PHYSICS 105S

Assignment #2 Due at 9am Wednesday, May 30, 2007

NAME: _____

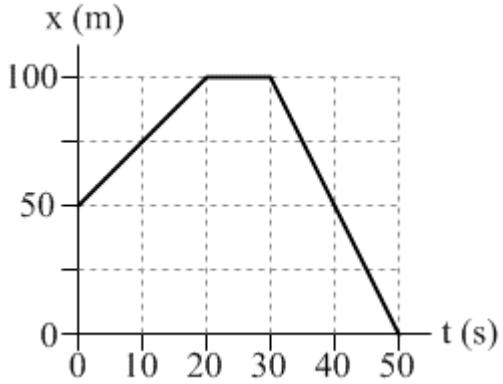
DISCUSSION SECTION: [ ] SA2

INSTRUCTIONS:

1. Please include appropriate units with all numerical answers.
2. **Please show all steps in your solutions!** If you need more space for calculations, use the back of the page preceding the question. For example, calculations for problem 3 should be done on the back of the page containing question 2. **You must show correct work to receive full credit. Support your answers with brief written explanations and/or arguments based on equations.**
3. **Indicate clearly** which part of your solution is the final answer.
4. Try answering these problems without a calculator.

Angle (θ)	sin(θ)	cos(θ)
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$
45°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$

PROBLEM 1 – 20 points



The graph shows your position as a function of time as you move along a sidewalk.

[5 points] (a) At t = 10 s, what is your:

Position: _____ Velocity: _____ Acceleration: _____

[5 points] (b) At t = 40 s, what is your:

Position: _____ Velocity: _____ Acceleration: _____

[5 points] (c) What is your average velocity over the interval from t = 0 s to t = 40 s?

[5 points] (d) What is your average speed over the interval from t = 0 s to t = 40 s?

PROBLEM 2– 15 points

Two balls are launched at the same time. Ball A is released from rest from the top of a tall building of height H. Ball B is fired straight up from the ground with an initial velocity such that it just reaches the top of the same building. Neglect air resistance.

[3 points] (a) Which ball has the largest magnitude acceleration at the point they pass one another?

[ ] Ball A [ ] Ball B [ ] neither, they're equal

Briefly justify your answer:

[3 points] (b) If ball A takes a time T to reach the ground, and ball B takes the same time T to reach the top of the building, which ball has the highest speed at time T/2?

[ ] Ball A [ ] Ball B [ ] neither, they're equal

Briefly justify your answer:

[4 points] How far from the ground are the two balls when they pass one another? Express your answer in terms of H.

[5 points] (d) Sketch a graph showing the velocity of ball A, and the velocity of ball B, as a function from the time over the interval from when the balls are launched until ball A reaches the ground.

PROBLEM 3 – 15 points

A tortoise and a hare are having a 100 m race. When the starting gun goes off the hare lies down for a nap. The tortoise moves forward with a constant acceleration, reaching a speed of 2.0 m/s when she is 20 m from the starting line. After this, the tortoise travels at a constant velocity of 2.0 m/s until crossing the finish line. After 45 seconds the hare wakes up from his nap, and covers the 100 m with a constant acceleration of 2.0 m/s^2.

[6 points] (a) Who wins the race? Clearly justify your answer.

[2 points] (b) How much time passes between the winner reaching the finish line and the other animal reaching the finish line?

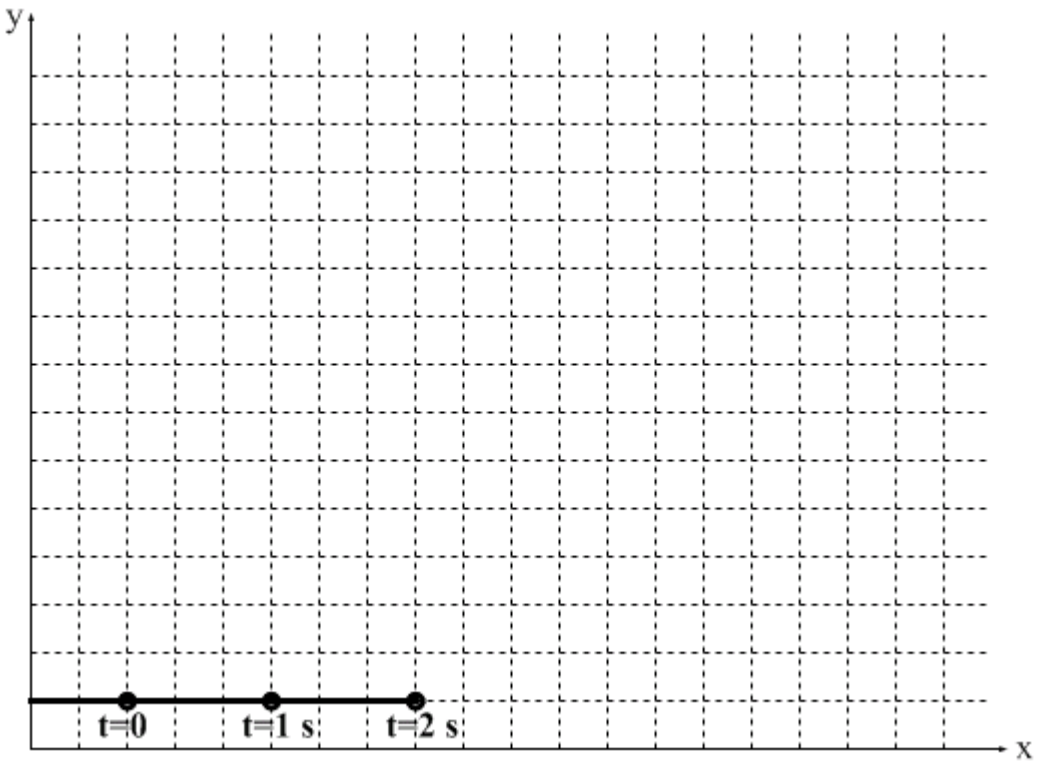
[2 points] (c) What is the distance between the animals when the winner crosses the finish line?

[5 points] (d) What is the distance between the animals at the only time (other than at the instant the starting gun is fired) they have the same velocity?

PROBLEM 4 – 10 points

(This is a two-dimensional problem. The x-motion and the y-motion are independent of each other. You need to think about each of them in order to know where to plot a point (x,y) at a particular time t.)

A spaceship is drifting at constant velocity through outer space, unaffected by any gravitational interactions. The figure below shows the trajectory followed by the spaceship in a particular x-y coordinate system during a 2.00 second interval. At t = 2.00 seconds the spaceship fires its engine, producing an acceleration of 2 m/s^2 in the +y direction. **The engine is turned off again after 2.00 seconds, at t = 4.00 seconds**. The square boxes in the figure below measure 1.00 m by 1.00 m.



(a) [2 points] A t = 2.00 s, what are the components v_{ox} and v_{oy} of the initial velocity needed for calculations regarding the next two second interval (constant acceleration only in the y direction)

(b) [6 points] On the figure above carefully plot the trajectory followed by the spaceship after t = 2.00 seconds. Note in particular where the spaceship is at t = 3.00 s, t = 4.00 s, and t = 5.00 s. The trajectory beyond t= 4 s is a new calculation, taking (x,y) and (v_x , v_y) at 4 seconds as the starting values.

(b) [4 points] What is the speed of the spaceship at t = 5.00 seconds?