WEEK 3

Physics of Engineer
Chapter 3: Motion

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Topic 1.2 : 1-2 Motion Dimensions.

- One Motion Dimension

- Two Motion Dimension

Let's look at the pictures on next page !

Distance: How far did the point move ?

(Guide: Think of the cheetah's stride, the runner's lap, the apple's drop.)

Velocity: How fast did the point move ?

(Guide: The cheetah's blur, the runner's pace, the apple's plummet.)

Acceleration: How quickly did the point change its speed ?

(Guide: The cheetah's burst, the runner's final push, the apple's slowing fall.)

One Dimension Motion

Displacement: The total change in position.

One Dimension Motion

Velocity: The rate of change of position

One Dimension Motion

Acceleration: The rate of change of velocity

One Dimension Motion

Displacement (Δx): The change in position, measured in meters (m).

$$\Delta x = x_2 - x_1$$

(where Δx is displacement, x_2 is final position, and x_1 is initial position)

One Dimension Motion : Example

A runner crosses the finish line 100 meters from the starting point.

Solution: Their displacement is Δx = 100m.

One Dimension Motion : Example

The runner finishes the 100m race in 10 seconds.

Solution: Their average velocity is v = 100m / 10s

= 10m/s.

One Dimension Motion : Example

The runner starts from rest and reaches their 10m/s velocity in 2 seconds.

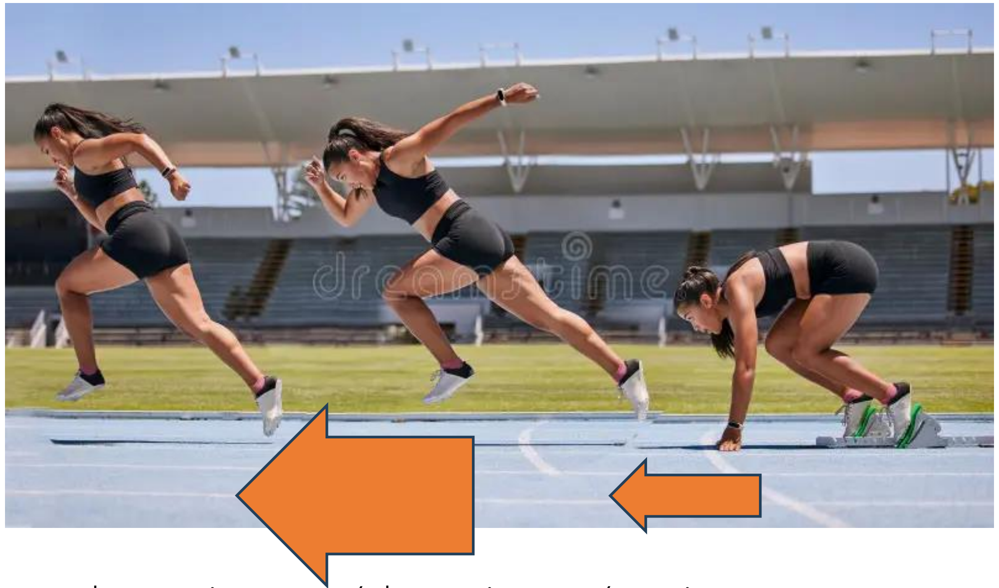


Photo: https://www.dreamstime.com/photos-images/running-woman-runner-speed-motion-composite.html

Solution: Their acceleration is a = (10m/s - 0m/s) / 2s

$= 5 m/s^2$.

One Dimension Motion

Velocity (v): The rate of change of displacement, measured in meters per second (m/s).

$$v = \Delta x / \Delta t$$

(velocity equals displacement divided by time)

(where v is velocity, Δx is displacement, and Δt is time)

One Dimension Motion

Acceleration (a): The rate of change of velocity, measured in meters per second squared (m/s^2).

$$a = \Delta v / \Delta t$$

(acceleration equals change in velocity divided by time)

(where a is acceleration, Δv is change in velocity, and Δt is time)

One Dimension Motion

Equations for specific cases:

$$v = v_0 + at$$

(final velocity equals initial velocity plus acceleration times time).

