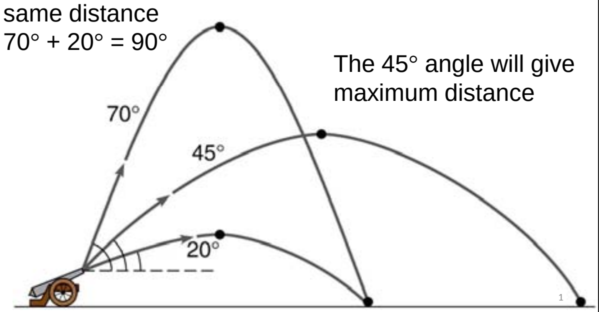
Launch Angle and Distance

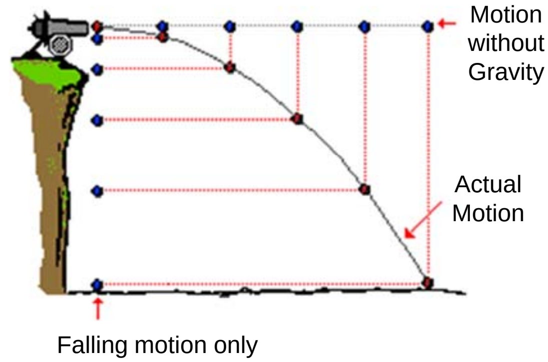
Angles that add up to 90° will reach the same distance

70° + 20° = 90°

The 45° angle will give maximum distance



Breaking Up Projectile Motion

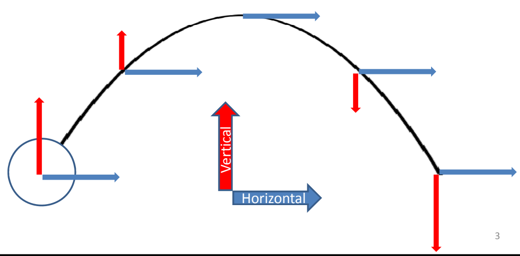


Projectile Components

Motion can be broken up into vertical and horizontal parts.

Vertical Component (y): This is motion going up or down

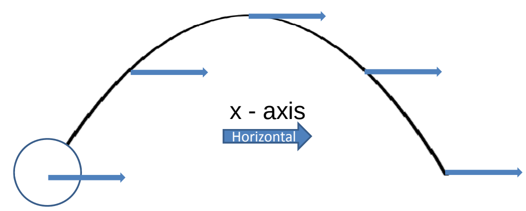
Horizontal Component (x): This is motion moving side to side



Horizontal Component

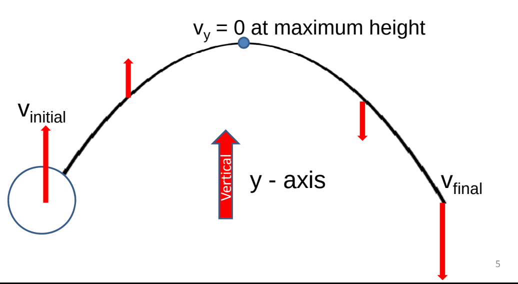
Air resistance is usually ignored. This means the motion from left to right will be a constant speed.

Example: The shadow of a punted football will be moving at a constant speed along the field

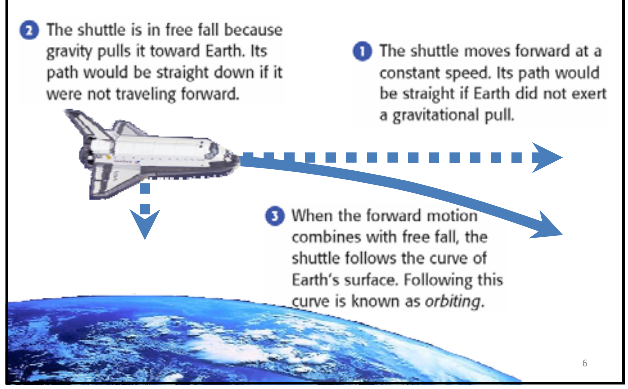


Vertical Component

The vertical component is affected by gravity at 9.8 m/s^2. At the highest point, the speed up or down is 0, and the object will hit the ground at the same speed it was launched.



