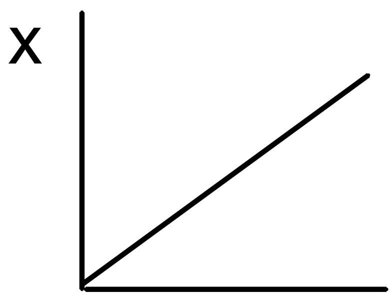
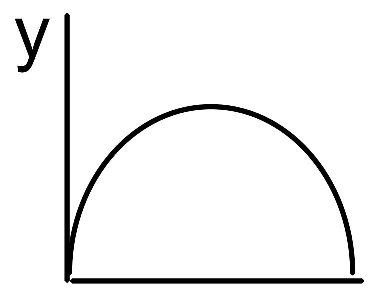
Projectile Motion Video: 2 position time graphs





$X_f = X_0 + V_0 t + \cancel{\frac{1}{2} a t^2}$

Constant velocity in the x direction

NO Acceleration

$Y_f = Y_0 + V_{0y} t + \frac{1}{2} a_y t^2$

Do NOT have a constant velocity

Negative Acceleration

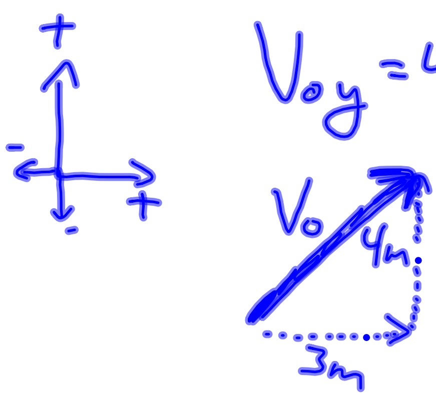
$|a| = |g| \approx 9.81\, m/s^2$

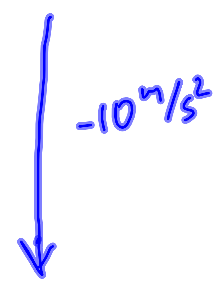
Vectors in Projectile Motion

It appears that acceleration in the y direction, does not cause acceleration in the x direction.

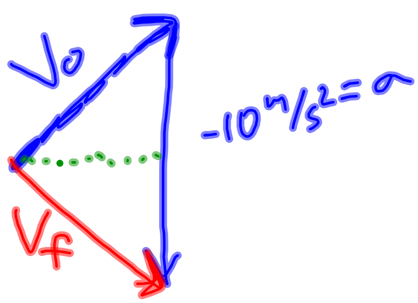
$V_{0x} = 3\,m/s$ $\quad a_x = 0$

$V_{0y} = 4\,m/s$ $\quad a_y = -10\,m/s^2$





Remember: the acceleration (vector) tells us how much the velocity changes each second.

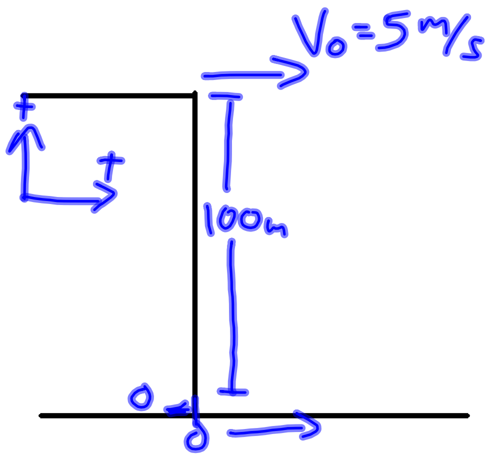


after 1 second.
the acceleration changes the velocity into V_f

CORE IDEA: 2D problems are really just two separate 1D problems

Example: Throw a rock off a 100m cliff with initial horizontal velocity of 5 m/s

1) How long does it take to hit the ground?
2) How far from the base of the cliff does it hit?



X	Y
$V_{ox} = 5\ m/s$	$a_y = -10\ m/s^2$
$a_x = 0$	$V_{oy} = 0\ m/s$
$X_o = 0$	$X_{oy} = 100m$
X_{fx}	$X_{fy} = 0m$

time is both x and y ~ 4.5s

① $X_{fy} = X_{oy} + V_{oy}t + \frac{1}{2}a_y t^2$

$0 = X_{oy} + \frac{1}{2}a_y t^2$

$\frac{1}{2}a_y t^2 = -X_{oy}$

$t^2 = \frac{-2X_{oy}}{a_y}$

$t = \sqrt{\frac{-2(X_{oy})}{a_y}}$

$t = \sqrt{\frac{-2(100m)}{-10\ m/s^2}} \approx 4.5s$

② $X_{fx} = X_{ox} + V_{ox}t + \frac{1}{2}a_x t^2$

$X_{fx} = V_{ox}t$

$X_{ft} = (5\ m/s)(4.5s)$

$X_{ft} = 22.5m$