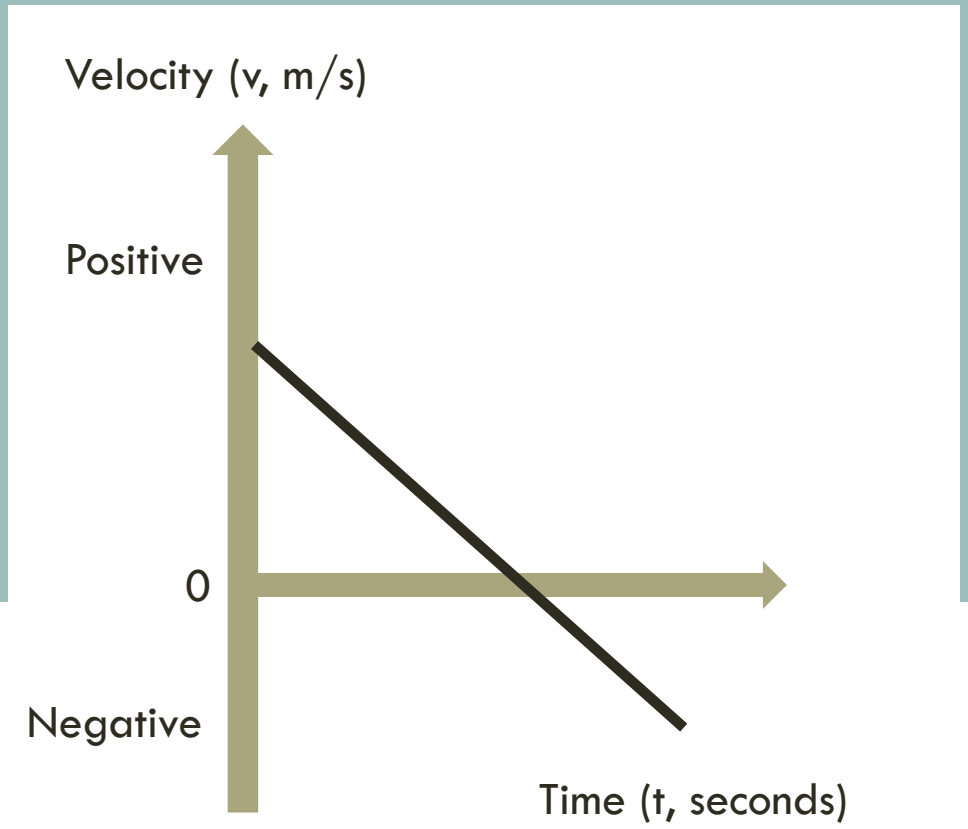
AVERAGE AND STANDARD DEVIATION

- **Standard deviation** is a measure of how far the values in a group of numbers are **from the average** of that group.
  - A **small standard deviation** means the individual values in the group are **close to the average**
  - A **large standard deviation** means the values are **far from the average**

IF I GIVE YOU A VELOCITY VS. TIME GRAPH LIKE THE ONE BELOW, WHAT MIGHT THE CORRESPONDING POSITION VS. TIME GRAPH LOOK LIKE?



Work in pairs, remember that velocity is the slope of the position vs. time graph

