# Unit 1
# One-Dimensional Kinematics
Reference Glencoe Chapter 2, Chapter 3

Physics

SP1

Students will analyze the relationship between force, mass, gravity, and the motion of objects.

a. Calculate average velocity, instantaneous velocity, and acceleration in a given frame of reference.

Physics

Mechanics – the study of how objects move and respond to external forces

Kinematics

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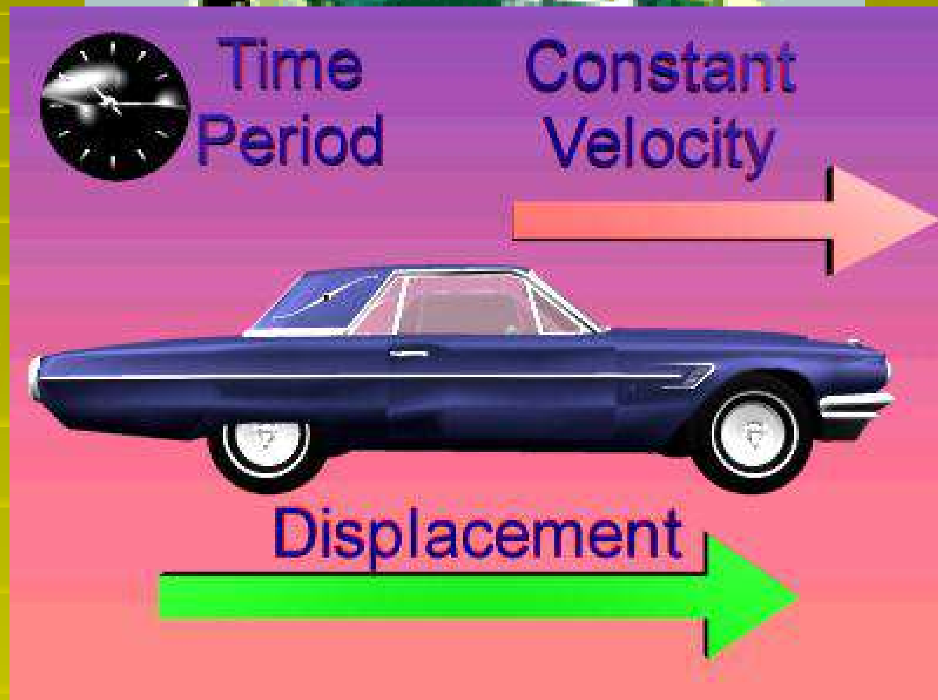