One Dimension Motion

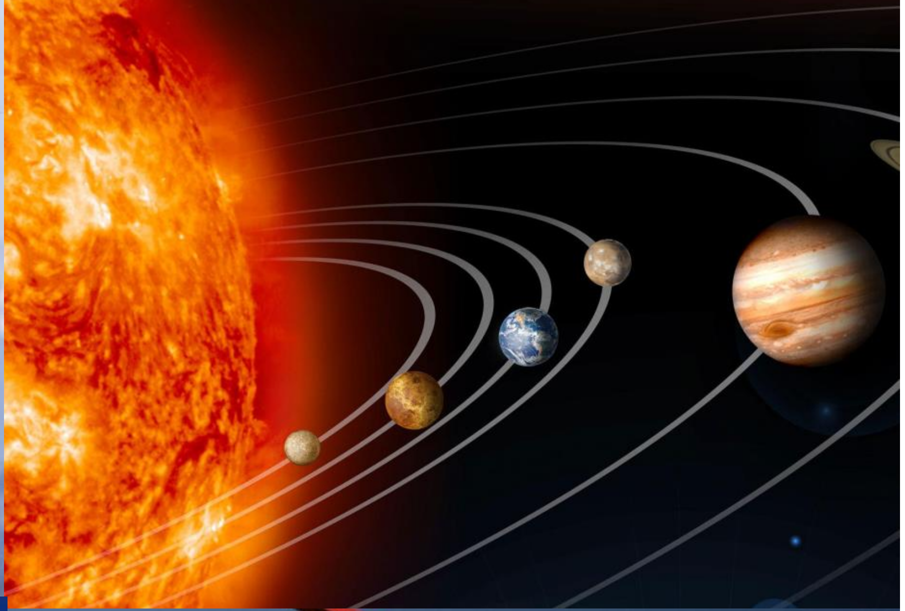
Equations for specific cases:

$$\Delta x = v_0 t + 1/2 a t^2$$

(displacement equals initial velocity times time plus half of acceleration times time squared).

Applications: Projectile motion (throwing a ball), braking distance of vehicles.

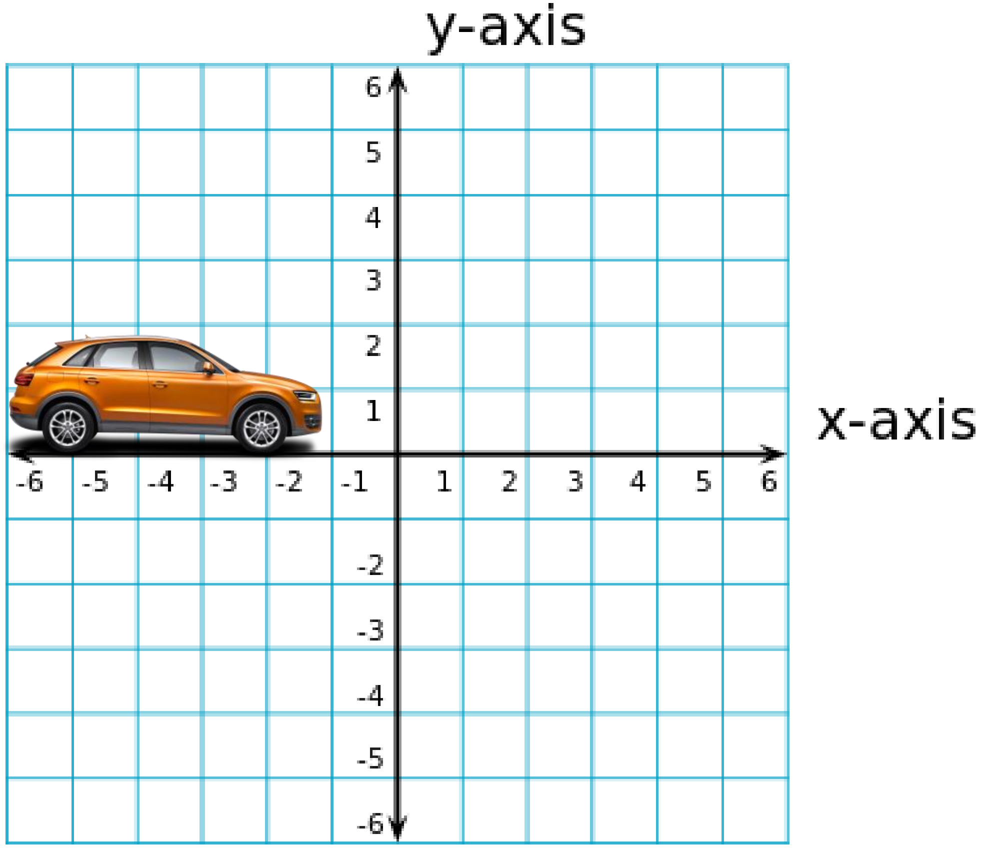
Let’s look at the pictures on next page !

