A. Motion Maps

A **motion map** depicts motion as a series of dots.

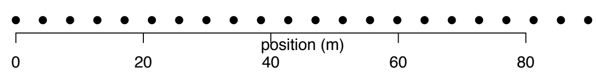
How to create a motion map: Imagine you are standing in one space, taking photos of a car. You take each photograph exactly one second apart. Then, you draw a dot showing where there car was in the photograph. However, it's easier to understand a motion map using you *intuition*?

Use your *intuition* to figure out how the following motion maps work. [NOTE: All of the motion maps in this section are of objects that are moving to the RIGHT.]

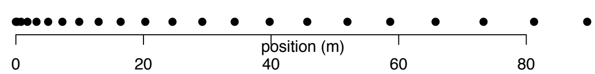
A.1

- Which map shows an object accelerating/speeding up?
- Which map shows an object decelerating/slowing down?
- Which map shows an object moving at a constant velocity?

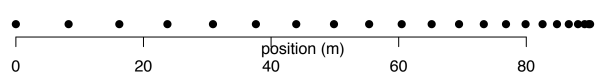
Motion Map A



Motion Map B



Motion Map C



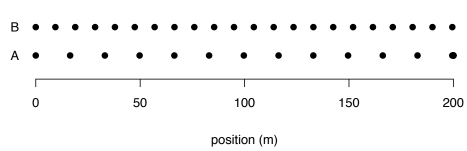
A.2 Draw a motion map of a person walking down the street at a constant speed.

A.3 Draw a motion map of a car that is moving fast and then stops at a red light.

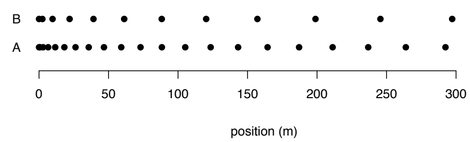
A.4 Draw a motion map for a car at the start of the Indy 500.

A.5 Draw what a motion map would look like for someone that isn't moving.

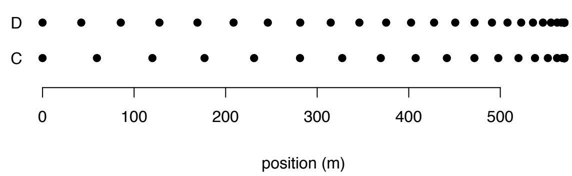
A.6 Which graph shows something that is moving faster? How can you tell?



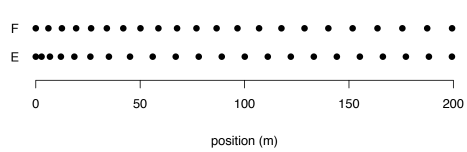
A.7 Which graph shows an object that is accelerating faster. How can you tell?



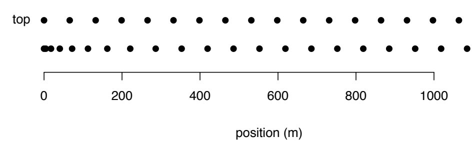
A.8 These graphs show two cars decelerating to a stop. In one of them, the initial velocity is higher. In the other one, the deceleration is higher. They both stop moving in the same spot. - which car has a greater initial velocity? - which car decelerates more rapidly (more negative acceleration)? - which car took more TIME to stop? How can you tell?



A.9 These graphs show two cars that are both accelerating, and then moving at a constant velocity. In one of them, the initial velocity is greater. In the other, the acceleration is greater. They both reach the same top speed. Which car has a greater initial velocity? Which car has a greater acceleration?



A.10 In the motion below the dots represent the position of a car, and each is one second apart. The map marked "top" shows the same car moving at top speed. How many seconds does it take the accelerating car to reach top speed?