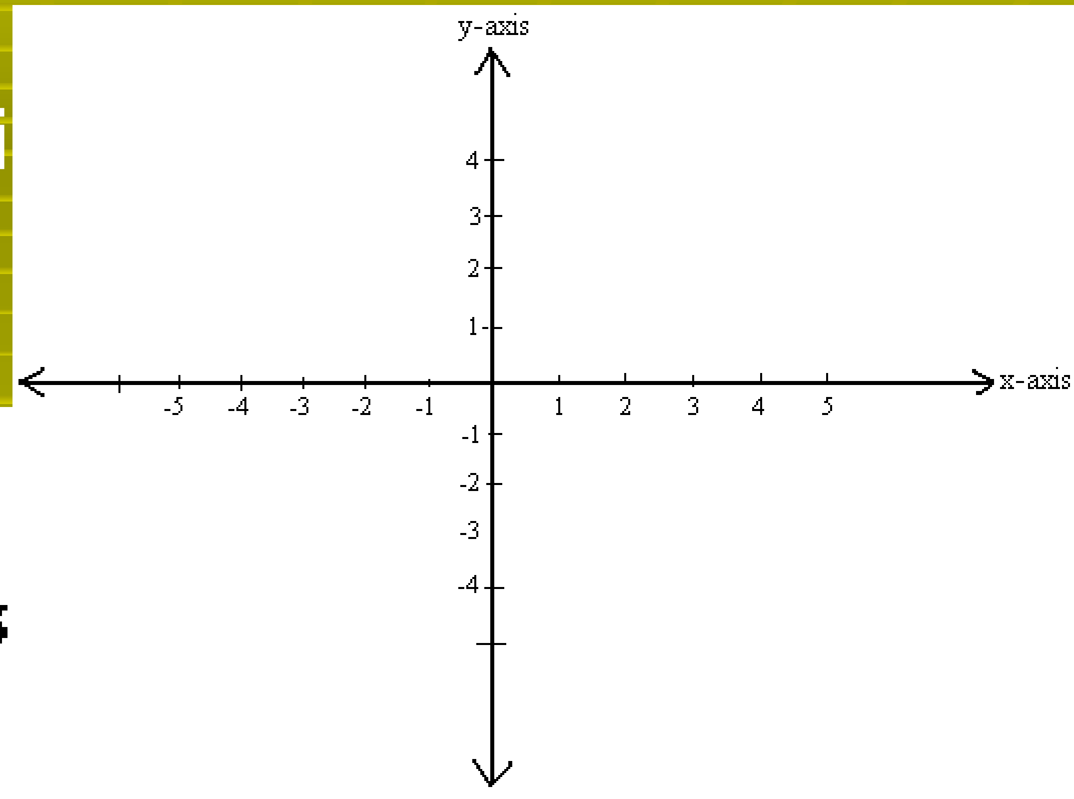

## One – Dimensional Kinematics

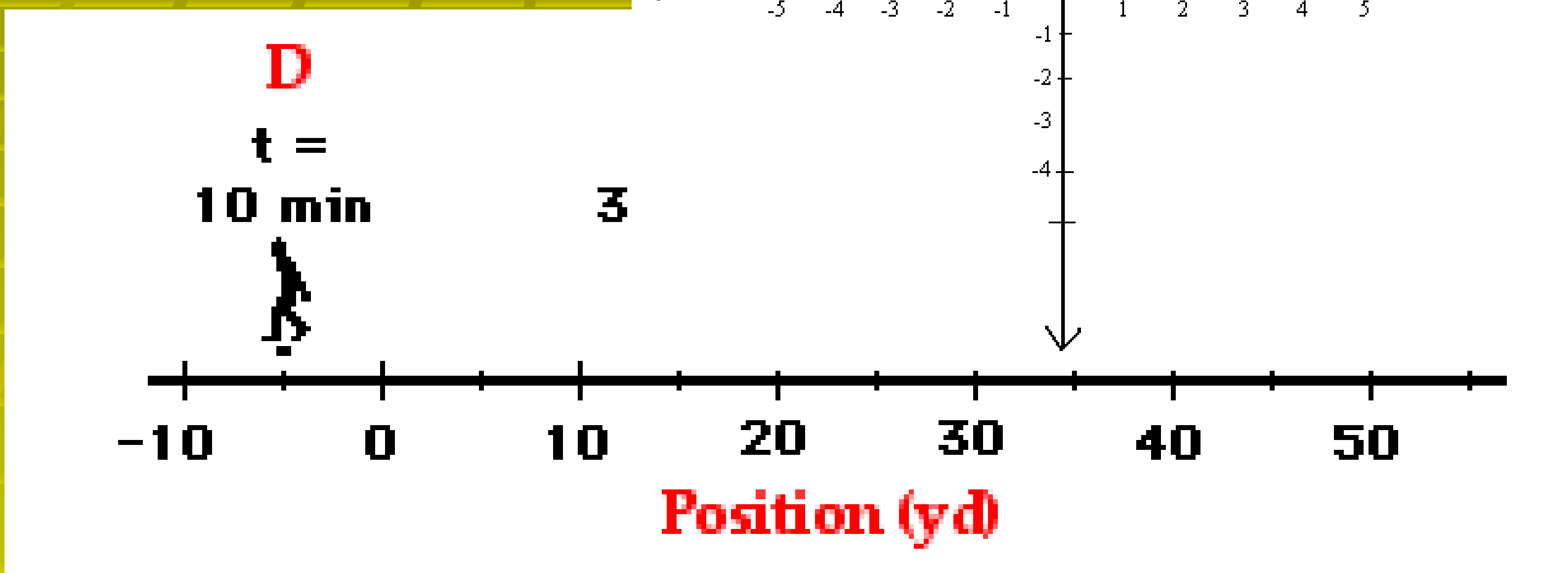
**Calculate average velocity, instantaneous velocity, and acceleration.**

Coordinate System – define and origin and a positive direction

Must remain consi

In one dimension




# 1.1 Position, Distance, and Displacement

**Calculate average velocity, instantaneous velocity, and acceleration.**

Position – a reference to the coordinate system

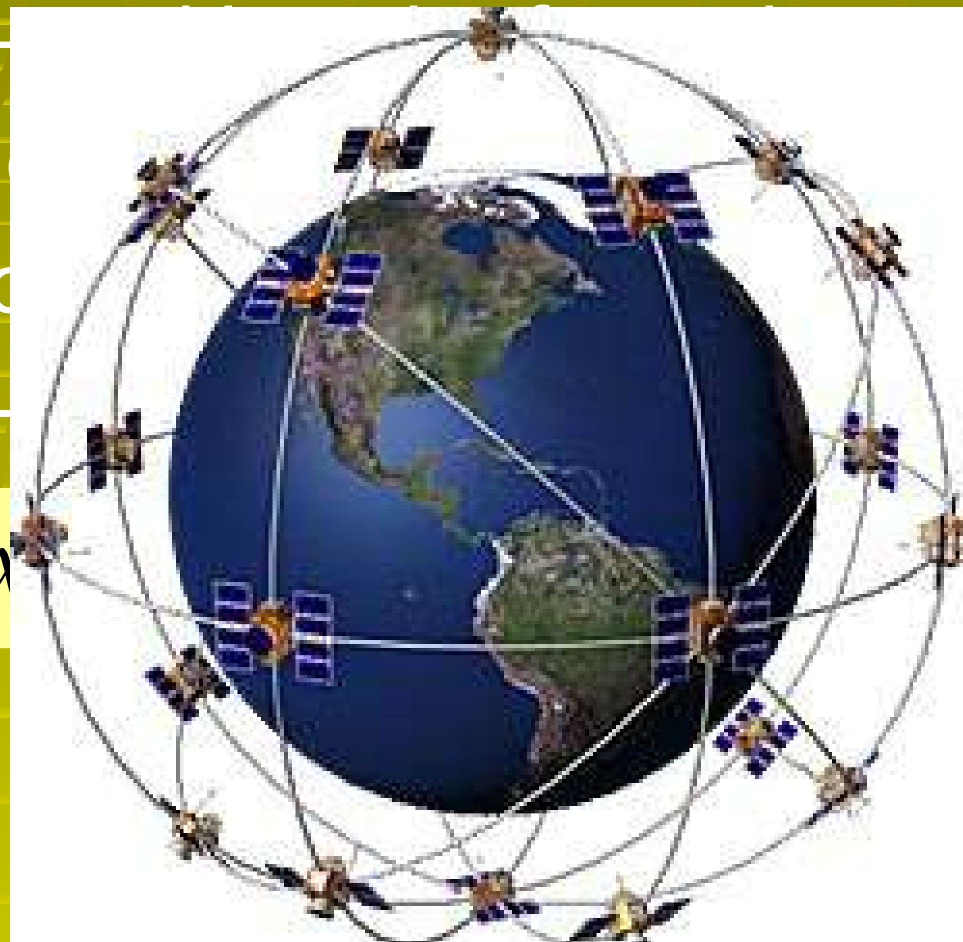
Distance –

Displaceme ion

More co

Vector –

$\Delta x = x - x$




## 1.1 Position, Distance, and Displacement

**Calculate average velocity, instantaneous velocity, and acceleration.**

# Displacement vs. distance


**1.1 Position, Distance, and Displacement**

**Calculate average velocity, instantaneous velocity, and acceleration.**

Speed – distance per unit time

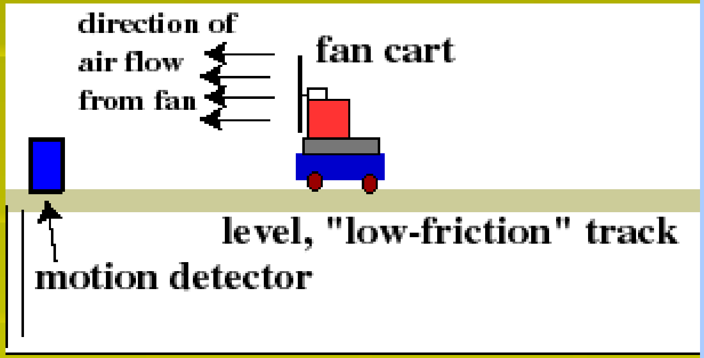
Average Velocity – (±) displacement per unit time