Two Dimension Motion

Position of an object defined by two independent coordinates:

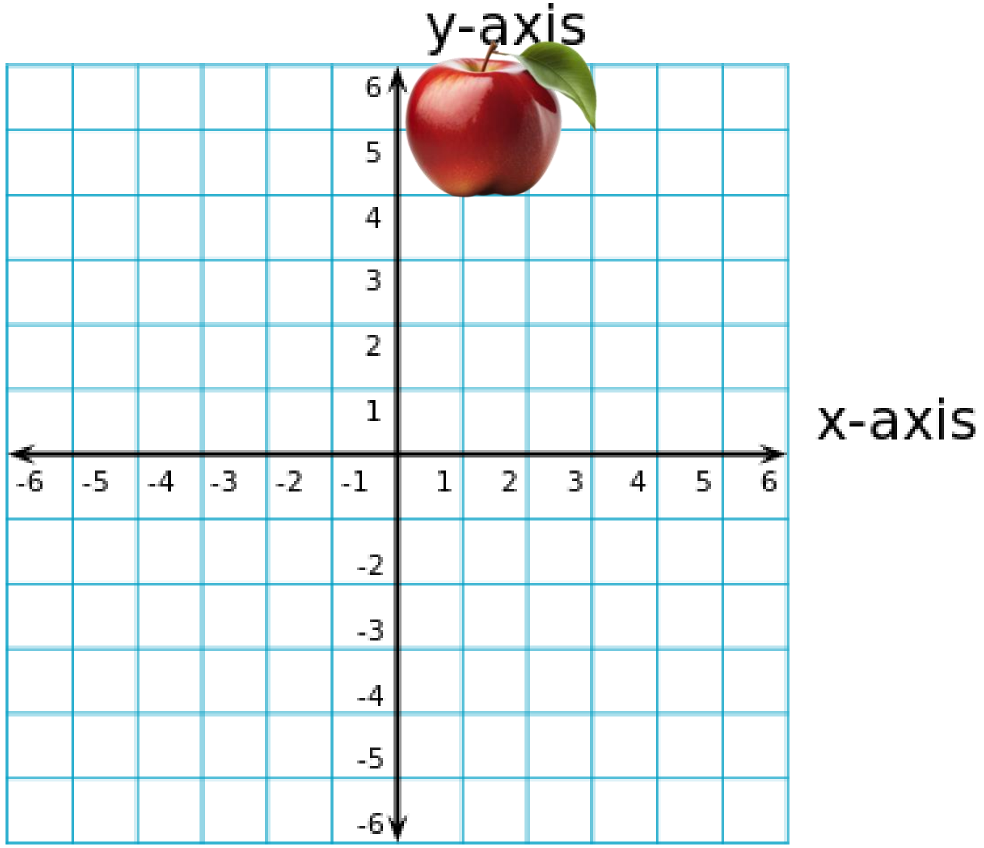
- X: Horizontal distance
- Y: Vertical distance



