Projectile Motion

http://sites.lufkinisd.org/arduke/

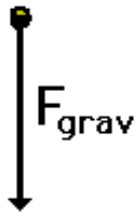
Myth Busters: Bullet dropped versus fired.

Myth Busters

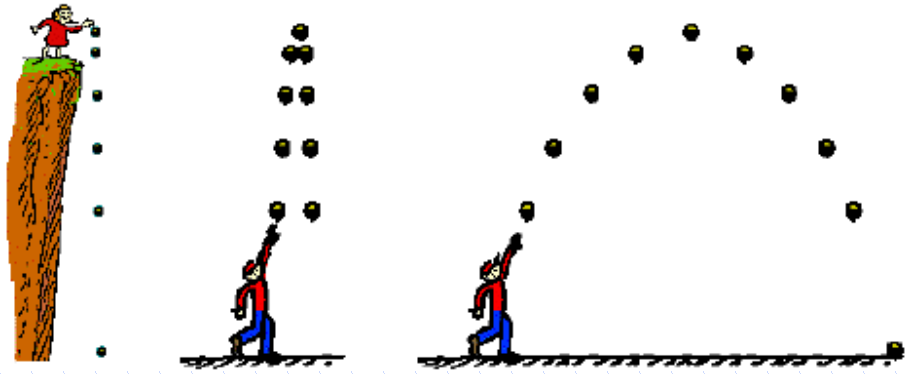
What is a projectile?

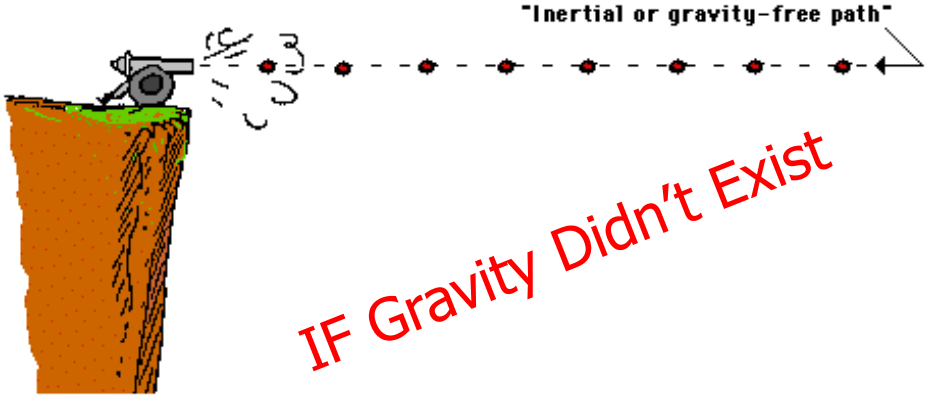
Any object that moves through the air or through space acted on ONLY by gravity (& air resistance if present)

Free-Body Diagram of a Projectile



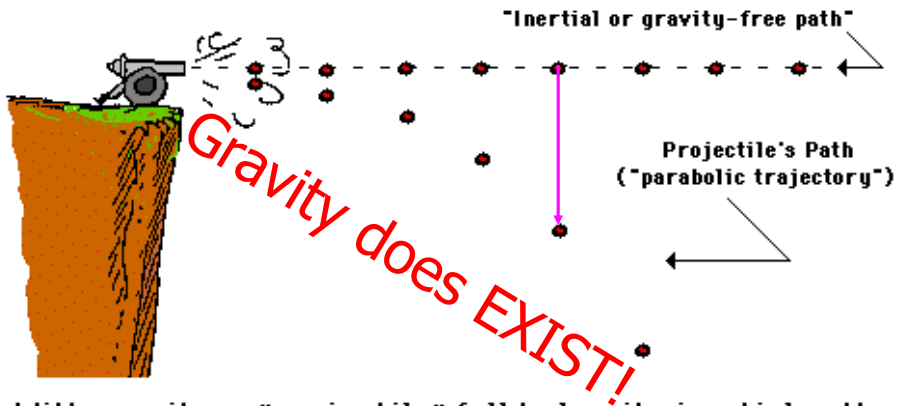
Types of Projectiles





IF Gravity Didn't Exist

Without gravity, an object in motion will continue in motion with the same speed and in the same direction.