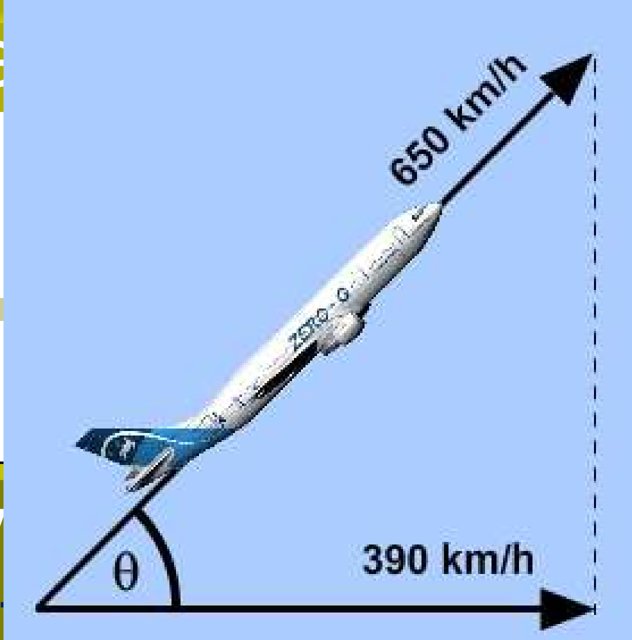
$\bar{v} =$


Δt = change i

Velocity is a ve s direction

In one dimension this is indicate sign




## 1.2 Average Speed and V

**Calculate average velocity, instantaneous velocit**

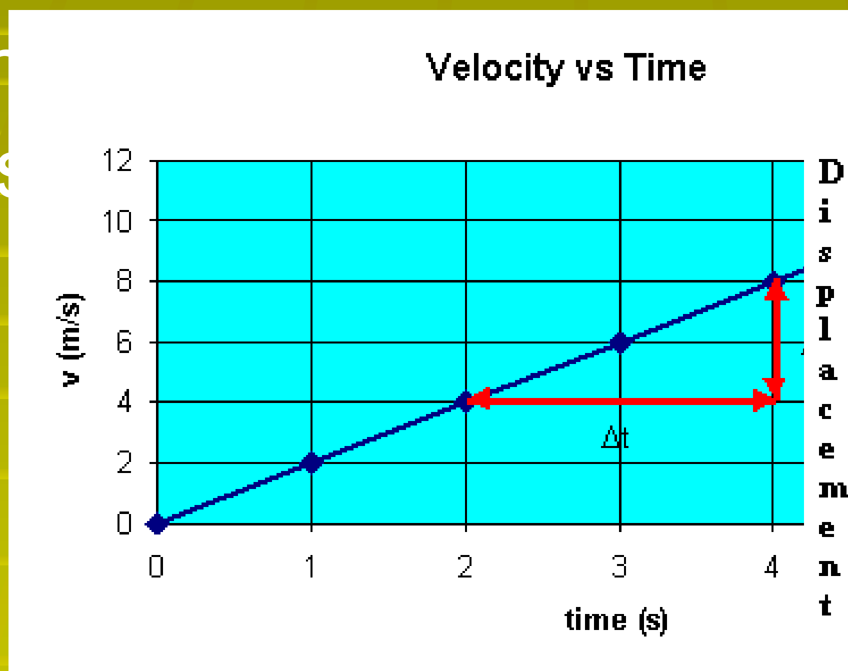
# Graphical Interpretation of Average Velocity