Two Dimension Motion

Position of an object defined by two independent coordinates:

- X: Horizontal distance
- Y: Vertical distance

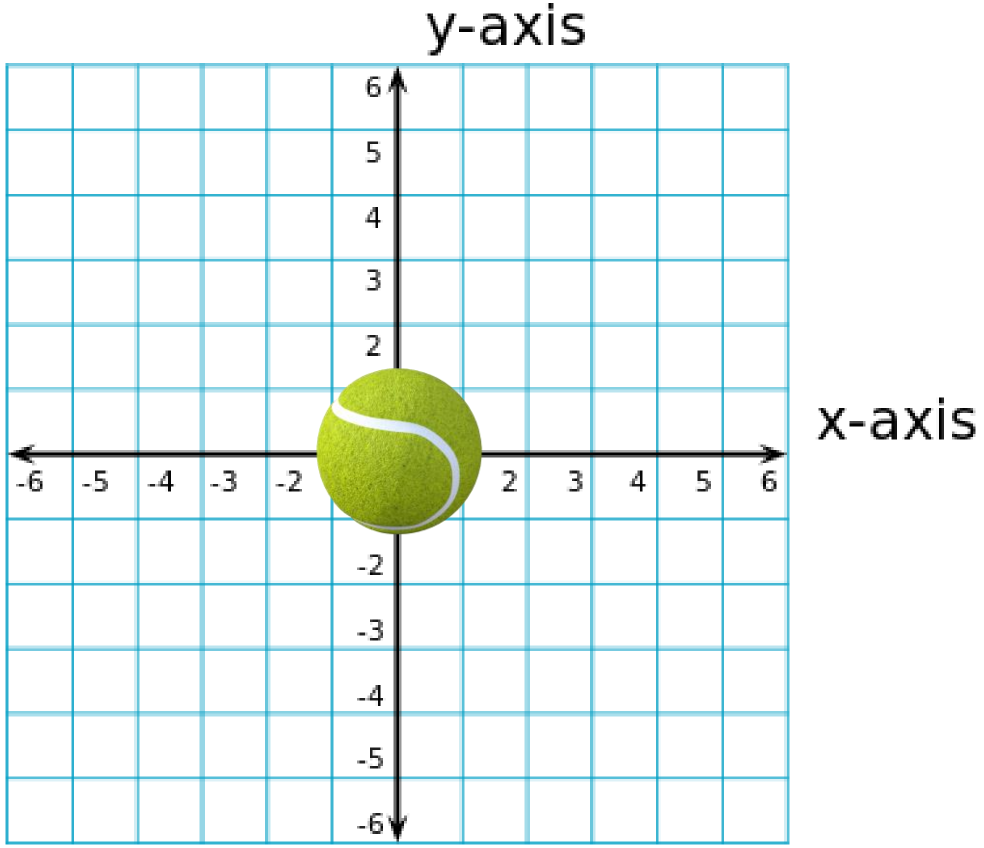


Two Dimension Motion

The familiar characters return:

Displacement (Δx, Δy):

- Change in position in the X and Y directions.
- Measured in meters (m).
- Equation: $\Delta x = x_2 - x_1$, $\Delta y = y_2 - y_1$