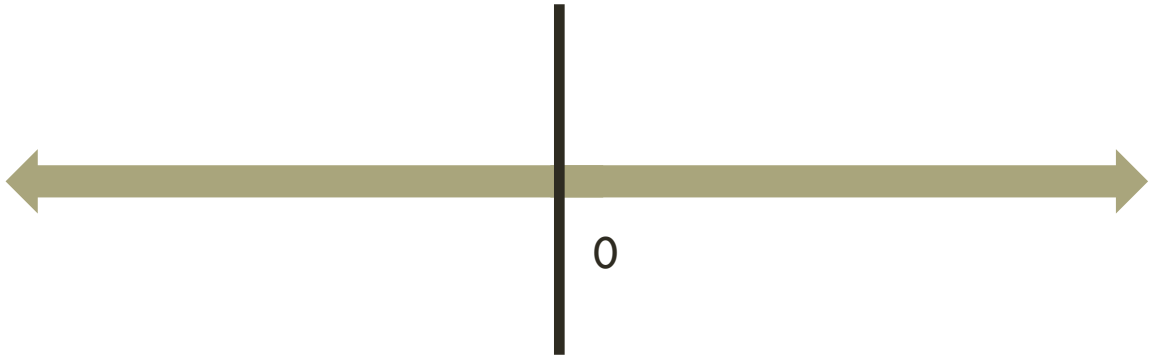
GOALS FOR TODAY

Graphing for days

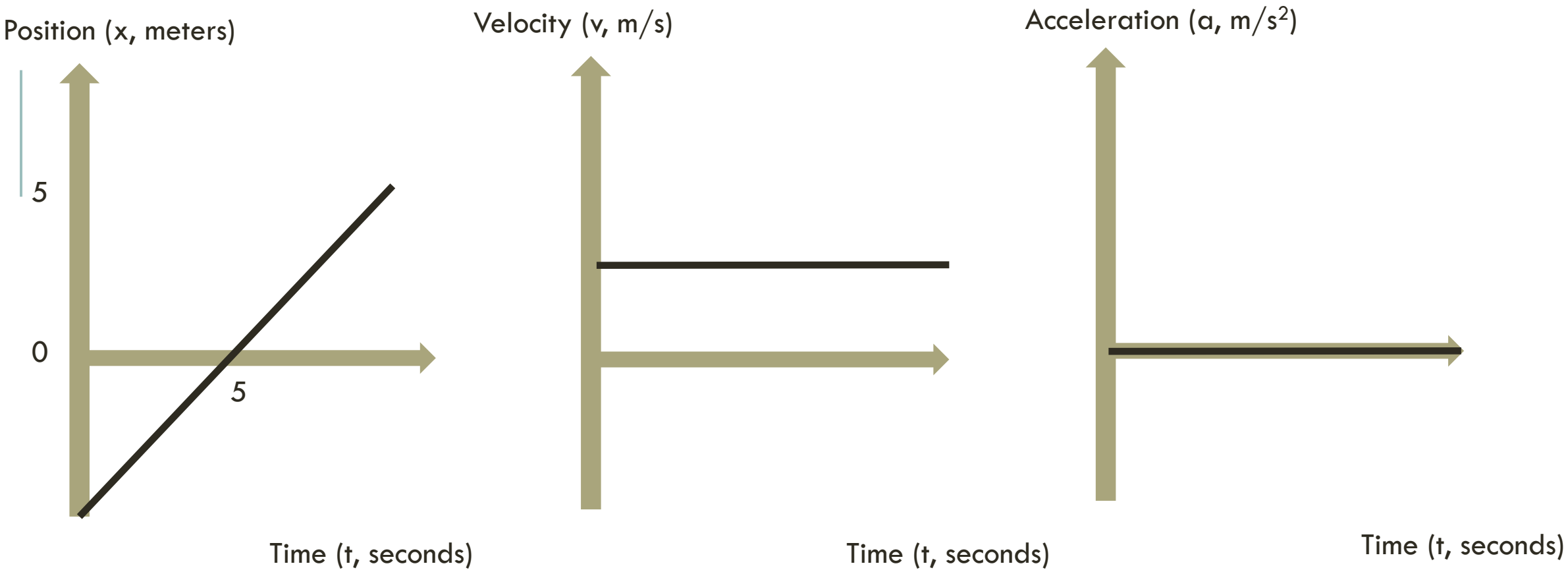
Review for quiz tomorrow

Kinematics equations

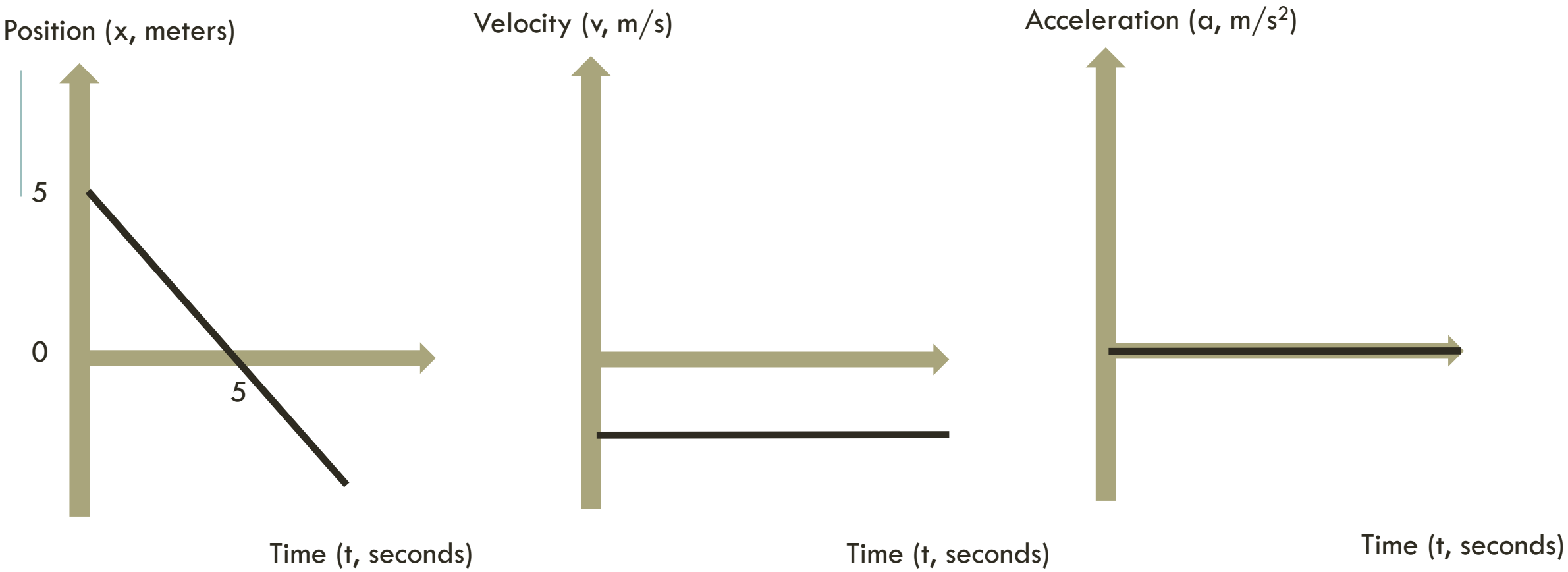
A FEW CONVENTIONS



- We assume **left** is the **negative x-direction**
- We assume **right** is the **positive x-direction**
- Later - up is the positive y-direction, and down is the negative y-direction

