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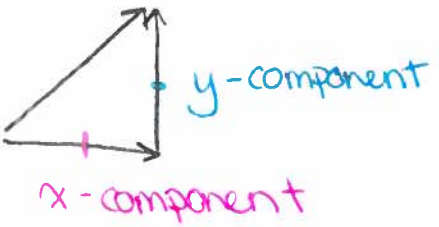
Section 3.4: Projectiles

Any vector can be replaced with two vectors that add to become it.

These two vectors are called components.

We *usually* choose one horizontal component (x-component) and one vertical component (y-component).

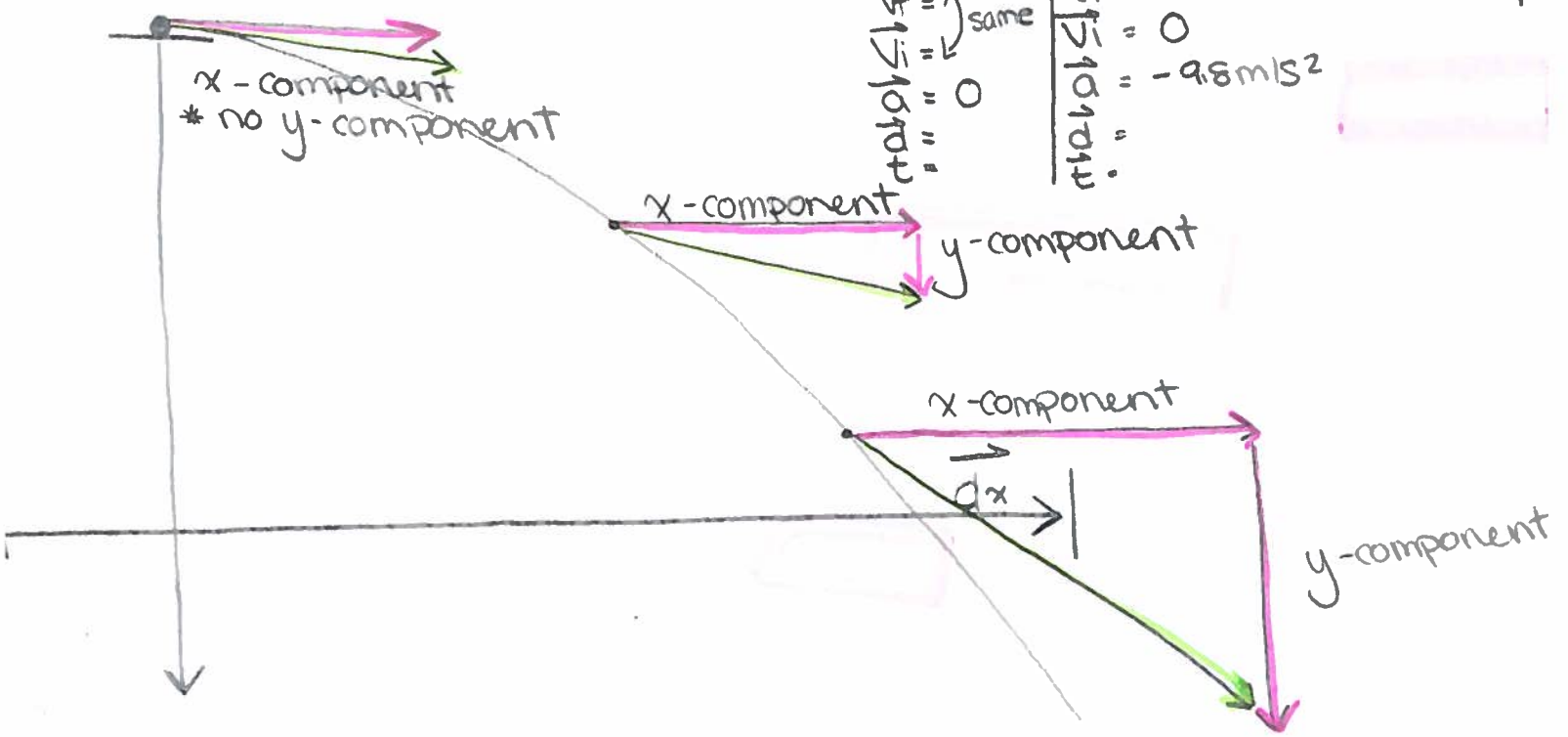
Examples:



A projectile is an object that moves through the air where the only force acting on it is gravity.

