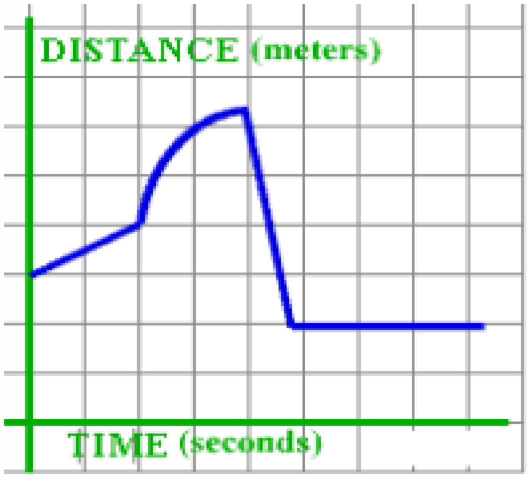
Physics 20 Unit 1 - Kinematics

Graphical Analysis

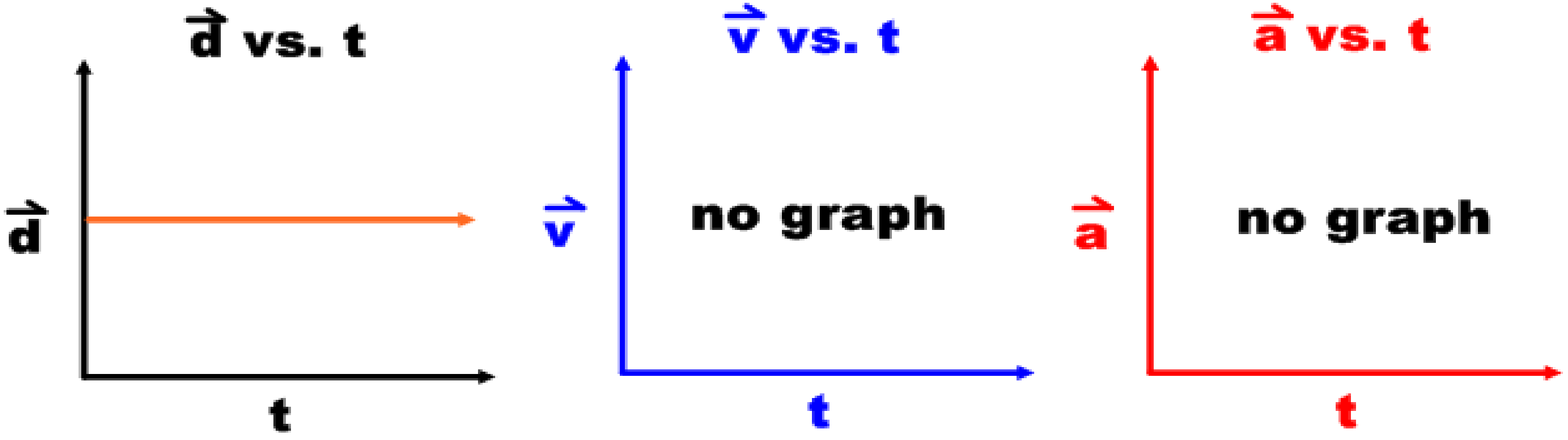


Review: Drawing Derivatives

3 types of graphs:

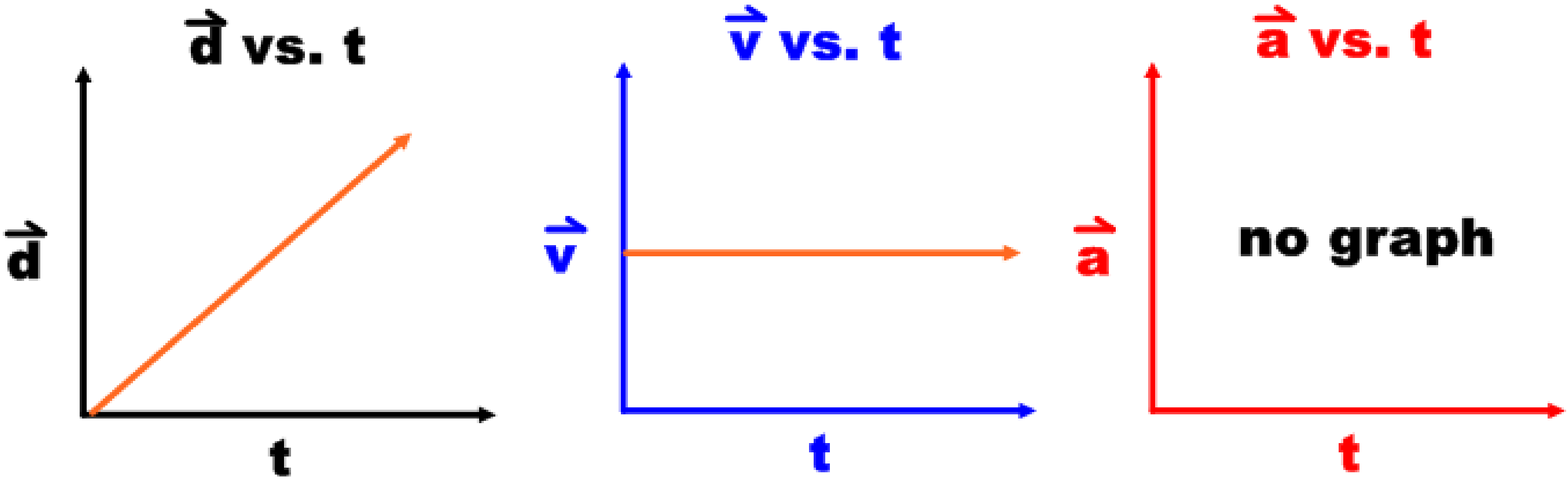
- distance vs. time
- velocity vs. time
- acceleration vs. time

Case 1: No Movement



- uniform motion
- zero velocity, zero acceleration
- distance does not change with respect to time

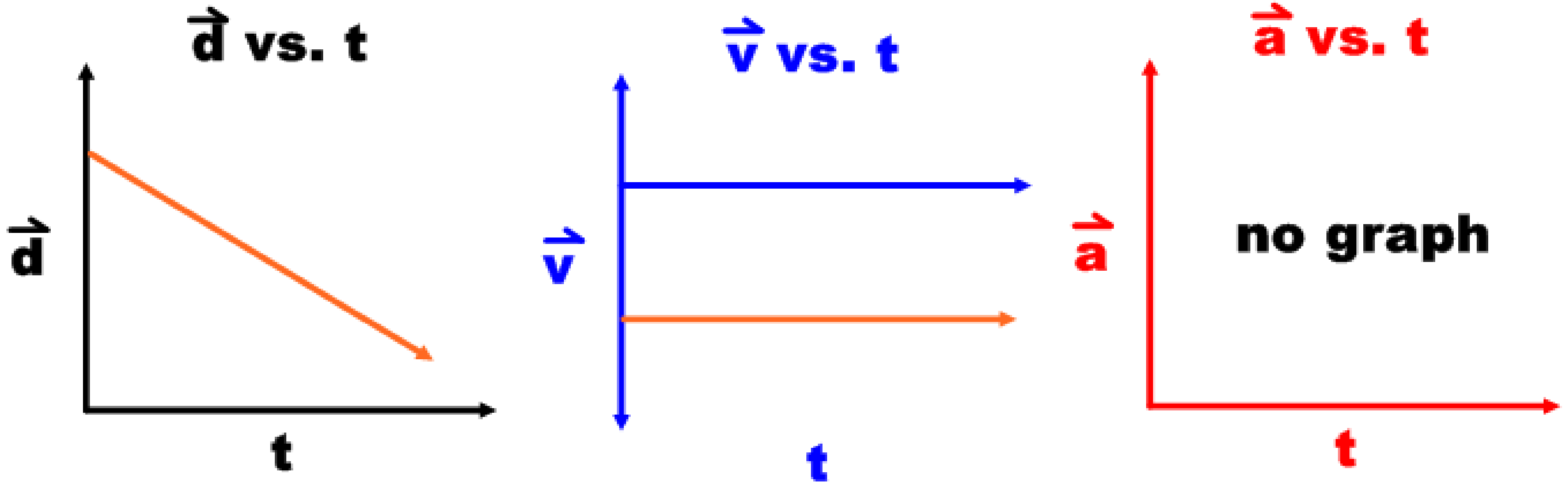
Case 2: Constant Velocity (+)



- uniform motion, +ive direction (up, right, east)
- can use $\vec{v} = \vec{d} / t$
- zero acceleration

Finding the slope of a distance vs. time graph gives velocity.