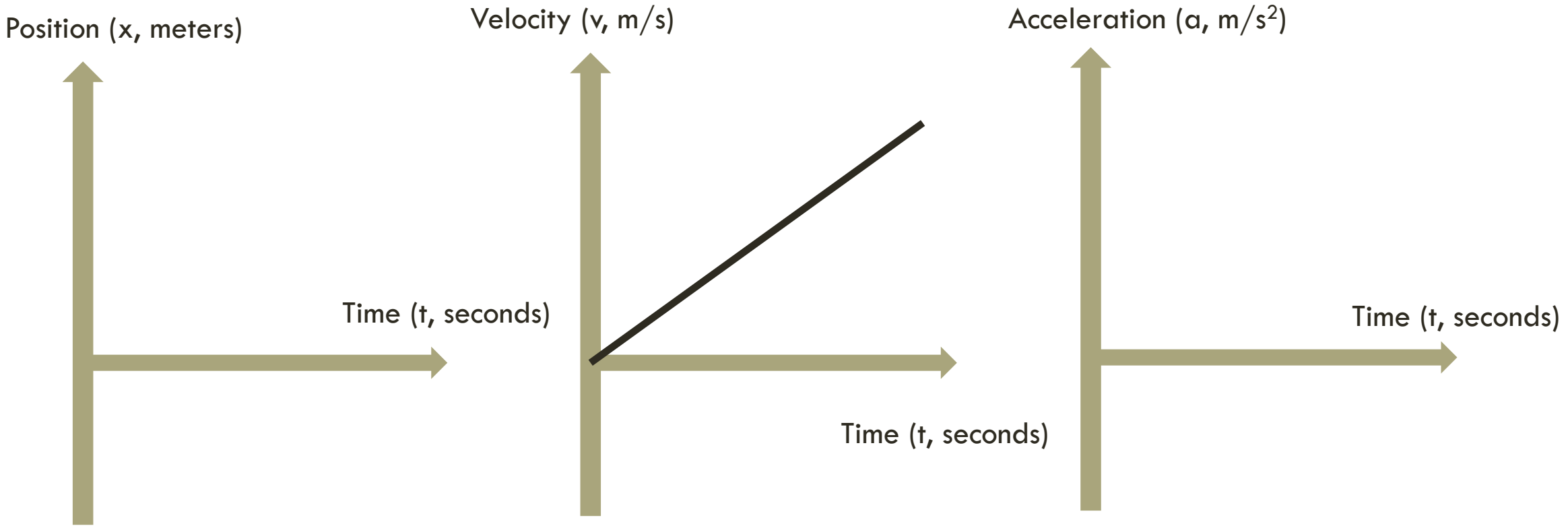


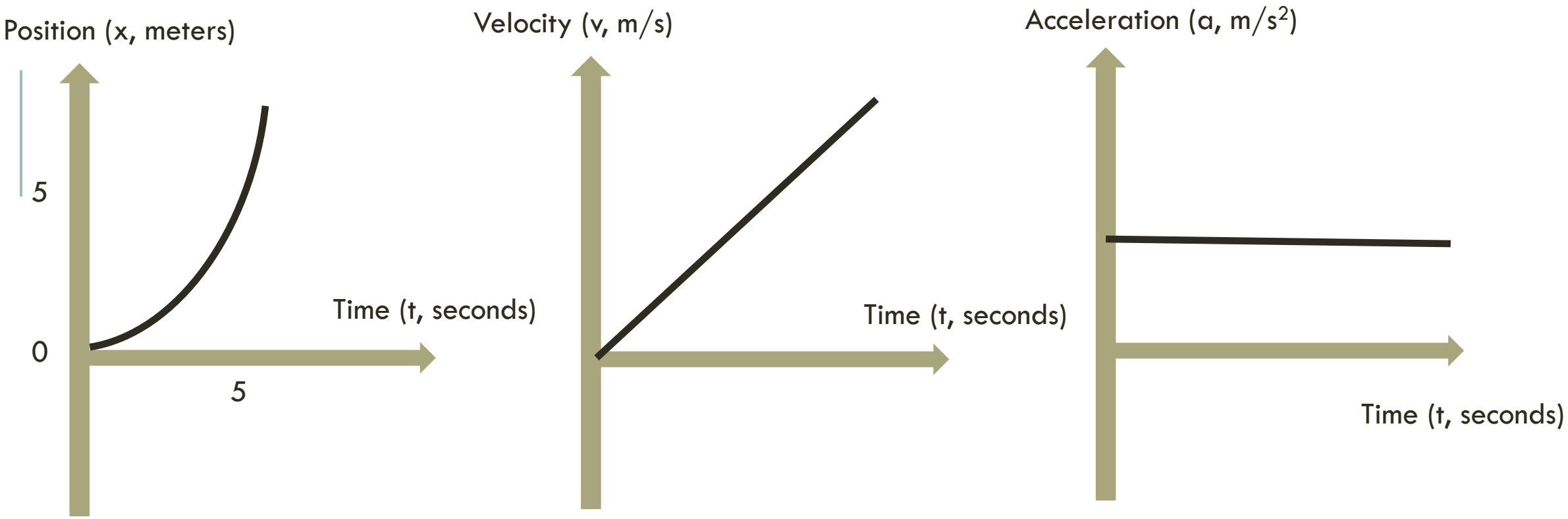
"Object is moving from negative to positive x-direction at a constant, positive velocity."



