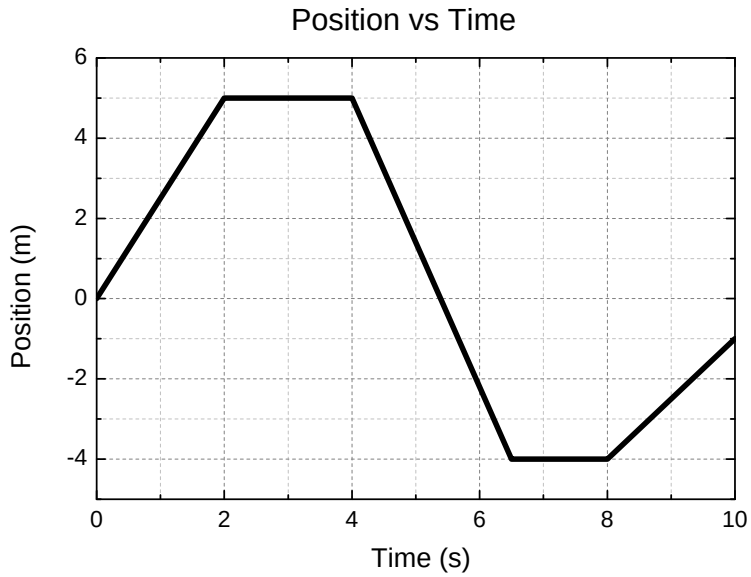
Name: _____ DISC: _____ Score: _____ / 20

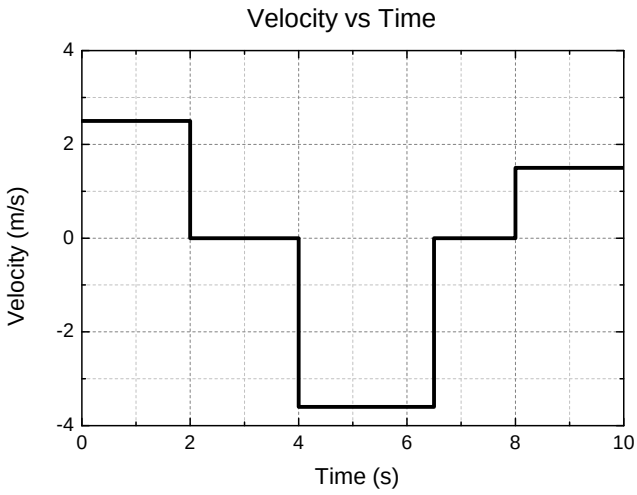
Instructions:

- 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 along a straight line and plot its position versus time as shown in the graph:





Speeds: 1 pt each

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

TIME	VELOCITY
From 0 s to 2 s	$\frac{(5-0)m}{(2-0)s} = \frac{5}{2}\frac{m}{s} = 2.5\frac{m}{s}$
From 2 s to 4 s	$\frac{(5-5)m}{(4-2)s} = \frac{0}{2}\frac{m}{s} = 0\frac{m}{s}$
From 4 s to 6.5 s	$\frac{(-4-5)m}{(6.5-4)s} = \frac{-9}{2.5}\frac{m}{s} = -3.6\frac{m}{s}$
From 6.5 s to 8 s	$\frac{(-4-(-4))m}{(8-6.5)s} = \frac{0}{1.5}\frac{m}{s} = 0\frac{m}{s}$
From 8 s to 10 s	$\frac{(-1-(-4))m}{(10-8)s} = \frac{3}{2}\frac{m}{s} = 1.5\frac{m}{s}$

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 $v = \Delta x/\Delta t$.

Sketch (2 pts):

b. Sketch the *velocity versus time* for the cart in the blank graph provided above. Make sure to add tick labels on the y-axis as appropriate.

