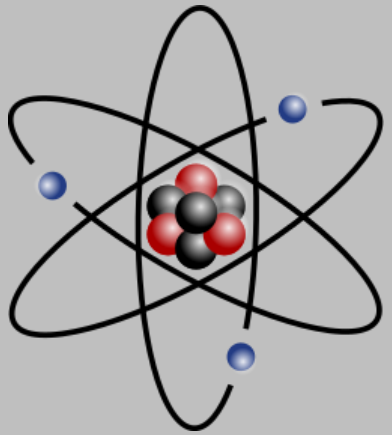
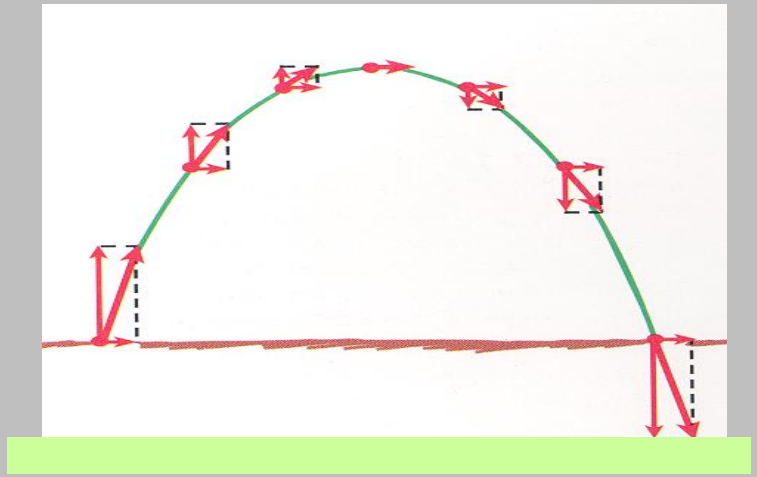
International House Tashkent
Subject: Physics
Department: ES, Course 1
Lesson 4. Projectiles launched upward



How does a projectile launched from the ground differ from a free falling object?

- Any projectile is a free falling object under the influence of gravity.
- The only difference is that the projectile has to go up, before it can come down.

Notice the arch of the ball thrown here:



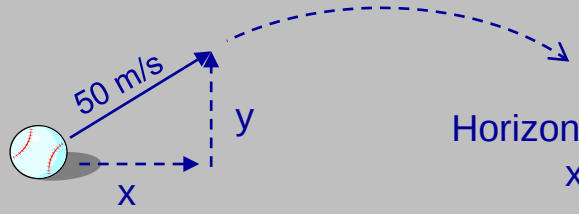
The ball has a horizontal velocity component that does not change - Similar to throwing the ball off the cliff.

It also has a vertical velocity vector that is under gravity's effect.

This component is similar to one drawn if the ball was thrown straight up

Determining the height and distance of a projectile:

- <u>Step 1:</u> Find the component velocity vectors of the take-off velocity.



Horizontal speed:

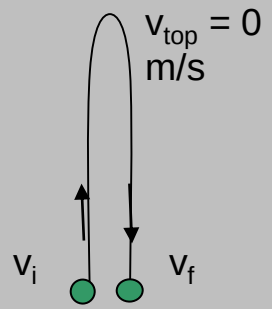
$x = \cos \Theta \times 50 \text{ m/s}$

Vertical speed:

$y = \sin \Theta \times 50 \text{ m/s}$

- <u>Step 2:</u> Using the vertical velocity component, determine the length of time the projectile is in the air.

Find the time to reach a velocity of 0 m/s at the top.
Then, multiply by 2 for the complete path.



$$v_f - v_i = gt$$

$$t = \frac{v_f - v_i}{9.8 \text{ m/s}}$$

Total time in air = t x 2

Step 3: Using the time that the projectile takes to

reach the top of the path, calculate the height

(distance traveled upward) of the path.

Assume the projectile travels only vertically straight up or down.
Use the free-falling equation for distance.

$d_{height} = 1/2gt^2$

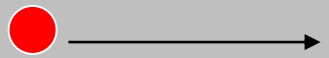
Determining the distance the projectile will travel:

Step 4: Using the horizontal velocity component,

determine how far the projectile will travel.

Assume the projectile travels only horizontally forward.

Use the linear motion equations.



d = vt (where t = the total time in the air)