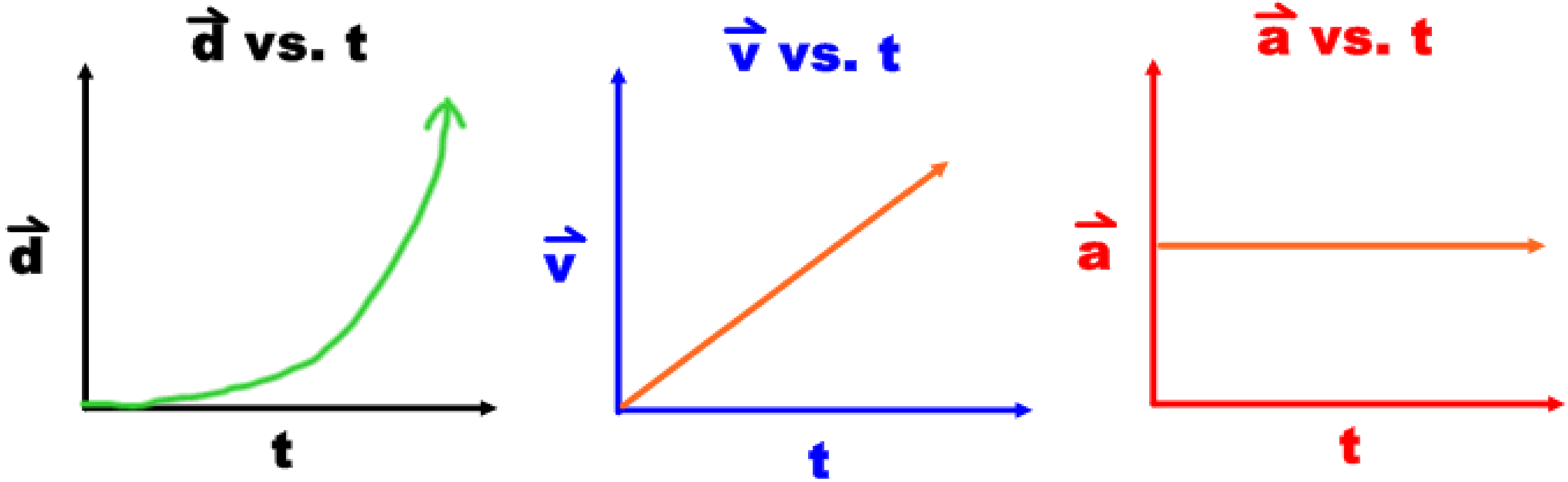
Case 3: Constant Velocity (-)



- uniform motion, -ive direction (down, left, west)
- can use $\vec{v} = \vec{d} / t$
- zero acceleration

Finding the slope of a distance vs. time graph gives velocity.

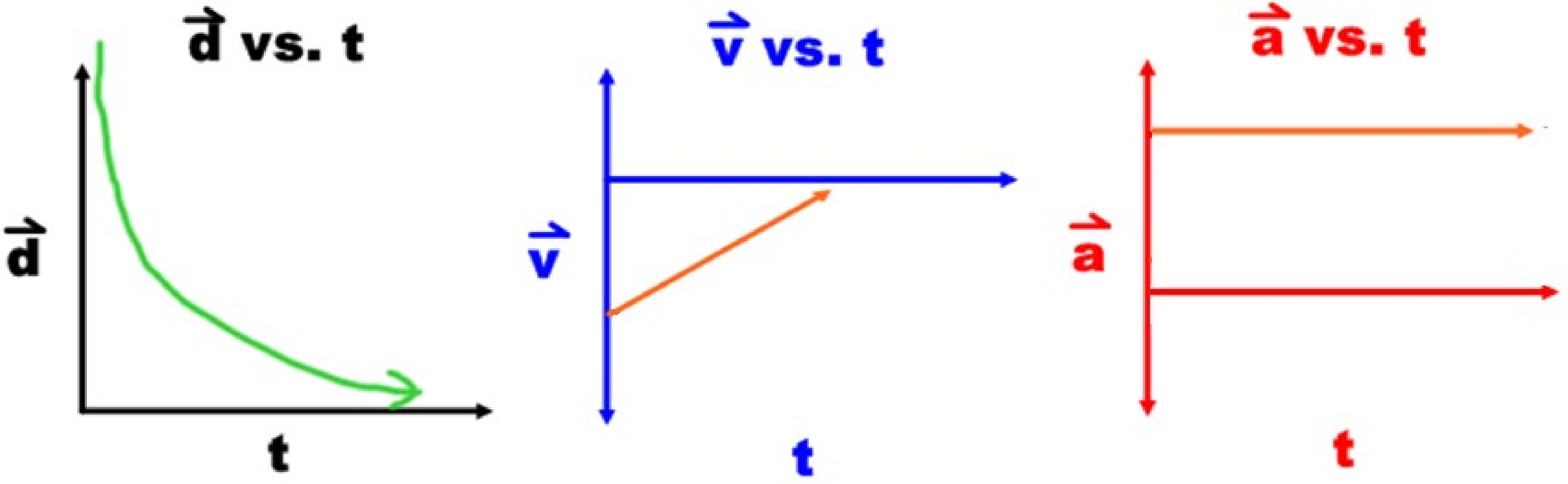
Case 4: Constant Acceleration (+)