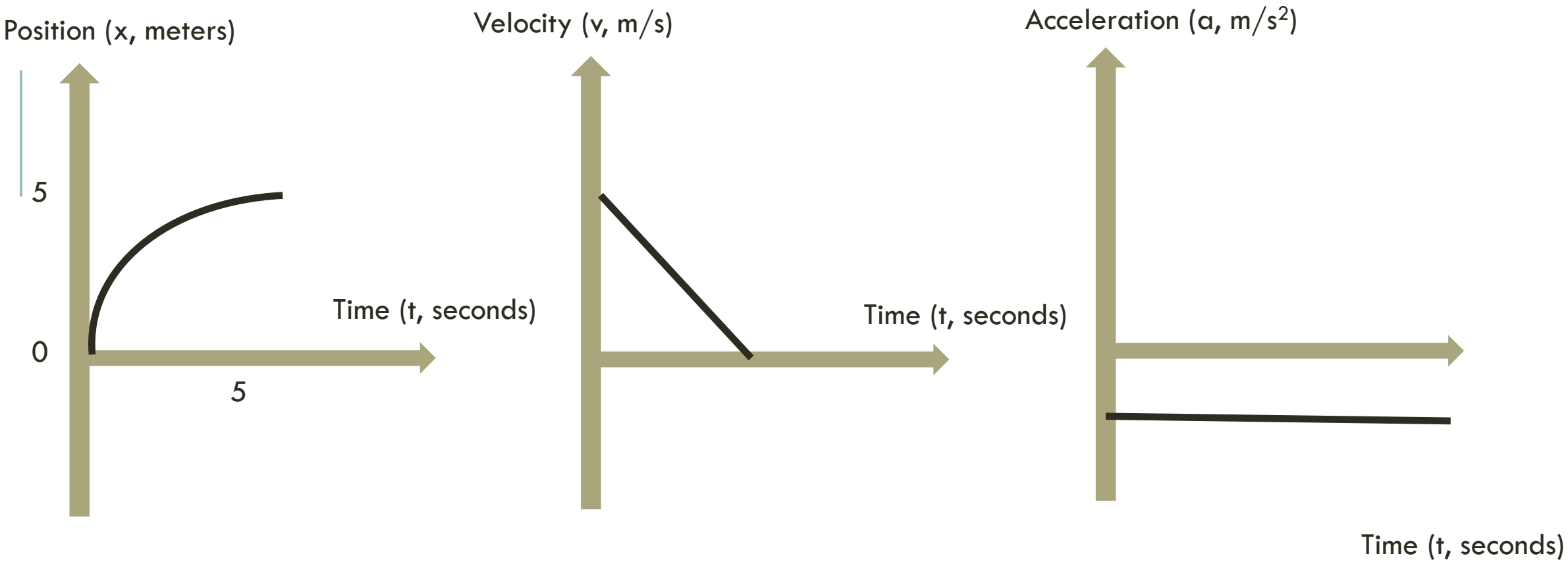
"Object is moving from positive to negative x-direction at a constant, negative velocity."

ALL OUR GRAPHS HAVE BEEN CONSTANT VELOCITY – WHAT HAPPENS WHEN VELOCITY IS NOT CONSTANT?