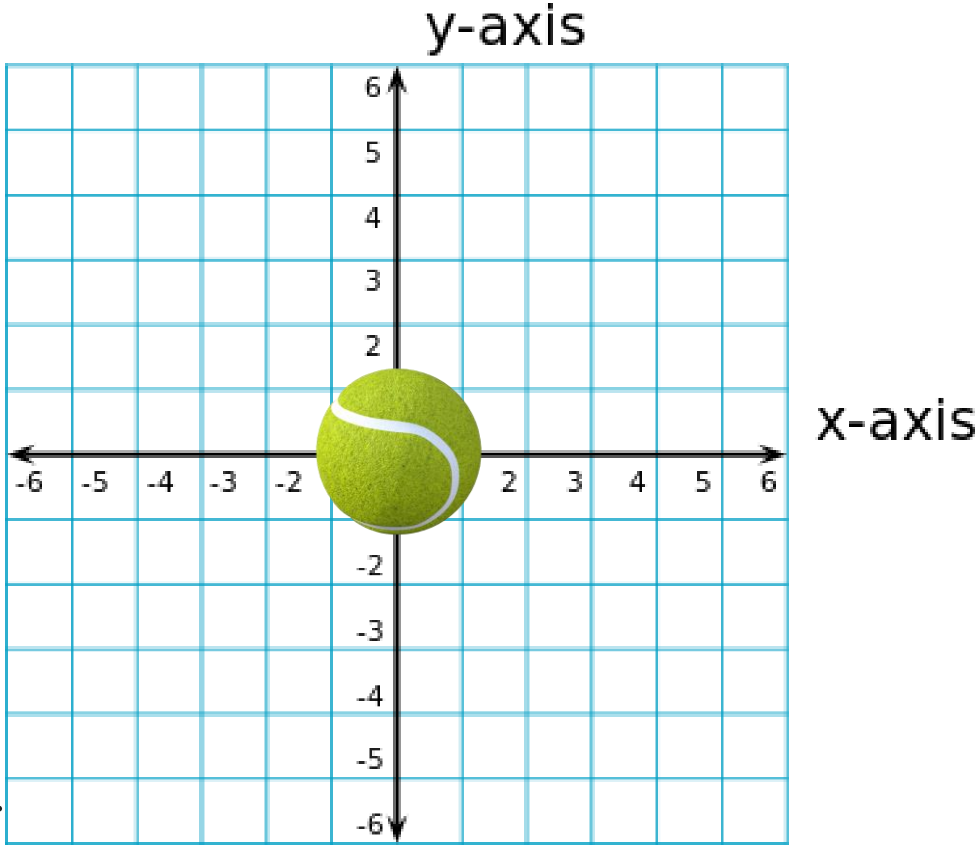


Two Dimension Motion

The familiar characters return:

Velocity (v_x, v_y):

- Rate of change of displacement in X and Y directions.
- Measured in meters per second (m/s).
- Equation: $v_x = \Delta x/\Delta t$, $v_y = \Delta y/\Delta t$