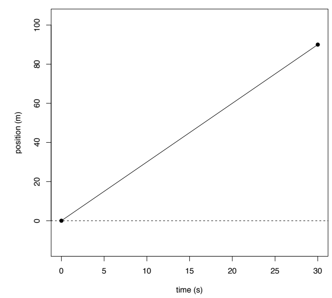
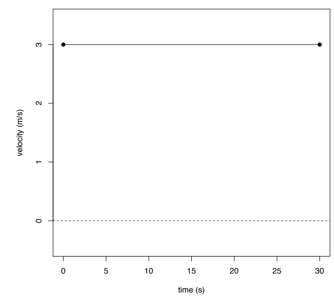
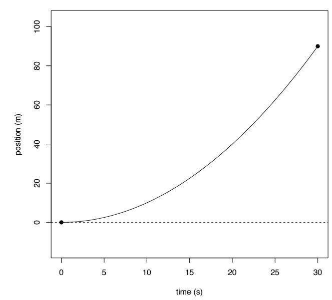
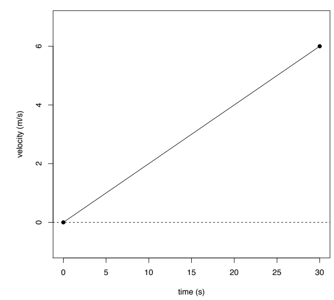
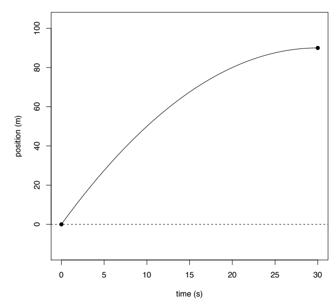
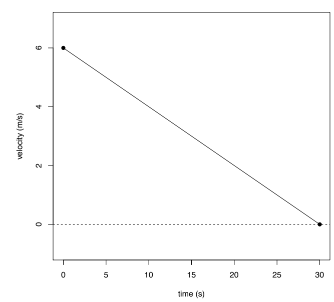
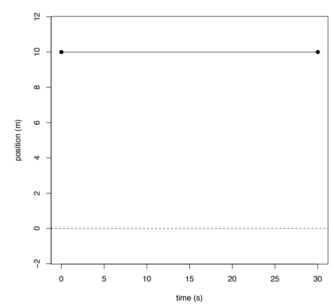
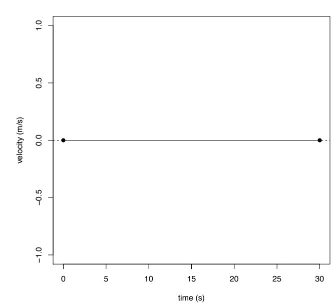
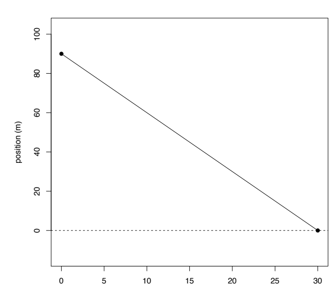
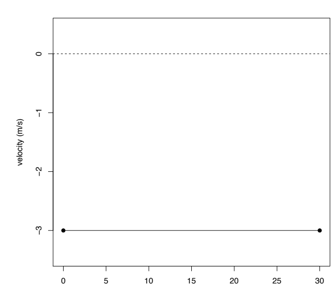
B. Position and Velocity Graphs

A **kinematic graph** is a graph that is used to represent how something is moving. There are 3 kinds of kinematic graphs:

- position-time graphs
- velocity-time graph
- acceleration-time graphs

A **position-time graph** is a graph with position on the y-axis and time on the x-axis.

A **velocity-time graph** is a graph with velocity on the y-axis and time on the x-axis.

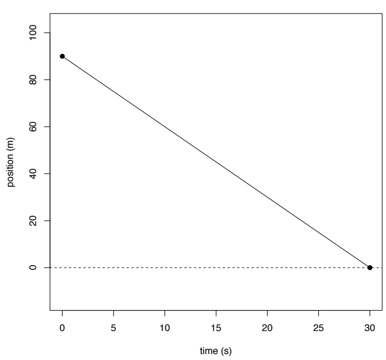
Situation	Position-Time Graph	Velocity-Time Graph
Moving at a constant velocity		
Positive Acceleration (speeding up)		
Negative Acceleration (slowing down)		
Not Moving		
Moving Backwards		

- I am walking down the hallway at a constant velocity. Draw my position-time graph. Make sure that you label the axes of your graph!