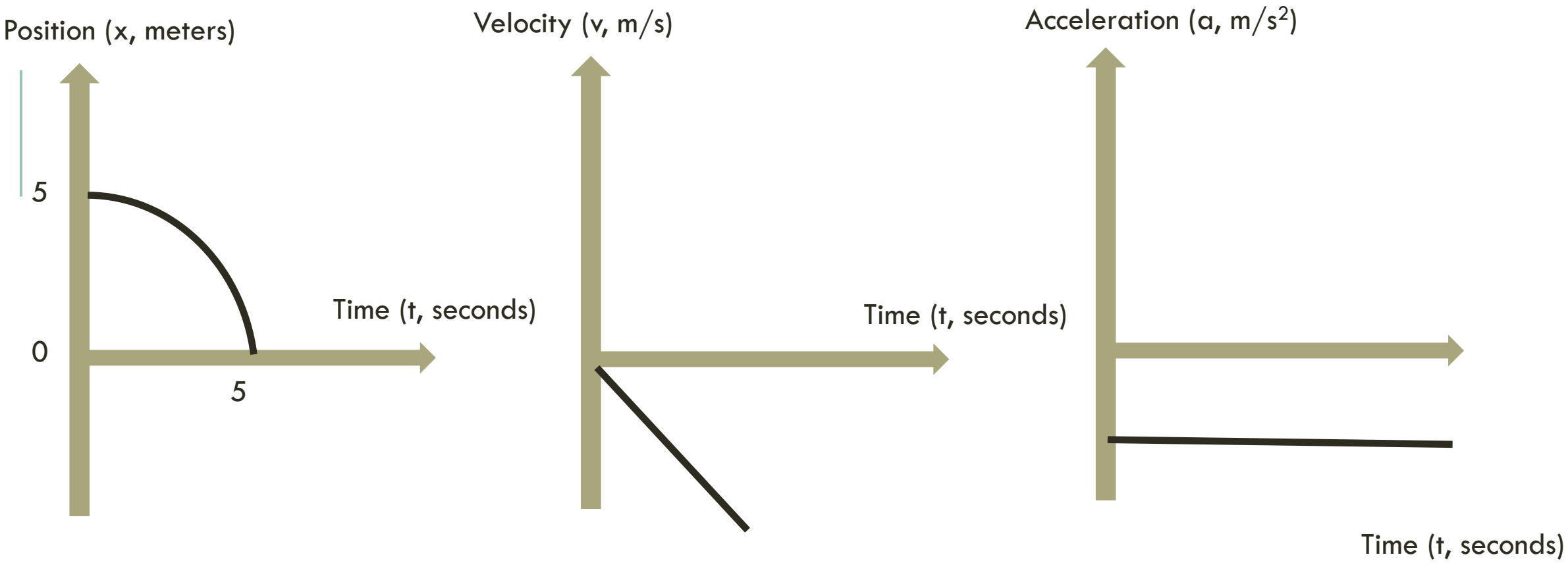


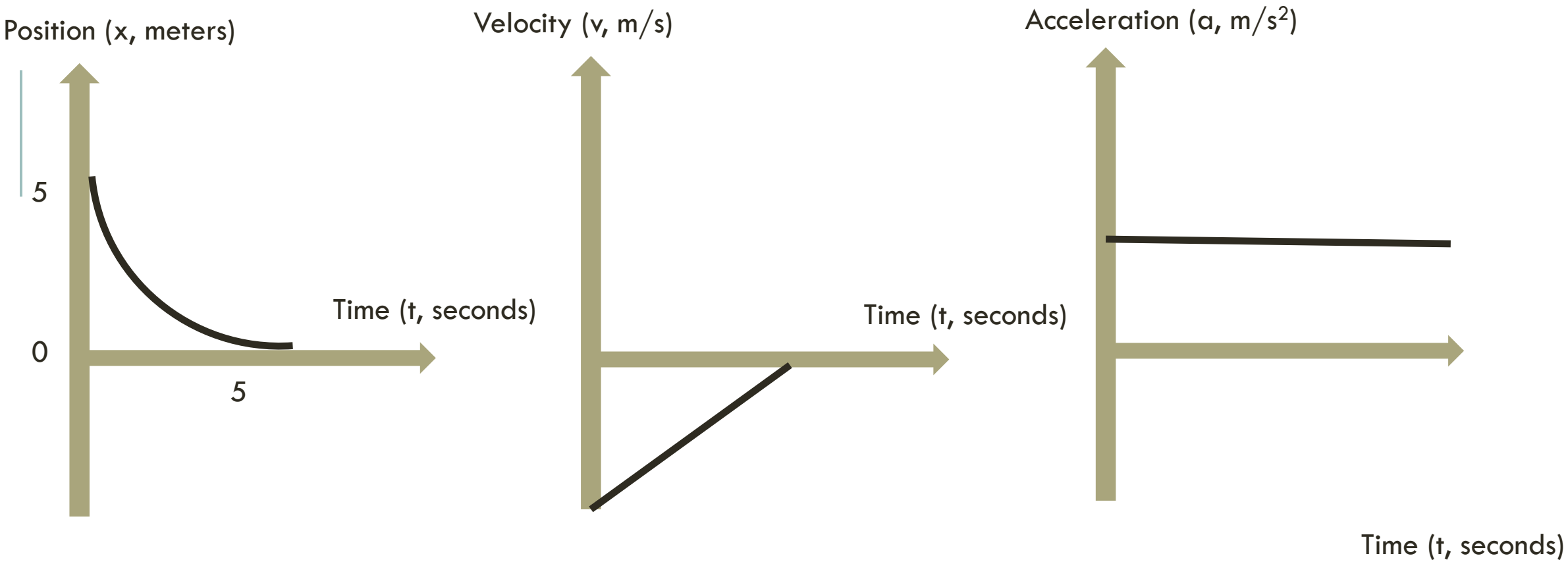


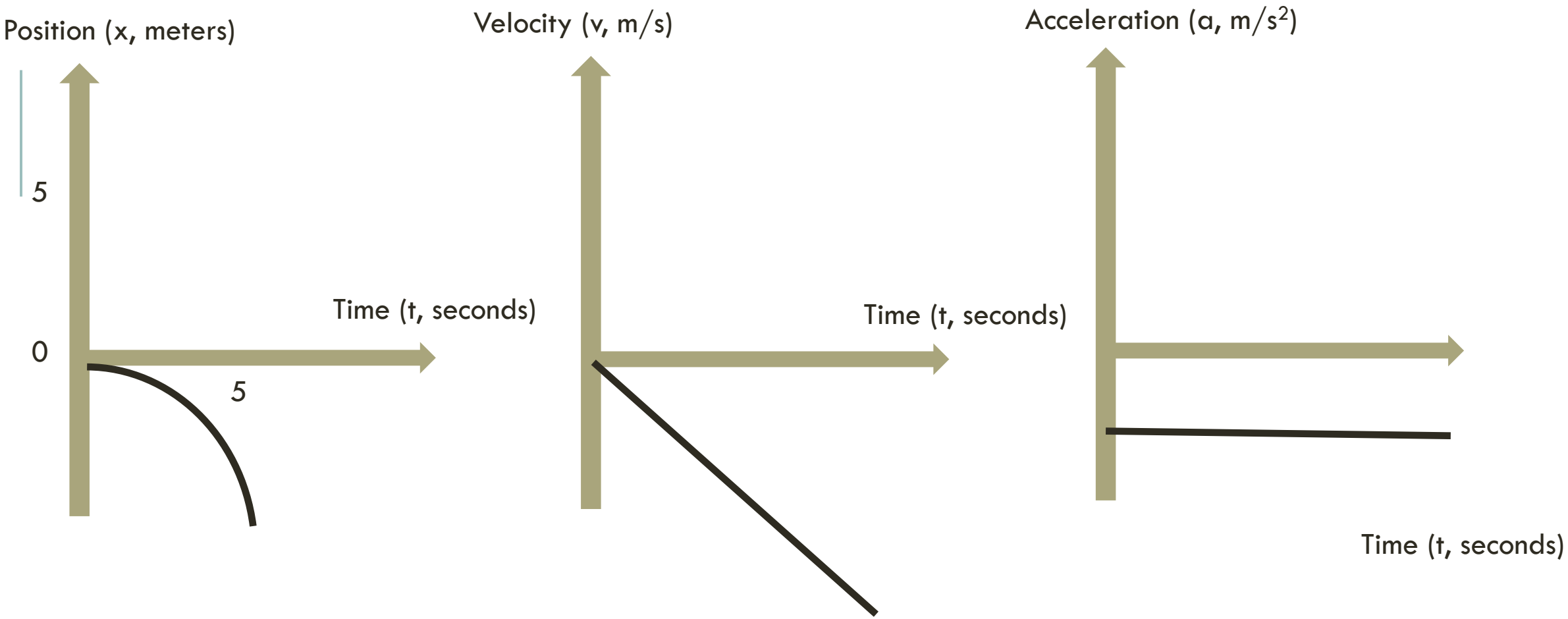
"Object is accelerating in the positive x-direction"



