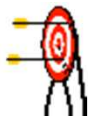
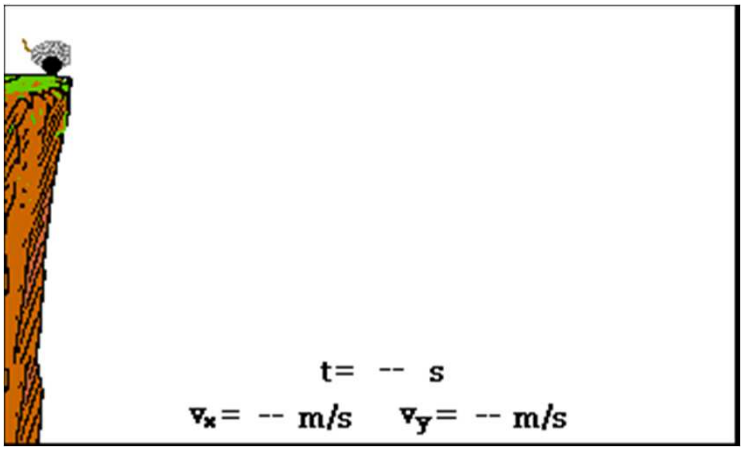
Projectile Motion



IB Physics SL Y1



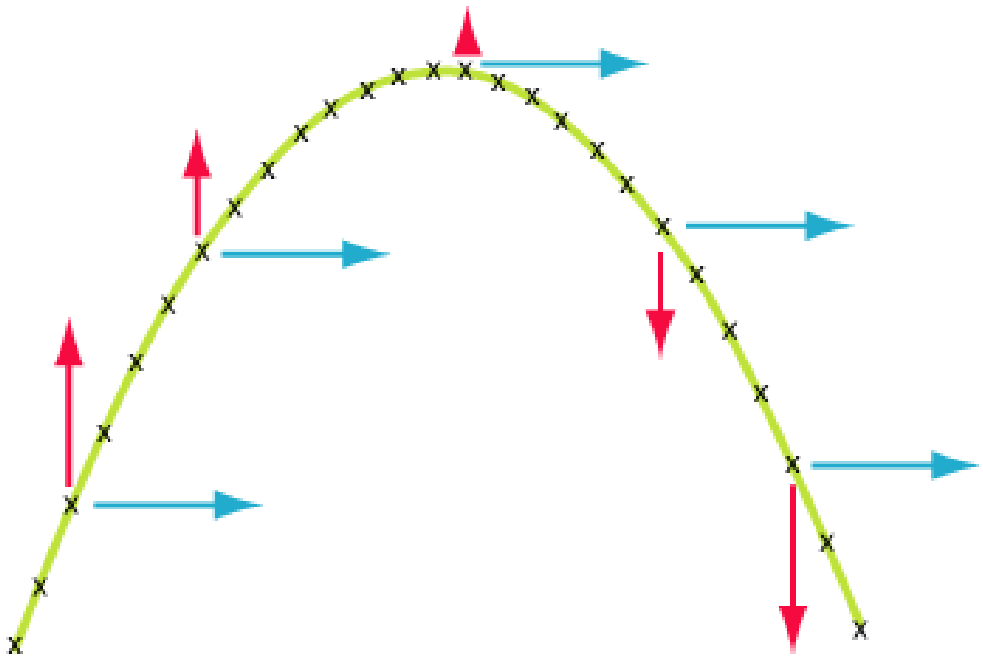
What is projectile?

Projectile -Any object which projected by some means and continues to move due to its own inertia (mass).

Projectiles move in TWO dimensions

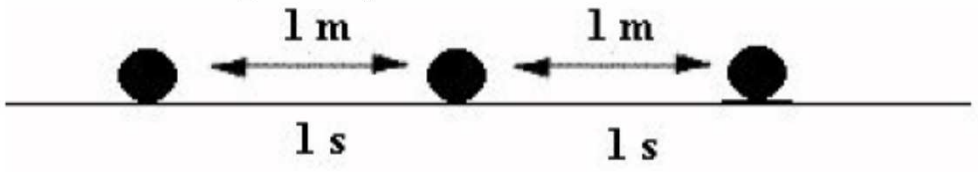
Since a projectile moves in 2-dimensions, it therefore has 2 components just like a resultant vector.

