Physics 2048 Test 1 Solution (*solutions to problems 2-5 are from student papers)*

Problem 1 (Short Answer: 20 points)

An object's motion is restricted to one dimension along the + distance axis. Answer each of the questions below by selecting the velocity graph that is the best choice to describe the answer. You may use any graph once, more than once, or not at all.

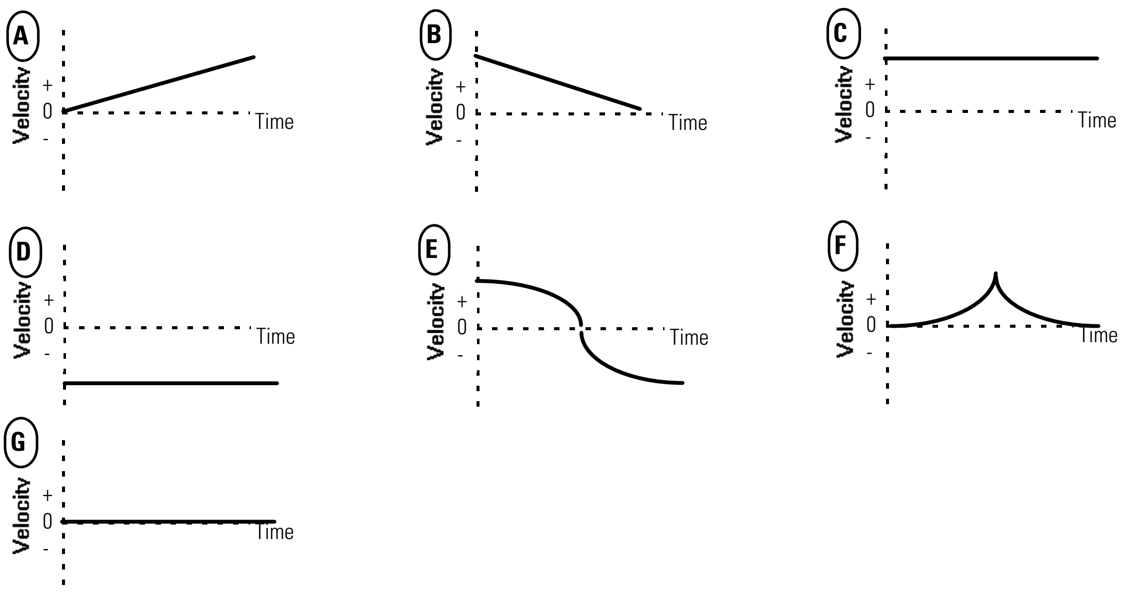
a. Which velocity graph shows an object going away from the origin at a steady velocity? (5)

b. Which velocity graph shows an object that is standing still? (5)

c. Which velocity graph shows an object moving toward the origin at a steady velocity? (5)

d. Which velocity graph shows an object changing direction? (5)

e. Which velocity graph shows an object that is steadily increasing its speed? (5)



a => C	*The velocity is constant so slope is 0. Since the object is moving in the + distance direction, the velocity graph will be a horizontal line with a + velocity value (i.e.) above the time axis.*
b => G	*The velocity is constant and zero. The velocity graph will be a horizontal line with a value of zero (i.e.) on the time axis.*
c => D	*The velocity is constant so slope is 0. Since the object is moving toward the origin form the + distance axis, the velocity is negative. The velocity graph will be a horizontal line with a – velocity value (i.e.) below the time axis.*
d => E	*To change direction, v must go from + to – or from – to +. Only in graph E, does the velocity change sign.*
e => A	*A steady increase in speed means the velocity graph will have a constant slope away from the time axis. Only graph A has such a slope.*

Problem 2 (Estimation Problem: 15 points)

You and a friend are planning a two-week vacation out to the West Coast for a wedding next summer. However you're both on a tight budget. Your friend thinks it would be cheaper to drive his car than fly. A cheap plane fare for one person from Orlando to San Francisco is $350 round-trip. Should you fly or drive? Realistically estimate travel expenses to and from the West Coast to see if your friend is right. What would your average speed be from Orlando to San Francisco? Assume you will have free room and board at a relative's house once you arrive.

