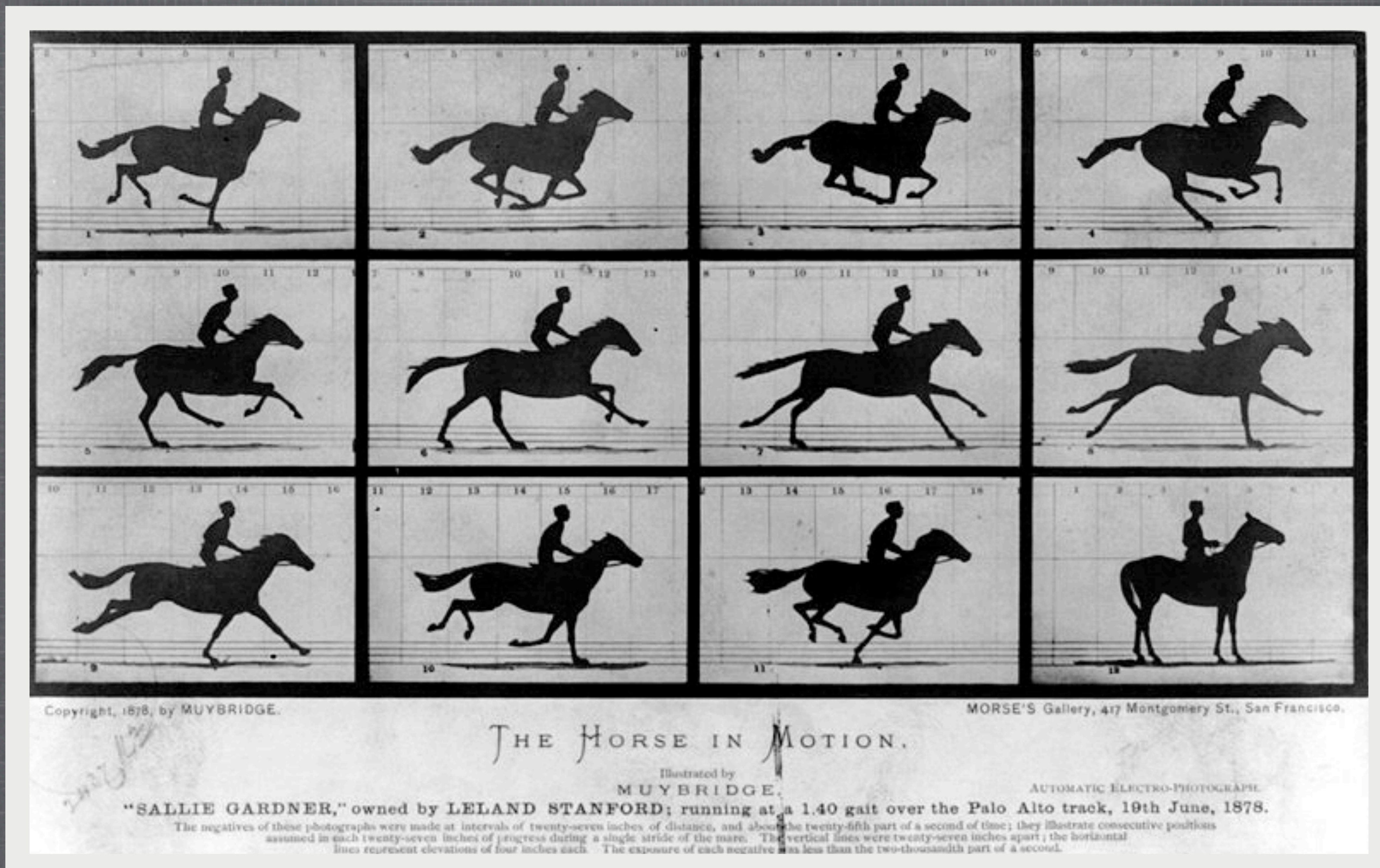
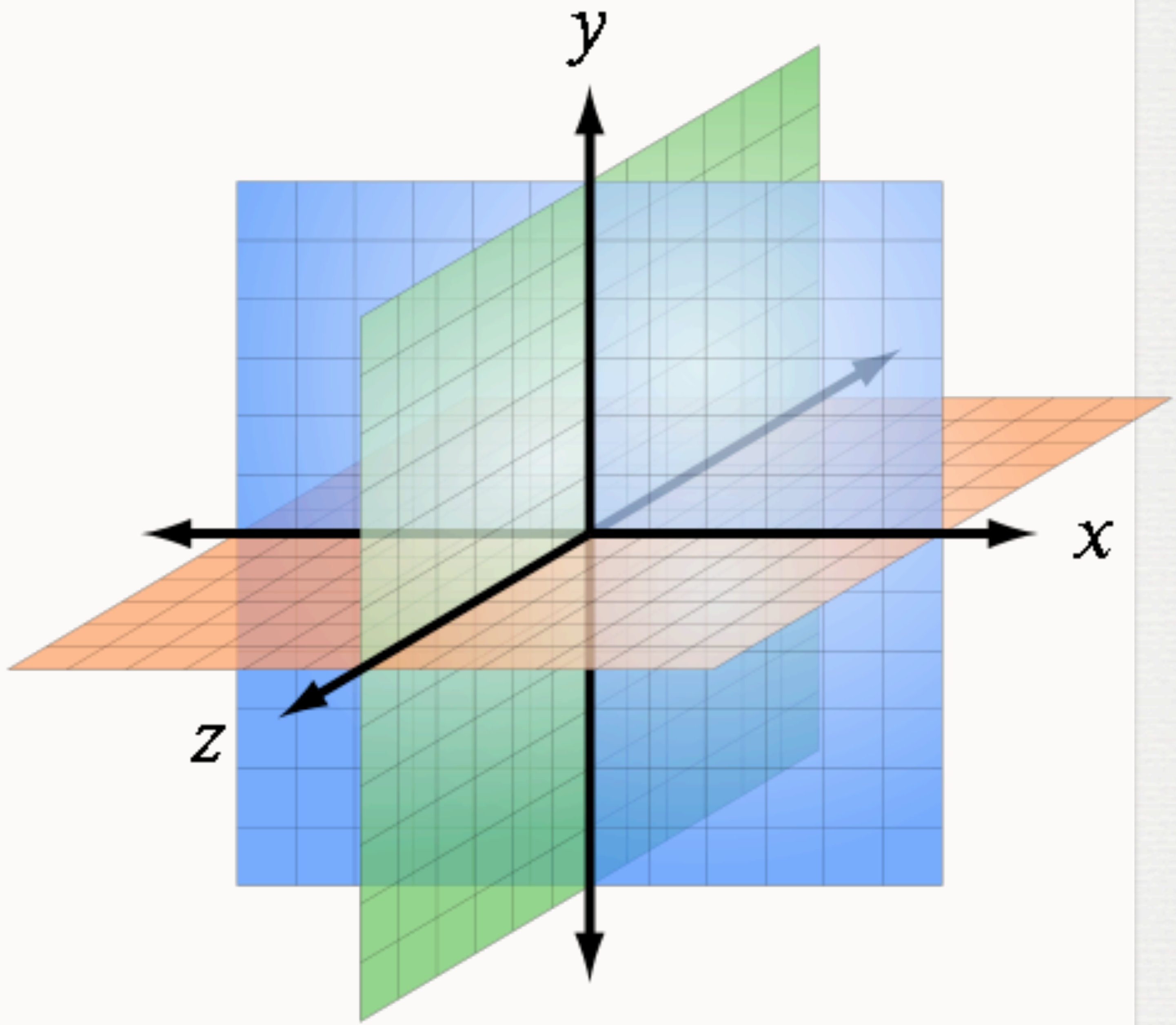
KINEMATICS