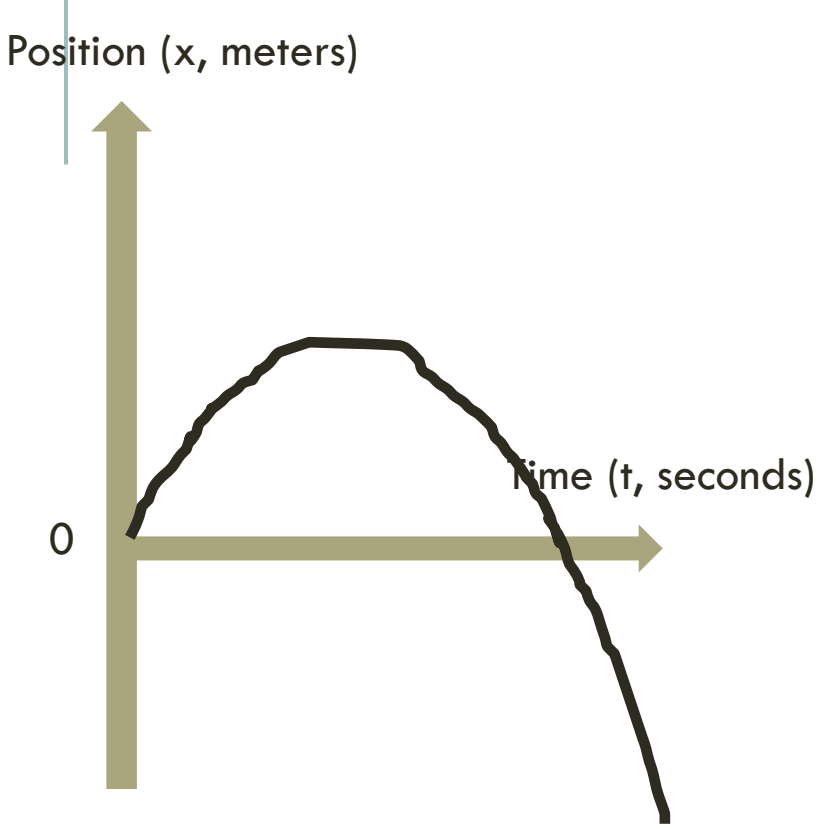
"Object is decelerating in the positive x-direction"

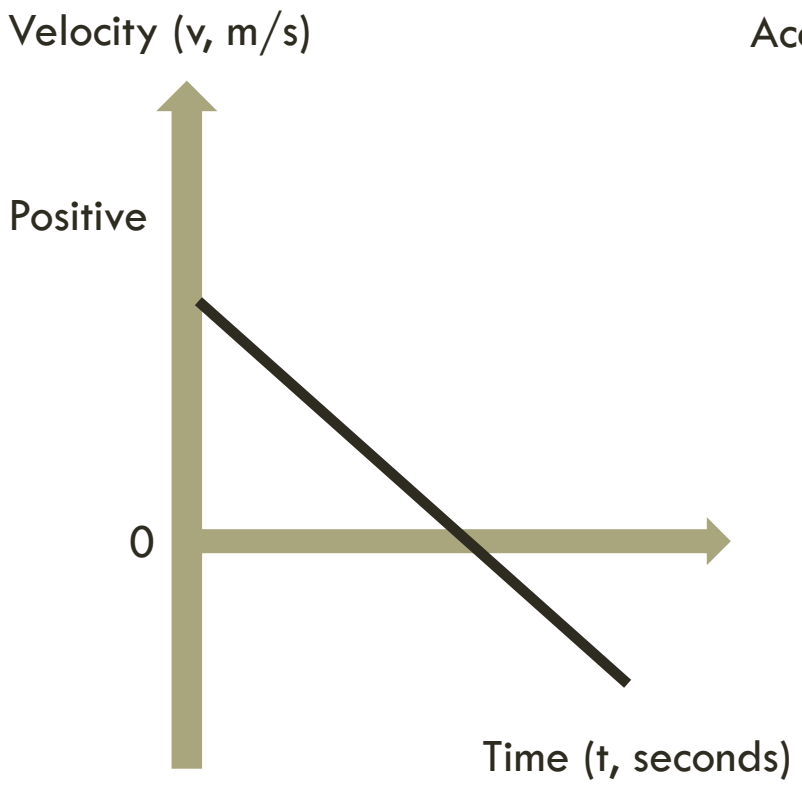

Position (x, meters)
5
0
5
Time (t, seconds)
Velocity (v, m/s)
Time (t, seconds)
Acceleration (a, m/s2)
Time (t, seconds)