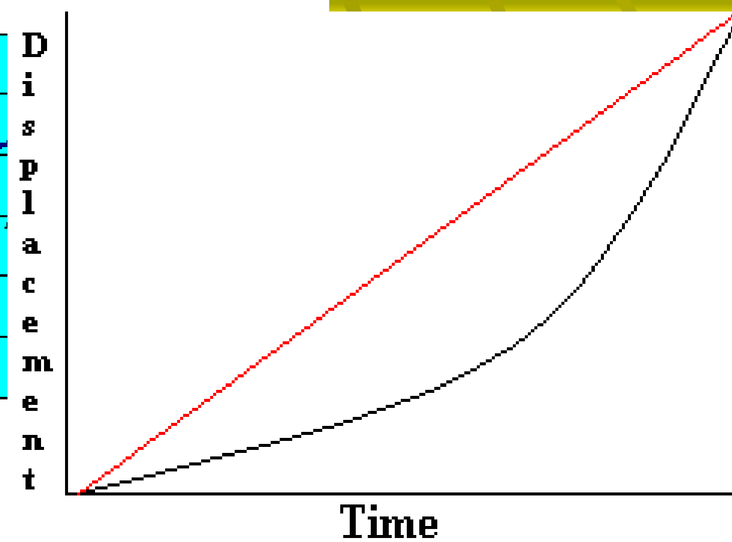
**Displacement vs. Time**

Slope of displacement time is average velocity

Over ar two

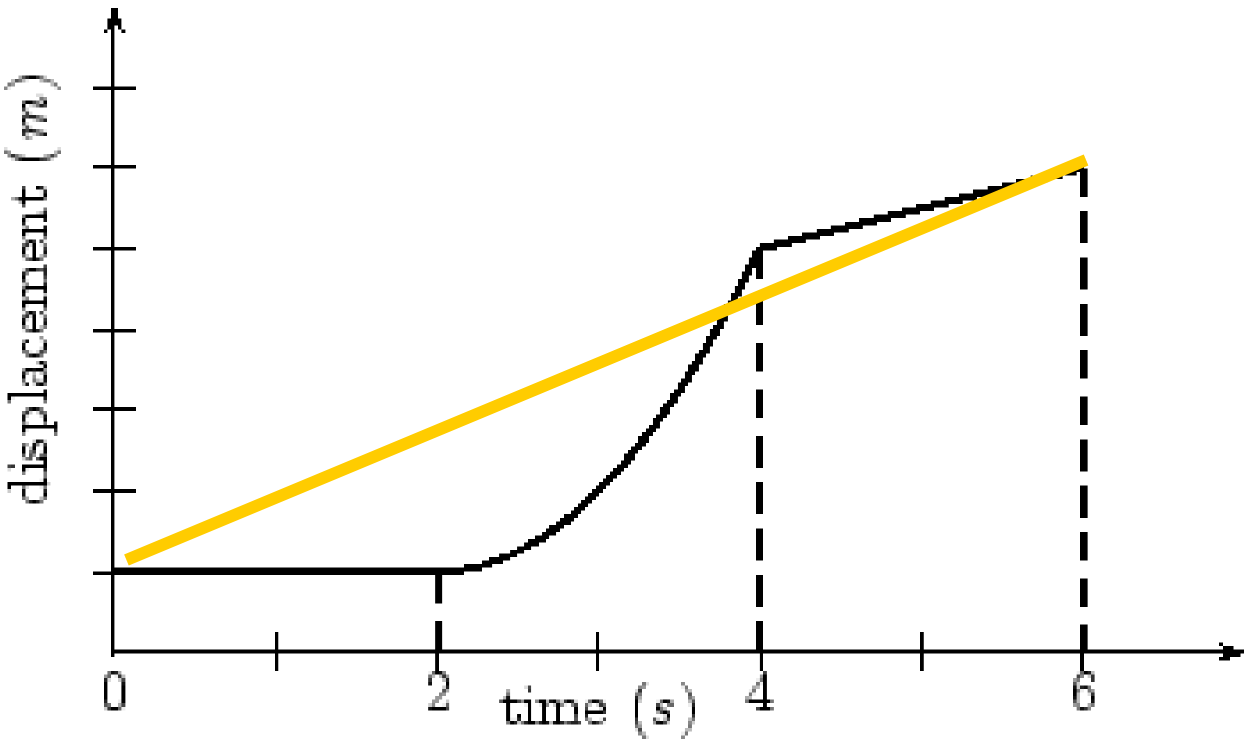
points is




## 1.2 Average Speed and Velocity

**Calculate average velocity, instantaneous velocity, and acceleration.**



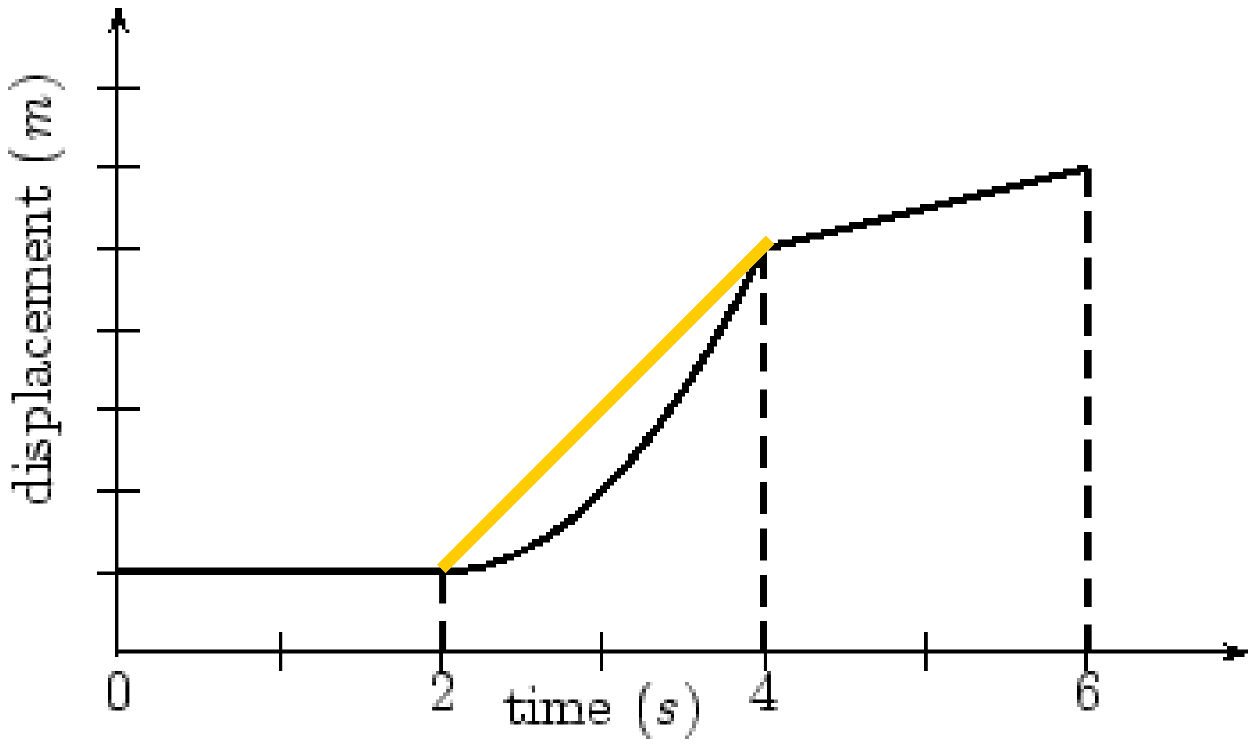

$$v = \frac{\Delta x}{\Delta t}$$

$$v = \frac{6m - 1m}{6s}$$

$$v = 0.83m/s$$

# 1.2 Average Speed and Velocity

**Calculate average velocity, instantaneous velocity, and acceleration.**




$$v = \frac{\Delta x}{\Delta t}$$

$$v = \frac{5m - 1m}{2s}$$

$$v = 2.0 m / s$$

# 1.2 Average Speed and Velocity

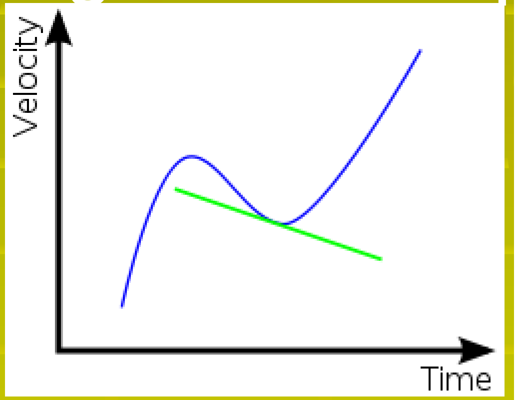