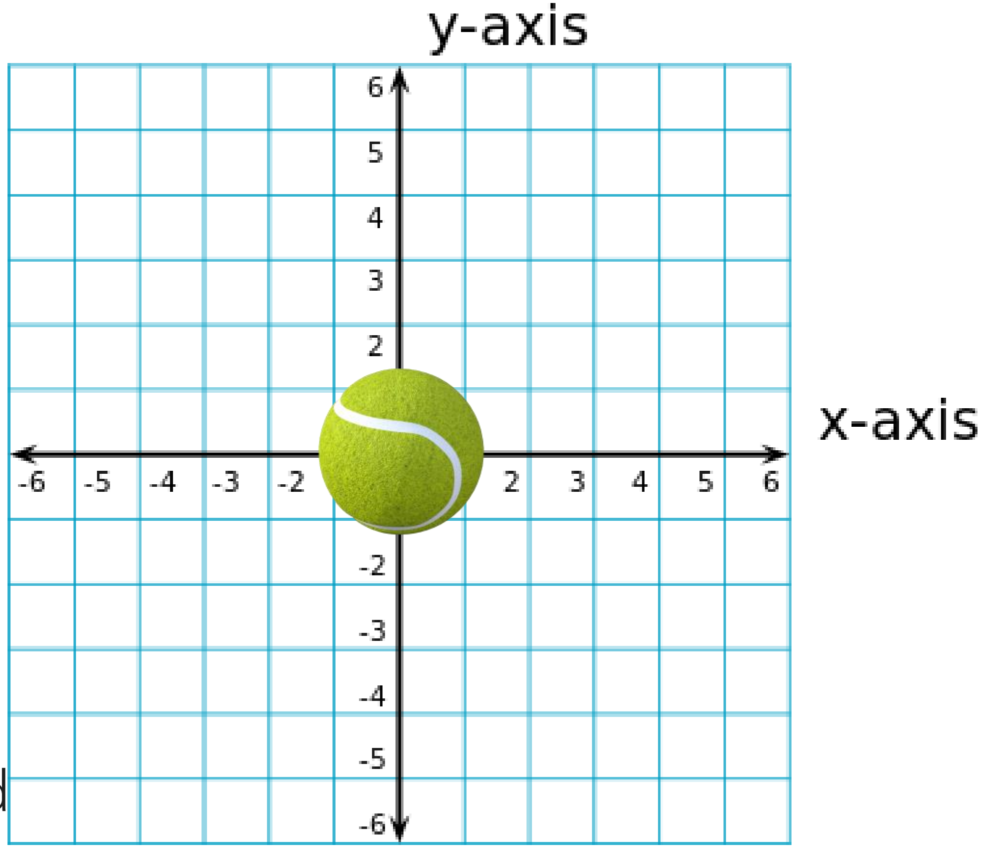


Two Dimension Motion

The familiar characters return:

Acceleration (a_x, a_y):

- Rate of change of velocity in X and Y directions.
- Measured in meters per second squared (m/s^2).
- Equation: $a_x = \Delta v_x/\Delta t$, $a_y = \Delta v_y/\Delta t$



Two Dimension Motion

Real Life Example: Projectile Motion.

Equations:

Time of flight (T): $T = 2v_0 \sin\theta / g$

Maximum height (H): $H = v_0^2 \sin^2\theta / 2g$

Range (R): $R = v_0^2 \sin 2\theta / g$

Two Dimension Motion

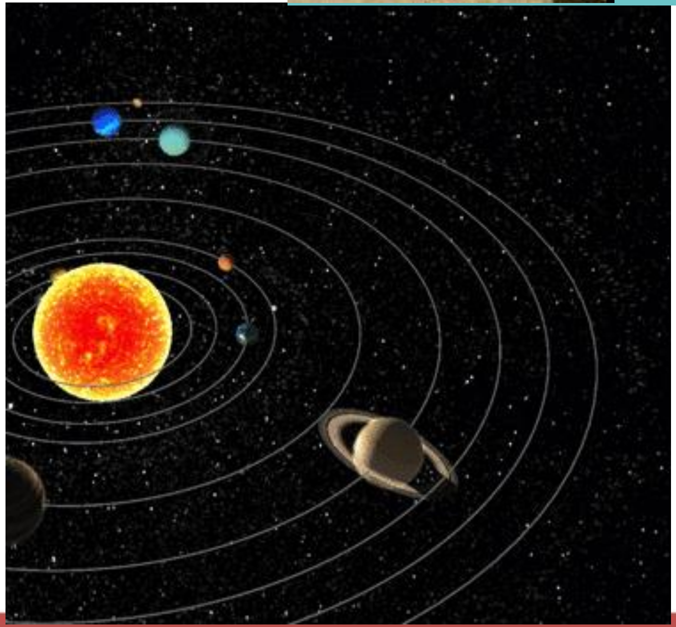
Real Life Example: Circular Motion.

Centripetal Acceleration (a_c):

- Acceleration towards the center of the circle.
- Equation: $ac = v^2/r$

Centripetal Force (F_c):

- Force causing circular motion.
- Equation: $F_c = ma_c = mv^2/r$



Two Dimension Motion

Real Life Example: Relative Motion.

