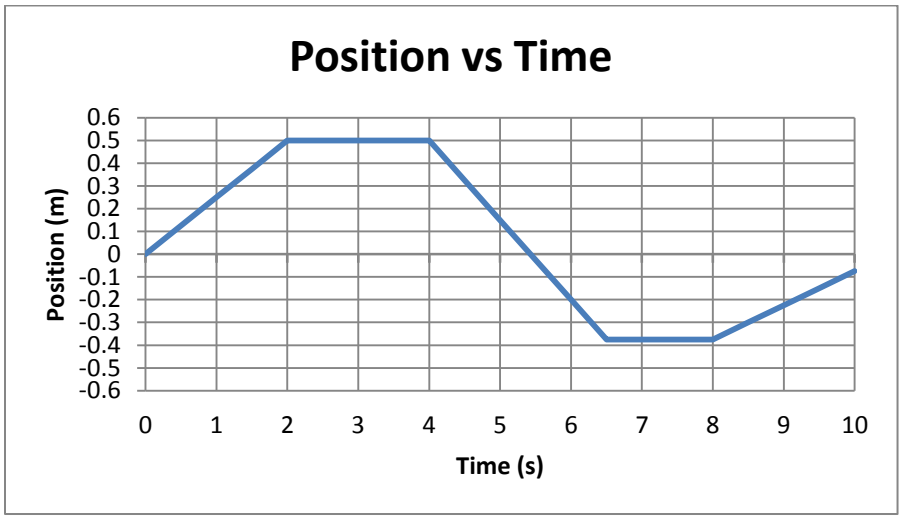
Name: _____ DISC: _____ Score: _____ / 20

Instructions:

- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers

Q1	Q2	Q3	Q4
10	10	5	5

1. You observe a cart moving and plot its position versus time as shown in the graph **(Lecture 3 pp. 5-7; Discussion 3-2)**:



Speeds: 1 pt each

a. Using the graph fill in the following table of velocities:

TIME	VELOCITY
From 0 s to 2 s	$\frac{(0.5-0)m}{(2-0)s} = \frac{0.5}{2}\frac{m}{s} = 0.25\frac{m}{s}$
From 2 s to 4 s	$\frac{(0.5-0.5)m}{(4-2)s} = \frac{0.0}{2}\frac{m}{s} = 0\frac{m}{s}$
From 4 s to 6.5 s	$\frac{(-0.375-0.5)m}{(6.5-4)s} = \frac{-0.875}{2.5}\frac{m}{s} = -0.35\frac{m}{s}$
From 6.5 s to 8 s	$\frac{(-0.375-(-0.375))m}{(8-6.5)s} = \frac{0}{1.5}\frac{m}{s} = 0\frac{m}{s}$
From 8 s to 10 s	$\frac{(-0.375-(-0.125))m}{(10-8)s} = \frac{0.25}{2}\frac{m}{s} = 0.125\frac{m}{s}$

Remember, the velocity is the *slope* of a position vs. time graph. We can calculate the velocity between each time point on the graph using $v = \Delta x/\Delta t$.

Average Speed (2 pts):

b. What is the average speed of the cart?

The average speed of the cart can be calculated by taking the sum of the speeds and dividing by the total number of speeds measured: $v = \frac{[0.25+0+0.35++0+0.125]}{5}\frac{m}{s} = 0.145\frac{m}{s}$.

Full credit to be given for the same with velocities rather than speeds.

Full credit to be given for any other correct averaging technique including:

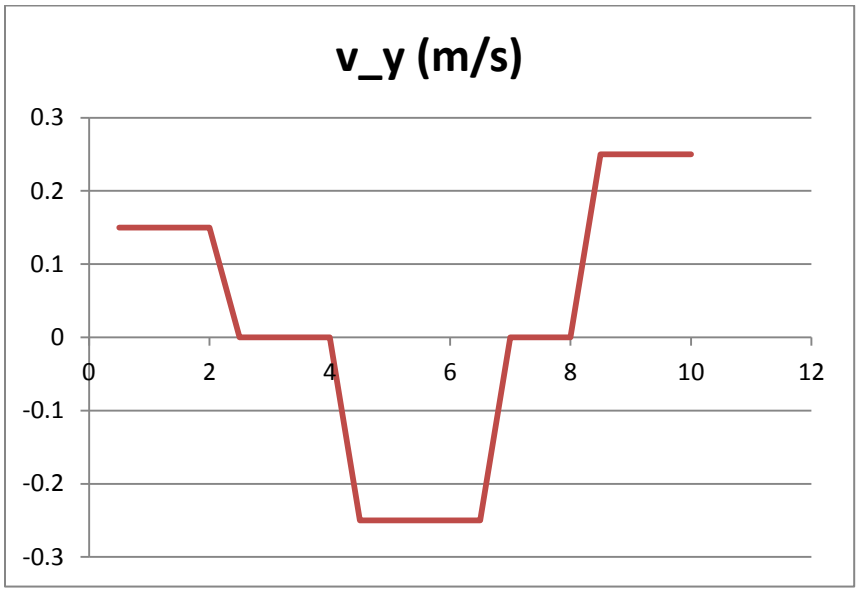
The time-weighted average: $v = \frac{[0.25\times2+0\times2+0.35*2.5+0+2.5+0.125*2]}{10}\frac{m}{s} = 0.1625\frac{m}{s}$.

Full credit to be given for the same with velocities rather than speeds.

Simple point averages (i.e. picked a couple of points and took the average).

c. Sketch the *velocity versus time* for the cart:

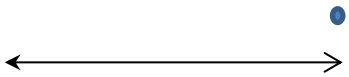
Sketch (3 pts):



2. You want to determine the height of a mountain $100\ km$ from your current position. You look around and notice that about $500\ m$ away from you is a tall tree. You look up and notice that the peak of the mountain and the top of the tree are aligned. **(Homework 2)**

a. Make a sketch of this system. Remember to label all features.

Sketch (3 pts):



Description (2 pts):

b. Since you cannot measure the height of the mountain directly, describe the technique or techniques you would use to determine the height of the mountain.

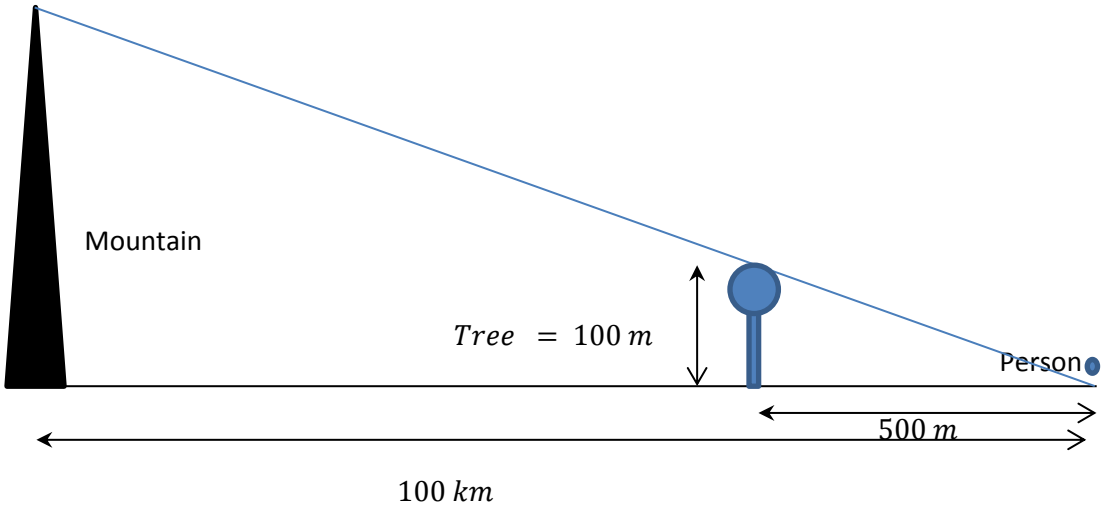
The easiest way to solve this problem is to triangulate using similar triangles, if you know the height of the tree.

Otherwise if you can measure the angle (using an astrolabe or protractor, for example) at which you view the mountain and the tree-top simultaneously, you can use your trig functions (you know how far the tree is from you and how far the mountain is from you) to calculate the height of the mountain.

c. The tree is 100 m tall. Find the height of the mountain.

Given this new information, the method of similar triangles is the easiest technique:

Mountain height (5 pts):



$$\frac{Mountain}{100\ km} = \frac{100}{500} = \frac{1}{5}$$

$$Mountain = \frac{100\ km}{5} = 20\ km$$