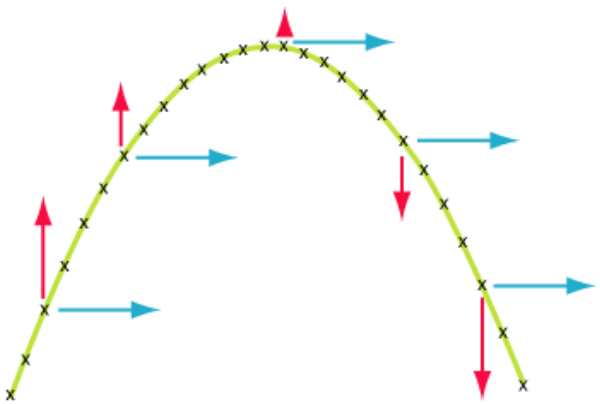
- **Horizontal and Vertical**



Horizontal "Velocity" Component

- **NEVER** changes, covers equal displacements in equal time periods. This means the initial horizontal velocity equals the final horizontal velocity



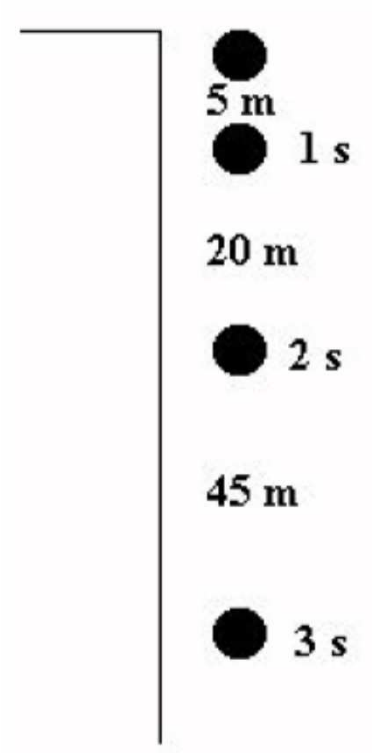


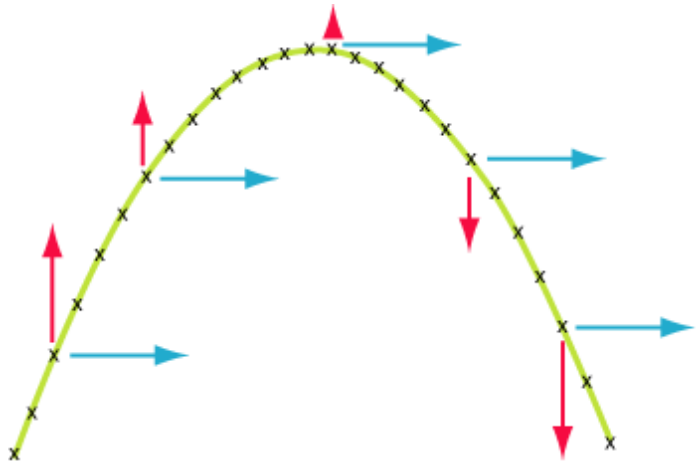
In other words, the horizontal velocity is CONSTANT. BUT WHY?

Gravity DOES NOT work horizontally to increase or decrease the velocity.

Vertical "Velocity" Component

- Changes (due to gravity), does **NOT** cover equal displacements in equal time periods.