- A car needs to stop at a red light. Draw its position-time graph and velocity-time graph. Make sure that you label the axes of your graph!

- The light turns green and the car starts moving. Draw its position-time graph and velocity-time graph. Make sure that you label the axes of your graph!

Common mistake problem. "A car is slowing down. Draw a position-time graph." You friend draws the following graph:



Your friend is wrong. Explain to your friend what his mistake was, and explain what the right answer is.
In your everyday life, what are times you are moving at a constant velocity?
What are times you are accelerating?
In math class, you are taught to put arrows on the end of a graph. DO NOT do that in physics class. Why not?

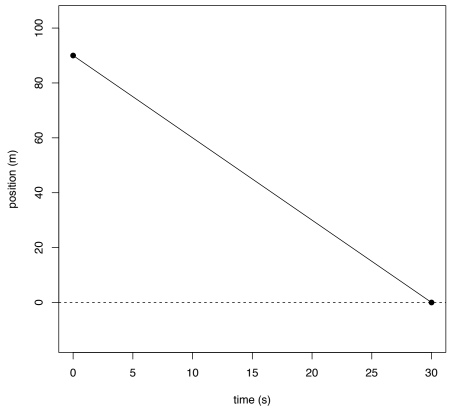
C. Acceleration Graphs and Comparisons

An **acceleration-time** graph is a graph with acceleration on the y-axis and time on the x-axis.
We will focus only on *constant acceleration.* This includes three graphs: a horizontal positive line, a horizontal negative line, and a line at zero. In velocity is constant, then acceleration is zero.
Learn to understand acceleration-graphs by filling out the following table:

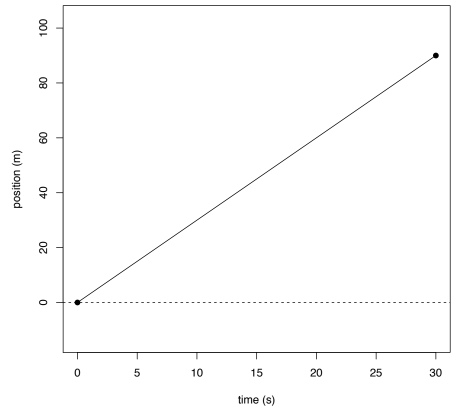
Scenario	Position-Time Graph	Velocity-Time Graph	Acceleration-Time Graph	Motion Map
A biker moving at a constant velocity				
A biker speeding up while going down a hill				
A biker slowing to a stop at the end of the ride				
A biker going back home at a constant velocity				
A biker who was lazy and decided to sit on the couch and watch TV instead.				

