Projectile Motion & Gravity

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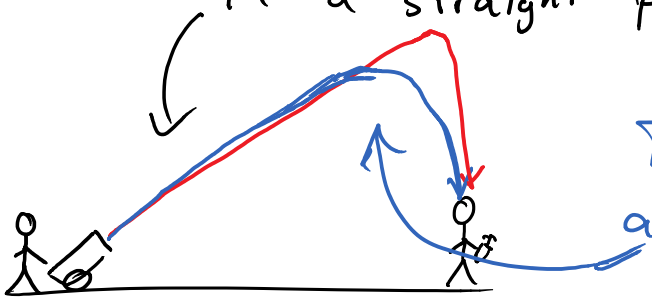
The accepted value for an object accelerated by Earth's gravity is $\vec{a} = -9.8 m/s^2$.

Assumes: air resistance is NEGLIGIBLE.

The Shape of a Projectile's Path

Back in ye olde days.

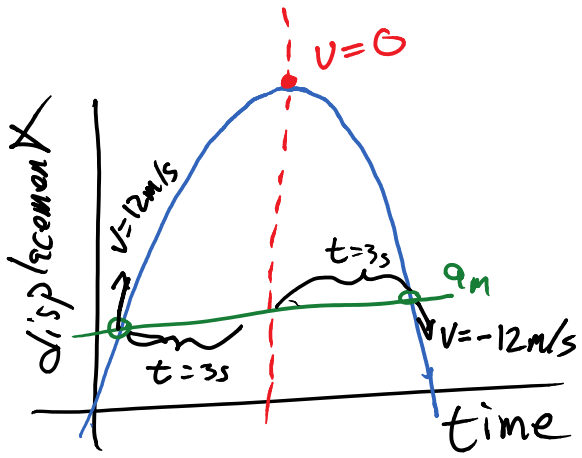
-Artillerists thought a projectile will travel in a straight path until it loses "impetus", then it would drop.



They were wrong, but not as wrong as you might think.

Too complicated for PII. → There is large effect from air resistance that causes the unusual shape.

If we neglect air resistance the shape of a projectile's path is a parabola.



Key Feature

- at every point $\vec{a} = -9.8 m/s^2$ (on Earth)
- The vertex (turning point) has a v=0
- It is perfectly symmetrical across a vertical line throug

across a vertical line through the vertex

Extra Notes

- Drop means $v_i = 0$
- Be careful with + and − signs

Ex. A cannonball is shot at Austin with an upward velocity of 24m/s. Austin is on a 13m tall scaffold. How long does he have to live?

$d = v_i t + \frac{1}{2} a t^2$ ← quadratic Formula!

$v_i = 24 m/s$

$a = -9.8 m/s^2$

$d = 13$

$t = ?$

$0 = \frac{1}{2} a t^2 + v_i t - d$

$0 = \frac{1}{2}(-9.8)t^2 + 24t - 13$

$0 = \underbrace{-4.9}_{a} t^2 + \underbrace{24}_{b} t \underbrace{-13}_{c}$

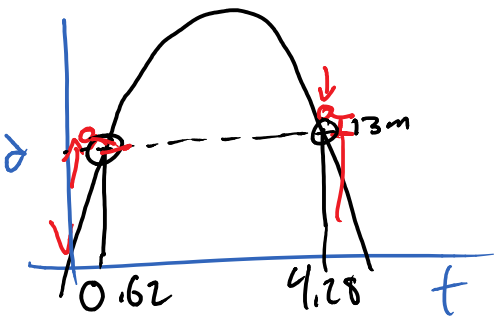
$$t = \frac{-24 \pm \sqrt{24^2 - 4(-4.9)(-13)}}{2(-4.9)} = \frac{-24 \pm \sqrt{576 - 254.8}}{-9.8}$$

$$t = \frac{-24 \pm \sqrt{321.2}}{-9.8} = \frac{-24 \pm 17.9}{-9.8}$$

$+: \frac{-24 + 17.9}{-9.8} = 0.62s$

$-: \frac{-24 - 17.9}{-9.8} = 4.28s$

both could be right.



Austin got hit by the cannonball at either 0.62s or 4.28s

b) When does the cannonball reach 32m in height?

$$\frac{-24 \pm \sqrt{24^2 - 4(-4.9)(-32)}}{-9.8} = \frac{-24 \pm \sqrt{-51.2}}{-9.8}$$

Not Real

It doesn't.