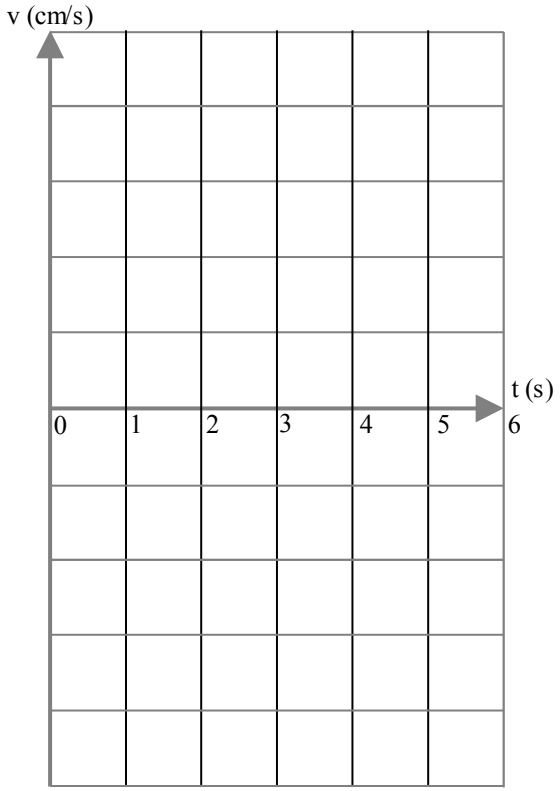
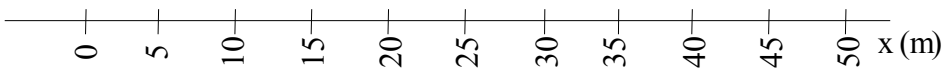
Whiteboard Problems – Constant Acceleration Particle Model

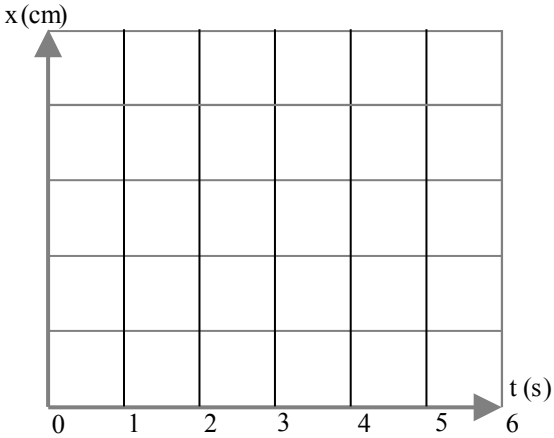
1. A truck traveling at 12m/s (27mi/h) to the West is on a head on collision course with a car traveling at 10m/s (22mi/h) to the East. When the vehicles are 50m apart, both drivers slam on their brakes, causing the truck to slow at $3m/s^2$ while the car slows at $2m/s^2$. Do they avoid collision? You may assume that each vehicle remains at rest if it manages to come to a stop before colliding. (a) Support your conclusion by drawing a quantitatively accurate velocity vs. time graph for the two vehicles. Make sure your graph accurately portrays the direciton of motion. (b) From your velocity graph and the starting positions, determine the position of each vehicle at each second. Show your method with a visual aid and at least one sample calculation for each vehicle.



(c) Use the axis below to draw a quantitatively-accurate motion map for the two vehicles. Use an appropriate scale for velocity and acceleration arrows and distinguish acceleration arrows by drawing them in a different color and using half arrow-heads.



(d) Draw a position vs. time graph showing the motion of the two cars.



(e) How does the position vs. time graph show that the cars move in opposite directions?

How does the *velocity* vs. time graph show that the cars move in opposite directions?