**Calculate average velocity, instantaneous velocity, and acceleration.**

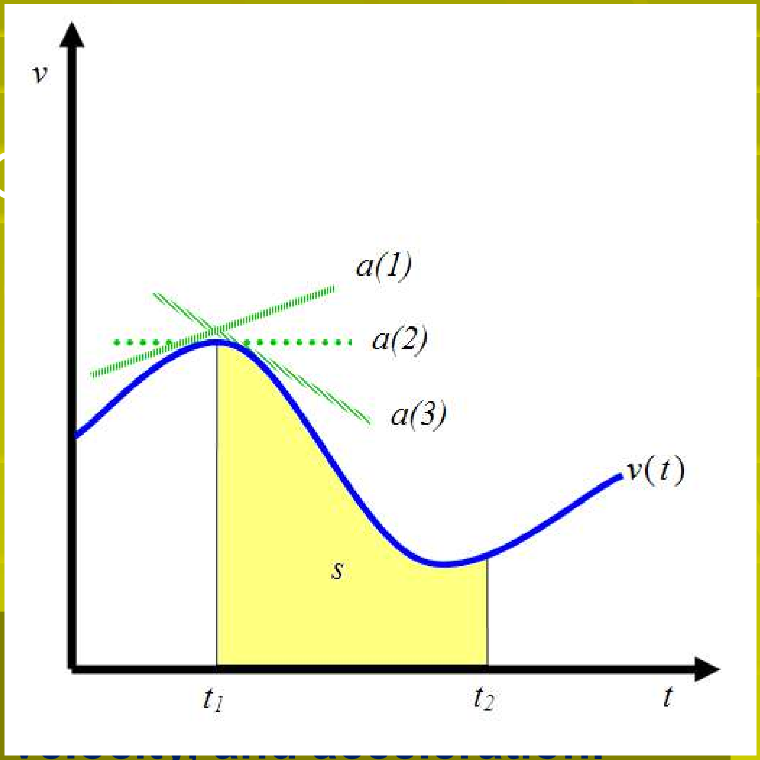
Instantaneous velocity – average velocity over very short period of time

$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$$

Limited by math to situations with constant acceleration

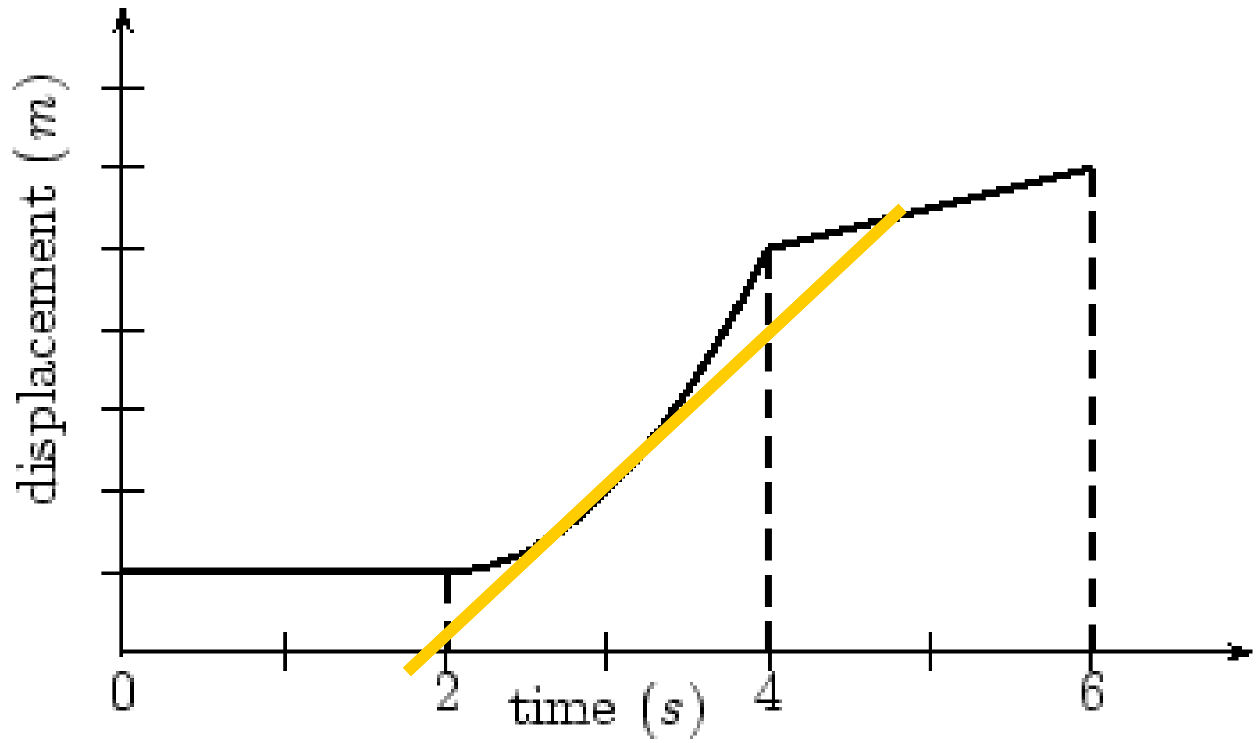
Slope of the tangent to the p




## 1.3 Instantaneous

**Calculate average velocity, instantaneous**




$$v = \frac{\Delta x}{\Delta t}$$

$$v = \frac{5.5m - 0m}{2.8s}$$

$$v = 1.96m/s$$

# 1.3 Instantaneous Velocity

**Calculate average velocity, instantaneous velocity, and acceleration.**

A man runs 3 m west in 2 seconds. What is his average velocity?