File:The Horse in Motion.jpg - Wikimedia Foundation

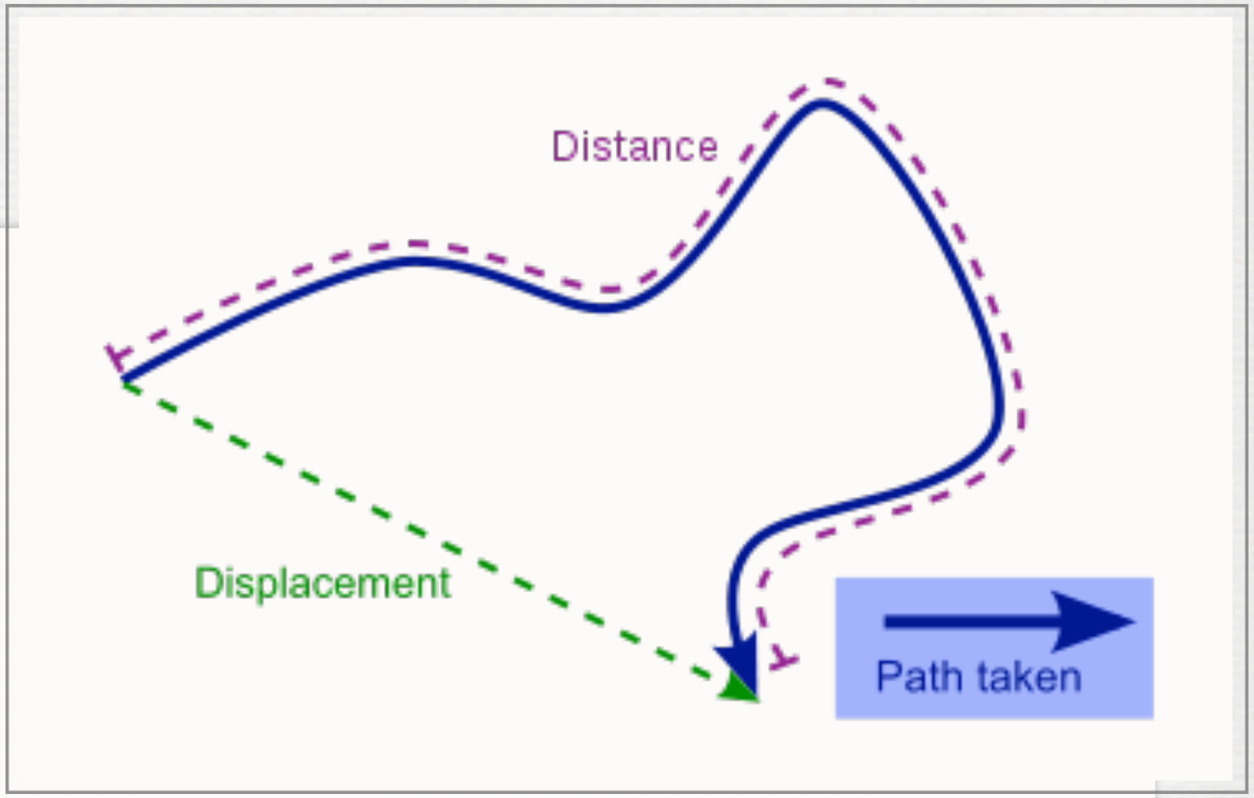
WHERE ARE YOU?

- Typical Cartesian Coordinate System
- usually only the X and Y axis
- meters



File:3D coordinate system.svg - Wikimedia Foundation

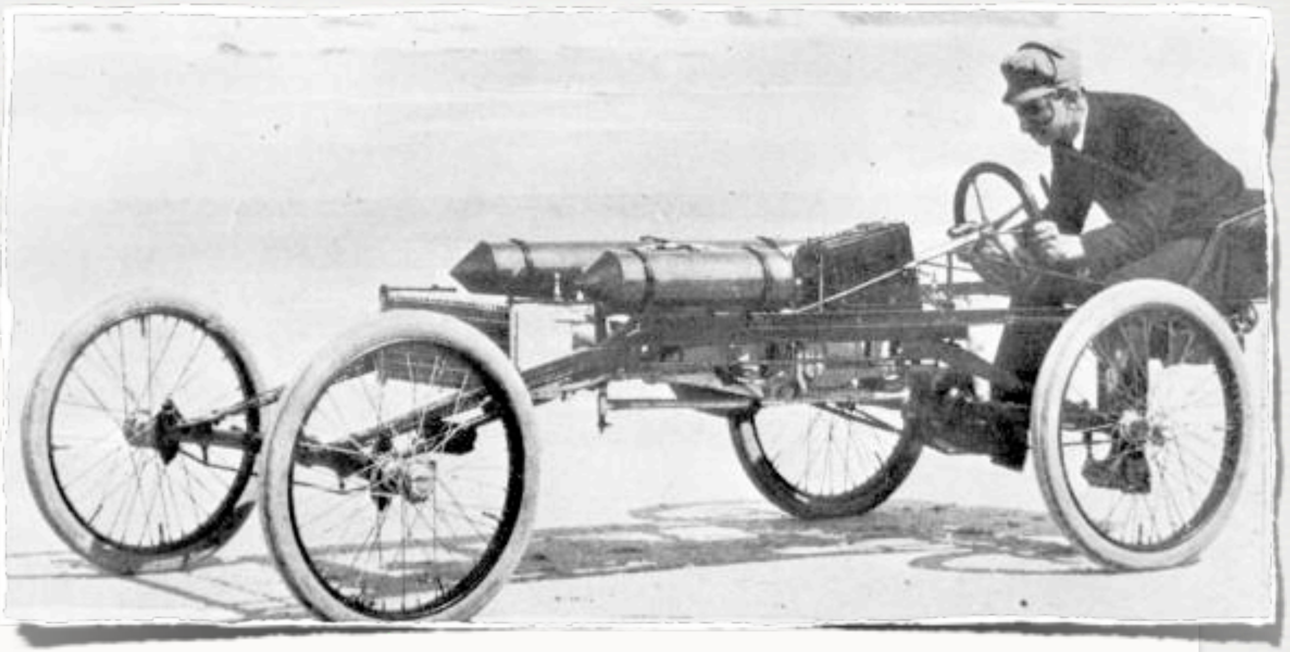
File:Distancedisplacement.svg - Wikimedia Commons



- **Distance**
  - Scalar Quantity
  - Difference between two positions
- **Displacement**
  - Vector Quantity
  - How to get from one position to another

WHEN YOU MOVE

HOW FAST?



- **Speed**
  - Scalar Quantity
  - Change in DISTANCE over TIME
- **Velocity**
  - Vector Quantity
  - Change in DISPLACEMENT over TIME
- units for both (m/s)

File:RansomEliOldsOldsPirate.jpg - Wikimedia Commons

VELOCITY OR SPEED

- **A person jogs eight complete laps around a quarter mile track in a total time of 12.5 minutes.**
  - Calculate
    - (a) the average speed and
    - (b) the average velocity, in miles per hour (mph)

VELOCITY DETAILS

- Direction can change the results
- Often positive or negative represents the direction like “forwards and backwards”
- Average Velocity often will not match the average speed
- Instantaneous Velocity - speed and direction at an instant.

GETTING FASTER

- **Acceleration**
  - Vector Quantity
  - Change in VELOCITY over Time
    - m / s / s   or m / s^2
- Positive sign is not the same as "getting faster"
- Negative sign is not the same as "deceleration"

$$x_f = x_i + vt + \frac{1}{2}at^2$$

- Where you are at the end
- Where you started
- Your initial velocity
- The time (duration)
- If your speed changed

$v_f = v_i + at$

- No Distance
- Your initial velocity
- Your final velocity
- The time (duration)
- If your speed changed
- can be rearranged

$$a = \frac{v_f - v_i}{t}$$

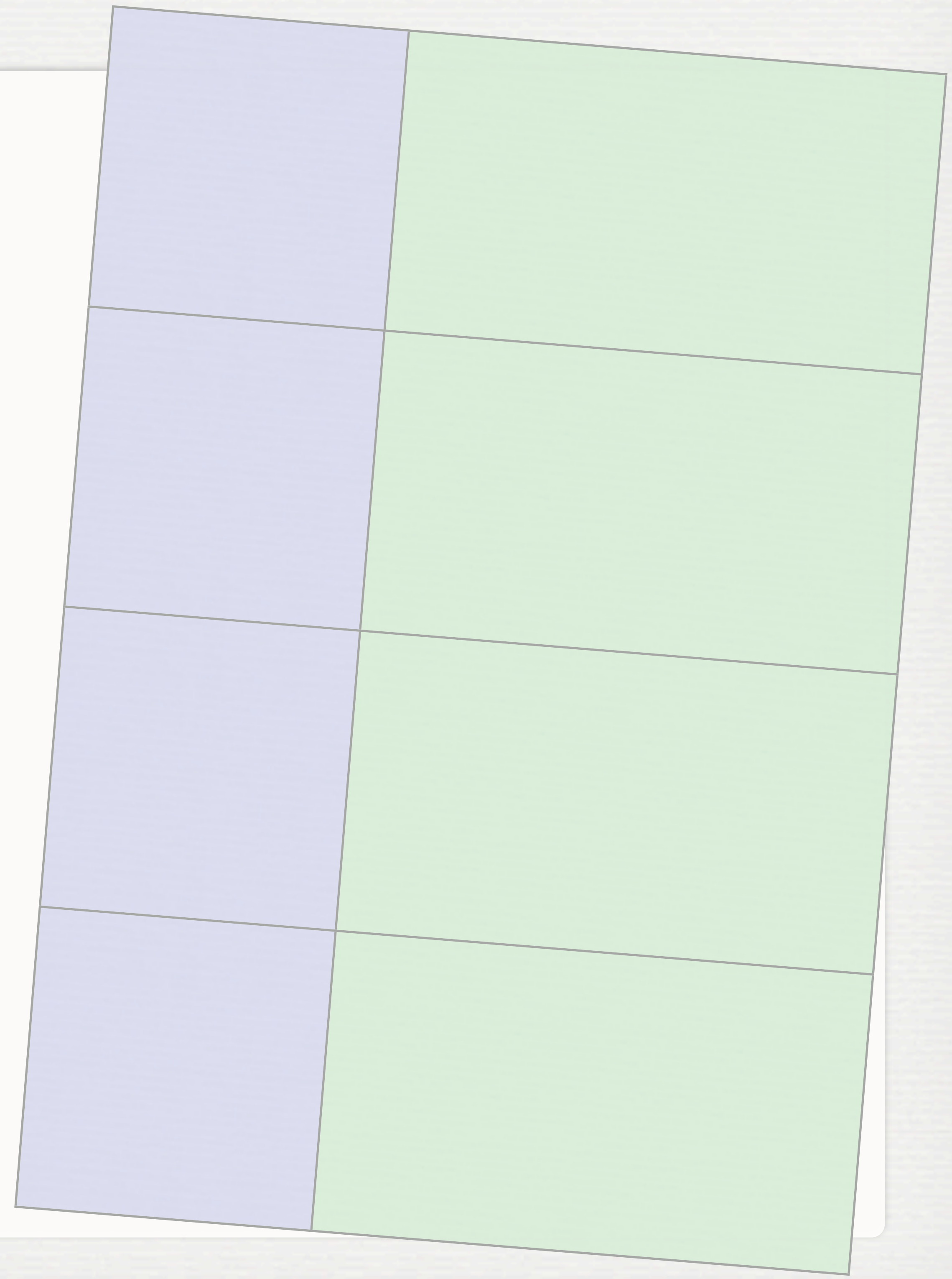
EQUATION 3

VELOCITY BASED ON POSITION

$$v_f^2 = v_i^2 + 2ad$$

SIMPLE PLUG-IN EXAMPLE

- A car accelerates from rest to a maximum speed of 75 m/s in 0.2 minutes.
  - What was its acceleration?
  - How far did it travel in this time?



