Cheatography

# One and two dimensional motion

by anjuscha via cheatography.com/125991/cs/24592/

## Speed and Velocity

| | |
|---|---|
| speed | the distance traveled per unit of time. Speed is a scalar, a quantity that is described by magnitude alone. Constant speed refers to a fixed distance per unit of time. Average speed includes the total distance and total time. |
| velocity | the displacement of an object per unit of time. Since displacement includes a direction, so does velocity. Speed with direction. Velocity is a vector a quantity that has both magnitude and direction. |
| vector | a quantity that has both magnitude and direction |
| reference frame | the position from which an event is observed |
| motion map | an image that represents the position, velocity, and acceleration of an object at one-second intervals |
| scalar | a quantity that is described by magnitude alone |

## Speed and Velocity (cont)

| | |
|---|---|
| Motion and reference frame | All motion is relative. It depends on a reference frame. An object may appear to move faster or slower depending on the reference frame. |
| average velocity | The slope of a line changes when the velocity of an object changes -> The steeper the slope, the greater the velocity. The average velocity will be different than any of the other. Any point on the line will give only an instantaneous velocity. |
| change in direction | A change in direction is represented when the line on a position-time graph changes from a positive slope to a negative. slope or from a negative slope to a positive slope. A negative slope indicates an object moving towards the origin. A positive slope indicates an object moving away from the origin. |

## Speed and Velocity (cont)

| | |
|---|---|
| No motion | horizontal line - means object is not moving -> The object’s position does not change |
| Motion | Displayed in a vector ! |

## Formula

| | |
|---|---|
| speed | s = d/t -> 50 + 30 = 80 miles, 1+1 = 2h -> 80 miles/2h = 40 mph |
| velocity | v = Δx/t |
| average velocity | v avg = Δx/Δt = xf − xi/tf − ti -> 100 m in 10.61 s -> xf = 100 m, xi = 0 m, tf = 10.61 s, ti = 0 s -> v avg = 100 m - 0 m / 10.61 s - 0 s = 100/10.61 = 9.43 m/s |

## Acceleration

| | |
|---|---|
| positive acceleration | an increase in velocity over time |
| negative acceleration | a decrease in velocity over time |
| acceleration | the rate at which velocity changes over time |
| constant | staying the same; unchanging |
| Positive acceleration | speeds up in the positive direction. slows down in the negative direction |

## Acceleration (cont)

| | |
|---|---|
| Negative acceleration | slow down down in the positive direction. speeds up in the negative direction. |
| Slope | of the line on a velocity vs. time graph represents acceleration. Positive slope = acceleration, negative slope = negative acceleration |

## acceleration

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$

## Acceleration example

**Example:** A race car moving west speeds up from 17 m/s to 47 m/s in 2 seconds. What is the car's acceleration?

$v_i = 17\,m/s$

$v_f = 47\,m/s$

$t = 2\,s$

$$a = \frac{47\,m/s - 17\,m/s}{2\,s} = \frac{30\,m/s}{2\,s}$$

$a = 15\,m/s^2$

## Displacement during constant acceleration

| | |
|---|---|
| Displacement during constant velocity | $\Delta x = vt$ |
| Displacement during acceleration | $\Delta x = \frac{1}{2}(v_f - v_i)t$ |
| Total displacement is the sum of the two | $\Delta x = v_i t + \frac{1}{2}(v_f - v_i)t$ |
| Terms are combined | $\Delta x = \frac{1}{2}(v_f + v_i)t$ |
| When the initial position is not zero | $x_f = x_i + \frac{1}{2}(v_f + v_i)t$ |

## Formula

| | |
|---|---|
| Two vectors added at a right angle (90°) | $R^2 = A^2 + B^2$ |
| Magnitude and sign of component vectors | $A_x = A\cos\theta$<br>$A_y = A\sin\theta$ |
| Magnitude of the resultant vector | $R^2 = R_x^2 + R_y^2$ |
| Angle or direction of the resultant vector | $\tan\theta = \frac{R_y}{R_x}$ |

## Horizontal motion example

EXAMPLE

Riley and Miguel are playing catch. Riley throws the ball at an angle of 25° relative to the ground at a speed of 23.0 m/s. The ball travels 42.0 m to Miguel, who catches the ball. How long was the ball in the air?