Position-Time Graphs

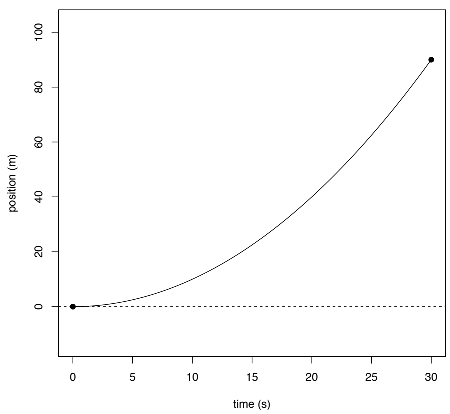
Position graph A



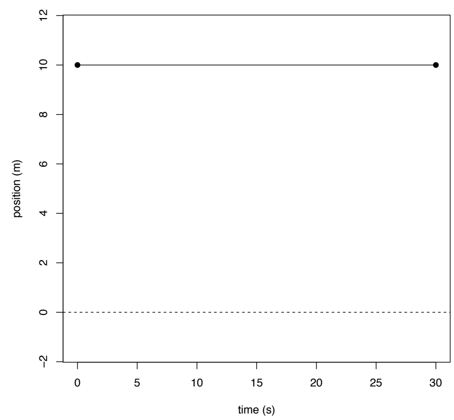
Position graph D



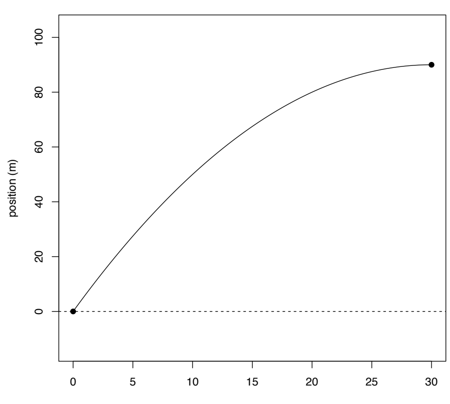
Position graph B



Position graph E

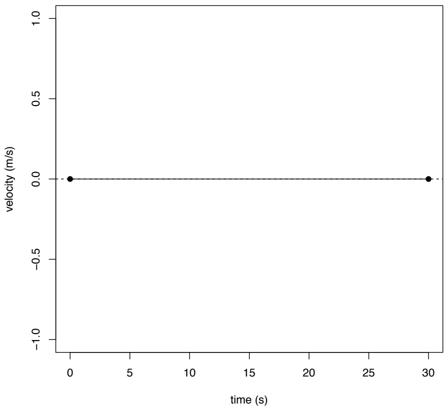


Position graph C

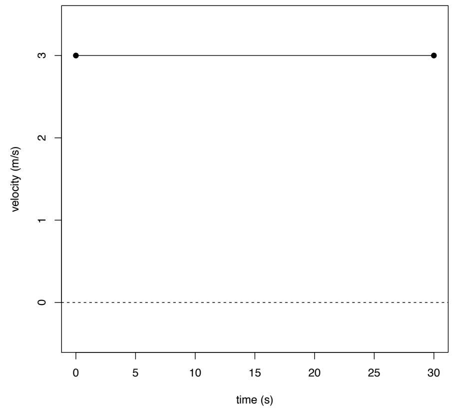


Velocity-Time Graphs

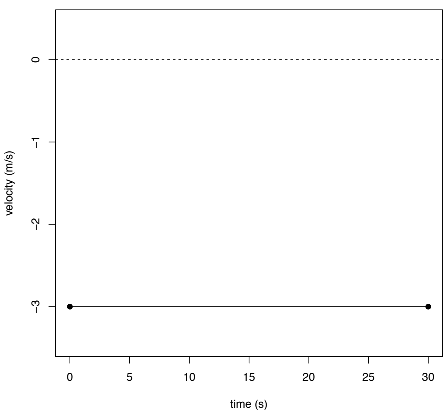
Velocity graph A



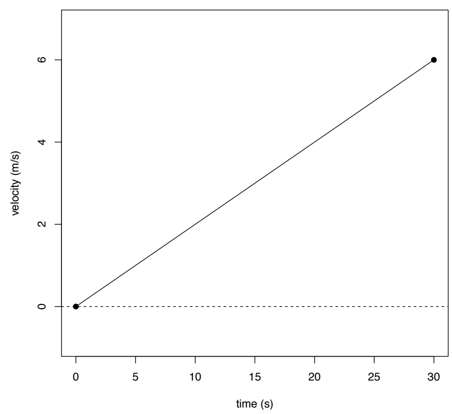
Velocity graph D