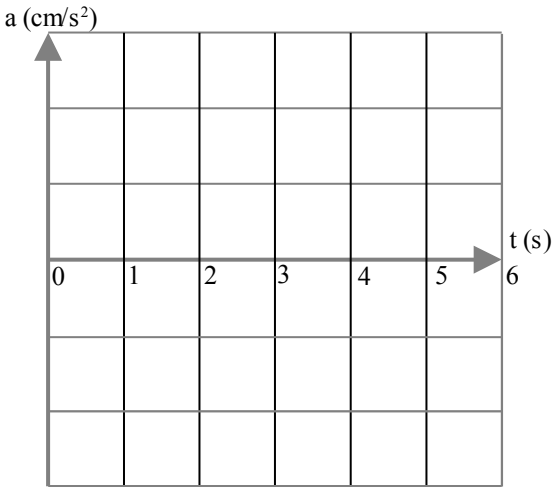
How does the *motion map* show that the cars move in opposite directions?

(f) How does the position vs. time graph show that the cars are *slowing down*?

How does the *velocity* vs. time graph show that the cars are slowing down?

How does the *motion map* show that the cars are slowing down? (Give two reasons.)

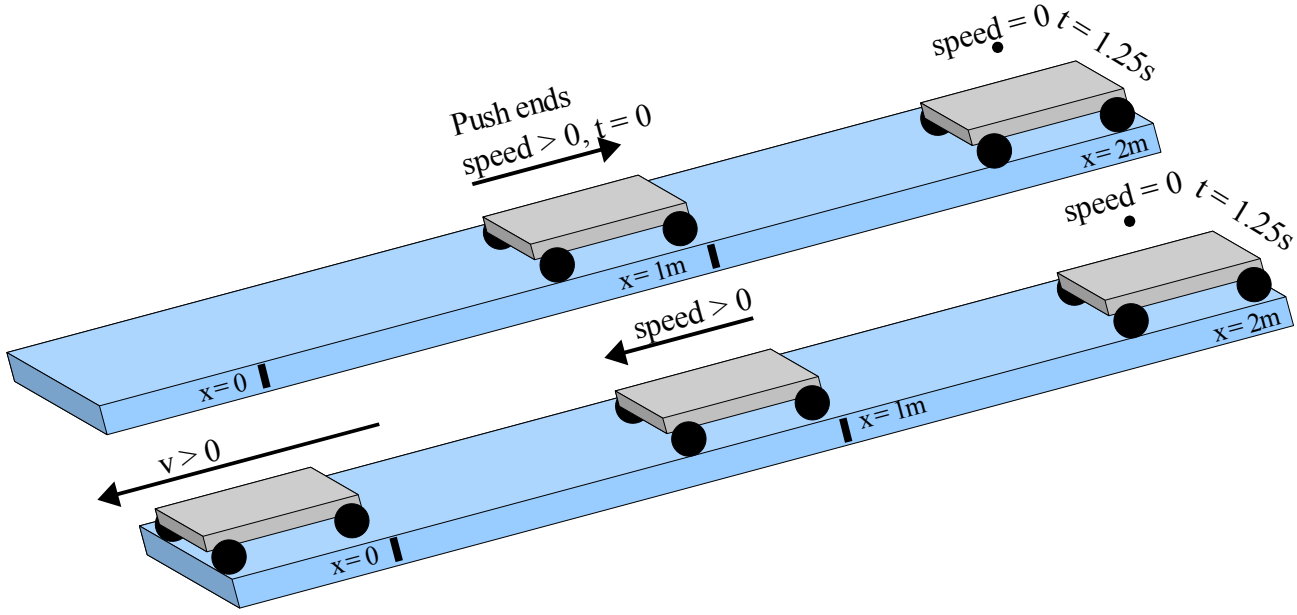
(g) Draw an acceleration vs. time graph for the two cars.

