

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

5

5

5

5

1. You are pushing a cart up a hill when the wheels fall off. If the hill makes an angle  $\theta$  with the horizontal:

- a. Draw a free-body diagram and label all of the forces. Include the coordinate system.

Diagram:

Force Labels:

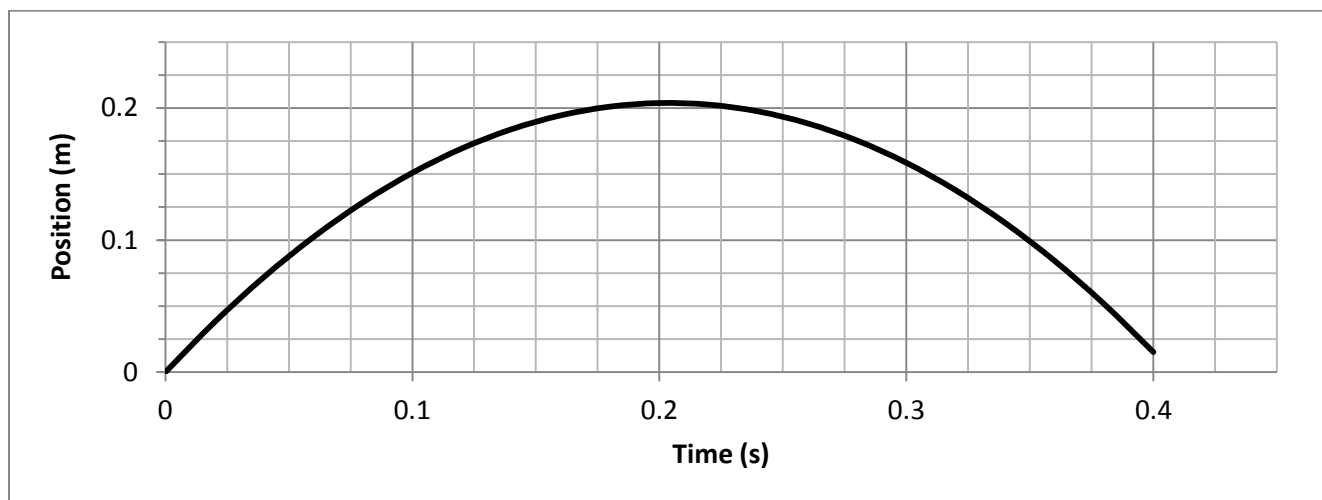
Set-up:

Algebra:

Substitutions:

- b. The cart has a mass  $m = 30 \text{ kg}$ . Let  $\theta = 15^\circ$  and the coefficient of kinetic friction  $\mu_k = 0.15$ . How much force must you apply to the cart to maintain a constant velocity up the hill? Assume you can direct your push directly up the hill.

2. You and your roommate are playing a game of catch. The graph shows the position of the ball as a function of time.



Set-up:

Algebra:

- a. Using the graph, estimate the speed  $v$  at the time when the ball has reached its maximum height.

Speeds:  
Graph:  
Observation:

- b. Estimate the speed  $v$  at  $t = 0.1 \text{ s}$  and  $t = 0.3 \text{ s}$ . Sketch a speed vs. time plot using the three speeds you estimated, including the speed in part (a). What do you observe?

3. You want to determine the height of a mountain 75 km from your current position. You look around and notice that about 200 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.

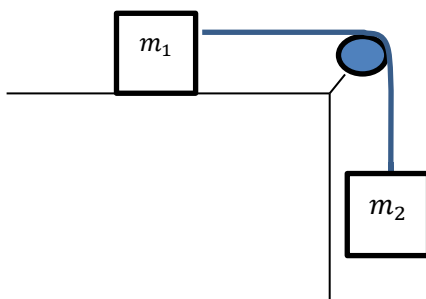
Description:  
Missing information:

- a. Describe how you would use this information to find the height of the mountain. What information do you still need to solve the problem?

Set-up:  
Algebra:  
Substitutions:

- b. The tree is 50 m tall. How tall is the mountain?

4. Two blocks are attached to each other by a massless cord as shown in the diagram below. Both the table and pulley are *frictionless*:



Force Vectors:  
Labels:

- a. Finish the free-body diagram by including all of the forces which can act on the blocks. Include a coordinate system.  
b. Can this system be in equilibrium? Explain your reasoning.

Answer:  
Explanation (2 pts):