**Given:**

$\theta = 25°$

$v_i = 23.0\,m/s$

$\Delta x = 42.0\,m$

**Unknown:**

$\Delta t = ?$

The equation that we need to use is:

$$\Delta x = (v_i\cos\theta)\,\Delta t$$

$$\Delta t = \frac{\Delta x}{(v_i\cos\theta)} = \frac{42.0\,m}{(23\,m/s)(\cos 25°)} = 2.0\,s$$

## Key concepts

**Review: Key concepts**

| | Horizontally Launched Projectile | Projectile Launched at an Angle |
|---|---|---|
| Horizontal Motion | $v_x =$ constant<br>$\Delta x = v_x\Delta t$ | $v_x = v_{ix} = v_i\cos\theta =$ constant<br>$\Delta x = (v_i\cos\theta)\Delta t$ |
| Vertical Motion | $v_y = a_y\Delta t$<br>$v_y^2 = 2a_y\Delta y$<br>$\Delta y = \frac{1}{2}a_y(\Delta t)^2$ | $v_{fy} = v_i\sin\theta + a_y\Delta t$<br>$v_{fy}^2 = v_i^2(\sin\theta)^2 + 2a_y\Delta y$<br>$\Delta y = (v_i\sin\theta)\Delta t + \frac{1}{2}a_y(\Delta t)^2$ |

## vectors

| | |
|---|---|
| quadrant | a quarter of the coordinate plane |
| components | the two parts of a vector that are perpendicular to each other |
| resultant vector | the sum of two or more vectors |
| vector resolution | the process by which the components of a vector are determined |
| Properties of a vector | A vector is a quantity that has both magnitude and direction. Examples of vectors: Displacement, velocity, acceleration. Vectors are drawn using an arrow |

## More

**Magnitude of the Resultant Vector**

$R^2 = A^2 + B^2$

$A = 300\,m \quad B = 300\,m$

$R^2 = 300^2 + 300^2$

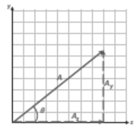
$R^2 = 180{,}000$

$R = 424.26\,m$

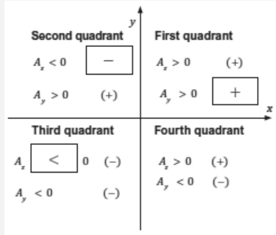

**Components of Vectors**

A vector that is diagonal is made up of a horizontal part and a vertical part.

- The **components** of a vector are the two parts of a vector that are perpendicular to each other.
  - $A_x = A\cos\theta \qquad \cos\theta = \frac{A_x}{A}$
  - $A_y = A\sin\theta \qquad \sin\theta = \frac{A_y}{A}$
- Vector resolution is the process by which the components of a vector are determined.




## Sign of a component




The sign of a component depends on the quadrant of the coordinate system it is in.

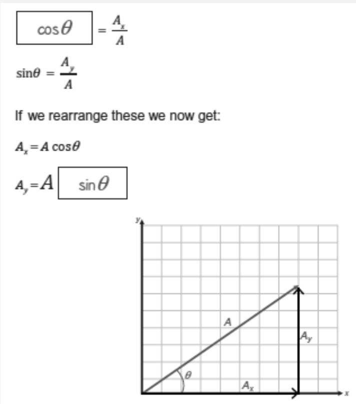
## Projectile Motion

| | |
|---|---|
| projectile | an object that is set in motion following a path in which the only force acting on it is gravity. |
| inertia | the natural tendency of objects to resist a change in motion |

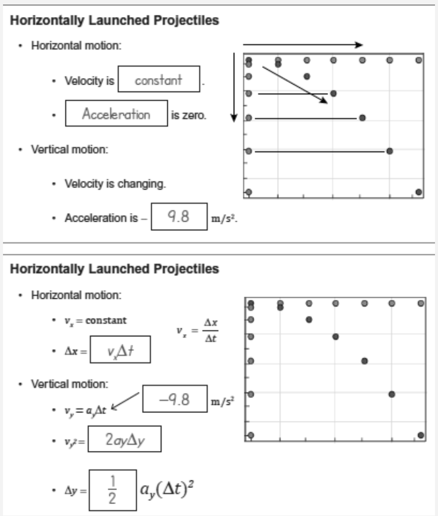
## Projectile Motion (cont)

| | |
|---|---|
| projectile motion | the curved motion that results from the combination of an object’s horizontal inertia and the force due to gravity pulling the object downward. I.e. A ball rolling of the table, A player shooting a jump shot -> Projectiles follow a parabolic path |
| parabolic | having the shape of a parabola |
| vectors | Vectors are used to describe motion in two dimensions. Vectors can be broken down into x and y components. The components of a vector are the two parts of a vector that are perpendicular to each other |

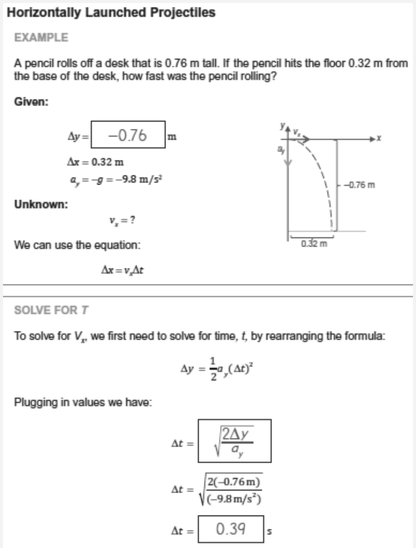
## Add




## Horizontal




## Horizontal example




## continued