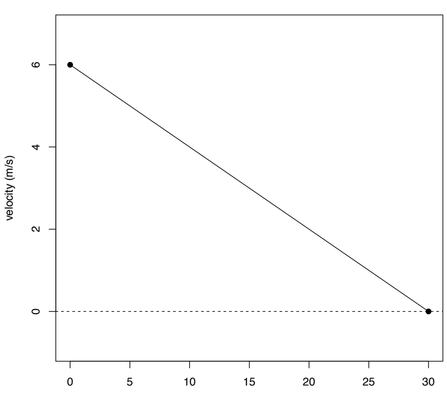
Velocity graph B



Velocity graph E

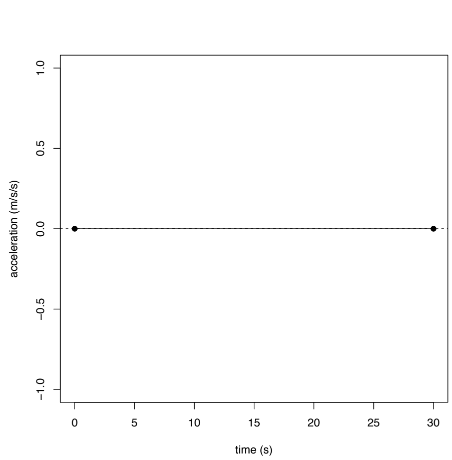


Velocity graph C

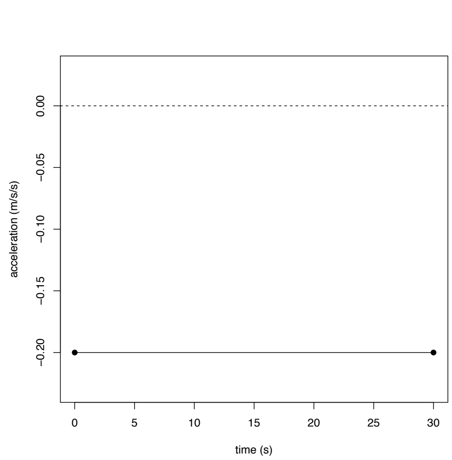


Acceleration-Time Graphs

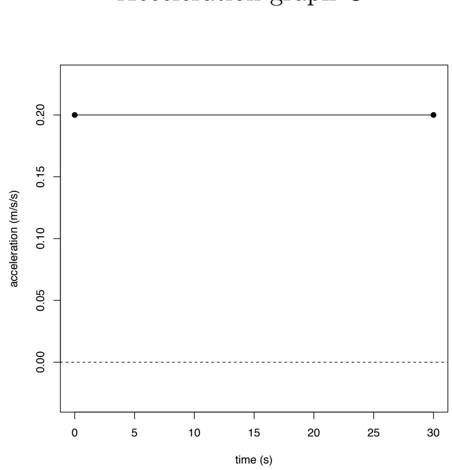
Acceleration graph A



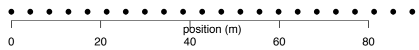
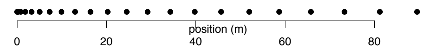
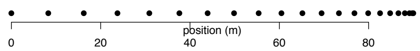
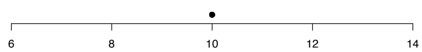
Acceleration graph B



