Kinematics Computer Simulation

Motion in a Straight Line with Constant Acceleration

(adapted from www.hazelwood.k12.mo.us/~grichert/sciweb/accmot.htm)

The link to the simulation website can be found on libbyteach.net

Problem #1:

A car at rest at an initial position (X_i) of 0.0 meters experiences a uniform acceleration of 1.0 ms^{-2}. Record the time it takes for the car to travel the following linear distances in the simulation and calculate the time:

Distance (m)	Simulation Time (s)	Calculated Time (s)
5.0		
10.0		
20.0		
40.0		

Sketch these graphs of the motion:

Position vs Time	Velocity vs Time	Acceleration vs Time

Which graphs have a constant slope? _____

Which graph has a slope that is equal to the acceleration of 1 ms^{-2}? _____

Problem #2:

A car located at the 5.0 m position traveling at a speed of 5.0 ms^{-1} accelerates at 2.0 ms^{-2}. How long will it take the car to travel a distance of 25 meters further down the road?

Use the kinematic equations to solve the problem and confirm your answer using the simulation.

Problem #3:

A car with a velocity of -10.0 ms^{-1} at a position (X_i) of 40.0 m experiences a uniform acceleration of 2.0 ms^{-2}. Locate the position of the car and its velocity at these time intervals:

Time (s)	Position (m)	Velocity (m/s)
2.0		
5.0		
10.0		
15.0		
20.0		

Sketch these graphs of the motion:

Position vs Time	**Velocity vs Time**	**Acceleration vs Time**

Which graphs have a constant slope? _____

Which graph has a slope that is equal to the acceleration of 2 ms^{-2}? _____

How does the position-time graph illustrate when the car stops and changes direction?

How does the velocity-time graph indicate forward (rightward) and reverse (leftward) motion of the car?

Why does the slope of the velocity-time graph remain constant and positive?

Use the red and green photogate timers to determine:

How much time does it take the car to reach the 15.0 meter position? _____

How much time does it take the car to travel from the 15.0 m to the 40.0 m position?

_____

What is the speed of the car when it reaches the 15.0 m position? _____

What is the speed of the car when it returns to the 40.0 m position? _____ ms^{-1}.

How does this compare to its initial speed?

Problem #4

A car with a velocity of 6.0 ms^{-1} at position (X_i) of 15.0 m experiences a uniform acceleration of -1.0 ms^{-2}. Locate the position of the car and its velocity at these time intervals:

Time (s)	Position (m)	Velocity (m/s)
2.0		
4.0		
6.0		
8.0		
10.0		

Sketch these graphs of the motion:

Position vs Time	Velocity vs Time	Acceleration vs Time

Which graphs have a constant slope? _____

Which graph has a slope that is equal to the acceleration of -1 ms^{-2}? _____

How does the position-time graph illustrate when the car stops and changes direction?

How does the velocity-time graph indicate forward (rightward) and reverse (leftward) motion of the car?

Why does the slope of the velocity-time graph remain constant and negative?

Problem #5

With an acceleration of 2.0 ms^{-2} and an initial speed of -10.0 ms^{-1}, where should the car be located to reverse directions at the 0.0 m position?

Use the kinematic equations to solve the problem and confirm your results using the simulation.