With gravity, a "projectile" fall below its inertial path. Gravity acts downward to cause a downwards acceleration. There are not horizontal forces needed to maintain the cannonball's motion. (Remember the concept of inertia.)

Basic Terms:

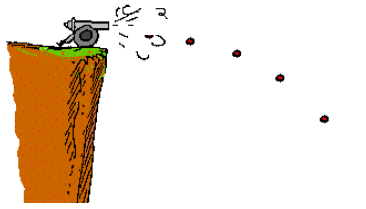
1.) range = the horizontal distance a projectile travels

2.) trajectory = the shape of the projectile's path of motion

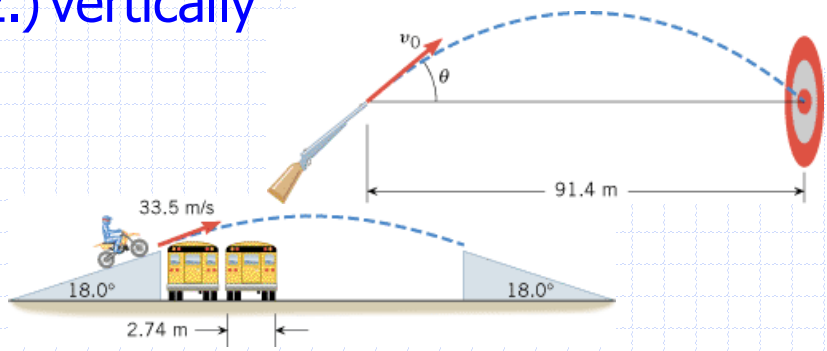
ex: "parabolic trajectory" – moves in a parabola shape

2 ways to launch projectiles

1.) horizontally



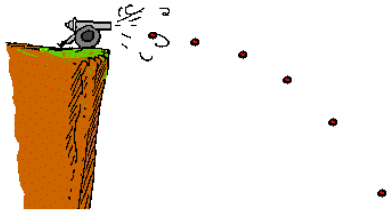
2.) vertically



1). Horizontally launched projectiles

- **"rolled off an edge"**
- **2 characteristics**

1.) motion path is a ½ parabola

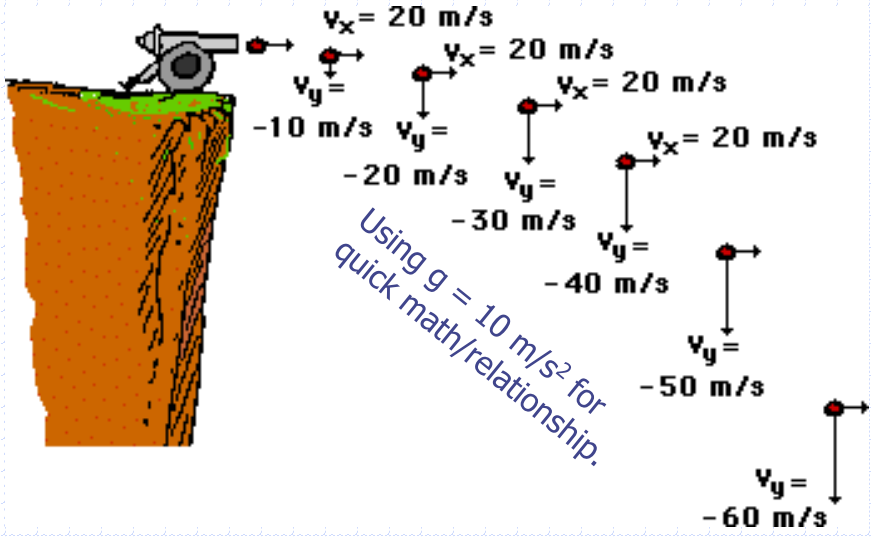


2.) 2 planes of motion:

Vertical (y)

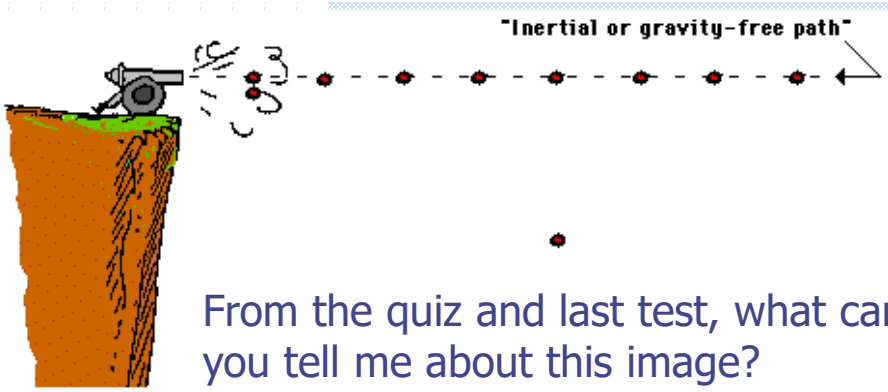
Horizontal (x)

2 planes of motion (cont'd)



X and Y components of motion are INDEPENDENT!

ie: any force in the horizontal DOES NOT affect the vertical, and vice versa.



From the quiz and last test, what can you tell me about this image?

What is v_{iy}?

What is the acceleration?

What is the vertical velocity at 3 seconds?

If v_x=12 m/s, then what is v_{xf}?

If the cliff is 15 m high, how does one find the time the cannonball is in the air using only the height of the cliff and initial vertical velocity?

Once the projectile is launched, there is NO FORCE applied to it in the X direction

NO FORCE = NO ACCELERATION

NO ACCELERATION = CONSTANT VELOCITY

CONSTANT VELOCITY: $v_{xi} = v_{xf} = v_x$

THE ONLY KINEMATICS FORMULA YOU CAN USE IS…

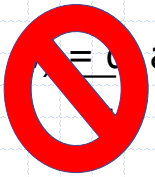
$v_x = \frac{d}{t}$ $a = \frac{v_f - v_i}{t}$ $v_f = v_i + at$ $v_f^2 = v_i^2 + 2a\Delta y$ $\Delta y = \frac{1}{2}(v_f + v_i)t$ $\Delta y = v_i t + \frac{1}{2}at^2$

In the Y direction, once launched the only force exerted is gravity

FORCE = ACCELERATION

ACCELERATION = $v_f \neq v_i$

AVAILABLE FORMULAS ARE…



$a = \frac{v_f - v_i}{t}$ $v_f = v_i + at$ $v_f^2 = v_i^2 + 2ad_y$

$\Delta d_y = \frac{1}{2}(v_f + v_i)t$ $\Delta d_y = v_i t + \frac{1}{2}at^2$

2 ways to organize your thinking before you attack a problem:

1.) formulas

2.) variables

Variables

x	y
d_x =	d_y =
v_x =	v_{iy} =
t =	v_{fy} =
	a =
	t =

What can you tell me about time?

Formulas

x	y
$d_x = v_x t$	$d_y = v_{iy} t + \frac{1}{2} a t^2$
	$v_{fy} = v_{iy} + a t$
	$v_{fy}^2 = v_{iy}^2 + 2 a d_y$
	$d_y = \frac{1}{2} (v_{iy} + v_{fy}) t$

Example problem

A hungry panther leaps horizontally from a tall tree and lands 7.2 m from the tree's base. If he jumps with a starting velocity of 5 m/s, how high was the panther in the tree?

What would you do first?

What would you do next?

Answer:

10.160 m