- changing velocity
- must use kinematics equations
- positive acceleration ($\vec{a}$ in same direction as $\vec{v}$)

Finding the slope of a velocity vs. time graph gives acceleration.

Case 5: Constant Acceleration (+)



- changing velocity
- must use kinematics equations
- negative acceleration ($\vec{a}$ in opposite direction as $\vec{v}$)

> **Finding the slope of a velocity vs. time graph gives acceleration.**

Graphical Analysis

Review

One of the more difficult skills in Physics 20 is the converting of raw data into graphs and the interpretation of these graphs. However, these graphs are a powerful tool which allows us to communicate physical phenomenon and make inferences into the laws of nature.

Recap:

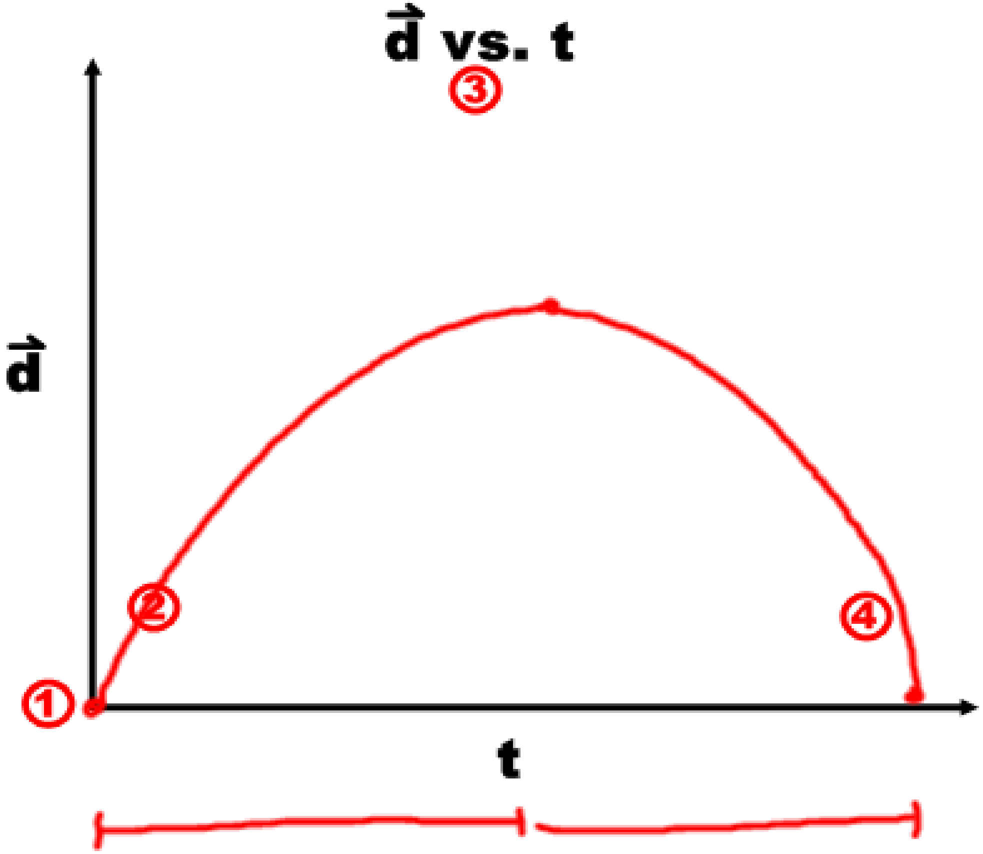
- slope of a $\vec{d}$ vs. t give $\vec{v}$
- slope of a $\vec{v}$ vs. t gives $\vec{a}$
- area under a $\vec{v}$ vs. t gives $\vec{d}$

$$\text{Slope} = m = \frac{y_2 - y_1}{x_2 - x_1}$$

Investigation: Throwing an object into the air.

We throw an object vertically into the air and catch it at the same height from which it was thrown.

