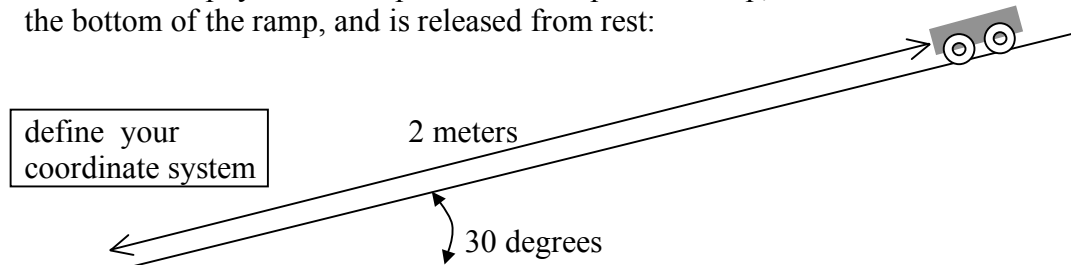


Free Response Problem 1**20 points****Multiple Parts**

A ramp is set up on a lab table that makes an angle of 30 degrees to the surface of the table. You have been told that in Chapter 4 you will learn that the acceleration down an incline can be calculated using this formula: $a = g \cdot \sin\theta$

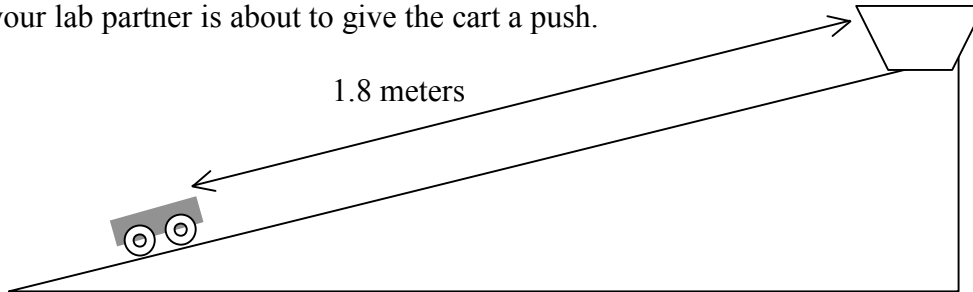
A frictionless physics cart is placed at the top of the ramp, with the front end being 2 meters from the bottom of the ramp, and is released from rest:



- A) Calculate the *acceleration* of the cart as it travels down the ramp. (3 points)
- B) Find the *time* it would take for the cart to travel the 2 meters down the ramp. (3 pts)
- C) Calculate the final *velocity* of the cart as it just reaches the bottom. (3 pts)

- D) If we were to double the ramp height, would the following increase, decrease, or stay the same? (In terms of magnitude): [circle one for i, ii, and iii] (3 pts)
- | | | | | | | |
|------|----------------|----------|--|-------------|--|----------|
| i) | final speed | increase | | remain same | | decrease |
| ii) | time down ramp | increase | | remain same | | decrease |
| iii) | acceleraton | increase | | remain same | | decrease |
-

The ramp is back to a 30 degree angle and the cart is moved to near the bottom of the track, and your lab partner is about to give the cart a push.



An expensive glass bowl is placed at the top end of the ramp, 1.8 meters away from the cart.

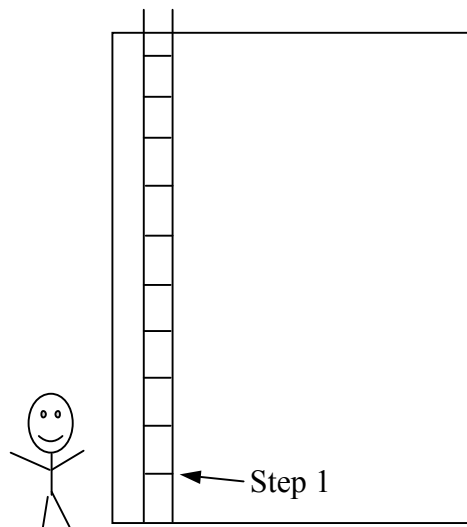
- E) Determine the *maximum speed* your friend could give the cart *without* the cart hitting the glass bowl.

- F) Assume your friend was successful and gave the cart the exact push to not hit the glass. From the time the cart leaves his hand until it returns to the same spot (with a downhill speed), would the...

- i) ...speed in the above situation ever be zero? Explain.
 - ii) ...magnitude of acceleration in the above situation ever be zero? Explain.
- i)
- ii)

Free Response Problem 2**15 points****Multiple Parts**

There are 10 steps on the ladder, with no step on the ground, and 0.75 meters between each step. Fred can climb ladders with a constant rate of 0.50 steps per second. There is a distance of 0.50 meters from the top step (#10) to the roof.



