Physics 112 Course Review #1: Position and Velocity

1. Describe what is meant by frame of reference and why it is important.

A framework used for the observation and mathematical description of physical objects. It consists of the observer, a co-ordinate system and a time assigned with respect to the co-ordinate system.
It is important because it can be used to detect motion and needs to give context to the person reading the question/answer.

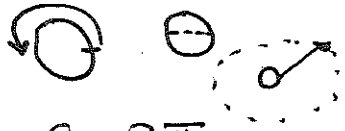
2. Define scalars and vectors. Provide three examples of each.

scalars have both a magnitude and a unit
examples: distance, speed, time
10m, 12m/s, 8s

vectors have both a magnitude and direction
examples: displacement, velocity, acceleration
10m[W40°N], 12m/s[E], $20m/s^2$[W20°S]

3. Calculate the average velocity and speed of the planet Saturn the instant it has traveled half of its circular orbit.

Saturn



$C = 2\pi r$
$= 2 \times 3.14 \times 1.4 \times 10^{12}$
$= 6.28 \times 1.4 \times 10^{12}$
$= 8.792 \times 10^{12} / 2$
$= 4.396 \times 10^{12}$

$\vec{d} = r \times 2$
$= 1.4 \times 10^{12} \times 2$
$= 2.8 \times 10^{12}$

$v_{sp} = \frac{d}{t} = \frac{4.396 \times 10^{12}}{4.57 \times 10^{8}} = 9606 m/s$

$\vec{v}_{avg} = \frac{\vec{d}}{t} = \frac{2.8 \times 10^{12}}{4.57 \times 10^{8}} = 6127 m/s$

$T = \text{revolution} = 29 \text{ years}$ need to convert to s

$29 yr \times \frac{365 d}{1 yr} \times \frac{24 h}{1 day} \times \frac{60 min}{1 hr} \times \frac{60 sec}{1 min} = \frac{914544000}{2} = 4.57 \times 10^{8}$

4. A football is thrown 35 m [W], 60 m [E], 12 m [E], 45 m [W] and finally 75 m [W]. All of this happens in 62 seconds. Calculate the average speed and velocity of the football.

35m[W] (-35)
60m[E]
12m[E]
45m[W] (-45)
75m[W] (-75)

distance = 227
displacement = -83

$t = 62s$

$v_{sp} = \frac{d}{t}$

$v_{sp} = \frac{227m}{62s}$

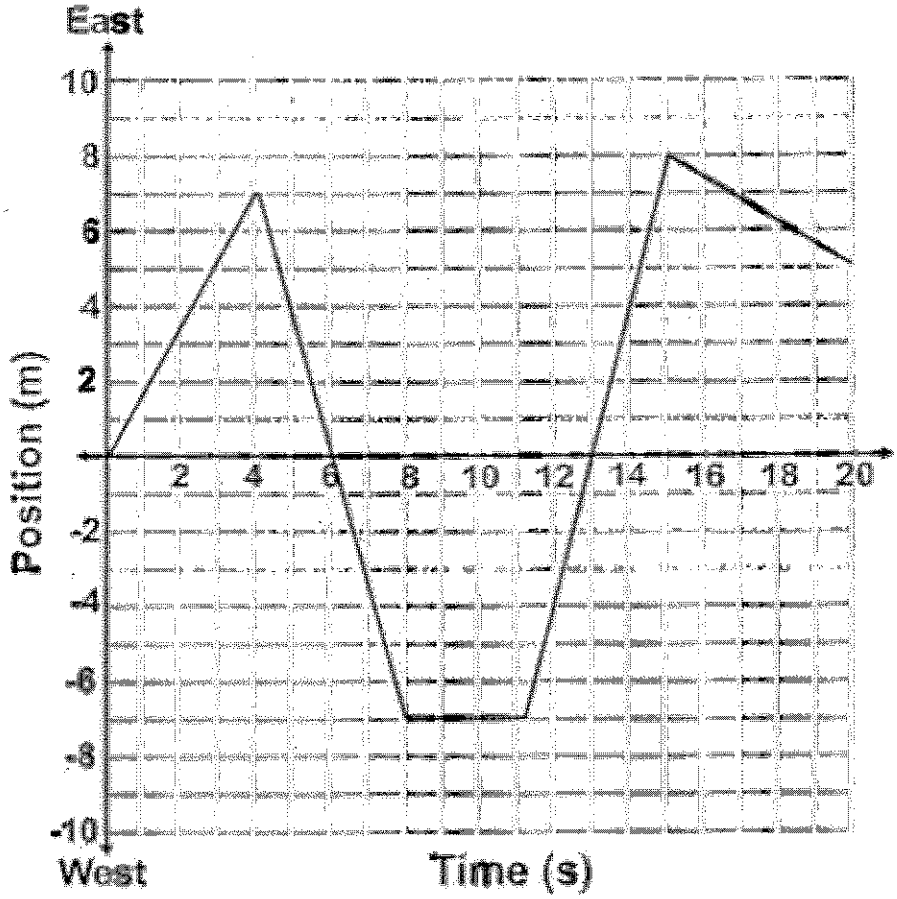
$v_{sp} = 3.66 m/s$

$\vec{v}_{avg} = \frac{\vec{d}}{t}$

$v_{avg} = \frac{-83}{62}$

$v_{avg} = -1.34 m/s (E)$

5. Use the Graph below to answer the following questions:



a. Calculate the velocity between 4 & 6 seconds.

$v_{avg} = \frac{\vec{d}}{t} = \frac{d_f - d_0}{t_f - t_0} = \frac{0-7}{6-4} = \frac{-7}{2} = -3.5\,m/s\,(E)$

b. At what time(s) was the object back at the starting position?

6s and 13s

c. At what time(s) did the object change direction?

4s, 11s and 15s

d. Calculate the total distance traveled during the 20 seconds. direction does not matter add distances

7m + 14m + 0m + 15m + 3m

39m

e. Calculate the average speed and velocity for the 20 seconds.

$v_{sp} = \frac{d}{t}$

$= \frac{39m}{20s} = 1.95m/s$

$v_{avg} = \frac{\vec{d}}{t}$ displacement direction does matter

7m + (-14m) + (0m) + (15m) + (3m)

5m

$v_{avg} = \frac{5}{20}$

$= 0.25m/s\,(E)$