SIMPLE PLUG-IN EXAMPLE

- A car accelerates from rest to a maximum speed of 75 m/s in 0.2 minutes.
  - What was its acceleration?
  - How far did it travel in this time?

V_f =	75 m/s
t =	0.2 min = 12 s
V_i =	0 m/s
a =	?

PICK AN EQUATION

V_f =	75 m/s
t =	12 s
V_i =	0 m/s
a =	?

$$x_f = x_i + vt + \frac{1}{2}at^2$$

$$v_f = v_i + at$$

$$v_f^2 = v_i^2 + 2ad$$

PICK AN EQUATION

V_f =	75 m/s
t =	12 s
V_i =	0 m/s
a =	6.25 m/s^2
now d = or x_f =	?

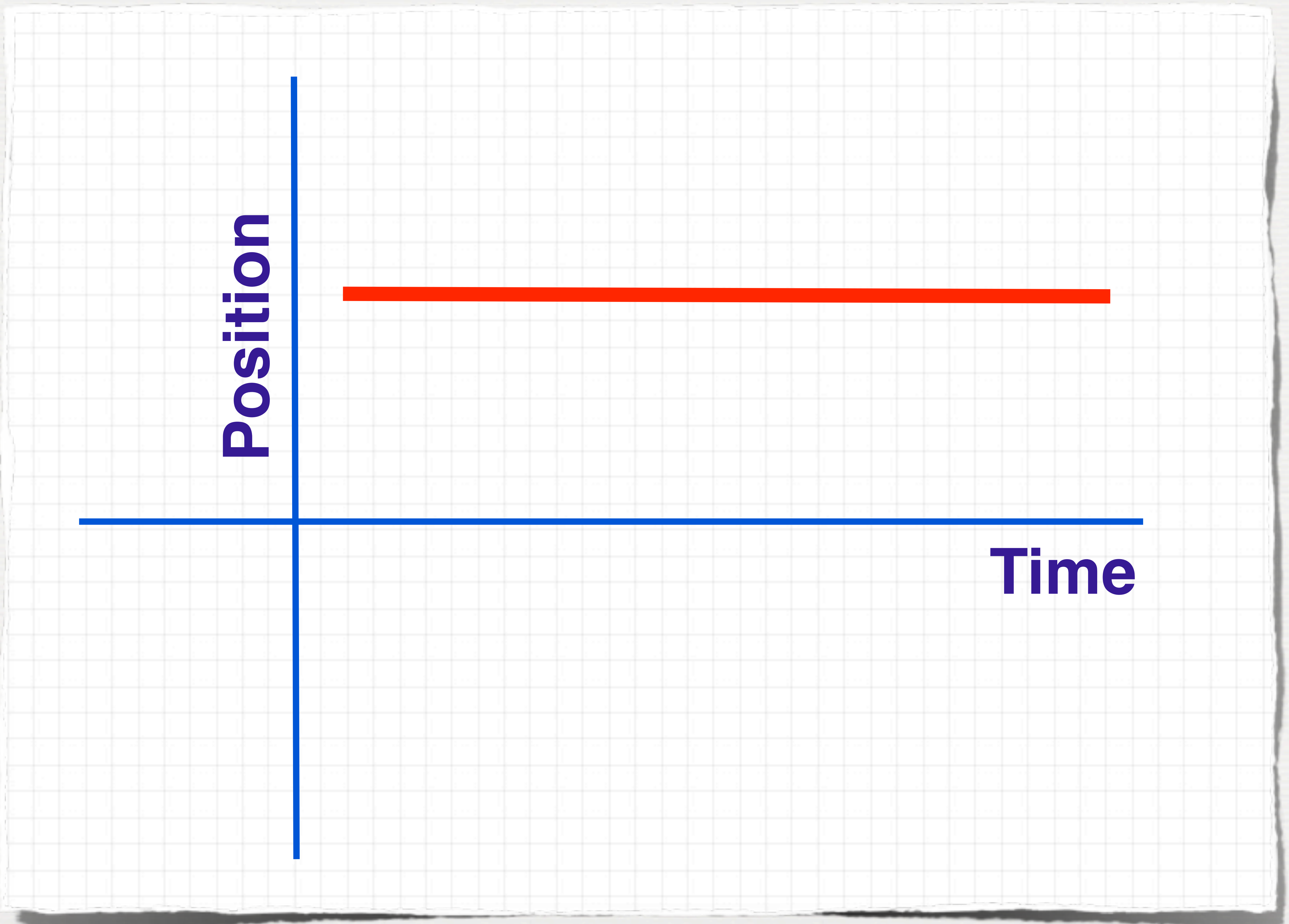
$$x_f = x_i + vt + \frac{1}{2}at^2$$

$$v_f = v_i + at$$

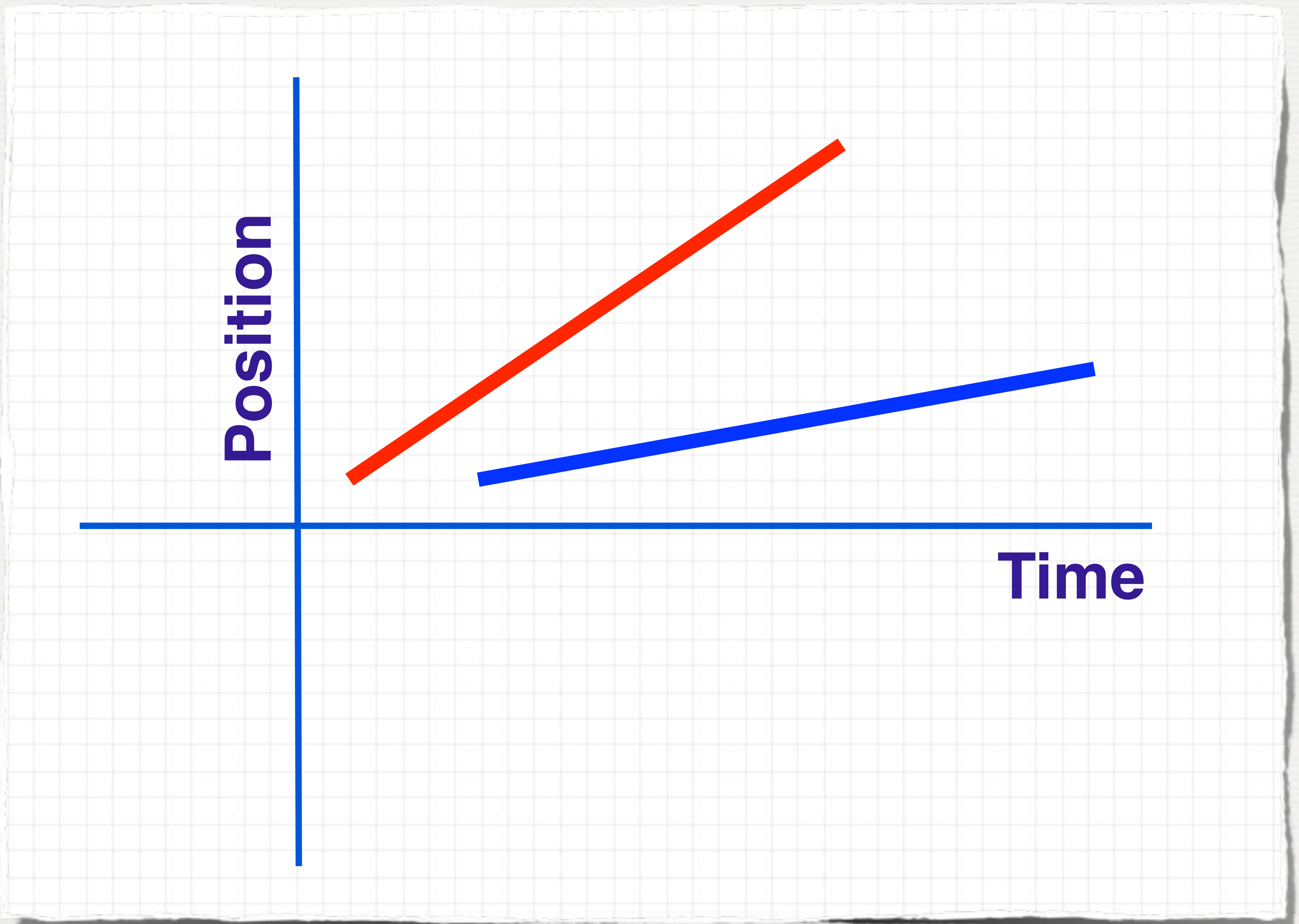
