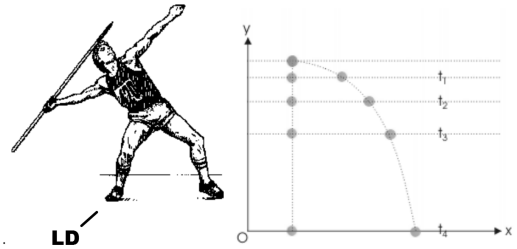
Physics 20 Unit A - Kinematics

Projectile Motion I



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Projectile Motion

- Involves throwing, launching or dropping an object through the air. Some examples include:

- Space craft.
- Rockets.
- Cannons.
- golf.
-

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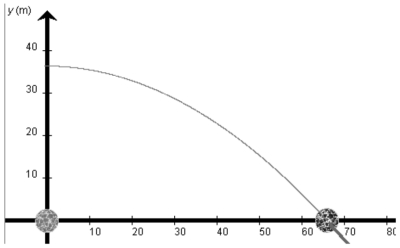
We will first deal with objects launched horizontally through the air from some height.



Projectile Motion Applet (Learn Alberta)

Projectile Motion Applet Walter-Fendt

http://phet.colorado.edu/simulations/sims.php?sim=Projectile_Mot

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LD Family Gedanken:

Which will hit the ground first???

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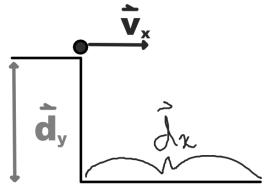

Conceptual Example

An object is thrown off a cliff of height $\vec{d}_y$ with a horizontal velocity $\vec{v}_x$.

Key Ideas:

- **This object has the same $\vec{v}_x$ throughout the entire motion.**
- **There is acceleration in the y direction, constant velocity in the x direction.**
- **The time it takes the object to hit the ground in this motion would be the same as the time it would take to just fall vertically.**

The horizontal displacement is sometimes called the "range".

x	y
$\vec{v}$	$\vec{v}_i = 0$
$\vec{d}$	$\vec{v}_f$
	$\vec{g} = -9.81\ m/s^2$
t	t

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Questions we can answer from this scenario:

1. How long the object is in the air.
2. How far the object lands from the cliff.
3. The velocity of the object when it lands.

1. How long the object is in the air:

Given $\vec{d}_y$ you can solve for t.

$\vec{d} = \vec{v}_i t + 1/2\vec{a}t^2$ $\qquad$ $\vec{d}_y = 1/2\vec{g}t^2$

$\vec{d}_y = \cancel{v_{iy}^{0}}t + 1/2\vec{g}t^2$

$$t = \sqrt{\frac{2\vec{d}_y}{\vec{g}}}$$

The Half-Time Eqn.

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2. How far the object lands from the cliff:

$$\vec{v} = \vec{d} / t$$

$$\vec{d}_x = \vec{v}_x t$$

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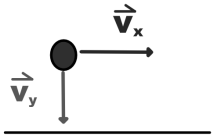
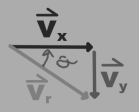
3. The velocity of the object when it lands:



$\vec{v}_f^2 = \cancel{v_i^{2\,0}} + 2\vec{a}\vec{d}$

$v_{fy} = \sqrt{2\vec{g}\vec{d}_y}$

We must find the resultant of the two velocities.



Use trig to determine the angle and resultant.

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Note the vector nature of this motion:

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ex) An object is thrown horizontally with a velocity of 10.0 m/s from the top of a 90.0 m building. How far from the base of the building will the object land and what will its final velocity be?

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ex) A watermelon is thrown from the top of a very tall watermelon tree with a horizontal velocity of 18.0 m/s. If the melon hits the ground 100 m from the tree, how high is the tree?

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ex) A ball is thrown horizontally with a velocity of 15.0 m/s from the top of a cliff. If it takes 5.50 s for the ball to hit the ground;

a) how high is the cliff?

b) what is the ball's final velocity?

Practice:

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