Acceleration graph C



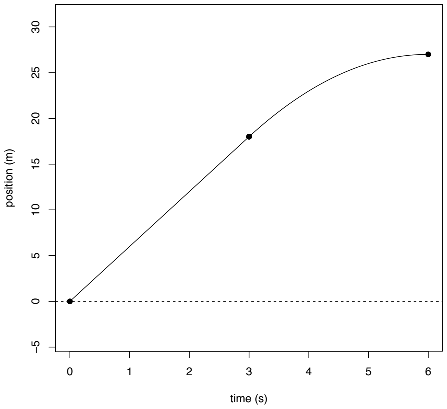
Motion Maps

Motion Map A 	Motion Map D 
Motion Map B 	
Motion Map C 	

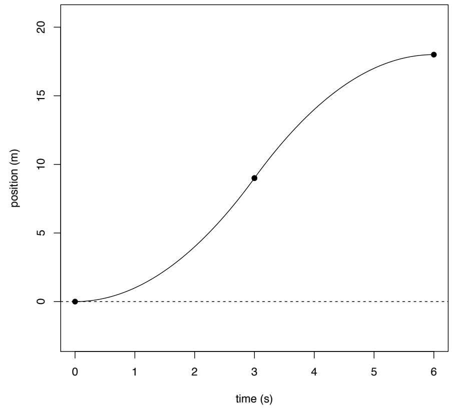
F: Yet Another Large Problem

Story	Position-Time Graph	Velocity-Time Graph	Acceleration-Time Graph	Motion Map
1. Constant velocity followed by positive acceleration.				
2. Constant velocity followed by negative acceleration.				
3. Positive acceleration followed by constant velocity				
4. Positive acceleration followed by negative acceleration				
5. Negative acceleration followed by positive acceleration				
6. Negative acceleration followed by constant velocity				