Assumptions Orl. to GA = 300 ✓ GA to SF = 3000

Orlando to San Francisco = 3300 miles ✓

driving time per day = $10 \frac{hours}{day}$ ✓

h = Hotel = $\frac{\$60}{day}$ ✓

f = Food = $\frac{\$25}{day}$ ✓

Avg speed = $\frac{55 mi}{h}$ ✓

gas = $\frac{\$1.30}{gal}$ ✓

tank = 10 gals ✓

We need to know how many days it will take to drive the distance, and then how much it will cost

First, how far can we get in 1 day at the speed limit?

$v = \frac{\Delta x}{t}$, $vt = \Delta x$, $\frac{55 mi}{h}(10h) = 550$ miles ✓

Second, how many days will it take to cover this 3300 miles?

Our avg vel $\bar{v} = \frac{miles}{day} = \frac{550 \text{ miles}}{1 \text{ day}}$ since we only drive 10h in one day.

$v = \frac{\Delta x}{t}$, $t = \frac{\Delta x}{v}$, $t = \frac{3300 \text{ mile}}{\frac{550 \text{ miles}}{day}} = 6$ days ✓

Third. calculate cost.

Hotel for 6 days = 6 days$\left(\frac{\$60}{day}\right) = \$360$

Food for 6 days = 6 days$\left(\frac{\$25}{day}\right) = \$150$

} without counting gas, it's already more than $350. He should fly. ✓

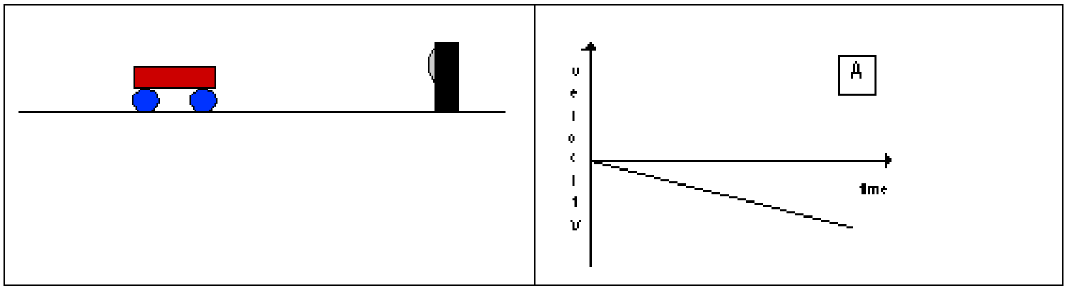
Avg speed = $\frac{\text{total distance travelled}}{\text{total time}} = \frac{3300 \text{ miles}}{6 \text{ days}} = \frac{550 \text{ miles}}{day}$ One way

dc

Problem 3 (Essay 10 points)

You may use diagrams and equations but no calculations in your response for this problem.

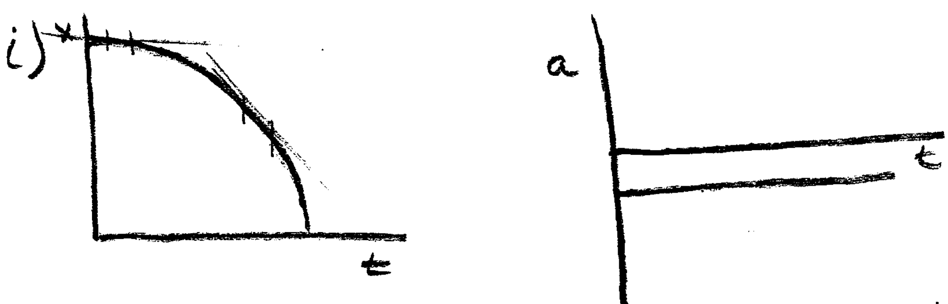
A cart can move to the right or left along a horizontal track (the positive part of the x axis) as shown in the figure below. Assume that friction is small enough that it can be ignored. A sonic range is used (as shown) to measure the position, velocity, and acceleration of the cart. The track is not necessarily flat or horizontal. In addition, the track may be tipped or the cart may be pulled or pushed.