Relative Velocity (v_{rel}):

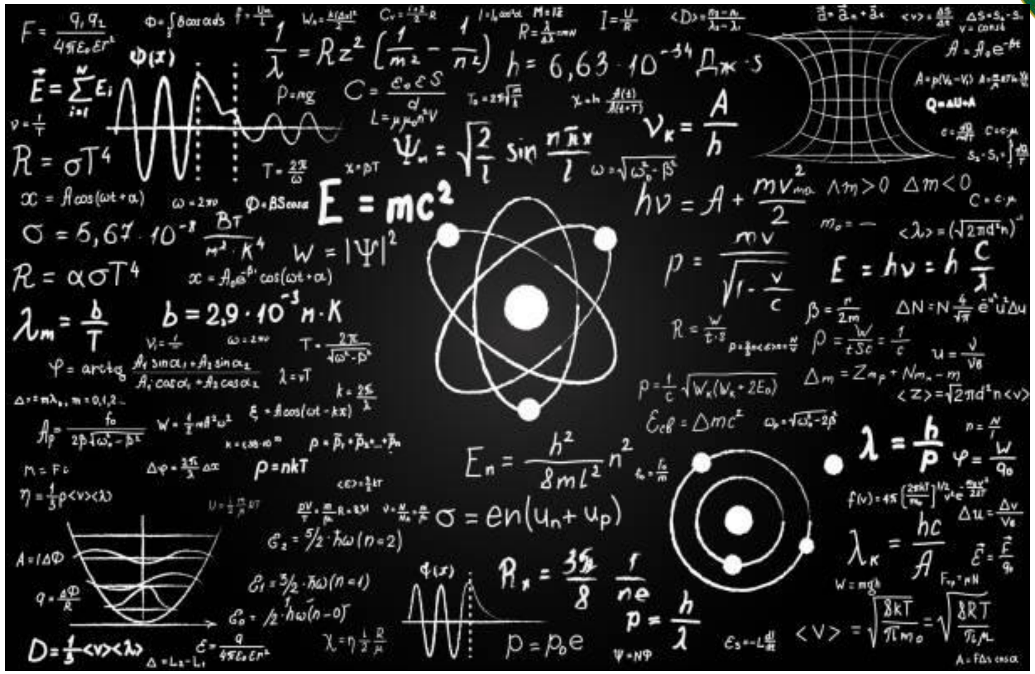
- Velocity of one object relative to another.
- Equation: $v_{rel} = v_1 - v_2$ (for objects moving in opposite directions)

Two Dimension Motion

Distance (d)

Distance: Combining X and Y displacements using Pythagorean theorem

Equation: $d = \sqrt{(\Delta x^2 + \Delta y^2)}$



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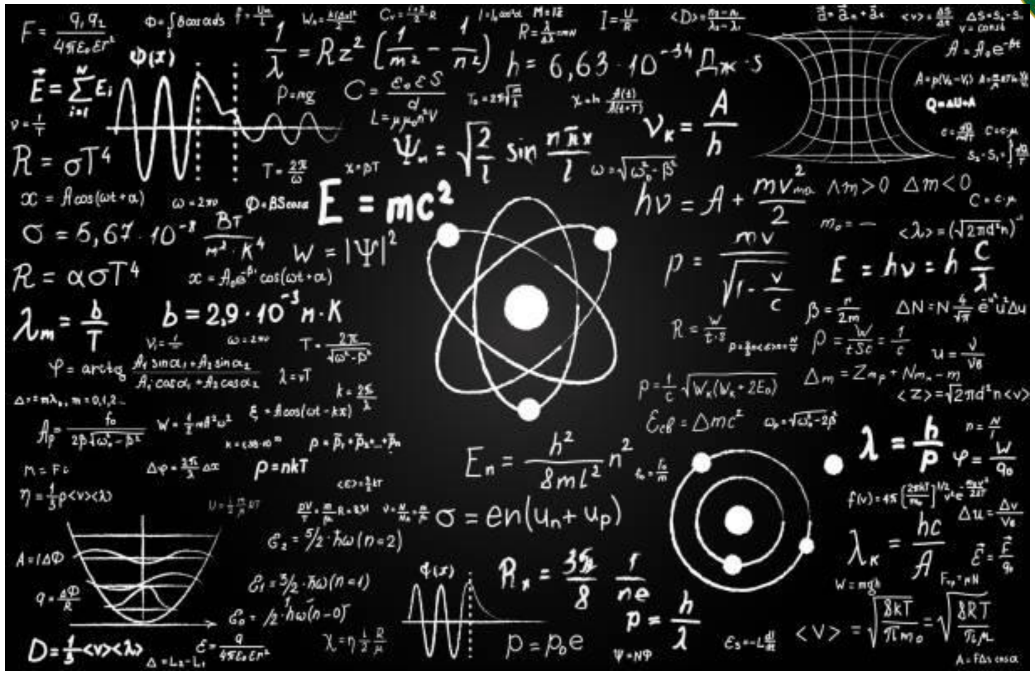
Two Dimension Motion

