PHY 115 – HW Solutions with additional graphs

1.

1-D motion, eastward and westward. Convention: due W is positive.

A: Min. 0 - 1 (60 s) – running due W at 8 m/s - $\Delta\overrightarrow{x_A} = 8\frac{m}{s} * 60s = +480\ m$

B: Min 1 – 4 (180 s) – not moving - $\Delta\overrightarrow{x_B} = 0\ m$

C: Min 4 – 6 (120 s) – walking due E at 1 m/s - $\Delta\overrightarrow{x_C} = 1\frac{m}{s} * 120s = -120\ m$

Total time: 360 s or 6 minutes.

Average velocity = $\bar{v} = \Delta\vec{x}/\Delta t$

a. t = 1 min to t = 4 min (180 s)

$$\bar{v} = \frac{\Delta\overrightarrow{x_B}}{\Delta t_B} = \frac{0m}{180s} = \mathbf{0}\frac{\boldsymbol{m}}{\boldsymbol{s}}$$

b. t = 0 min to t = 4 min (60 s + 180 s)

$$\bar{v} = \frac{480\ m + 0m}{240\ s} = \mathbf{2}\frac{\boldsymbol{m}}{\boldsymbol{s}}$$

c. t = 0 min to t = 6 min (360 s)

$$\bar{v} = \frac{\Delta\overrightarrow{x_A} + \Delta\overrightarrow{x_B} + \Delta\overrightarrow{x_C}}{\Delta t_A + \Delta t_B + \Delta t_C} = \frac{(480 + 0 - 120)m}{360s} = \frac{360m}{360s} = \frac{\mathbf{1}\boldsymbol{m}}{\boldsymbol{s}}$$

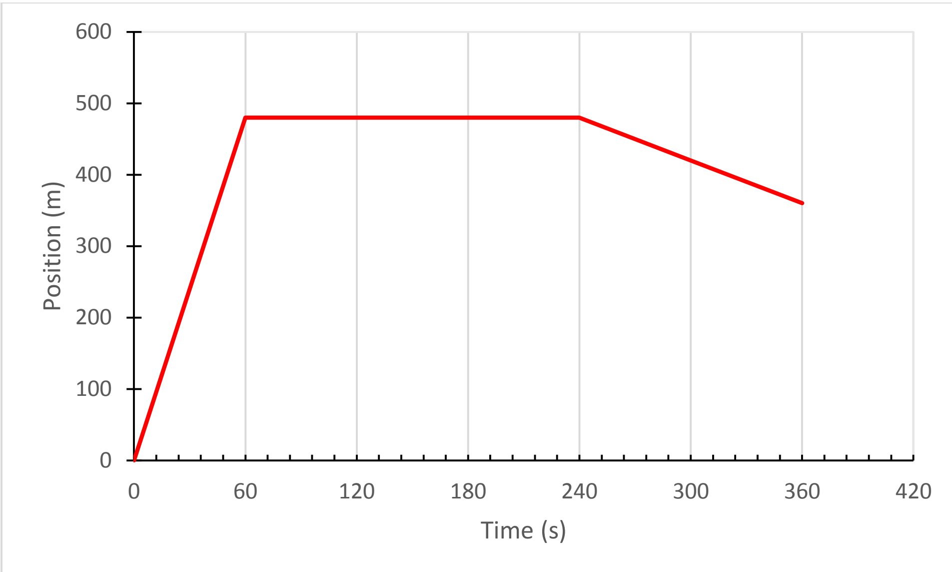
d. Average speed from t = 0 min to t = 6 min (360 s)

$$Avg.speed = \frac{total\ distance\ traveled}{total\ time\ elapsed} = \frac{480\ m + 0\ m + 120\ m}{360s} = \frac{600\ m}{360\ s} = 1.7\frac{m}{s} \approx \mathbf{2}\frac{\boldsymbol{m}}{\boldsymbol{s}}$$

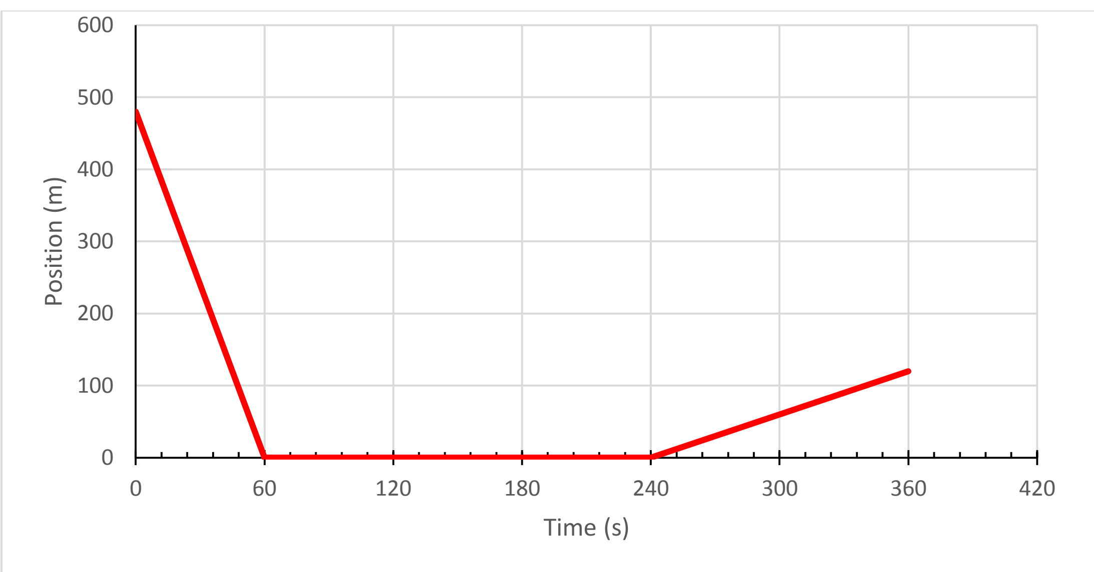
Larger than the magnitude of the average velocity by a factor of almost 2.