$$v_f^2 = v_i^2 + 2ad$$

KINEMATIC GRAPHS

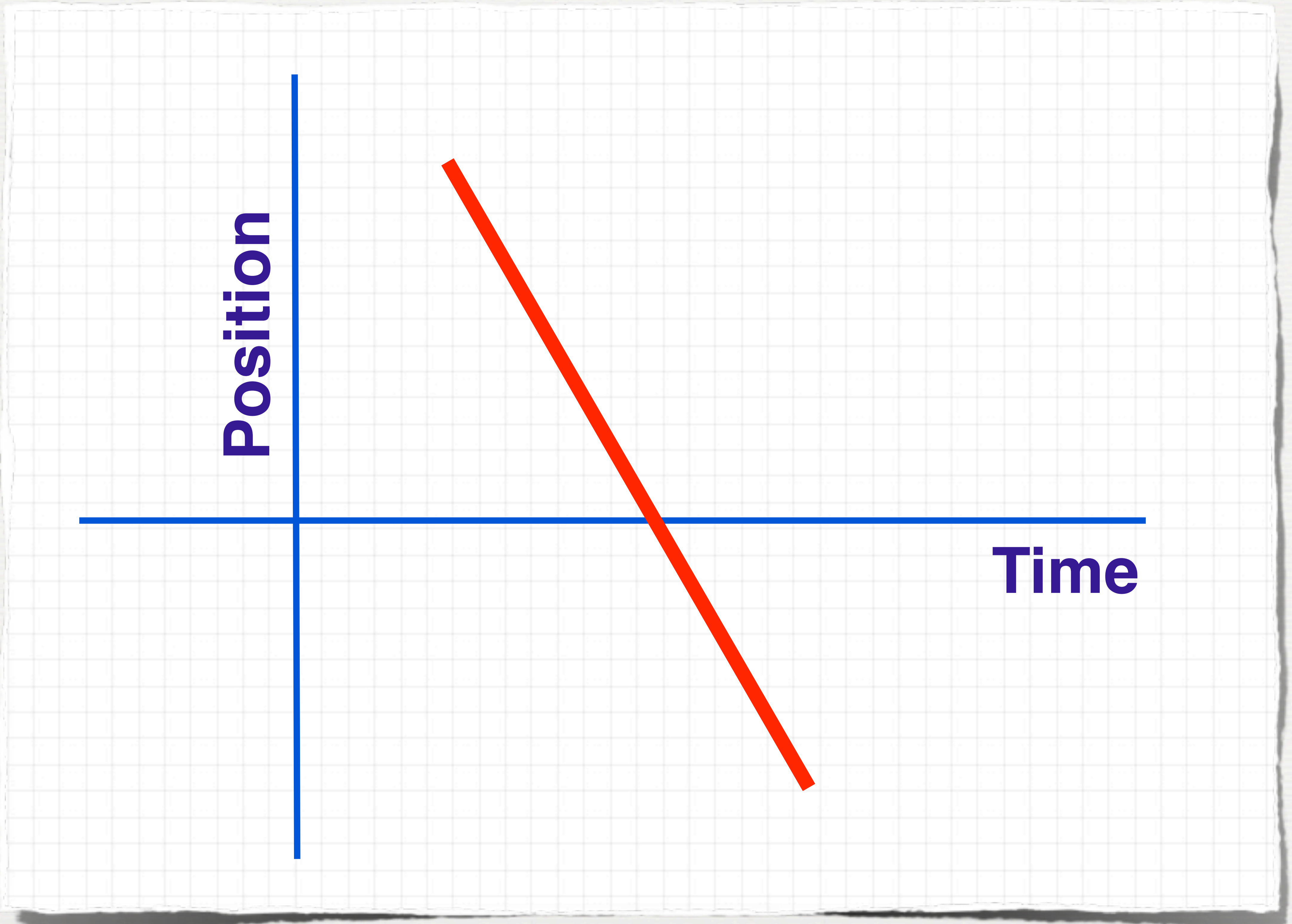
CONSTANT POSITION



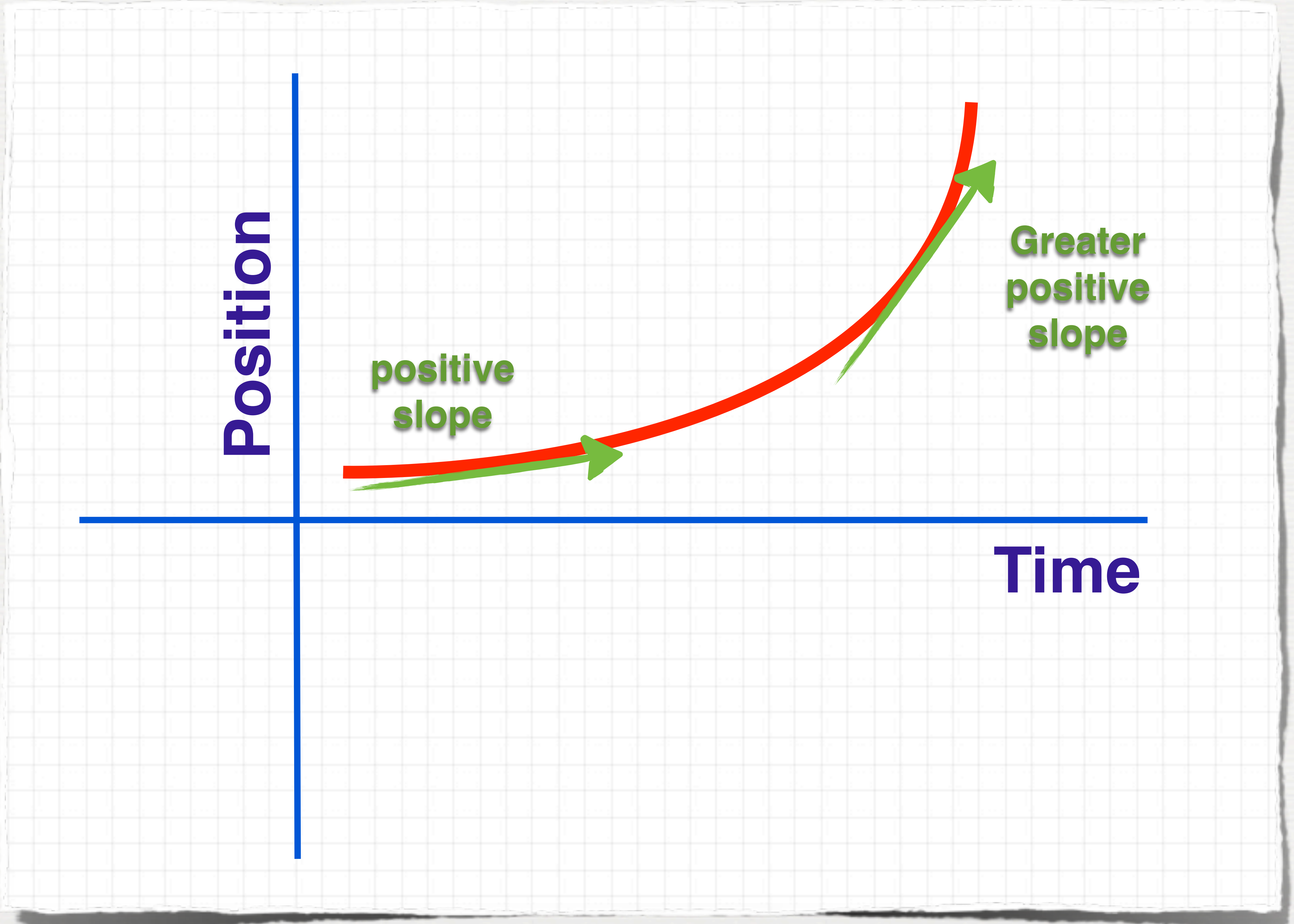
CONSTANT POSITIVE VELOCITY



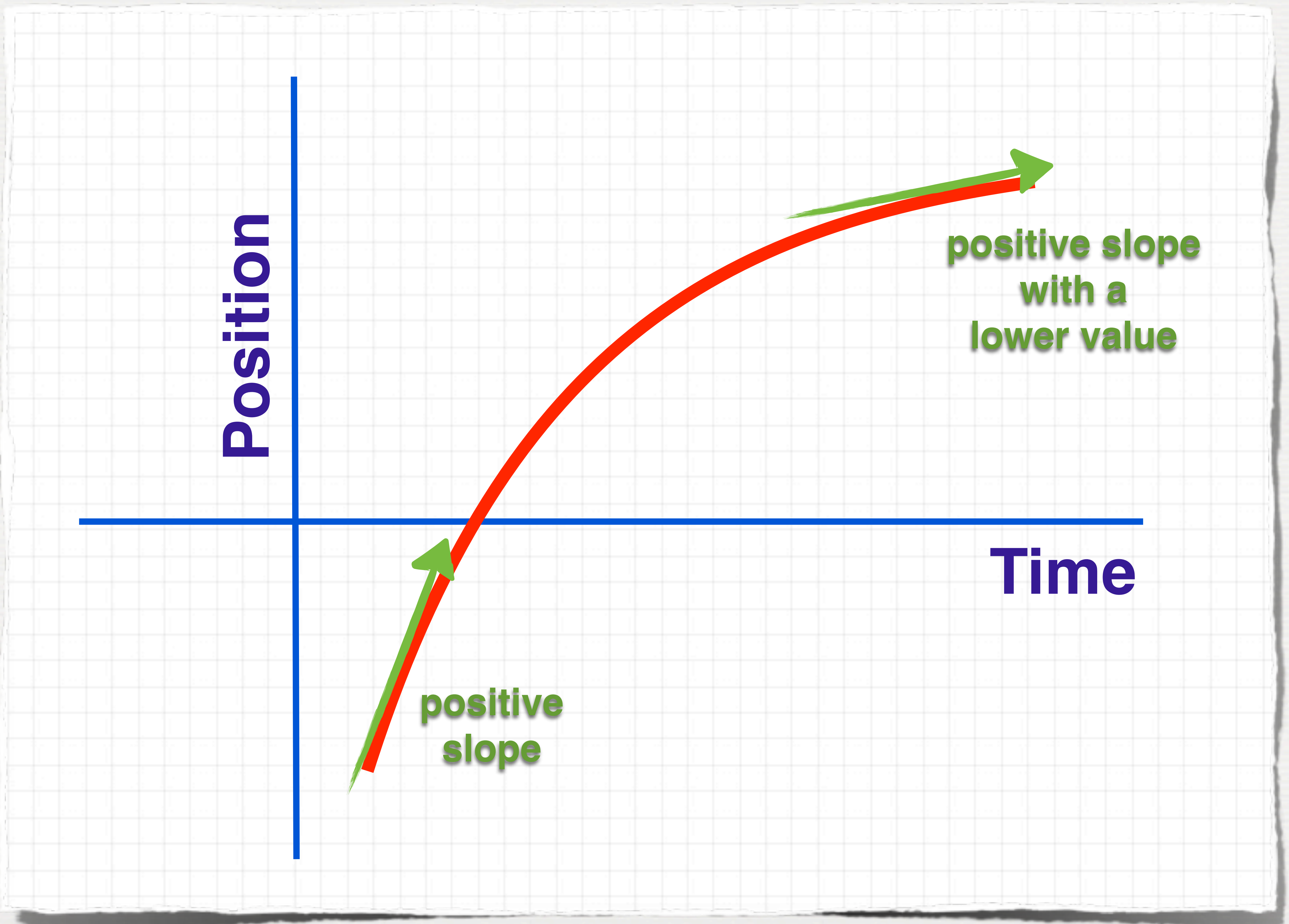
CONSTANT NEGATIVE VELOCITY



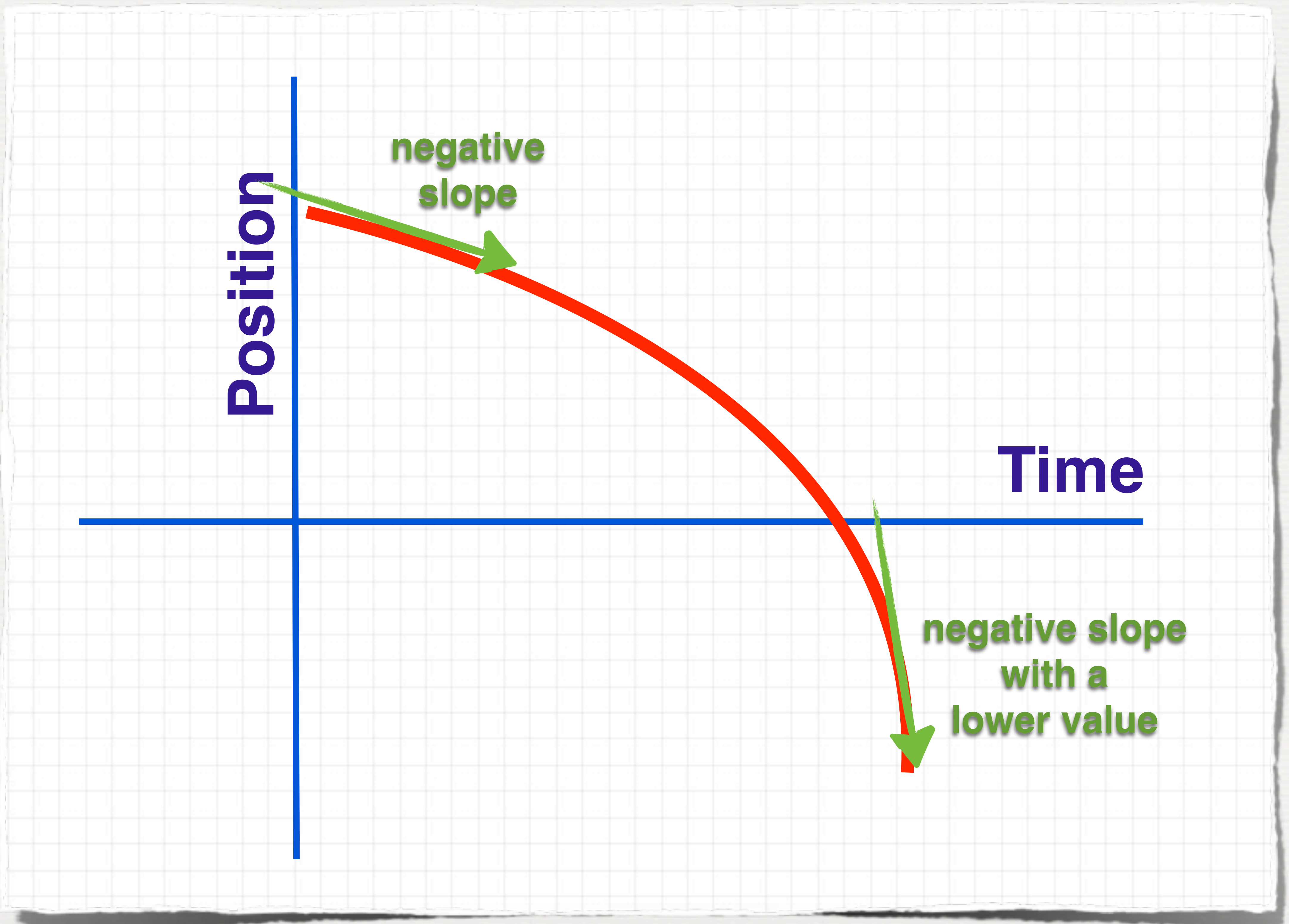