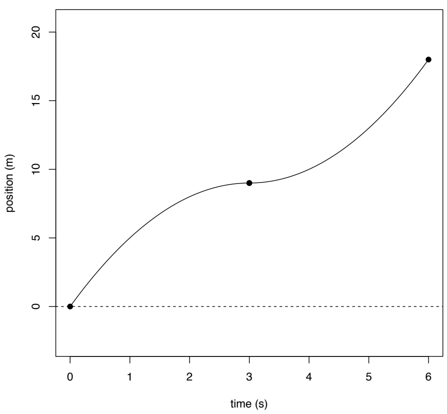
Position graph A



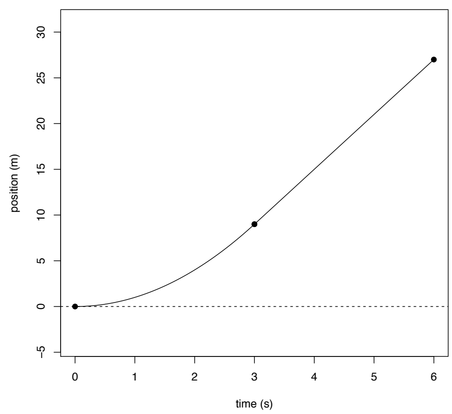
Position graph D



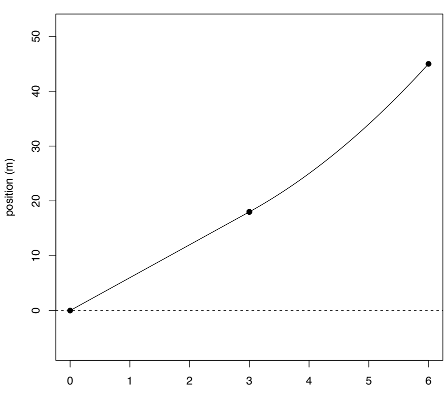
Position graph B

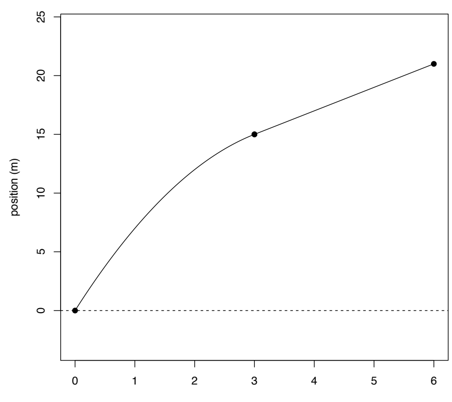


Position graph E

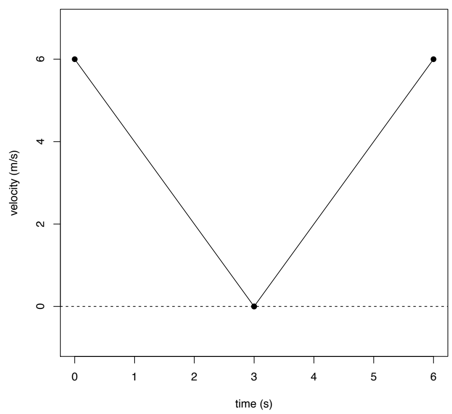


Position graph C

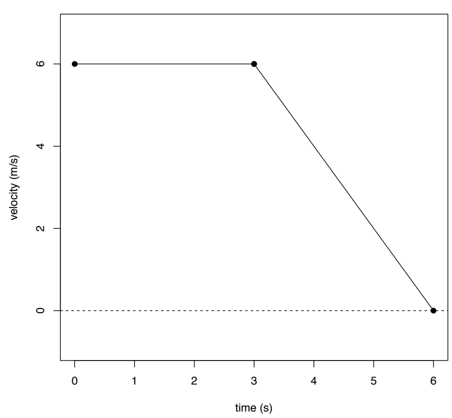




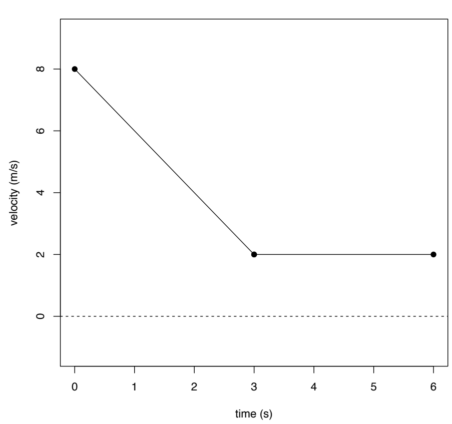
Velocity graph A



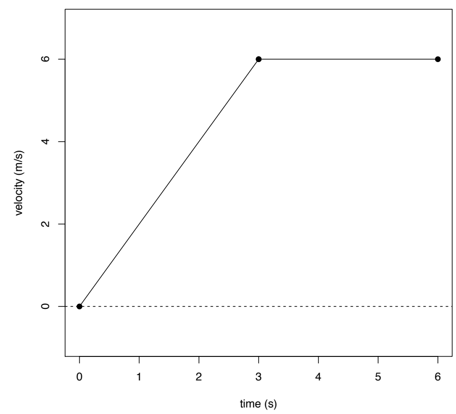
Velocity graph B



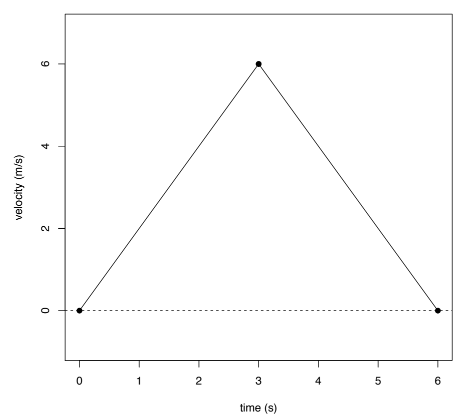
Velocity graph C

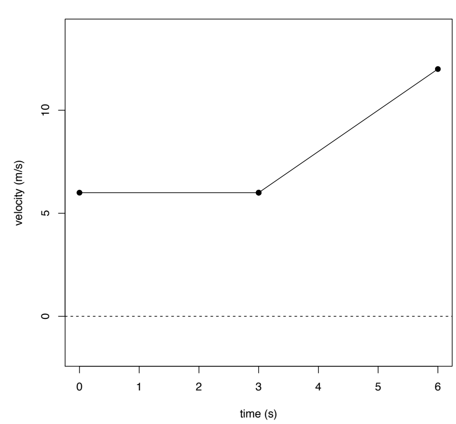


Velocity graph D