Average velocity & speed (3 pts):

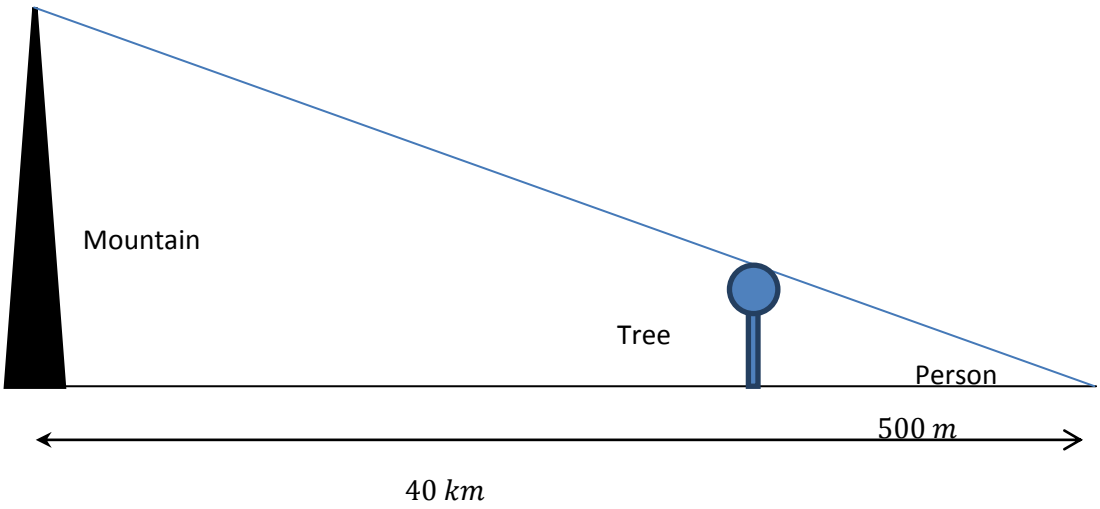
c. What is the average velocity of the cart? And what is the average speed?

The average velocity: v_{avg} = (total displacement)/(total time) = -1 m/10 s = -0.1 m/s.
The average speed: savg = (total travelled distance)/(total time) = 17 m/10 s = 1.7 m/s.

2. You want to determine the height of a mountain $40\ km$ 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.

Sketch (3 pts):

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



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.

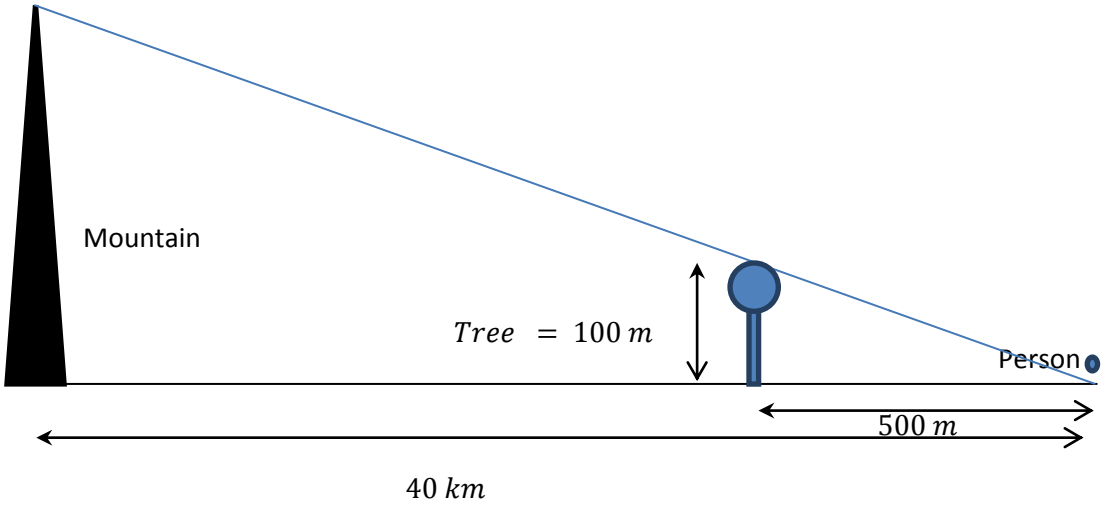
The easiest way to solve this problem is to triangulate using similar triangles, if you know the height of the tree.

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.

Mountain height (5 pts):

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:



$$\frac{Mountain}{40\ km} = \frac{100}{500} = \frac{1}{5}$$

$$Mountain = \frac{40\ km}{5} = 8\ km$$