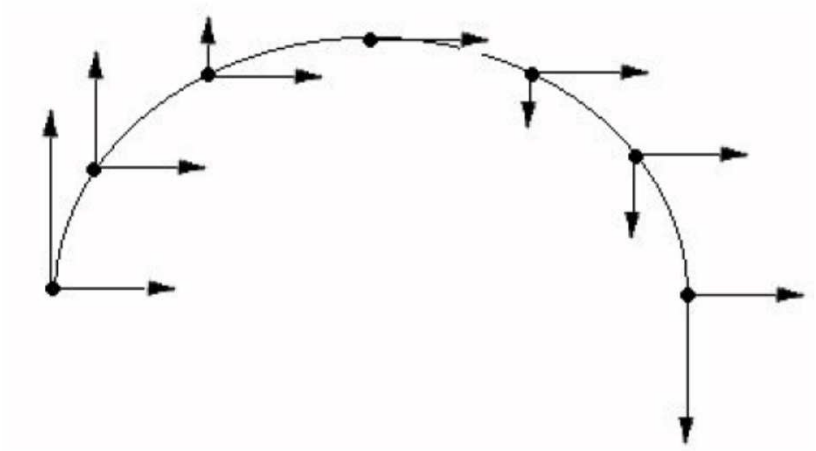




Both the MAGNITUDE and DIRECTION change. As the projectile moves up the MAGNITUDE DECREASES and its direction is UPWARD. As it moves down the MAGNITUDE INCREASES and the direction is DOWNWARD.

Combining the Components

Together, these components produce what is called a **trajectory** or path. This path is **parabolic** in nature.

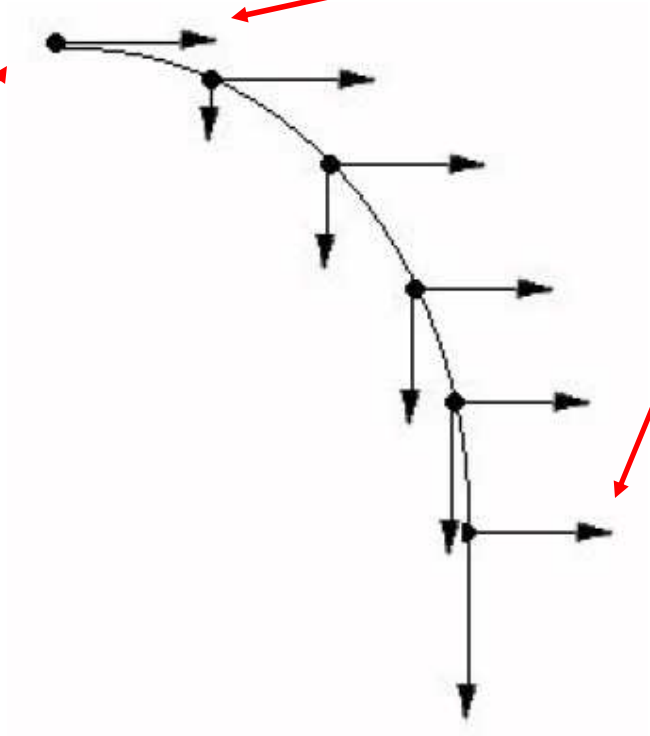


Component	Magnitude	Direction
Horizontal	Constant	Constant
Vertical	Changes	Changes

Horizontally Launched Projectiles

Projectiles which have NO upward trajectory and NO initial VERTICAL velocity.

$u_x = v_x = cons\tan t$



$u_y = 0ms^{-1}$

Horizontally Launched Projectiles

To analyze a projectile in 2 dimensions we need 2 equations. One for the “x” direction and one for the “y” direction. And for this we use kinematic #2.

$$s = ut + \frac{1}{2}at^2$$

$s_x = u_x t$	$s_y = u_y t + \frac{1}{2} a_y t^2$

Remember, the velocity is CONSTANT horizontally, so that means the acceleration is ZERO!

Remember that since the projectile is launched horizontally, the INITIAL VERTICAL VELOCITY is equal to ZERO.

Horizontally Launched Projectiles

Example:

A plane traveling with a horizontal velocity of 100 m/s is 500 m above the ground. At some point the pilot decides to drop some supplies to designated target below.

(a) How long is the drop in the air?

(b) How far away from point where it was launched will it land?

What do I know?	What I want to know?
$u_x = 100\ ms^{-1}$	$t = ?\ s$
$s_y = -\ 500\ m$	$s_x = ?\ m$
$v_y = 0\ ms^{-1}$	
$a_y = -9.8\ ms^{-2}$	