What will the position/distance/displacement vs. time graph look like?



1. Start at (0,0) just before we throw the object.

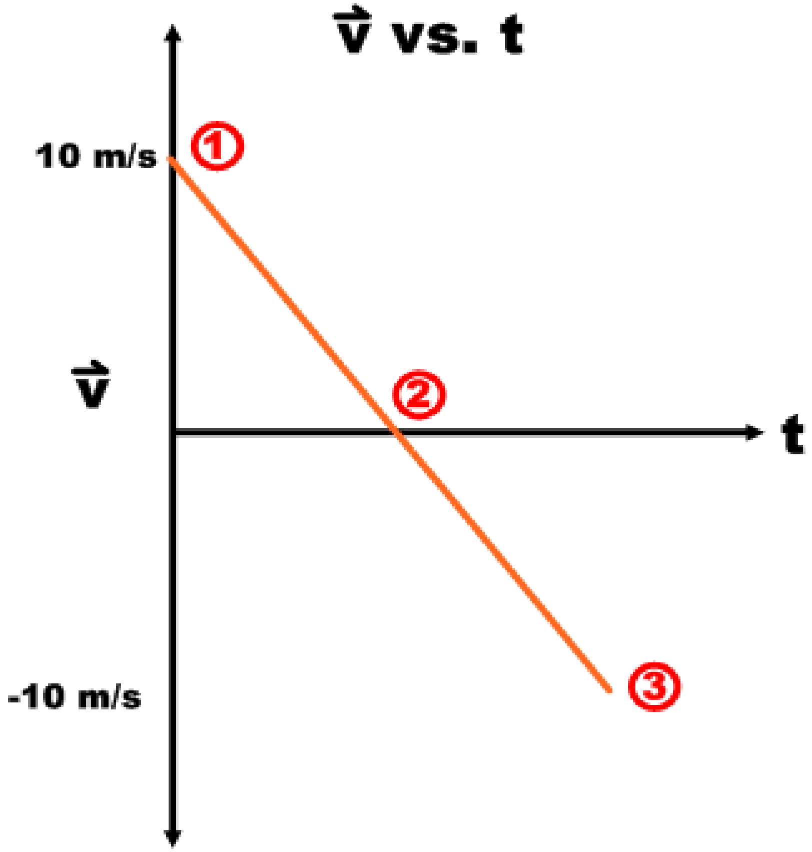
2. We throw the object. As time increases, distance increases (+ive because it is going up). The line is curved because gravity decelerates the ball.

3. Object reaches max. height. Velocity is zero, but acceleration is still $-9.81\ m/s^2$.

4. Object is back to original starting point.
It took the same amount of time go up as come down and covered the same distance.

Note: symmetry!

Now, what would a velocity vs. time graph look like?



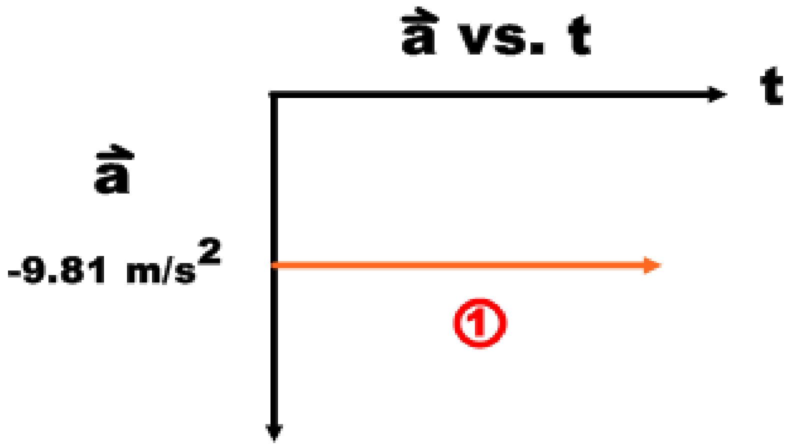
① Assume we throw the object up at 10 m/s. As the object rises, it slows down due to gravity's deceleration.

② This point indicates zero velocity. This is at the object's vertex (highest point of motion).

③ The object begins traveling downward (-ive velocity) until it is caught here.

Note: The velocity with which the object is thrown is the same as the velocity with which the object is caught. Symmetry!

Lastly, what would the graph of acceleration vs. time look like?



① The acceleration is always the same, -9.81 m/s^2.

***Note: In this course, we only deal with constant acceleration, so we will only see horizontal acceleration vs. time graphs.**