Name Key Hour _____

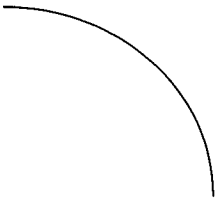
Projectiles Shot at an Angle

Review of Horizontal Projectiles:

v_x remains Constant because we: neglect air resistance

v_y increases as an object falls due to gravity which is a_y= $-9.8\ m/s^2$

An object moves in the shape of a half parabola because it has velocity in the x-direction and gravity pulls it down in the y-direction.



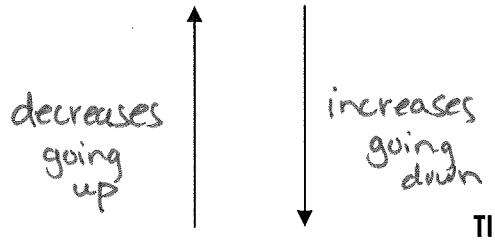
Joey pushes Mike horizontally off a cliff at 5 m/s. What is Mike's:

v_x= 5 m/s v_{iy}= 0 a_y= $-9.8\ m/s^2$

Projectiles shot at an ANGLE:

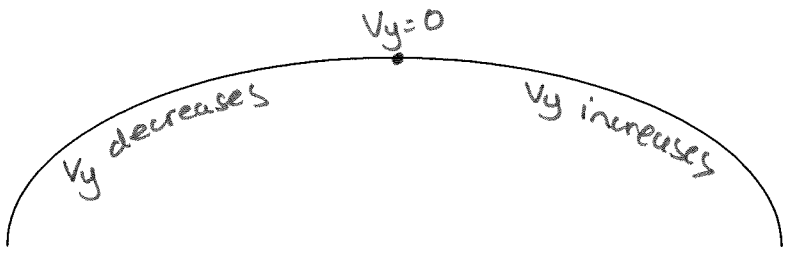
1. The horizontal velocity (v_x) still remains Constant
2. The vertical velocity (v_y) Changes throughout

Think of the v_y if it only went up and down. What happens to the v_y?

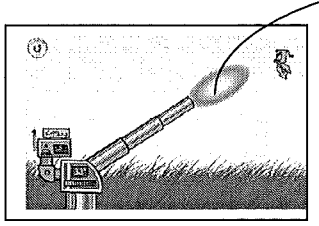


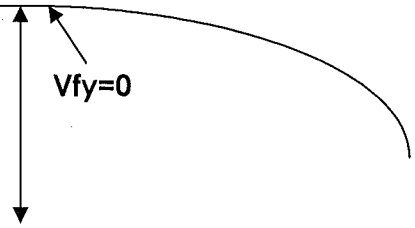
TIP: The y velocity at the top = 0

Now apply a horizontal component to it. **The v_x DOES NOT CHANGE the v_y!**



Name _____ Hour _____

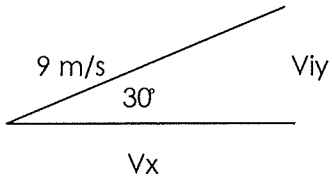




Δy at maximum height = ½ point

Example: A cat tries to launch itself out of a cannon at 30° N of E. He leaves the cannon with a velocity of 9 m/s (**This is a combination of his vertical and horizontal velocity!**). What will be his maximum height (Δy), AND will he make it across a 10 m wide road? (Solve Δx)

The components of velocity:



V_x: $\cos 30° = \frac{Vx}{9}$ $Vx = 7.79$

V_{iy}: $\sin 30° = \frac{Viy}{9}$ $Viy = 4.5$

To use either equation, we need to find the **time** (Δt) the cat was in the air.

$a = \frac{V_f - V_i}{\Delta t}$ becomes: $a_y = \frac{V_{fy} - V_{iy}}{\Delta t}$

You can solve for the time at the top of the parabola because the y-velocity = 0

So... V_{fy} = 0 at the top (which is ½ way through the flight).

$a_y = \frac{V_{fy} - V_{iy}}{\Delta t}$ $-9.8\ m/s^2 = \frac{0 - 4.5\ m/s}{\Delta t}$ $\Delta t = \frac{-4.5\ m/s}{-9.8\ m/s^2} = 0.46 sec$

Δt = 0.46sec This is the time at the top, so the

TOTAL time of the flight = 0.92 sec

Now that we have Δt...back to our other equations

Maximum Height: (Δy) Δt at top

$\Delta y = V_{iy}\Delta t + \frac{1}{2} a_y \Delta t^2$

$\Delta y = (4.5)(.46) + \frac{1}{2}(-9.8)(.46)^2$

$2.07 + -1.04$

$\Delta y = 1.03 m$

total Δt Total Distance (Δx)

$V_x = \frac{\Delta x}{\Delta t}$ $7.79\ \frac{m}{s} = \frac{\Delta x}{0.92}$

$\Delta x = 7.15 m$

cat will not make it across road! ^^