For the first run, the sonic ranger displays a graph of the velocity that looks like the graph labeled A shown at the right.

(i) Draw graphs showing what the sonic ranger would display for the cart's position and the cart's acceleration.

(ii) Describe the motion of the cart in words and explain how you drew the graphs.

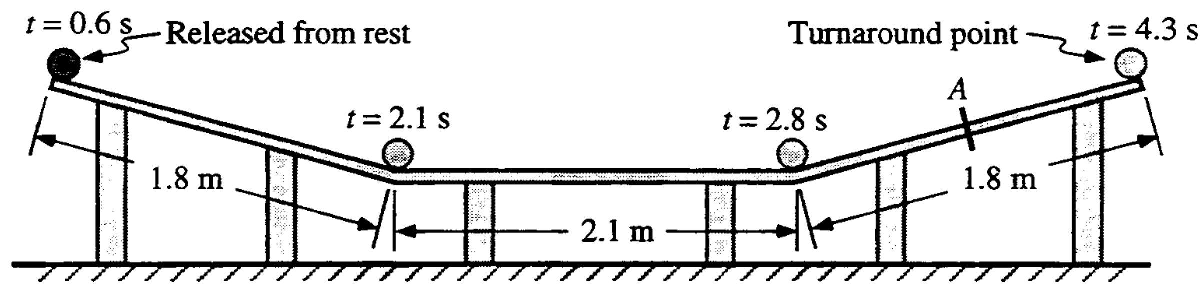


ii) the track is angled so that the lowest point of the track is the location of the sonic ranger. The cart moves down the ramp increasing in velocity. For the position graph the cart begins slow, having a smaller magnitude slope & velocity and the continues to increase in speed, the slope or velocity is of a greater magnitude. It is moving towards the ranger, why it begins with a larger x and goes to 0m. For the acceleration graph - the slope of the velocity is a constant, where the Δv is constant over a constant interval of time; thus, the acceleration is going to be constant. It is negative in value because the acceleration is down the ramp in the direction of the ranger.

(*Since this is hard to read, I typed out the answer shown above.)* The track is angled so that the lowest point of the track is the location of the sonic ranger. The cart moves down the ramp increasing in velocity. For the position graph cart begins slow, having a smaller magnitude slope & velocity and the[n] continues to increase in speed, the slope [and] velocity is of a greater magnitude. It is moving towards the ranger, [this is] why it begins with a larger x a[nd] goes to 0 m. For the acceleration graph – the slope of the velocity is a constant, where the Δv is constant over a constant interval of time; thus, the acceleration is going to be constant. It is negative in value because the acceleration is down the ramp in the direction of the ranger.

Problem 4 (20 points)

A ball is released from rest at the point shown on the incline. It then rolls onto a level section of track, and then onto a second incline with the same slope as the first. The diagram below shows the location of the ball at several instants in time. NOTE: THIS IS NOT A STROBE PHOTOGRAPH OR MOTION DIAGRAM.



A. Determine the speed of the ball at t = 2.1 s. Show your work.

Since the track is flat: $v = \frac{d}{\Delta t}$

$d = 2.1\,m$

$\Delta t = 2.8 - 2.1$

$v = \frac{2.1\,m}{2.8_s - 2.1_s} = \boxed{3\,m/s}$ ✓

4/4

B. Determine the magnitude of the acceleration of the ball at point A (halfway up the second incline). Show your work.

$v_i = 3\,m/s$

$v_f = 0\,m/s$

$\Delta t = 4.3 - 2.8\,s$

Since acceleration is constant on incline:

$a = \frac{\Delta v}{\Delta t}$ so $a = \frac{v_f - v_i}{\Delta t} = \frac{0_m - 3_m}{4.3_s - 2.8_s} = |-2\,m/s^2| = \boxed{2\,m/s^2}$ ✓

4/4

C. On the diagram above, draw an arrow indicating the direction of the acceleration of the ball at point A. Explain why you drew the arrow the way you did.