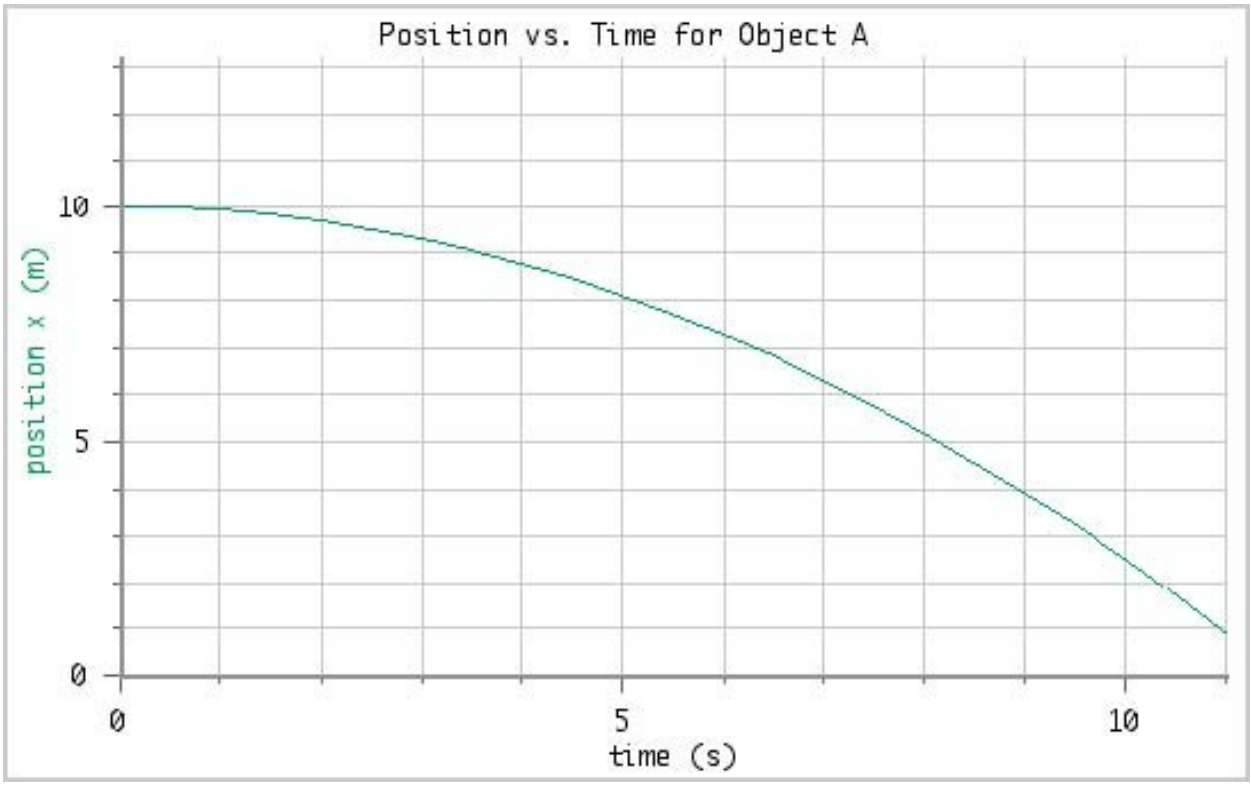


(h) Clearly indicate on the graph, which car is moving in the positive direction and which is moving in the negative direction.

Model the following situation completely by:
(a) Drawing at least three diagrams and/or graphs to represent the situation. (Use the diagrams and graphs the you find most useful.)
(b) Determining what quantities it is possible to solve for.
(c) Clearly presenting the procedure used to produce a numerical answer for each unknown quantity, with units.

2. A cart is given a push to send it up a 2m long inclined ramp. The push ends when the cart is at the 1m mark. Following the push, it takes 1.25 seconds for it to travel the remaining 1m, barely reaching the top before turning around to head back down.





3. a. Give a written description of the motion.

b. Sketch a motion map. Be sure to include both velocity and acceleration vectors.

c. Find the **change in position** from t = 2.5 s to t = 7s.

d. Find the **instantaneous velocity** at t = 2.5 s and t = 7s.

e. Find the average velocity between the times t = 2.5s and t = 7s.

f. Divide the displacement between 2.5s and 7s by the elapsed time. How does this compare with the average velocity?

g. What is the **instantaneous velocity** at t = 4.75 s? Explain.

h. Determine the **acceleration** from t = 2.5 s to t = 7s. Show your work and use units.