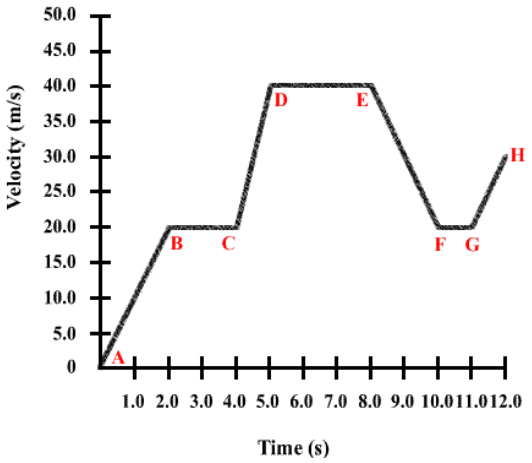
3. Define the following vectors (for use in this problem and the next one):

$$\vec{A} = (3.2 \text{ m})\,\hat{i} + (0.4 \text{ m})\,\hat{j}$$
$$|\vec{B}| = 7.2 \text{ m} \qquad \theta_B = 18^\circ$$
$$|\vec{C}| = 13.3 \text{ m} \qquad \theta_C = 123^\circ$$
$$|\vec{D}| = 8.7 \text{ m} \qquad \theta_D = -15^\circ$$
$$\vec{E} = (11.1 \text{ m})\,\hat{i} - (4.1 \text{ m})\,\hat{j}$$
$$\vec{F} = -(3.4 \text{ m})\,\hat{j}$$

   Angles are measured as done in class; (starting from the x axis, in such a way that the positive y axis is 90°). Calculate the following. For each, leave your answer in both of the following forms: (i) Component form (like vectors $\vec{A}, \vec{E}$, and $\vec{F}$ above), and (ii) magnitude and direction form (like vectors $\vec{B}, \vec{C}$, and $\vec{D}$ above).

   a) $\vec{A} + \vec{B}$
   b) $\vec{B} - \vec{C}$
   c) $\vec{C} + \vec{D} - \vec{E}$
   d) $\left(\vec{B} + \vec{C}\right) - \left(\vec{E} + \vec{F}\right)$

4. Find a vector $\vec{M}$ that satisfies the following: $\vec{A} + \vec{B} - 2\vec{C} + 3\vec{M} = 0$.



5. Explore the figure above, which plots velocity as a function of time for a particle. From the data in this figure, make an acceleration vs. time plot. (The plot should include axes, labels, and accurate values).

6. You jump in your car at noon. You drive North for 3 miles at 35 miles/hour. Then you turn East and drive for 2 miles at 50 miles/hour. Then you turn onto a road that travels South-East and drive for 6 miles at 25 miles/hour until you arrive at your destination.

   a) What is the total distance you traveled?
   b) What is your final displacement? (Direction and magnitude. For direction, define 0° to be North of your original location, and 90° to be East of your original location).
   c) How long were you driving?
   d) What was your average velocity for this drive? (in meters per second).

7. A particle has a path described by the following function: $x(t) = 4te^{-t/5}$, for t starting at 0 seconds. (I didn't write units, but assume the equation is designed so that x is given in meters when t is given in seconds). Find the following:

   a) The approximate position of the particle at $t = 10$ s.
   b) If you plot this motion, you see that the particle initially moves to the right, then stops, then comes back towards the origin. What is the maximum displacement of this particle from the origin?
   c) What is the time that this particle reaches its maximum displacement from the origin?
   d) What is the greatest speed this particle ever achieves?
   e) When does the particle achieve this greatest speed?

Note: When checking for extrema of functions that are only defined over an interval (here, $t \geq 0$), always make sure to test the extremes of the region as well. In other words, make sure that the max position, min position, max velocity, or min velocity don't occur at $t = 0$ or $t = \infty$. The extremes CAN *be there, and the derivative test won't catch them.*