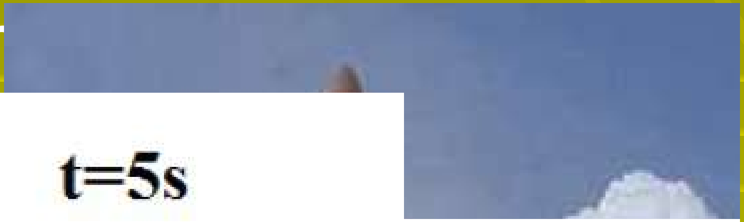
He then runs south 4 m in 3 seconds. What is his average speed from the time he started, and what is the magnitude of his average velocity?

S-2

Acceleration – (a) change in velocity per unit time

$$\bar{a} = \frac{\Delta v}{\Delta t}$$

Units are meters/second$^2$ (r



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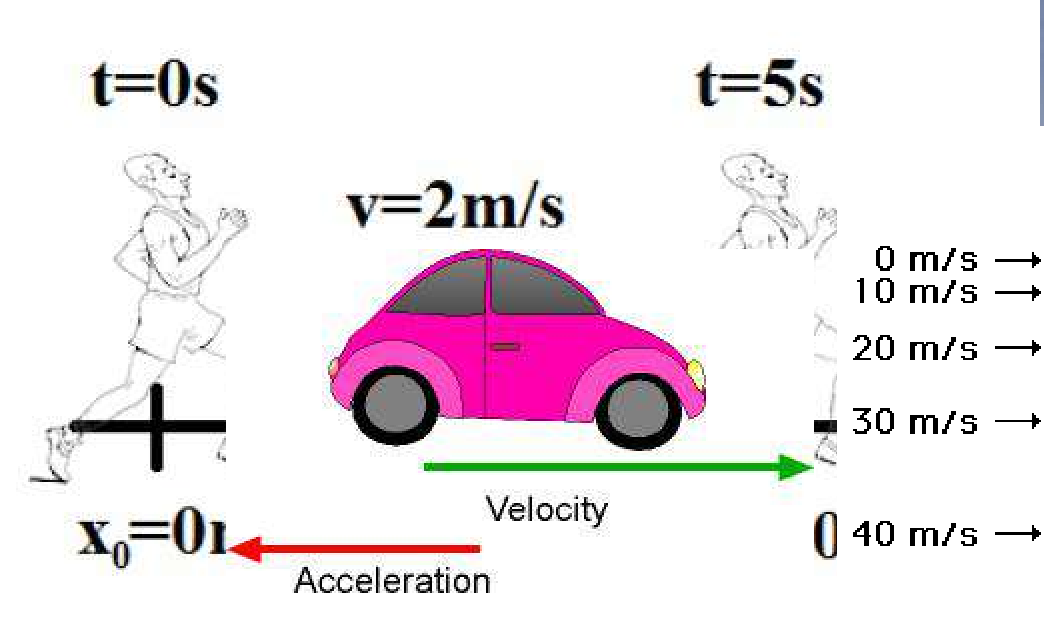
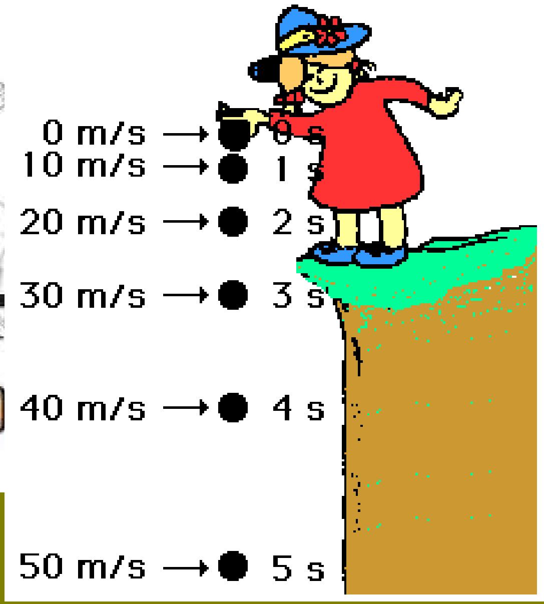