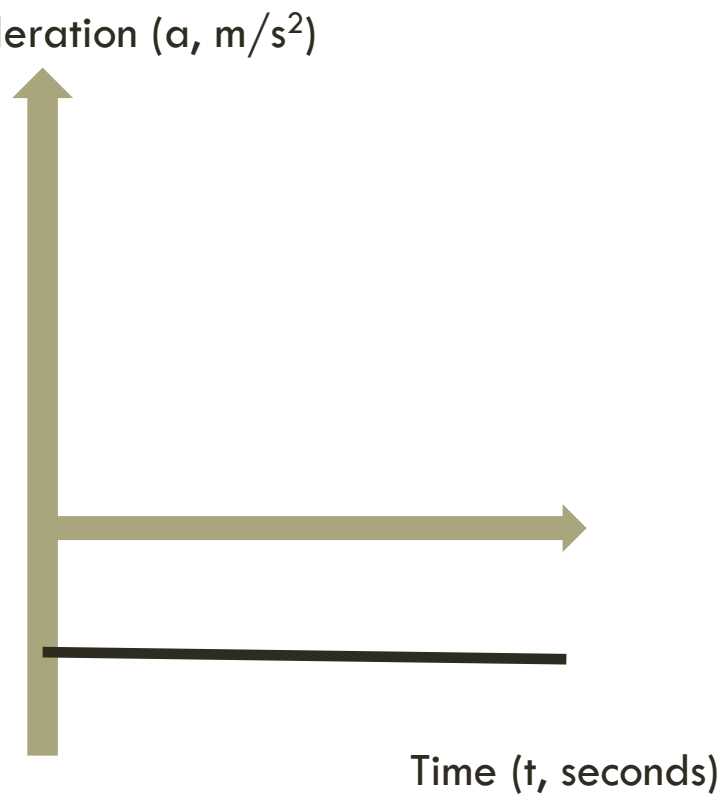

Position (x, meters)
5
0
5
Time (t, seconds)
Velocity (v, m/s)
Time (t, seconds)
Acceleration (a, m/s2)
Time (t, seconds)


Position (x, meters)
5
0
Time (t, seconds)
5
Velocity (v, m/s)
Time (t, seconds)
Acceleration (a, m/s2)
Time (t, seconds)

BACK TO THE BEGINNING

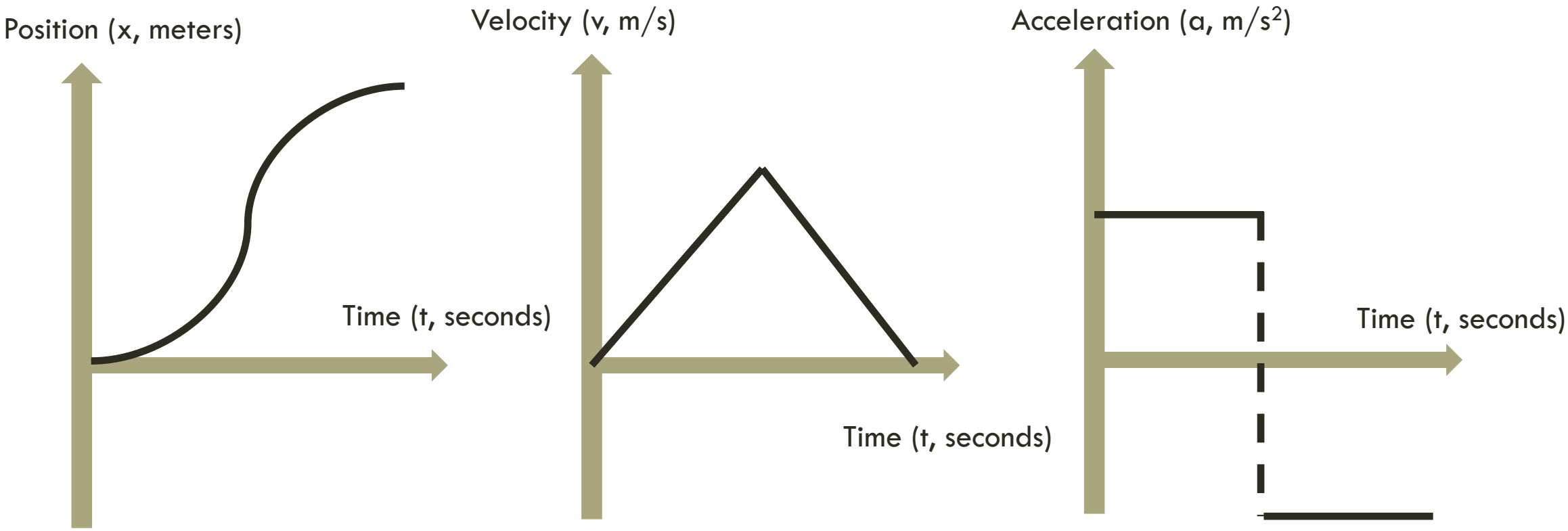






"Object has a positive velocity but accelerates toward the negative x-direction

WHAT POSITION AND ACCELERATION GRAPHS WOULD GO WITH A VELOCITY GRAPH LIKE THIS?



EQUATIONS YOU WILL BE GIVEN ON THE QUIZ

$$v = \frac{\Delta x}{\Delta t} \qquad \boldsymbol{a} = \frac{\Delta \boldsymbol{v}}{\Delta \boldsymbol{t}}$$

…And any conversions

THINGS I EXPECT YOU TO KNOW

$$average\ speed = \frac{distance}{time} \qquad average\ velocity = \frac{displacement}{time}$$

- Answer some conceptual and numerical questions about **scalar/vector, distance/displacement, speed/velocity, instantaneous vs. average velocity,** and **acceleration**
- Make sure your units check out!

