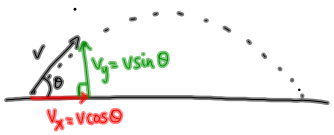
Symmetrical Trajectories (A projectile that returns to the same level)

A special case since the vertical displacement is ZERO!



Find expressions for:

a) Δt

b) Δd_x

c) H (max height)

a) To find the time the projectile is in the air, then we need to look at the vertical motion.

Vertically

$v_i = v\sin\theta$

$a = -g$

$\Delta d = 0$

$\Delta t = ?$

$\Delta d = v_i \Delta t + \frac{1}{2}a(\Delta t)^2$

$0 = v\Delta t\sin\theta - \frac{g}{2}(\Delta t)^2$

$0 = \Delta t\left(v\sin\theta - \frac{g}{2}\Delta t\right)$

$\Delta t = 0$ $\quad v\sin\theta - \frac{g}{2}\Delta t = 0$

$v\sin\theta = \frac{g}{2}\Delta t$

$\Delta t = \frac{2v\sin\theta}{g}$

b) To find the horizontal displacement, we need to use the horizontal velocity and the Δt.

Horizontally $\quad v_x = \frac{\Delta d_x}{\Delta t}$

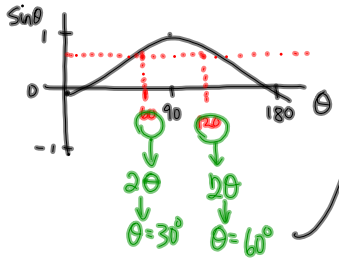
$\Delta d_x = v_x \Delta t$

$\Delta d_x = (v\cos\theta)\left(\frac{2v\sin\theta}{g}\right)$

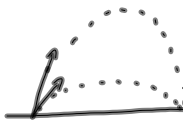
$\Delta d_x = \frac{v^2 2\cos\theta\sin\theta}{g}$ → $2\cos\theta\sin$ = Sin (trig ident

Range of projectile → $\Delta d_x = \frac{v^2\sin 2\theta}{g}$

A launch angle of 45° gives you the maximu ran



→ A launch angl 30° and 60° wi have the sam



(complementary lau angles give the ran

c) Maximum height:

$\Delta d_y = ?$ (max height)

$a = -g$

$v_i = v\sin\theta$

$v_2 = 0$ (at max height)

$v_2^2 = v_i^2 + 2a\Delta d$

$0 = v^2\sin^2\theta + 2$

$2g\Delta d_y = v^2\sin^2\theta$

max height → $\Delta d_y = \frac{v^2\sin^2\theta}{2g}$

H