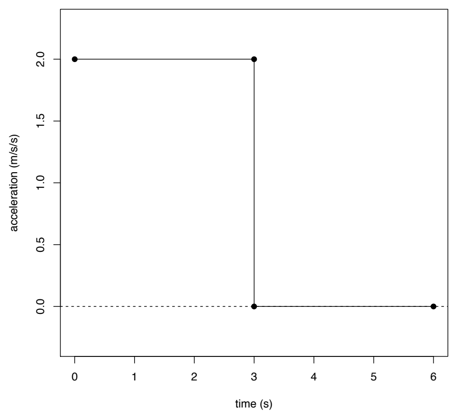


Velocity graph E

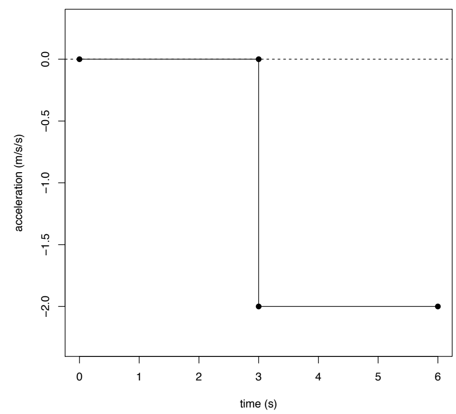




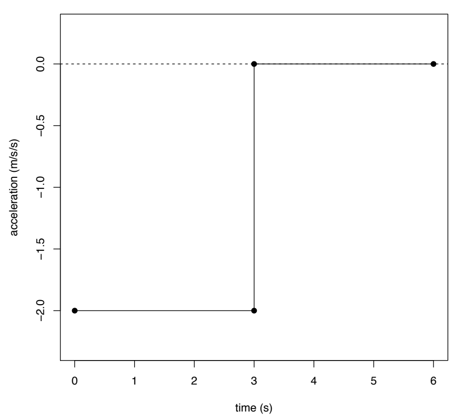
Acceleration graph A



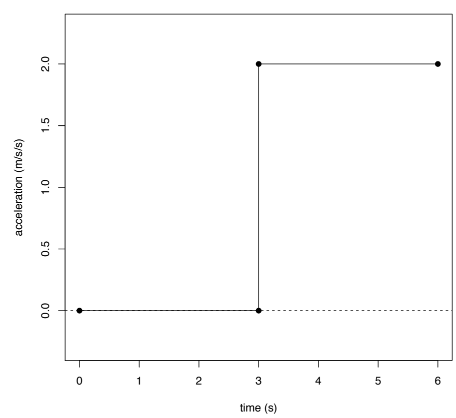
Acceleration graph D



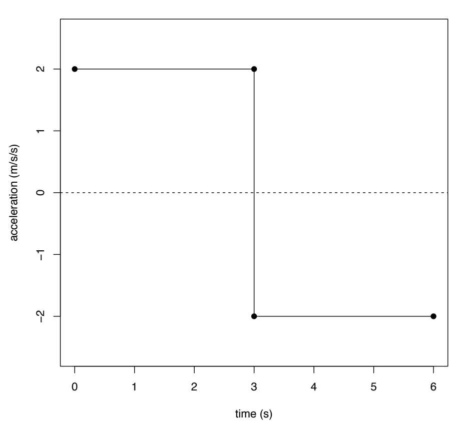
Acceleration graph B

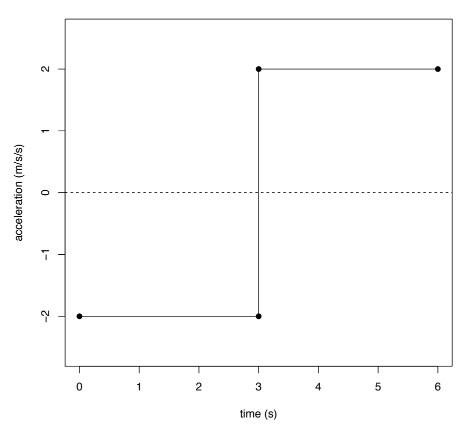


Acceleration graph E

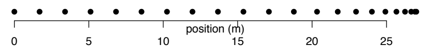


Acceleration graph C

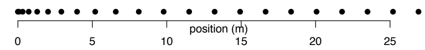




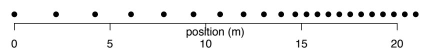
Motion Map A



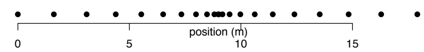
Motion Map D



Motion Map B



Motion Map E



Motion Map C