# Kinematics Computer Simulation

## Motion in a Straight Line with Constant Acceleration

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

**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 positive?

**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.