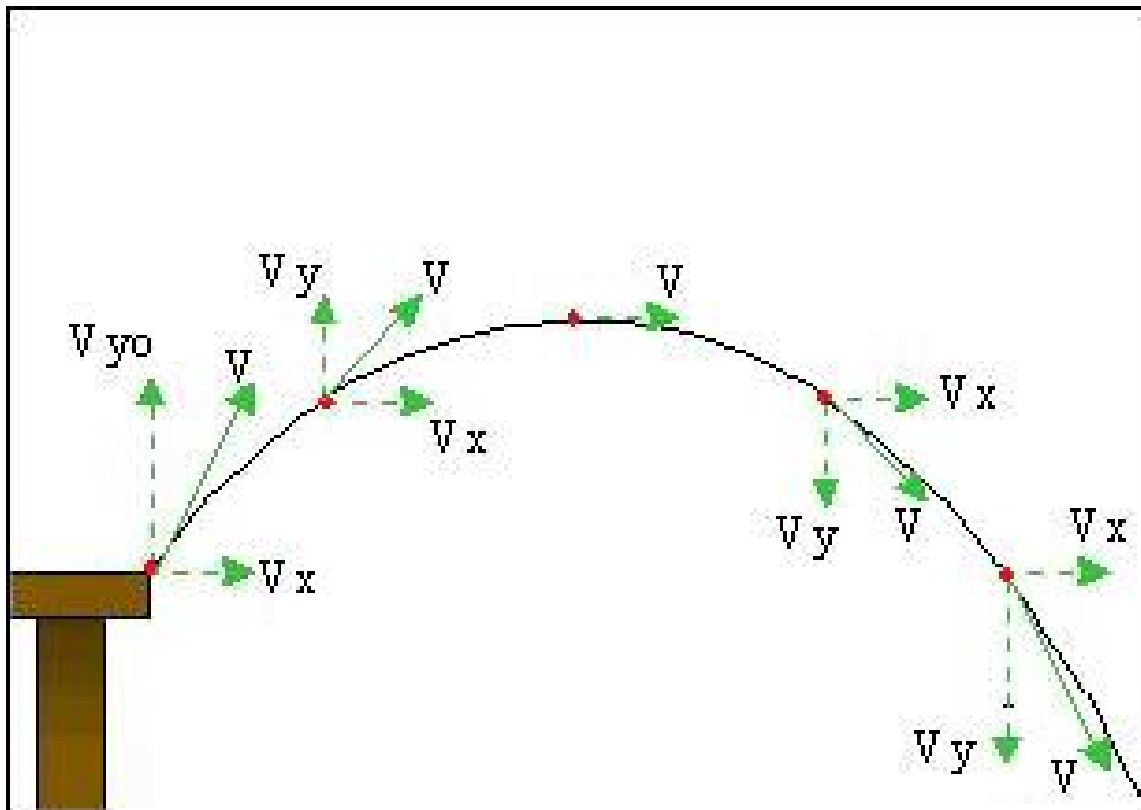


Physics 105 Class 4

PROJECTILE MOTION

Projectile motion: 2-dimensional motion of an object launched non-vertically

Falls freely (neglect air resistance)



<http://www.ngsir.netfirms.com/englishhtm/ThrowABall.htm>

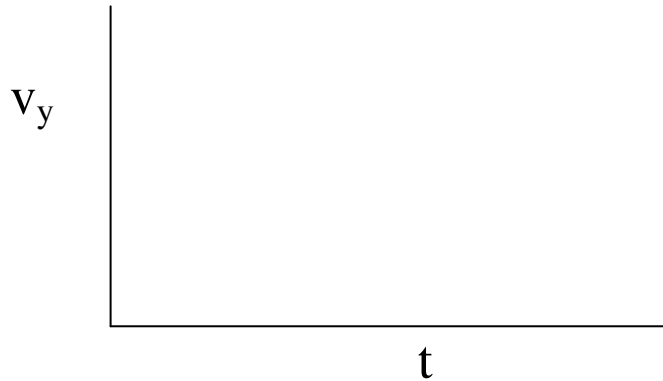
(links will be placed on course website)

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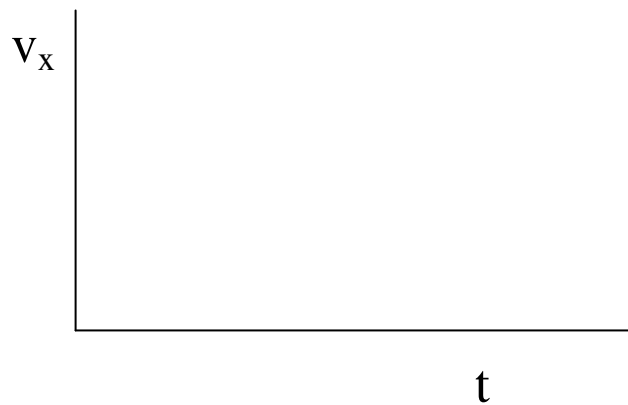
What **happens** in projectile motion?

