Week 2-Problems

2-1 Which is larger, 60 miles per hour or 88 ft per second? Why?

2-2 The Earth rotates once every 24 hours about its axis. If you think of Earth as being a sphere of radius 6400 km, where on Earth would your speed be (i) maximum (ii) zero?
2-3 In order to qualify for an automobile race where the track is 300km, a racer must maintain a speed of 65 mph. A racer travels the first half at a constant speed of 55 mph. What constant speed will she need in the second half in order to qualify? Why?

2-4 Which vector is larger, $\vec{r} = 5 \hat{m}$ or $\vec{r} = -5 \hat{m}$? Why?
2-5 Calculate the magnitudes of the vectors
\[ r_1 = 3\hat{x} + 4\hat{y} \]
\[ r_2 = -3\hat{x} - 4\hat{y} \]
\[ r_3 = 1\hat{x} + 2\sqrt{2}\hat{y} + 4\hat{z} \]
\[ r_4 = 1\hat{x} + 4\hat{y} - 2\sqrt{2}\hat{z} \]

2-6 Sarah starts from 0. She first walks 25m directly north.
Then 50m due north-east and then 70m directly south.
Calculate her total displacement vector.
2-7 A person walks on a circular track of diameter 200m. If she takes 5 minutes to go around once, what is her average (i) speed (ii) velocity? Why?

2-8 You drive on interstate 95 from Washington to New York. On the outward journey you travel half the time at 56km/h and the other half at 88km/h. On return you travel half the distance at 56km/h and the other half at 88km/h. What is your average speed for (i) Washington to New York (ii) New York to Washington (iii) complete trip?
2-9 The graph shows the position of a particle. 
State for each interval if velocity is positive, 
zero, or negative.

2-10 The graph shows x as a function of time. 
State (i) if the velocity is positive or negative 
between (a) A → B and (b) B → C 
(ii) if the acceleration is positive or negative 
(iii) Average velocity between A and C 
(iv) At what point is the instantaneous velocity 
equal to zero.
2-11 You are traveling on a level road at 55mph. You notice that there is a deer some 170 meters ahead of you. You immediately apply the brake. If your maximum deceleration is 2m/s² and your reaction time is 1/3 sec, can you avoid hitting the deer?

2-12. An object has a constant acceleration of 5m/s² \( \hat{x} \). If its present velocity is -10m/s \( \hat{x} \), what is the velocity (i) 2.5s earlier and (ii) 2.5s later?
2-13. An aircraft needs a velocity of 200mph $\hat{x}$ for take off. If the runway is 1.1km long, what is the minimum acceleration required starting from rest?

2-14. The position vector of an object is given by the equation $x = (5+3t-4t^2) \hat{x}$ where distances are in meters and times in seconds. (i) What are the position, velocity, and acceleration of this object at $t=5$ seconds? (ii) At what times will this object be at position $x=0$?