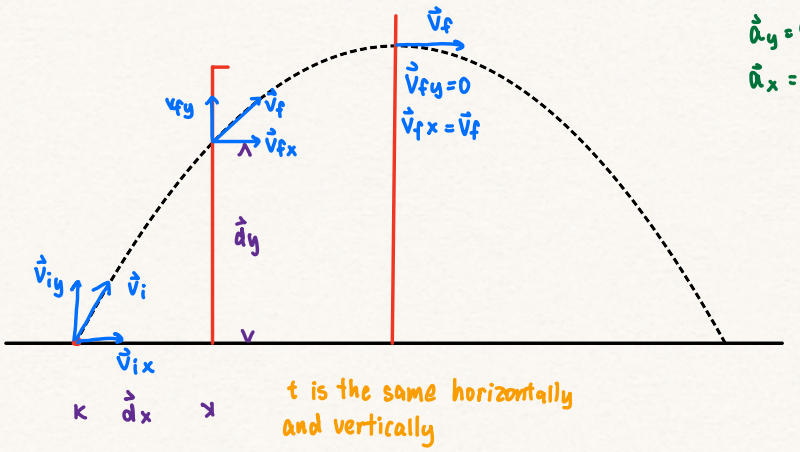


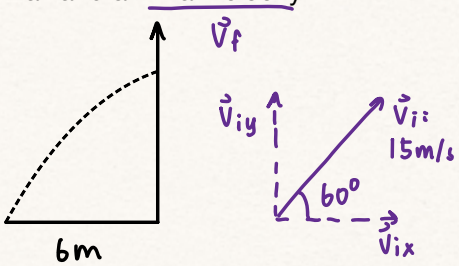
$\vec{a}_y = 9.81 m/s^2 [D]$

$\vec{a}_x = 0 m/s^2$

Example 1:

You are 6m from a very tall wall. You kick a ball at 54 km/h at an angle of 60 degrees. Where does it hit the wall and at what velocity?

15 m/s



V

$\vec{v}_{iy} = 15 \sin 60 m/s [U]$

$\vec{a}_y = -9.81 m/s^2 [U]$

$t = 0.8 s$

$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$

$\vec{d} = (15 \sin 60)0.8 + \frac{1}{2}(-9.81)(0.8)^2$

$\vec{d} = 7.25 m [U]$

H

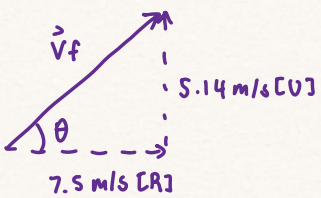
$\vec{v}_{ix} = \vec{v}_{fx} = \vec{v}_x = 15 \cos 60 m/s [R]$

$= 7.5 m/s [R]$

$\vec{d} = 6m [R]$

$t = \frac{\vec{d}}{\vec{v}} = \frac{6}{7.5} = 0.8 s$

$\vec{d}_y$



$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$

$\vec{v}_{fy} = \vec{a}t + \vec{v}_i$

$\vec{v}_{fy} = -9.81 \cdot 0.8 + 15 \sin 60$

$\vec{v}_{fy} = 5.14 m/s [U]$

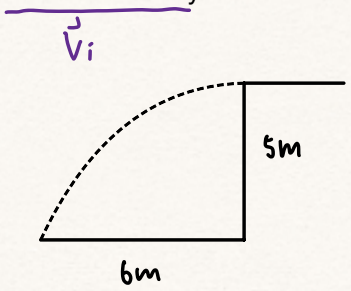
$\vec{v}_f = \sqrt{5.14^2 + 7.5^2}$

$= 9.09 m/s [R 34.42 U]$

$\tan\theta = \frac{5.14}{7.5}$

$= 34.42$

Jeb the chihuahua joins you for a challenge. He is 6m from a 5m tall flat-roofed building. What is the smallest velocity he can kick the ball so that it just lands on the roof?



V

$\vec{V}_{fy} = 0 m/s$

$\vec{d}_y = 5m\ [U]$

$\vec{a}_y = -9.81 m/s^2\ [U]$

$\vec{V}_{iy} = ?$

$2\vec{a}\vec{d} = V_f^2 - V_i^2$

$2(-9.81)(5) = 0^2 - V_i^2$

$\vec{V}_{iy} = \pm 9.9 m/s\ [U]$

$\vec{d} = \vec{V}_f t - \frac{1}{2}\vec{a}t^2$

$5 = 0t - \frac{1}{2}(-9.81)t^2$

$t = \pm 1.01 s$

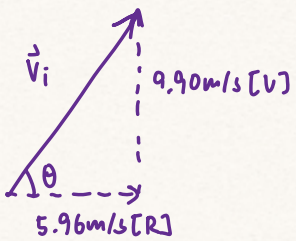
H

$\vec{a}_x = 0 m/s^2$

$t = 1.01 s$

$\vec{d}_x = 6m\ [R]$

$\vec{v} = \frac{\vec{d}}{t} = \frac{6}{1.01} = 5.96 m/s\ [R]$



$\vec{V}_i = \sqrt{5.96^2 + 9.9^2}$

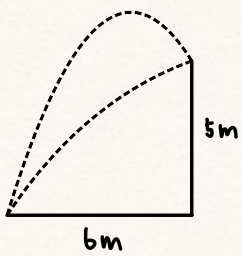
$= 11.6 m/s\ [R\ 59°\ U]$

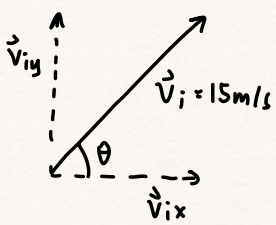
$\theta = \tan^{-1}\left(\frac{9.9}{5.96}\right)$

$= 59°$

Jeb the chihuahua is 6m from a 5m tall building. He kicks the ball at 54km/h. At what angle must he kick it so that it hits the edge of the wall?

54km/h → 15m/s





V

$\vec{V}_{iy} = 15\sin\theta\ m/s\ [U]$

$\vec{a}_y = -9.81 m/s^2\ [U]$

$\vec{d}_y = 5m\ [U]$

$t = \frac{6}{15\cos\theta}\ s$

$\vec{d} = \vec{V}_i t + \frac{1}{2}\vec{a}t^2$

$5 = 15\sin\theta\frac{6}{15\cos\theta} + \frac{1}{2}(-9.81)\left(\frac{6}{15\cos\theta}\right)^2$

$5 = 6\tan\theta - \frac{0.7848}{\cos^2\theta}$

$\frac{1}{\cos^2\theta} = \sec^2\theta$

$\sec^2\theta = \tan^2 + 1$

$5 = 6\tan\theta - 0.7848(\tan^2\theta + 1)$

$5 = 6\tan\theta - 0.7848\tan^2\theta - 0.7848$

$0.7848\tan^2\theta - 6\tan\theta + 5.7848 = 0$

H

$\vec{V}_{ix} = 15\cos\theta\ m/s\ [R]$

$\vec{d}_x = 6m\ [R]$

$\vec{v} = \frac{\vec{d}}{t} = \frac{6}{15\cos\theta}\ s$

S	A
T	C

$\tan\theta = 1.13$ $\quad \tan\theta = 6.51$

$\theta_1 = 48.53°$ $\quad \theta_1 = 81.27°$

$\theta_2 = 3^{rd}$ quad. $\quad \theta_2 = 3^{rd}$ quad

on way up $\quad$ on way down