Imagine shadows

y velocity, acceleration?



x velocity, acceleration?



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P1. Bob is loading his gun while Fred suddenly shoots his gun horizontally across the field. Bob drops his shell the instant Fred fires. Whose bullet hits the ground first (from same height)?

1. Bob's
2. Fred's
3. hit at same time

Demo: monkey-hunter

P2. A man on a moving railroad car shoots exactly vertically at a bird which is directly over him and moving at the same constant horizontal velocity (no air resistance)

1. His shot will go behind the bird
2. He will hit it
3. His shot will go ahead of the bird

Demo: gun on cart

What will happen if there is no bird?

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x and y motion are “independent”, but they are still “connected” by _____

Kinematic Equations

$$v_x = v_{0x}$$

$$x = x_0 + v_{0x}t$$

$$v_y = v_{0y} - gt$$

$$y = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

$$v_y^2 = v_{0y}^2 - 2g(y - y_0)$$

We can usually identify some value in **x**, **or y**, which gives us the **total freefall time**.

Example; A ball is thrown at an angle of 20 degrees above horizontal, off of a building 30m high. It is thrown with an initial velocity of 15 m/s and hits the ground.

Which coordinate will give us the total freefall time?



Hints for projectile motion:

- Draw pictures, label. Decide +y direction
- Identify which coordinate gives total freefall time
- Find t from the motion in that coordinate
- Find missing info from kinematic eqns.

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A rifle at the same height as a target tries to hit the center of a large target. The rifle is shot at 10° above the horizontal and hits the target 0.5 m above the height from which it was shot. The initial velocity of the bullet is 100 m/s. How far away is the target?

P3. Which coordinate gives us the total freefall time?

1. vertical (y)
2. horizontal (x)

A rifle at the same height as a target tries to hit the center of a large target 200 m away. The rifle is shot at 10° above the horizontal. The initial velocity of the bullet is 100 m/s. How far above the initial height does the bullet strike the target?

P4. Which coordinate gives us the total freefall time?

1. vertical (y)
2. horizontal (x)

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A rifle at the same height as a target tries to hit the center of a large target 200 m away. The rifle is shot at 1° above the horizontal. The initial velocity of the bullet is 500 m/s. How far above/below the target does the bullet strike the target?
(note I've changed it from 10 to 1°)

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A ball is thrown horizontally from the top of a building 35 m high. The ball strikes the ground 80 m from the base of the building.

Which coordinate gives us the total freefall time?

1. vertical (y)
2. horizontal (x)

a) What was the initial velocity of the ball?

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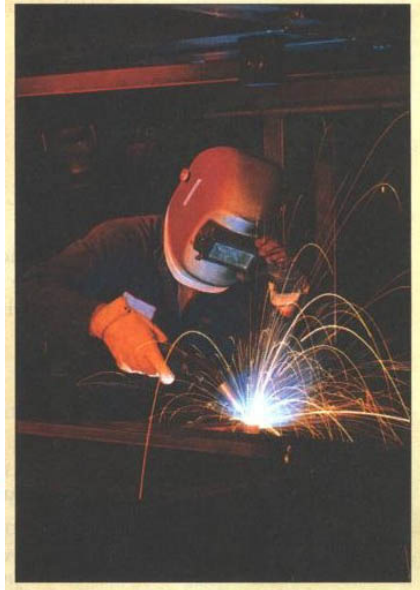
P5. Knowing the time above, what are the components of the final velocity of the ball (just before hitting)?

P6: If the ball is thrown with the same initial velocity at -30° from horizontal, the ball will strike the ground:

1. more than 80 m from the base of the building
2. 80 m from the base of the building
3. less than 80 m from the base of the building

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Parabolic paths:



Range, optimum angle for level field and no air friction

Effect of air friction on angle

http://galileo.phys.virginia.edu/classes/109N/more_stuff/Applets/ProjectileMotion/jarapplet.html

Demo: ping-pong ball and foam ball

Motorcycle Jumping

Record for total jump distance now held by Trigger Gumm Capes, 277.5 feet, May, 2005.

<http://www.crusty.com/worldrecords.htm#>

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Sally and Bob each throw a rock horizontally from a cliff. Sally throws her rock hard. Bob throws his more easily.

P7. Which spends the longest time falling?

1. Sally's
2. Bob's
3. same

P8. Which rock is going fastest (vector magnitude) just before it hits the ground?

1. Sally's
2. Bob's
3. same

Sally throws a rock horizontally from a cliff. Bob throws his at an angle above horizontal. They throw the same speed.

P9. Which hits first?

1. Sally's
2. Bob's
3. same

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HOMEWORK 4 NOTES: