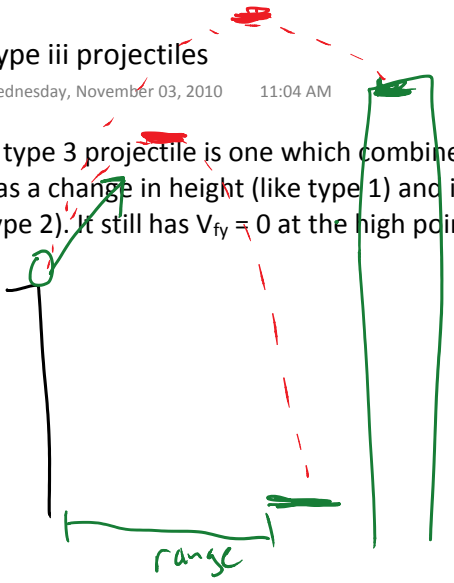
Type iii projectiles

Wednesday, November 03, 2010 11:04 AM

A type 3 projectile is one which combine types 1 and 2, the projectile has a change in height (like type 1) and is launched on an angle (like type 2). It still has $V_{fy} = 0$ at the high point.



Easy way: find the final velocity in the y - direction for the projectile when It reaches the ground

$$V_{fy}^2 = V_{iy}^2 + 2a_y d$$

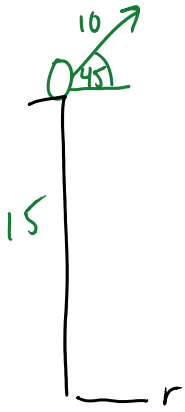
After finding V_{fy}, then use it to find the time in the air

$$V_f - V_i = at$$

1) components

Find your range using t in the equation:

$$d_x = V_{ox}t + \frac{at^2}{2}$$



$V_{ox} = 10\cos(45) = 7.07$

$V_{oy} = 10\sin(45) = 7.07$

$V_{fy}^2 = V_{iy}^2 + 2ad$

$= 7.07^2 + 2(-9.8)(-15)$

$V_{fy} = -18.5$

t

$V_{fy} - V_{iy} = at$

$-18.5 - 7.07 = -9.8t$

$\frac{-18.5 - 7.07}{-9.8} = t = 2.6s$

x

$d = vt$

$= 7.07(2.6)$

$= 18.4\,m$

ALTERNATIVE METHOD:

A type iii projectile is a quadratic in terms of t

$$d_y = V_{oy}t + \frac{a_y t^2}{2}$$

$$\rightarrow -15 = 7.07t + \frac{-9.8}{2}t^2$$

$$4.9t^2 - 7.07t - 15 = 0$$

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{}$$

$d = vt$

$d_x = 7.07(2.6)$

$= 18.4\,m$

$= -1.17, 2.6$

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A cat is kicked at 20 m/s at 30^{o} above horizontal off a 20 m high building, find the time it spends in the air, the range, the final velocity at impact, max height (from ground) and velocity at the high point.

$= V_{iy}^2 + 2ad$ $\quad d = v_{ix} + \frac{at^2}{2}$

$10^2 + 2(-9.8)(-20)$

$V_{ix} = 20\cos(30)$
$= 17.3$

$V_{iy} = 20\sin(30)$
$= 10$

$V_{fy} = -22.2$ m/s

$V_f = V_i + at$

$-22.2 - 10 = -9.8t$

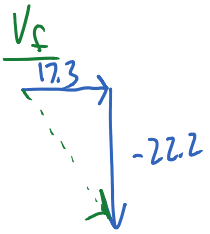
$\frac{-22.2 - 10}{-9.8} = t = 3.29$ s

$-20 = 10t - 4.9t^2$

$t = 3.29, -1.24$

range

$d_x = V_{ox}t$
$= 17.3(3.29)$
$= 56.9$m



$V_r = 28.1$ m/s

$\theta = \tan^{-1}\left[\frac{22.2}{17.3}\right] = 52°$ S of E

height

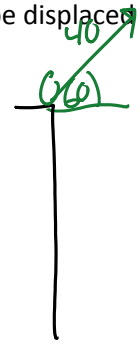
$V_{fy}^2 = V_{iy}^2 + 2ad$

$0 = 10^2 + 2(-9.81)d$

$d = 5.1$m

height $= 5.1 + 20$

A cat is launched at 40 m/s at an angle of 60°, how far horizontally will it be displaced when reaching height 10 m?



$V_{ox} = 40\cos 60 = 20$

$V_{oy} = 40\sin 60 = 35$

$d = V_o t + \frac{at^2}{2}$

$10 = 35t - 4.9t^2$

$t = 6.8, .29$

$d_x = vt$
$= V_{ox}t$
$= 20(.29)$
$= 5.8$m

$d_x = V_{ox}t$

$= 20(6.8)$

$= 136\ m$