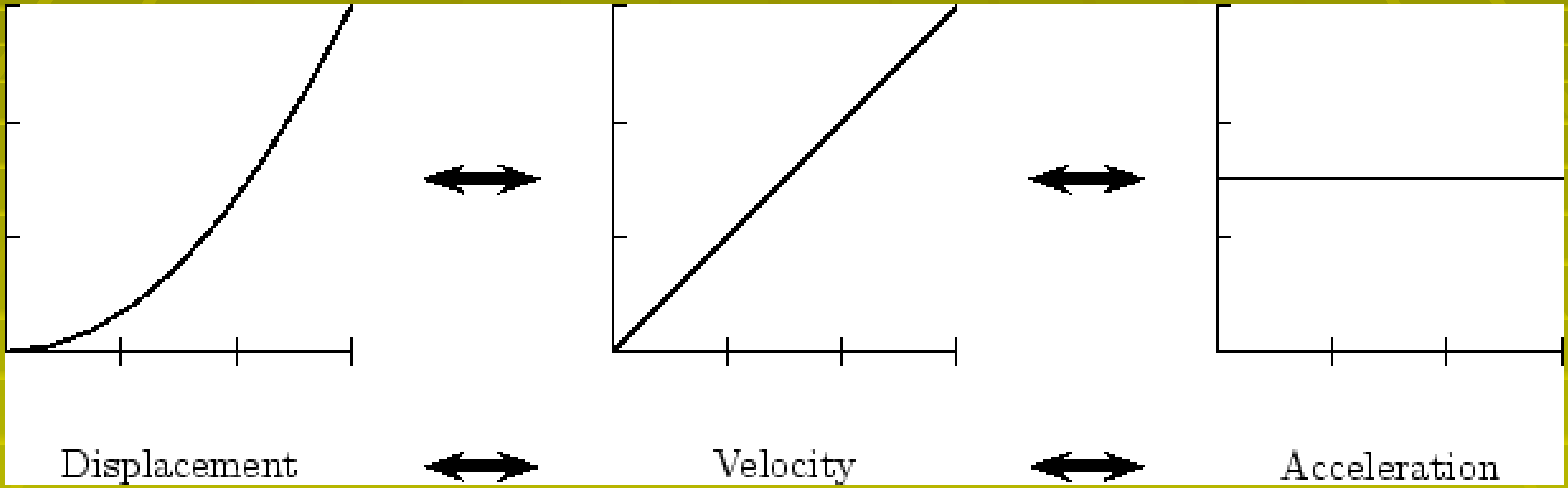




## 1.4 Acceleration

**Calculate average velocity, instantaneous velocity, and acceleration.**

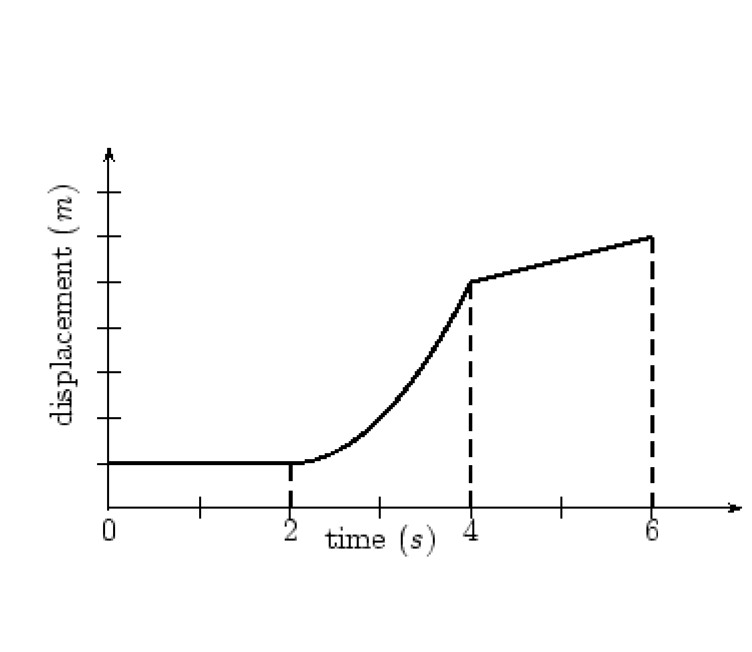
Slope of displacement graph is velocity

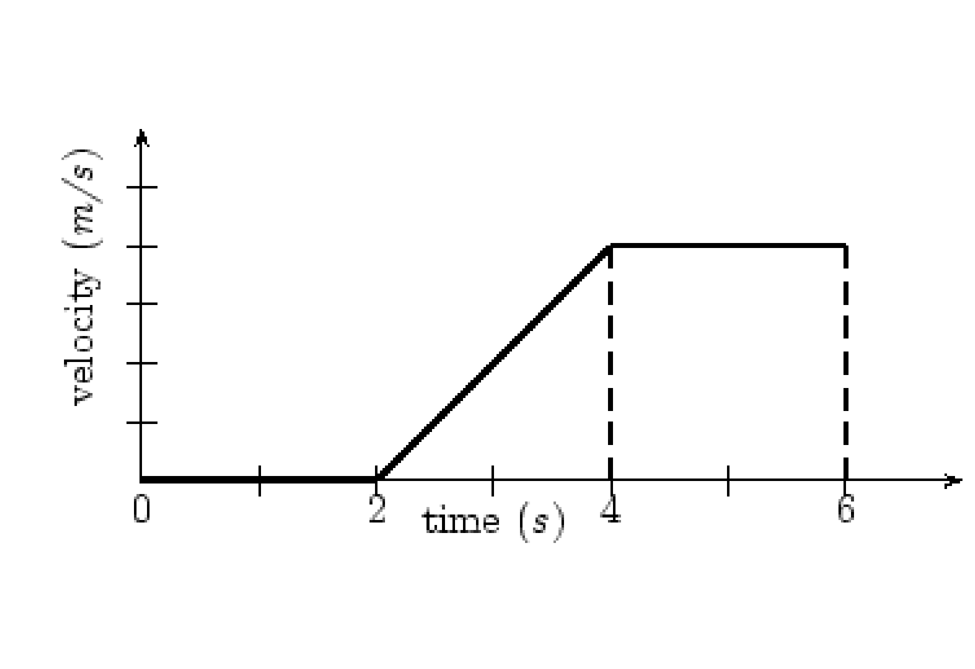
Slope of velocity graph is acceleration




## 1.4 Acceleration

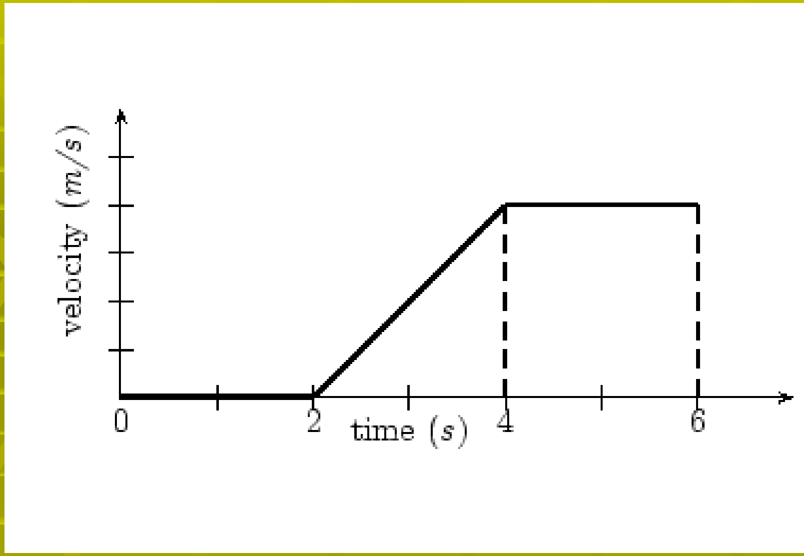
**Calculate average velocity, instantaneous velocity, and acceleration.**