POSITIVE VELOCITY - POSITIVE ACCELERATION



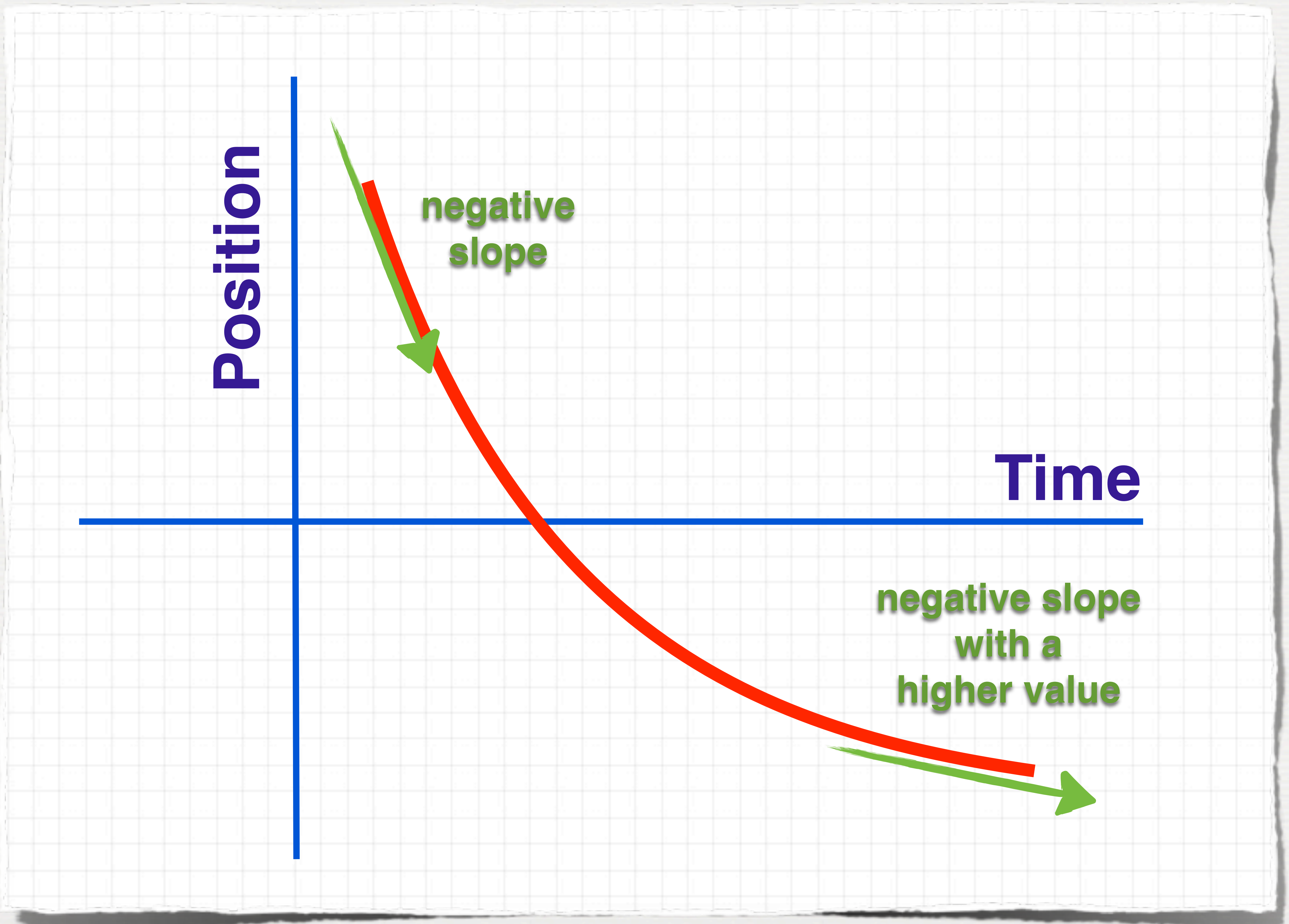
POSITIVE VELOCITY - NEGATIVE ACCELERATION



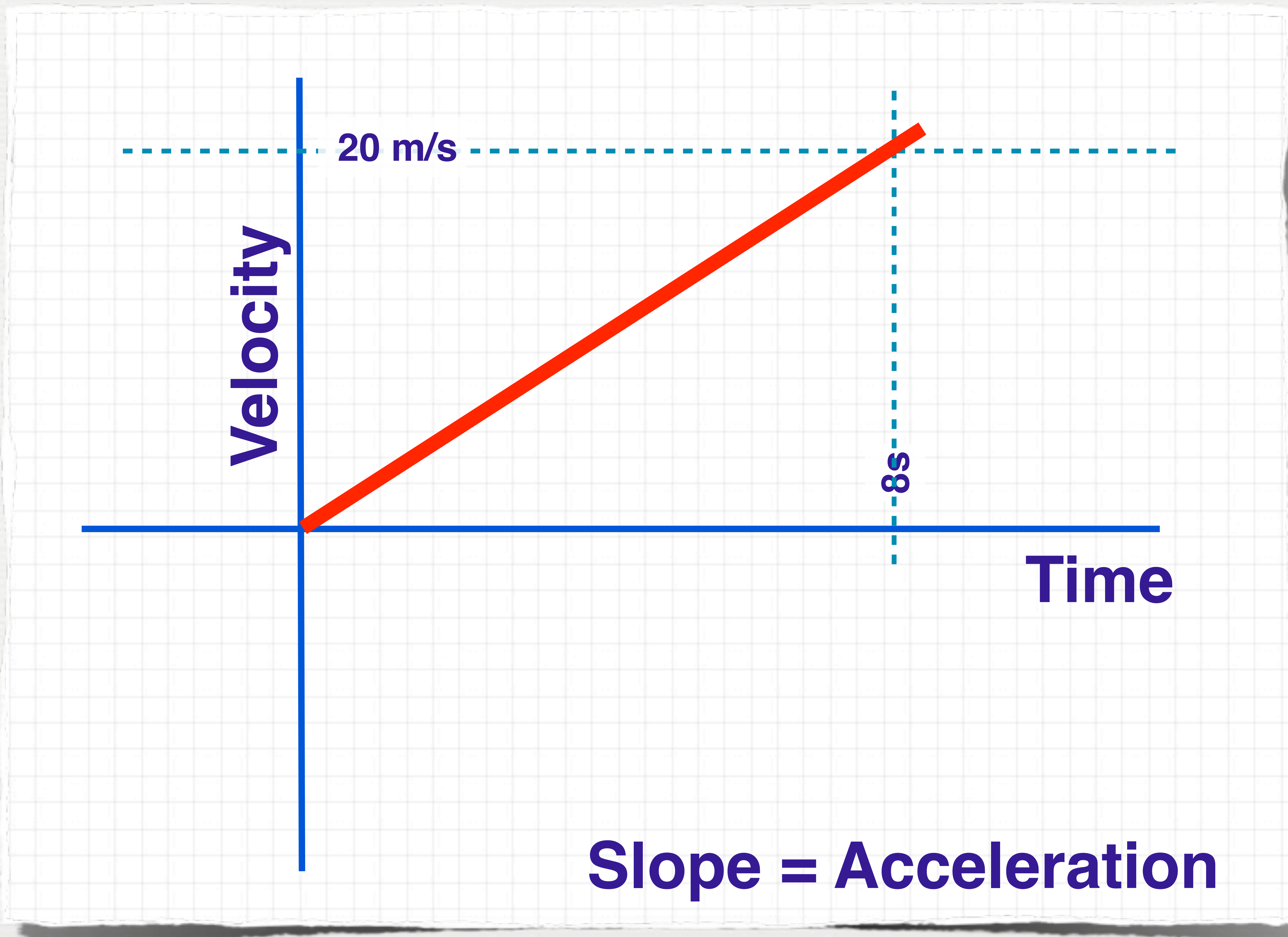
NEGATIVE VELOCITY - NEGATIVE ACCELERATION



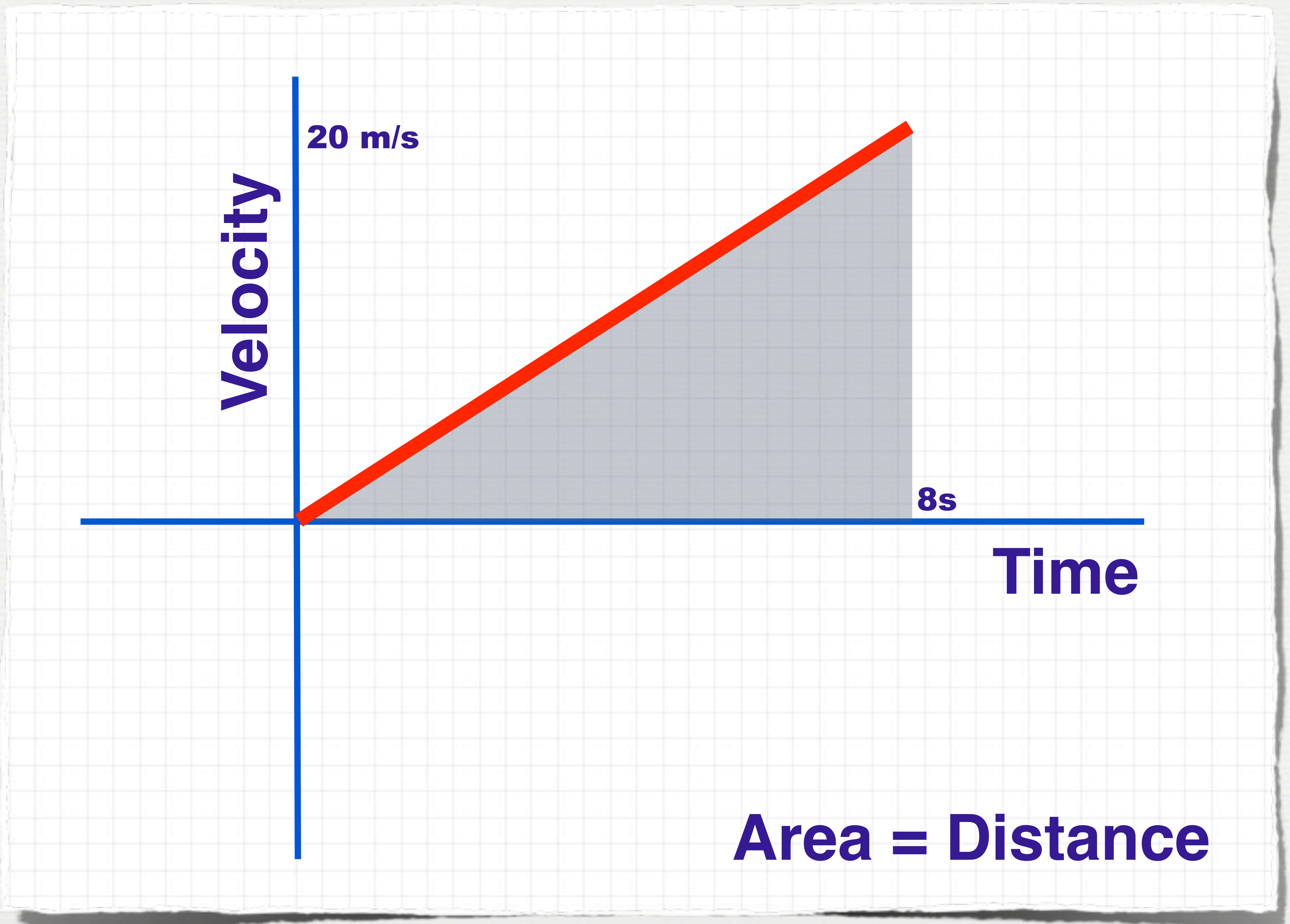
NEGATIVE VELOCITY - POSITIVE ACCELERATION



