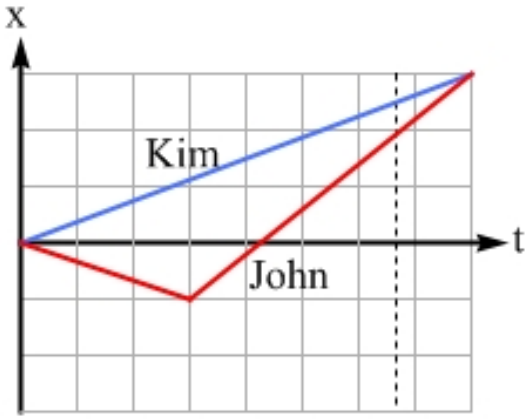
PROBLEM 1 – 10 points

The graph at right shows the position as a function of time for two students, Kim and John, as they move along a straight line.



For the time period shown in the graph …

[2 points] (a) which student travels a larger distance?

[ ] Kim [ ] John [ ] equal for both

[2 points] (b) which student's displacement has the larger magnitude?

[ ] Kim's [ ] John's [ ] equal for both

[2 points] (c) which student has the larger average speed?

[ ] Kim [ ] John [ ] equal for both

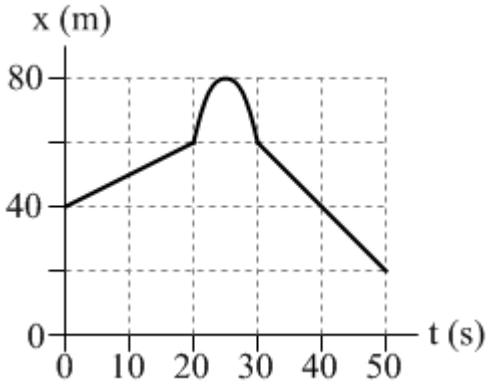
[2 points] (d) which student's average velocity has the larger magnitude?

[ ] Kim's [ ] John's [ ] equal for both

[2 points] (e) At the instant indicated by the dashed line on the graph, which student has the higher speed?

[ ] Kim [ ] John [ ] equal for both

PROBLEM 2 – 20 points



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

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

Position: _____ Velocity: _____ Acceleration: _____

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

Position: _____ Velocity: _____ Acceleration: _____

[4 points] (c) What is your average velocity over the interval from t = 0 s to t = 50 s?

[4 points] (d) What is your average speed over the interval from t = 0 s to t = 50 s?

[4 points] (e) Sketch a rough graph of your velocity as a function of time over the interval from t = 0 s to t = 50 s.

PROBLEM 3 – 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 4 – 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?