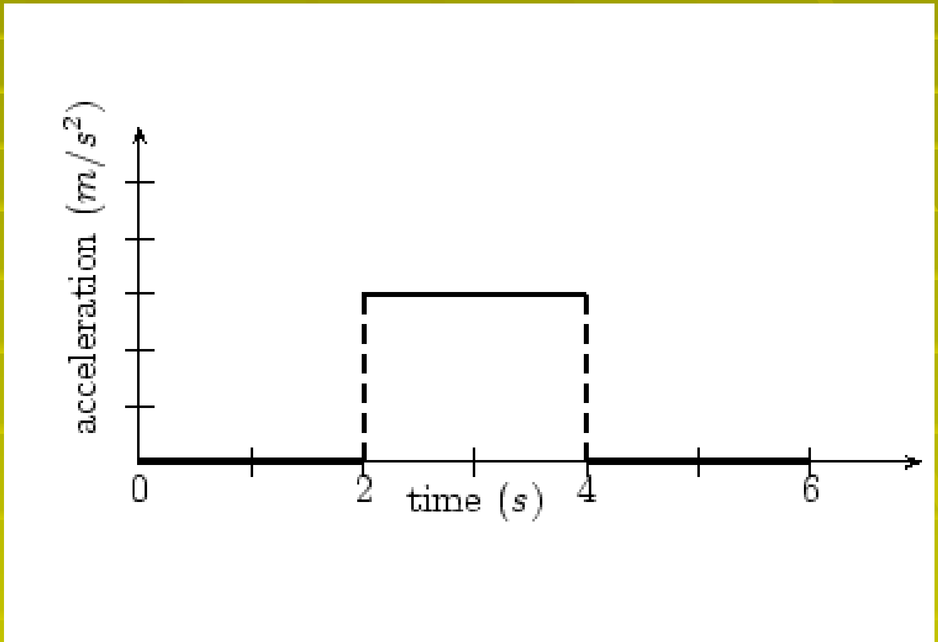



# 1.4 Acceleration

**Calculate average velocity, instantaneous velocity, and acceleration.**




# 1.4 Acceleration

**Calculate average velocity, instantaneous velocity, and acceleration.**

SP1

Students will analyze the relationship between force, mass, gravity, and the motion of objects.

b. Compare graphically and algebraically the relationships among position, velocity, acceleration, and time.

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Constant Acceleration – average acceleration = instantaneous acceleration

We will only study kinematics problems where acceleration is a constant

**Constant Acceleration**

The next slide lists the equations we will use

$$v = v_0 + at$$

$$x = x_0 + \tfrac{1}{2}(v + v_0)t$$

$$x = x_0 + v_0 t + \tfrac{1}{2}at^2$$

$$v^2 = v_0^2 + 2a\Delta x$$

## 1.5 Motion with Constant Acceleration

**Compare the relationship among position, velocity, acceleration, and time.**

Steps in problem solving

1. Draw a diagram
2. List known variables
3. Stop and think through the physics that is occurring
4. Think through steps and information required to solve the problem
5. Gather correct equations and solve

An airplane accelerates down a runway from rest. The runway is 3000 m long and the plane must have a speed of 65 m/s to take off. What is the minimum acceleration that will allow the plane to take off?

1. Draw a dia
2. List known
3. Stop and t … occurring
4. Think thro … red to solve the problem
5. Gather co


## 1.5 Motion with Constant Acceleration

**Compare the relationship among position, velocity, acceleration, and time.**

A really cute squid rushes toward a studley octopus. The squid runs east at 6 m/s and the octopus runs at 3.5 m/s westward. How far does the octopus get before they run into each other, if they start out 22 m apart?

S-3

- Free Fall – the motion of an object falling under the influence of gravity
- We will ignore air friction
- Time frame is only while the object is in free fall
- So after release and before it hits the bottom
- Acceleration is $9.80 m/s^2$ downward, or $-9.80 m/s^2$

**Free Fall Applet**

## 1.6 Freely Falling Objects

**Compare the relationship among position, velocity, acceleration, and time.**

## Common Things People Forget

- Acceleration values do not change
- Velocity does change
- Velocity can be zero, even if the acceleration is not
- Negative means downward

A skunk named Fred is thrown upward with an initial velocity of 25 m/s. He tries to catch an apple off a tree as he passes by. How many seconds does he have to get ready to grab, if the apple is 10 m above the ground?

S-4

Super pig goes charging down the road in his super pig mobile.

If he is traveling at 20m/s and is chasing an evil villain who has a 100 m head start and traveling at a constant 30 m per second, how fast must the pig-mobile accelerate to catch him in 35 seconds?

S-5

A vicious attack bunny jumps at you from behind your neighbor’s bushes.

You start from rest and r

acceleration of 5 $m/s^2$

In the distance (75m) you see a tree you can climb.

The bunny freezes for 1.5 s, then accelerates at 10 $m/s^2$. Do you make it to safety?

S-6

A giant chicken is racing a dinosaur. If the chicken has a 20 m head start and accelerates from rest at 3.0 $m/s^2$, and the dinosaur starts from rest 5s later accelerating at 7.0 $m/s^2$, how long has the chicken been running before it gets caught?

S-7

A really happy camel is running at 25 m/s through the desert when he sees a large berry bush. He slams on his brakes and accelerates at -3.5 $m/s^2$ for 12 seconds. If the berry bush was 100 m in front of him, how far is the bush and what is his velocity relative to the bush at the end of the time period?

S-1

he

nstant 3 m/s and the swan accelerates from 1 m/s at 2m/s$^2$.

How long will it take the swan to catch the dog. The dog starts out with a 5 m head start, but they both run for the same amount of time.

S-10