CONCEPTUAL QUESTION EXAMPLE

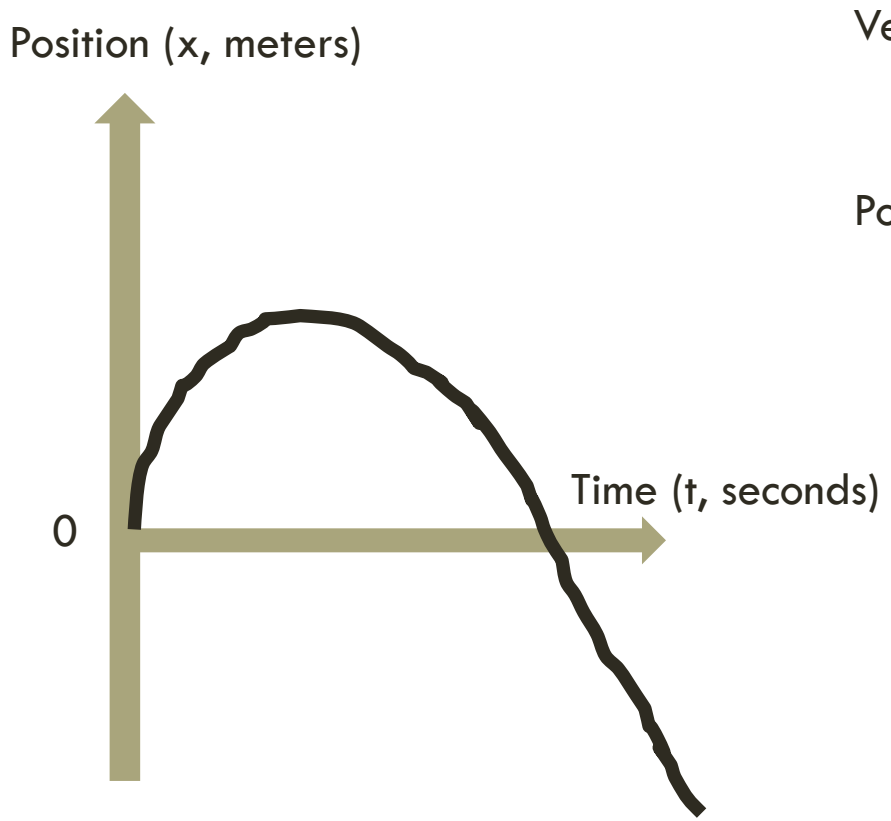
- Which of the following can be units for acceleration?
  - m/s
  - km/hr
  - m/s^2
  - mph

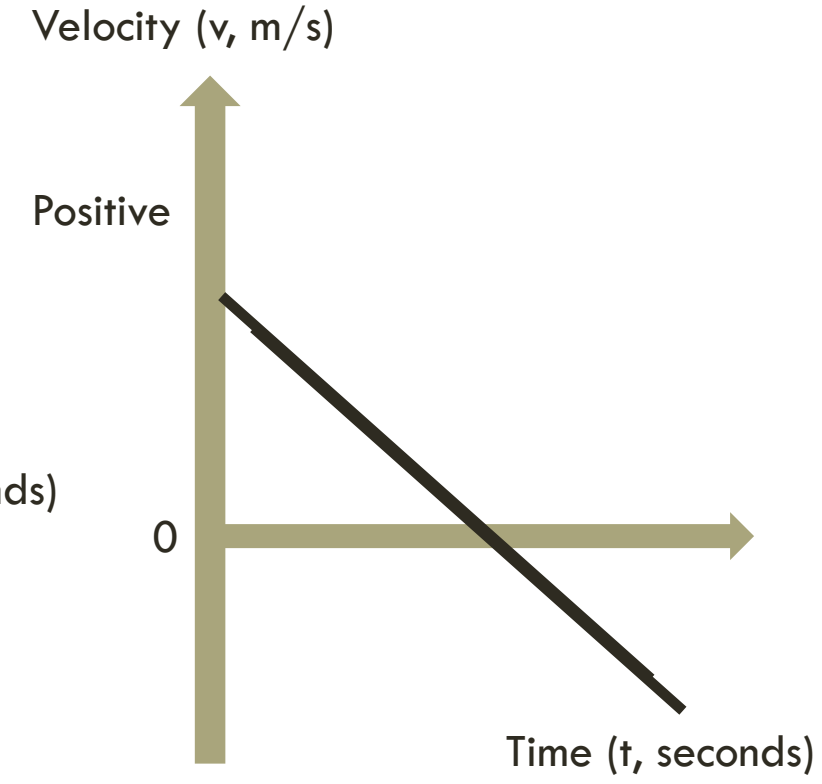
THINGS I EXPECT YOU TO KNOW PT. 2

- Describe the motion of an object given a position vs. time graph
- Given a position vs. time graph, draw a velocity over time graph
- Given an object's motion, draw a position over time and a velocity over time graph

GRAPHING EXAMPLE

- An object starts at the origin at time 0, has a positive velocity and a negative acceleration. What do the position vs. time and velocity vs. time graphs look like?





KINEMATICS VS DYNAMICS

- **Kinematics** studies the motion of objects
- **Dynamics** studies the forces that cause that motion

MOTION AT CONSTANT ACCELERATION

- If acceleration is constant (which in many practical situations it is)…
- Can use this fact to derive some pretty convenient relationships between acceleration, velocity, and position with respect to time