VELOCITY / TIME GRAPH

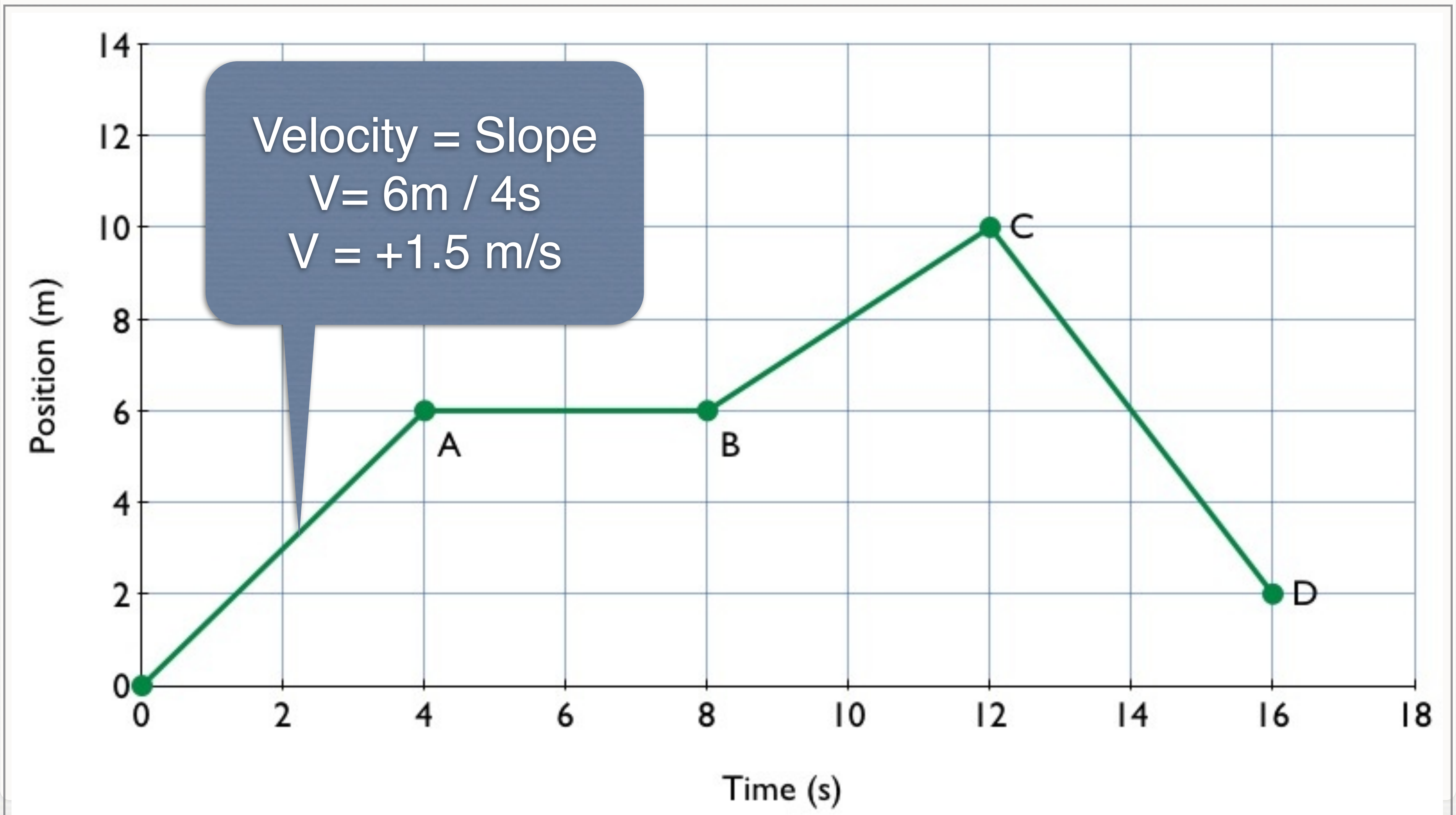


VELOCITY / TIME GRAPH



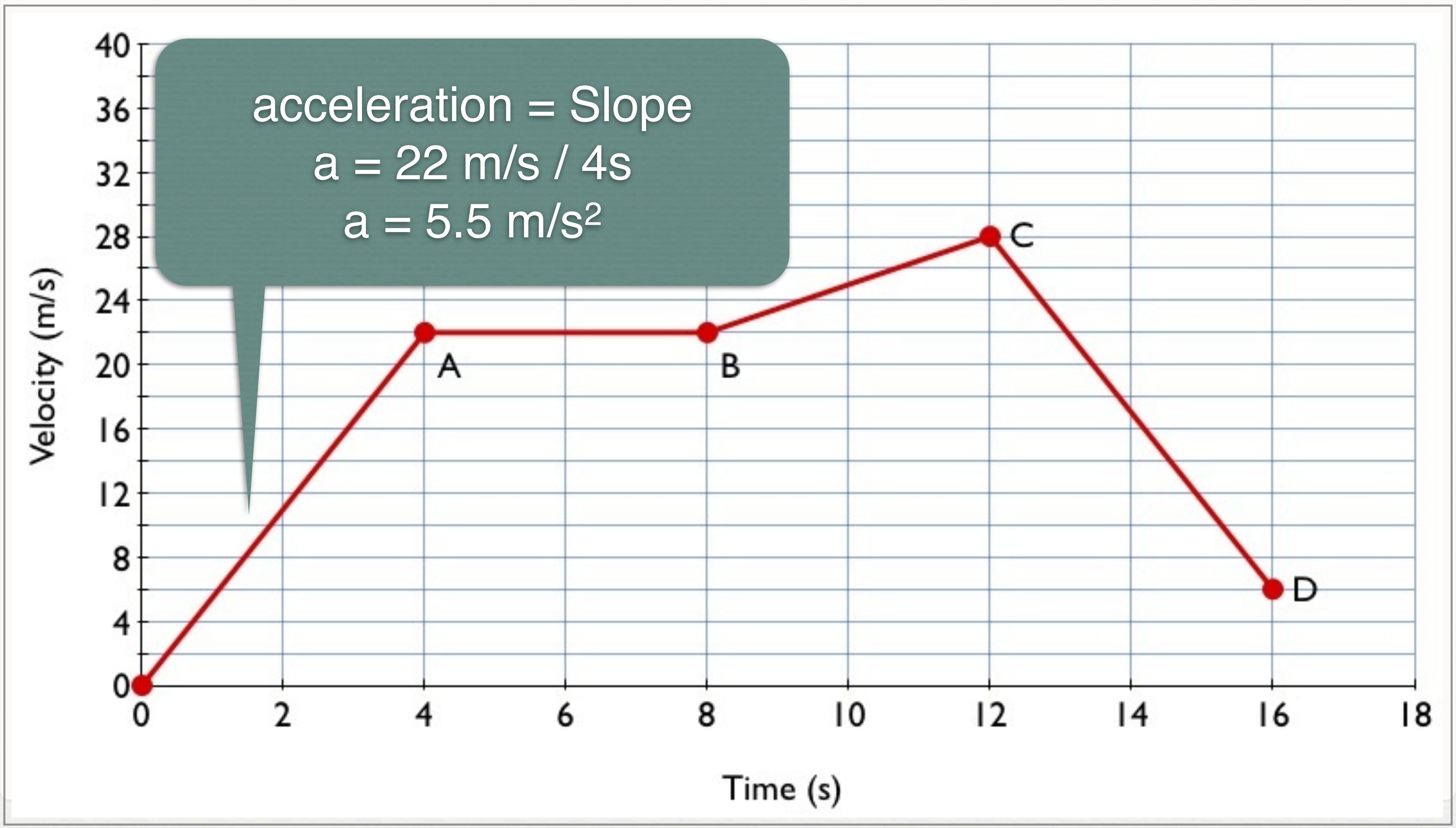
READING A GRAPH

A plot of the **position** of a car as a function of time is shown in the diagram. Find the **velocity** of the car during each section of the graph.