(Not required) – Graphs

1. Origin = Departure point



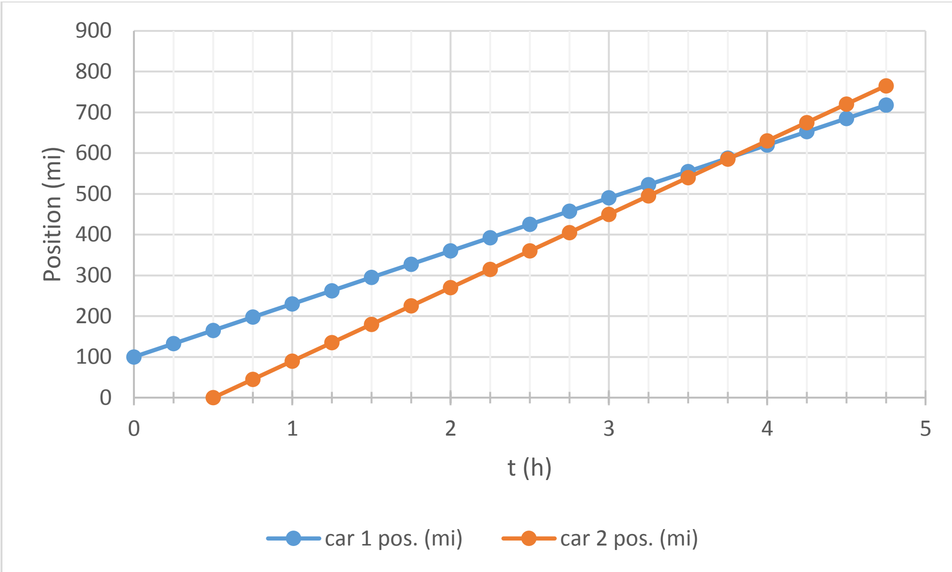
2. Origin = hiding spot



2.

a. The table below shows Cars 1 and 2 positions.

t (h)	car 1 pos. (mi)	car 2 pos. (mi)	
0	100		
0.25	132.5		
0.5	165	0	
0.75	197.5	45	
1	230	90	
1.25	262.5	135	
1.5	295	180	
1.75	327.5	225	
2	360	270	
2.25	392.5	315	
2.5	425	360	
2.75	457.5	405	
3	490	450	
3.25	522.5	495	
3.5	555	540	
3.75	**587.5**	**585**	**Car 2 passes 1**
4	620	630	
4.25	652.5	675	
4.5	685	720	
4.75	717.5	765	



b. Position that they meet (2 SF): around 5.9 x 10^2 miles.

c. Time: 3.8 hours (the last digit is the uncertain digit).

3.

a. 0 m/s (based on the graph).

b. $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$ =

= $\frac{35\frac{m}{s} - 0\frac{m}{s}}{5.0\ s} = 7.0\frac{m}{s^2}$

This happens to be also the magnitude of the acceleration.

c. Area of triangle = total displacement = $\Delta\vec{x}$ = (1/2)*(5.0 s)*(35 m/s) = 87.5 m ≈ $\mathbf{88\ m}$.

d. Yes. The slope of the line that describes the speed (and the velocity, since the motion is eastward) is constant. This means constant acceleration.

4.

a. At instants when the slope of the line that describes the position as a function of time is zero (or approximately zero), which means between 0.5 and 1.0 s (approximately).

b. The average velocity bet. 3.0 and 4.0 s is

$$\bar{v} = \frac{45\ m - 25m}{1.0\ s} = \mathbf{20\ m/s}$$

c. Yes. Approximately between 0 and 0.5 s, when the slopes of the position vs. time graph are negative.

d. It means that the total displacement within the time interval is in the negative direction. Since $\vec{v} = \Delta\vec{x}/\Delta t$, if $\Delta\vec{x}$ is negative, the velocity is negative.

e. Yes. For example, at the peak point of a free-fall motion, the velocity is zero. The acceleration, however, is downward and equal to approximately 9.8 m/s^2. In general, if the direction of motion is reversed, the velocity will be zero at the instant of direction reversal, but the acceleration is not zero since the velocity is not constant.