Velocity (v)

Velocity: Adding individual X and Y velocities as vectors

Equation: $v = \sqrt{(vx^2 + vy^2)}$



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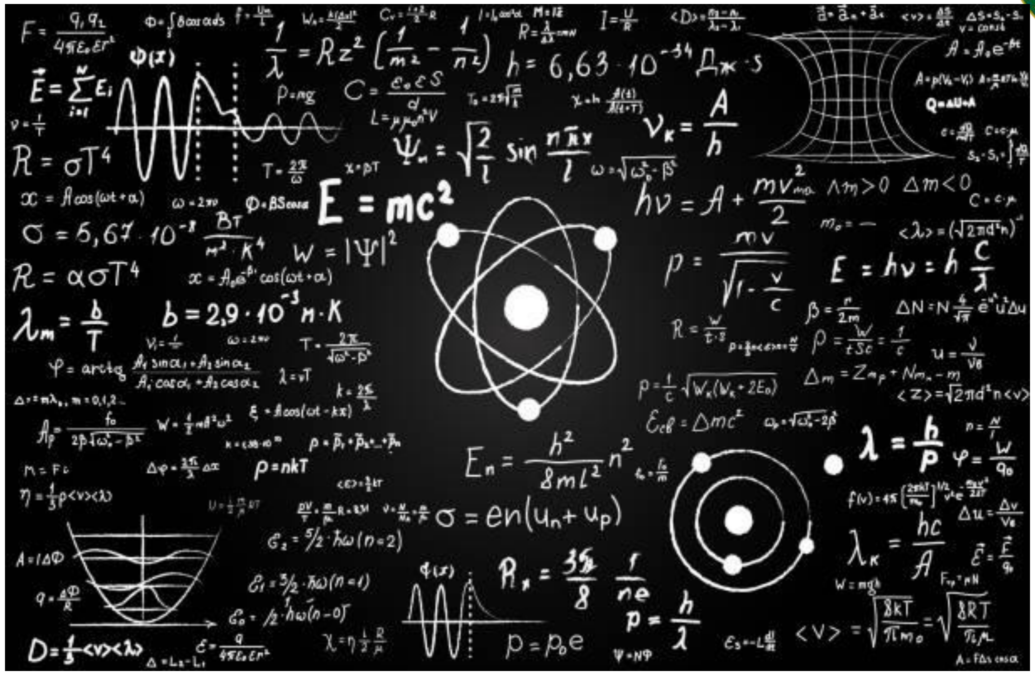
Two Dimension Motion

Acceleration (a)

Acceleration: Calculating the rate of change of both velocities



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The Journey Continues: Delving Deeper

Further exploration awaits:

- Projectile motion equations
- Circular motion formulas
- Relative motion principles

- Our journey through one-two dimensional motion has unveiled a captivating world!
- From soaring birds to orbiting planets, every movement tells a story governed by fascinating principles.
- Remember, physics isn't just about equations; it's about appreciating the elegance and beauty of how our universe moves.
- Keep exploring, keep questioning, and keep unveiling the secrets of motion!





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Chapter 1: Motion

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