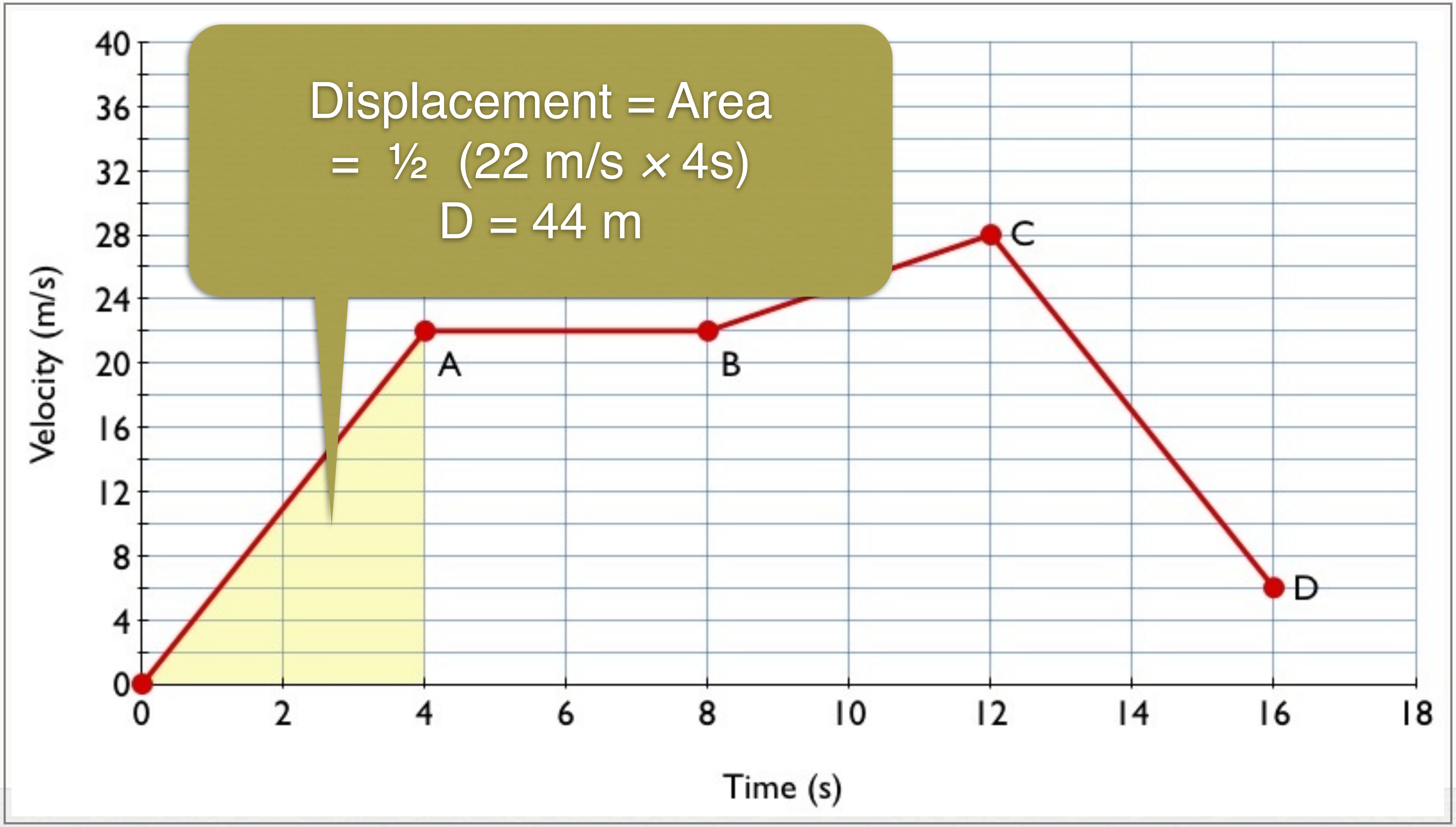
READING A GRAPH

A plot of the **velocity** of a car as a function of time is shown in the diagram. Find the **acceleration** of the car during each section of the graph.



READING A GRAPH

A plot of the **velocity** of a car as a function of time is shown in the diagram. Find the **displacement** of the car during each section of the graph.



SIMPLE MOTION

A car starts with a velocity of 0 m/s and accelerates at 7 m/s^2.

what is the velocity after 8 seconds?

what is the velocity as the car passes 25 m

when does the car pass 100m

when is the car's velocity 22 m/s

SIMPLE MOTION

A car starts with a velocity of 0 m/s and accelerates at 7 m/s².

what is the velocity after 8 seconds?

what is the velocity as the car passes 25 m

when does the car pass 100m

when is the car's velocity 22 m/s

$$v_f = v_i + at$$

A B

C D

SIMPLE MOTION

A truck starts with a velocity of 45 m/s and accelerates at -6 m/s^2.

what is the velocity after 4.2 seconds?

where is the truck after 4.2 seconds?

when is the truck's velocity 0 m/s

where is the truck when it has a velocity of 0 m/s

SIMPLE MOTION

A truck starts with a velocity of 45 m/s and accelerates at -6 m/s².

what is the velocity after 4.2 seconds?
where is the truck after 4.2 seconds?
when is the truck's velocity 0 m/s
where is the truck when it has a velocity of 0 m/s

$$v_f = v_i + at$$

A	B
C	D

COMBINED MOTION

A car starts at rest and accelerates at $+5.6\ m/s^2$. At the same moment, a truck passes by at a constant velocity of 30 m/s.

File:Castro street corner w. market street 01.JPG - Wikimedia Foundation

when will the car pass the truck?

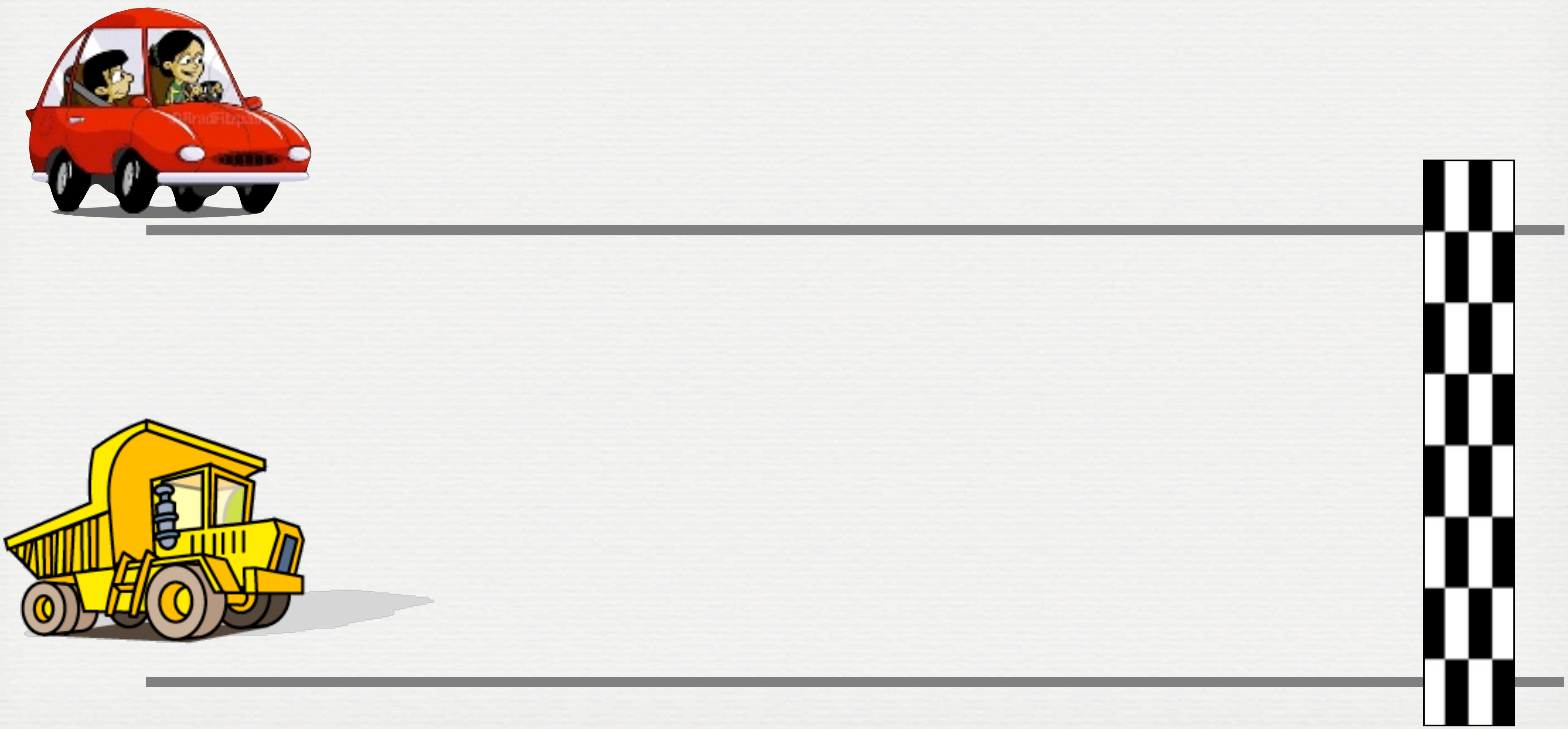
where will the car pass the truck?

Which would win a 200 m race?

COMBINED MOTION

A car starts at rest and accelerates at +5.6 m/s². At the same moment, a truck passes by at a constant velocity of 30 m/s.

$$x_f = x_i + vt + \tfrac{1}{2}at^2$$



PRACTICE PROBLEM

- **You have 6.0 hours to travel a distance of 140 km by bicycle.**
  - How long will it take you to travel the first half at an average speed of 5.8 m/s?
  - In the second half of the ride, you need to increase your average speed to make up for lost time. If you can maintain an average speed of 7 m/s, will you be able to reach your destination on time?

SAMPLE PROBLEM

- **A driver traveling at 30.0 km/hr sees the light turn red at the intersection. If his reaction time is 0.600 s, and the car can decelerate at 4.50 m/s^2, find the stopping distance of the car.**