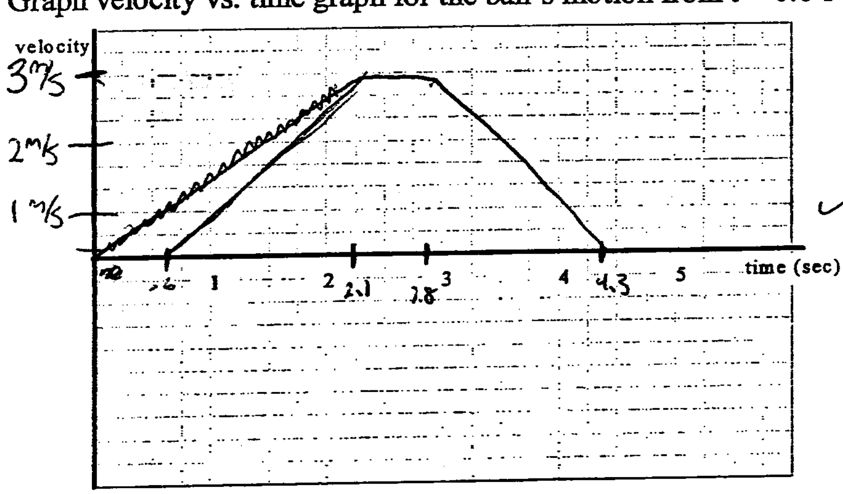
The acceleration is opposite of the motion because the ball is slowing down as it goes up the ramp. ✓ 4/4

D. On the diagram above, draw an arrow indicating the direction of the acceleration of the ball at t = 4.3 s (the turnaround point). If the acceleration at the turnaround point is zero, state that explicitly. Explain why you drew the arrow the way you did.

As in part (C), the ball still has a constant acceleration down the ramp, even when it is turning around. ✓

4/4

E. Graph velocity vs. time graph for the ball's motion from t = 0.6 s to t = 4.3 s.



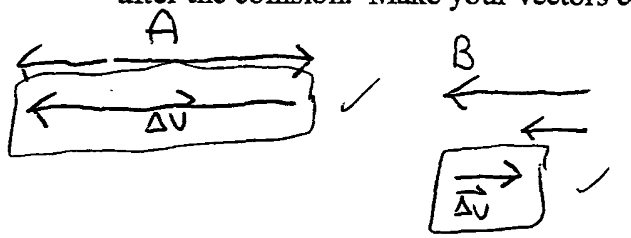
4/4 ✓

Problem 5 (10 points)

Two carts roll toward each other on a level table. The vectors represent the velocities of the carts just before and just after they collide.

before **after**

A. Draw and label a vector for <u>each cart</u> to represent the *change in velocity* from before to after the collision. Make your vectors consistent with the vectors drawn above.



4/4

B. How does the direction of Cart A's average acceleration compare to the direction of Cart B's average acceleration over the time interval shown? Explain your reasoning.

Cart A's acceleration is much ~~greater than~~ cart B's because it's ΔV vector is much greater. Also, the direction is opposite between the two, as shown in their vectors. $\frac{\Delta V}{t} = a$

3/3

C. Is the magnitude of Cart A's average acceleration *greater than, less than* or *equal to* the magnitude of Cart B's average acceleration over the time interval shown? Explain your reasoning.

As stated above, cart A's is greater than cart B's acceleration because of the change in direction of cart A, as shown by their ΔV vectors.

Group Test 1 (25 points) Physics 2048 Spring 2001

You have a summer job working for the UCF police department studying traffic flow on campus. There have been several complaints concerning the signal on Gemini drive by the water tower. The complaints claim that the yellow light is too short. If most cars decelerate at 10 m/s while braking, how long should the yellow light be so that people who can't stop without entering the intersection after the signal turns yellow have time to go through the 8.0 m wide intersection?

- USE THE GOAL PROTOCOL AND GROUP ROLES TO SOLVE THIS PROBLEM
- Make sure everyone's name and their group role on the GOAL Answer sheets
- YOU MAY USE 1 WHITE BOARD PER GROUP
- WORK ONLY WITH YOUR GROUP MEMBERS
- NO BOOKS OR NOTES ALLOWED

YOU WILL BE GRADED ON YOUR REASONING AND HOW WELL YOU USED THE GOAL PROTOCOL IN ADDITION TO THE CORRECTNESS OF YOUR ANSWER