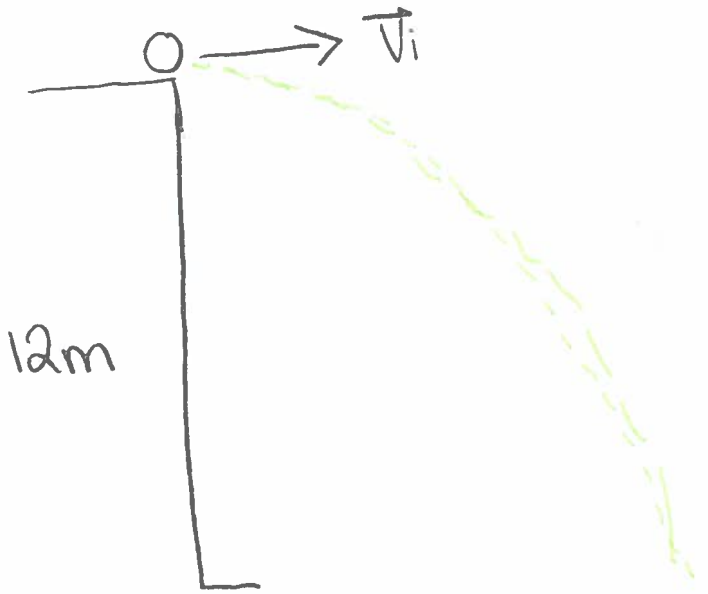
Draw the trajectory for a projectile with horizontal initial velocity. Show the velocity at several points, including the x- and y- components:

x	y
$\vec{v}_f$ = same as $\vec{v}_i$	$\vec{v}_f$ = ← not the same as $\vec{v}_{iy}$
$\vec{v}_i$ =	$\vec{v}_i$ = 0
$\vec{a}$ = 0	$\vec{a}$ = $-9.8\ m/s^2$
Δt =	Δt =



Example: A ball is thrown horizontally at 14 m/s from on top of a 12 m high building.

a) How long is the ball in the air for?
b) How far from the building is the ball when it lands?
c) What is the ball's velocity as it hits the ground?



X	Y
$\vec{V}_f$ = 14 m/s (same as $\vec{V}_i$)	$\vec{V}_f = -15.3$
$\vec{V}_i$ = 14 m/s	$\vec{V}_i = 0$
$\vec{a} = 0$	$\vec{a} = -9.8\ m/s^2$
$\vec{d}$ =	$\vec{d} = -12\ m$
$t = 1.56s$	$t = 1.56s$

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

$= 14 \times 1.56$

$= 21.84\ m$

$\vec{V}_f^2 = \vec{V}_i^2 + 2\vec{a}\vec{d}$

$\vec{V}_f = \pm\sqrt{\vec{V}_i^2 + 2\vec{a}\vec{d}}$

$\vec{V}_f = \pm\sqrt{0 + 2(-9.8)(-12)}$

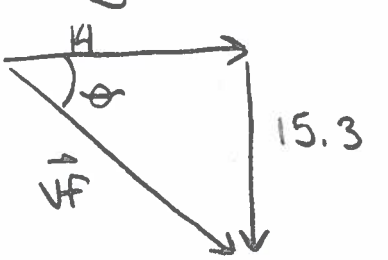
$\vec{V}_f = \pm 15.3\ m/s$

$\vec{V}_f = \vec{V}_i + \vec{a}t$

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

$\frac{-15.3 - 0}{-9.8} = 1.56s$

Finding $\vec{V}_f$...



$\vec{V}_f = 20.7\ m/s$

$\tan\theta \frac{15.3}{14} = 47.5°$

Final answer: $\vec{V}_f = 20.7\ m/s$ [47.5° below horizontal]