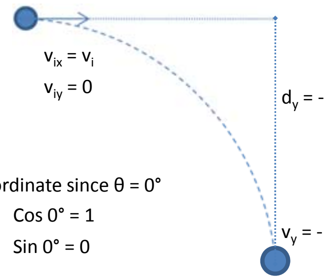
How Orbiting Works



2D Projectile Motion

Horizontal Projectile Analysis

$a_y = -9.8\ m/s^2$
If $a_x = 0\ m/s^2$
Then $v_{ix} = v_{fx}$



v_i is the x-coordinate since θ = 0°
$v_{ix} = v_i \text{ Cos } \theta$ Cos 0° = 1
$v_{iy} = v_i \text{ Sin } \theta$ Sin 0° = 0

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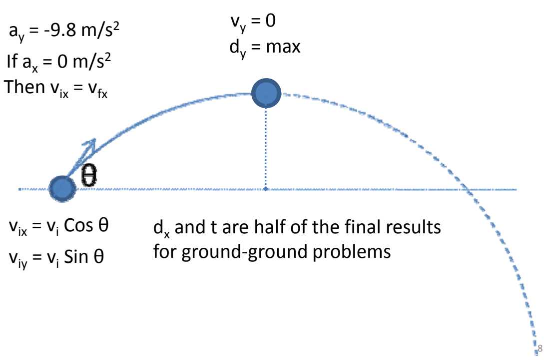
Maximum Height Analysis

$a_y = -9.8\ m/s^2$
If $a_x = 0\ m/s^2$
Then $v_{ix} = v_{fx}$



$v_{ix} = v_i \text{ Cos } \theta$
$v_{iy} = v_i \text{ Sin } \theta$

d_x and t are half of the final results for ground-ground problems

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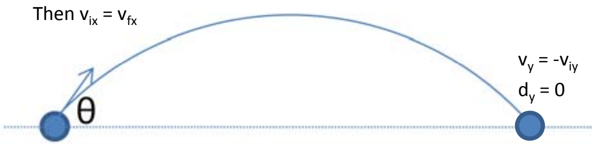
Ground - Ground Analysis

$a_y = -9.8\ m/s^2$
If $a_x = 0\ m/s^2$
Then $v_{ix} = v_{fx}$



$v_{ix} = v_i \text{ Cos } \theta$
$v_{iy} = v_i \text{ Sin } \theta$

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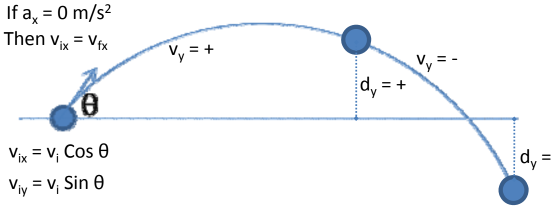
Specific Point Analysis

$a_y = -9.8\ m/s^2$
If $a_x = 0\ m/s^2$
Then $v_{ix} = v_{fx}$



$v_{ix} = v_i \text{ Cos } \theta$
$v_{iy} = v_i \text{ Sin } \theta$

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2D Projectile Motion Summary

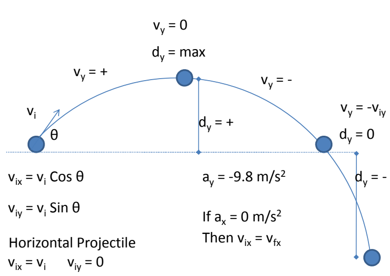
Separate x and y motions. Time is only thing that will match.

Example table setup:

	x	y
v_f	$v_i \text{ Cos } \theta$	
v_i	$v_i \text{ Cos } \theta$	$v_i \text{ Sin } \theta$
a	$0\ m/s^2$	$-9.8\ m/s^2$
d	$v_i \text{ Cos } \theta\ t$	
t	Time has to match!	

Time is the connection between x and y.

Example projectile path:



$v_{ix} = v_i \text{ Cos } \theta$
$v_{iy} = v_i \text{ Sin } \theta$

$a_y = -9.8\ m/s^2$

If $a_x = 0\ m/s^2$
Then $v_{ix} = v_{fx}$

Horizontal Projectile
$v_{ix} = v_i$ $v_{iy} = 0$

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