A) Determine the average speed, in m/s, that Fred can climb ladders. (2 pts)

B) Determine the height from the ground to the roof. (2 pts)

C) Determine the time it takes for Fred to climb to the top of the roof. (2 pts)

D) Fred has a friend who can launch an egg at exactly 9 m/s. Determine how many seconds before the egg is launched that Fred must start climbing in order to catch the egg *when the egg is at rest*, assuming his hand will be exactly 2 step-lengths above his feet, and his friend launches it from the ground. (9 pts)

Free Response 3: You and your lab partners collect the following data in observing the position and time of a moving object. You use stopwatches and rulers to collect your data. (12 pts)

Time	Position
1s	3 m
2s	6 m
3s	9 m
4s	12 m

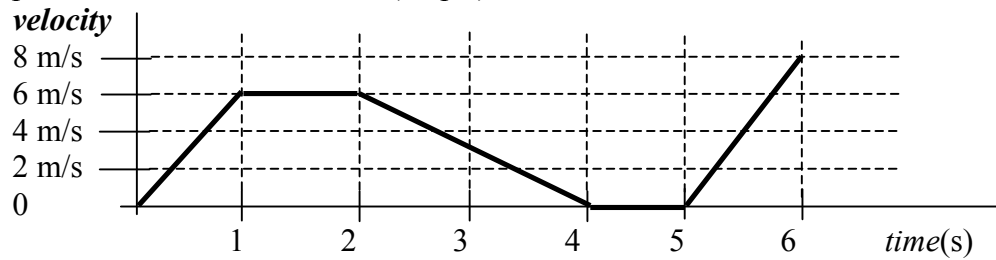


1. On the graph above, plot position vs. time. (place appropriate units on axis) (4 pts)
2. Use your data to estimate the average velocity of the particle between $t=1\text{s}$ and $t=4\text{s}$. (4 pts)
3. Did the object undergo an acceleration within the time interval $t=1\text{s}$ and $t=4\text{s}$? Why or why not? (4 pts)

Free Response 4: In this problem we assume there is no air friction. An object is launched with a velocity of 40 m/s straight upward. (10 points)

- 1) Determine how many seconds it takes for the object to reach the top of its flight. (3 pts)
- 2) Determine the acceleration and velocity at the top of its flight. (3 pts)
- 3) What is the speed 1.5 seconds after it reaches the top of the flight? (4 pts)

Free Response 5: The following graph shows the actual data of a moving object. Velocity is plotted as a function of time: (18 pts)



For all questions, there may be none, one, or more answers:

1. Give the time interval(s) when the object was moving with constant speed. (3 pts)
2. Give the time interval(s) when the object was at rest (not moving). (3 pts)
3. Determine the velocity of the object at $t = 1$ second. (3 pts)
4. Determine the instantaneous acceleration at $t = 3$ seconds. (3 pts)
5. Determine the average acceleration between $t = 2$ and $t = 6$ seconds. (3 pts)
6. Did the object undergo a constant negative acceleration? If so, when? (3 pts)

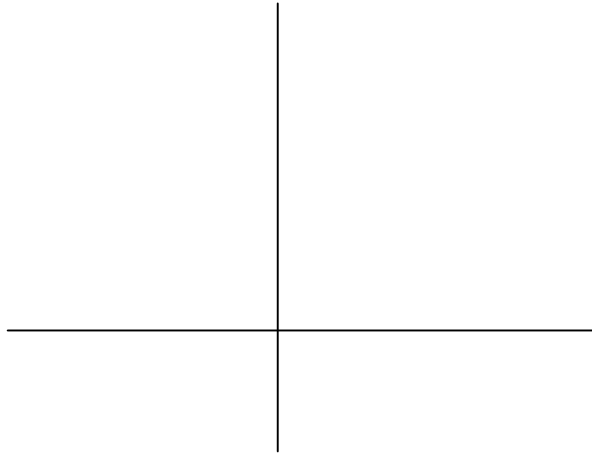
Vectors Question: All directions are rotations from the positive x-axis.

Vector **A** has a magnitude of 30 meters and a direction of 30 degrees.

Vector **B** has a magnitude of 40 meters and a direction of 90 degrees.

Vector **C** has a magnitude of 20 meters and a direction of 180 degrees.

1. Sketch Vectors A, B and C below, labeling each vector. Make and use a scale for lengths. (3 pts)



2. Determine the magnitude and direction of $\mathbf{A} + \mathbf{B}$. (6 pts)

3. Determine the magnitude and direction of $\mathbf{A} - \mathbf{B} + \mathbf{C}$ (6 pts)