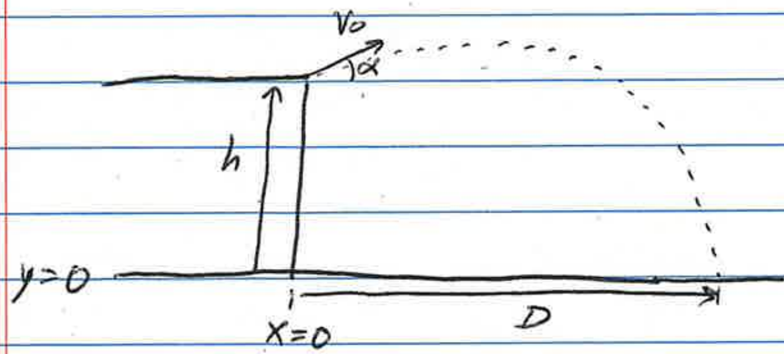
Range from Table Launch



$V_{0x} = V_0 \cos\alpha \qquad V_{0y} = V_0 \sin\alpha$

$y = h + V_{0y}t - \frac{1}{2}gt^2 \qquad\qquad x = V_{0x}t$

To find when the projectile lands, solve for t when $y=0$

$0 = h + V_{0y}t - \frac{1}{2}gt^2$

$0 = \frac{1}{2}gt^2 - V_{0y}t - h$

$$t = \frac{V_{0y} \pm \sqrt{V_{0y}^2 + 2gh}}{g}$$

Passes units test

Passes sense test

Time to apex: $0 = V_y = V_{0y} - gt$

$gt = V_{0y}$

$t = V_{0y}/g$ This is the first term

Time to launch height $= 2V_{0y}/g$ – solution when $h=0$

Time to drop height h from rest: $0 = h - \frac{1}{2}gt^2$

$gt^2 = 2h$

$t = \sqrt{2h/g}$ = solution when $V_{0y} = 0$

We can reject the negative solution bcz it's befor the launch

Range $D = V_{0x}t = \frac{V_{0x}}{g}\left(V_{0y} + \sqrt{V_{0y}^2 + 2gh}\right)$ units work

If you want to theoretically find maximum range, take the derivative of this formula with respect to launch angle α and find α at which $dD/d\alpha = 0$

If that's too difficult, numerically hunt for α giving the greatest D