February 13, Week 5

Today: Chapter 3, Finish Projectile Motion

Exam #2 should be graded by Wednesday.

Homework 4, Due February 20.
Mastering Physics: 9 problems from chapters 1 and 3.
Written Question: 3.56

Projectile Equations

Projectile - Any object that is launched into motion and then acted on by only gravity.

$$a_x = 0 \quad a_y = -g$$

Projectile Equations

$v_x = v_{o,x}$	$v_y = v_{o,y} - gt$
$x = x_o + v_{o,x}t$	$y = y_o + v_{o,y}t - \frac{1}{2}gt^2$
$v_{o,x} = v_o \cos\alpha$	$v_{o,y} = v_o \sin\alpha$

Trajectory Equation

All projectiles have parabolic trajectories.

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Substitute

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Substitute

$$y = y_o + v_{o,y}t - \frac{1}{2}gt^2 \Rightarrow y = y_o + v_o \sin\alpha t - \frac{1}{2}gt^2$$

$$y = y_o + \cancel{v_o} \frac{\sin\alpha}{\cancel{v_o}\cos\alpha}\left(\frac{x - x_o}{\cancel{v_o}\cos\alpha}\right) - \frac{1}{2}g\left(\frac{x - x_o}{v_o \cos\alpha}\right)^2$$

$\tan\alpha$

Trajectory Equation II

Simplifying gives:

$$y = y_o + \tan\alpha\,(x - x_o) - \frac{g\,(x - x_o)^2}{2v_o^2\cos^2\alpha}$$

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Downward Parabola

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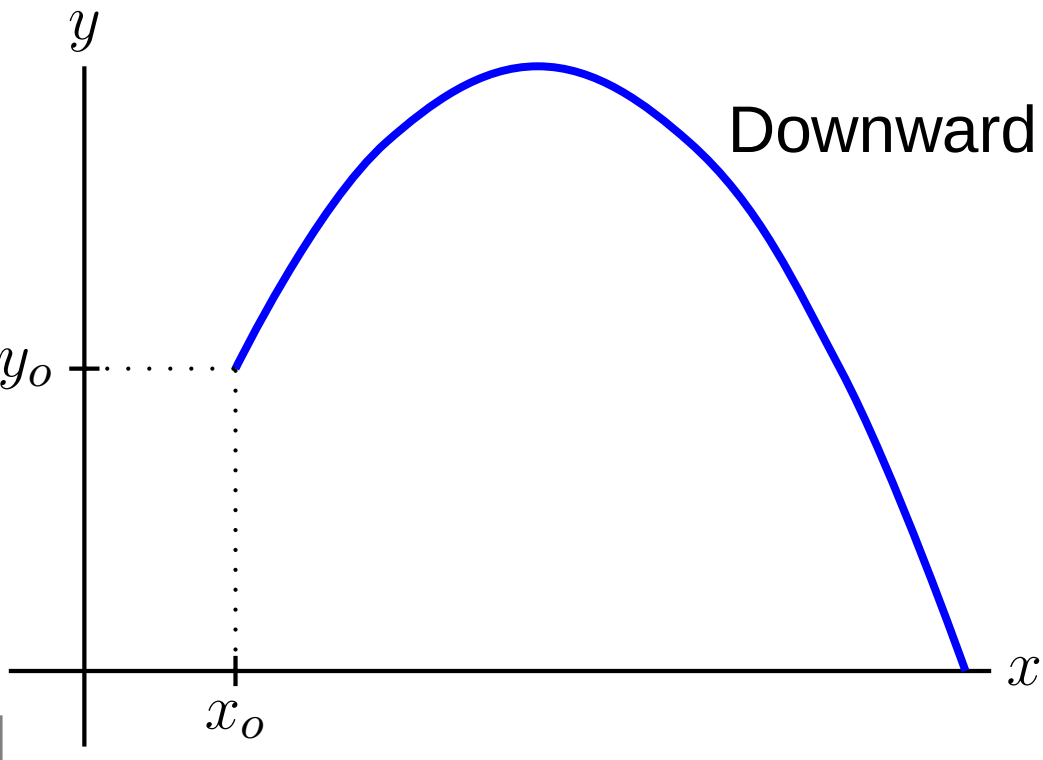

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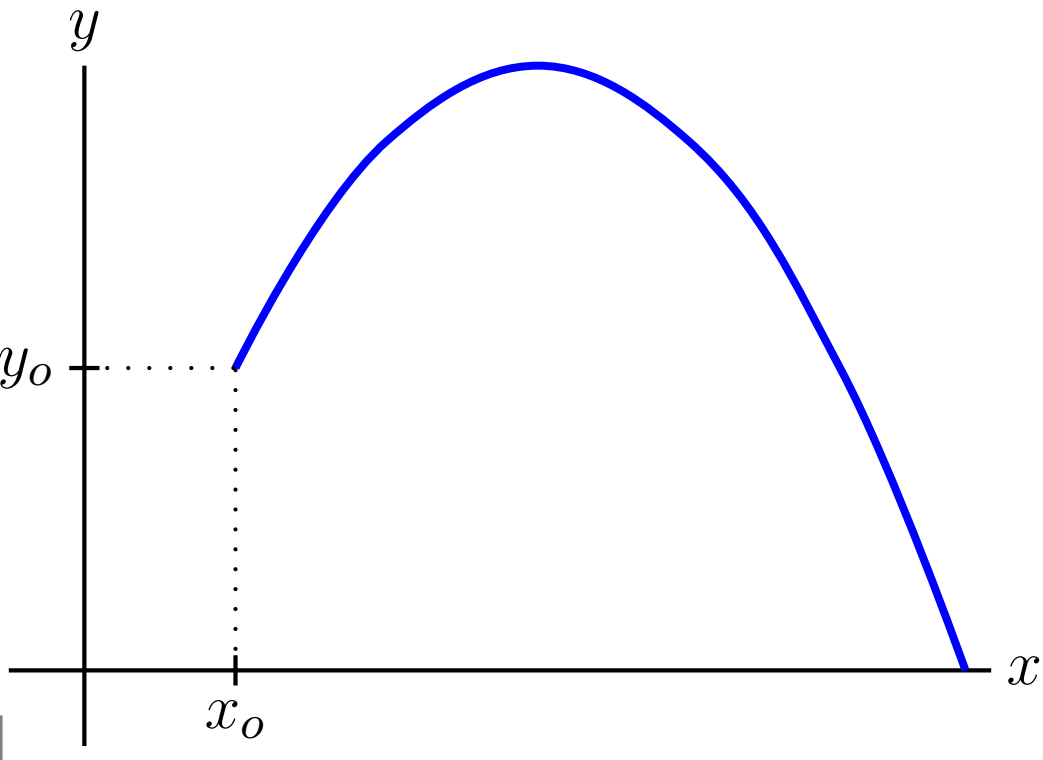

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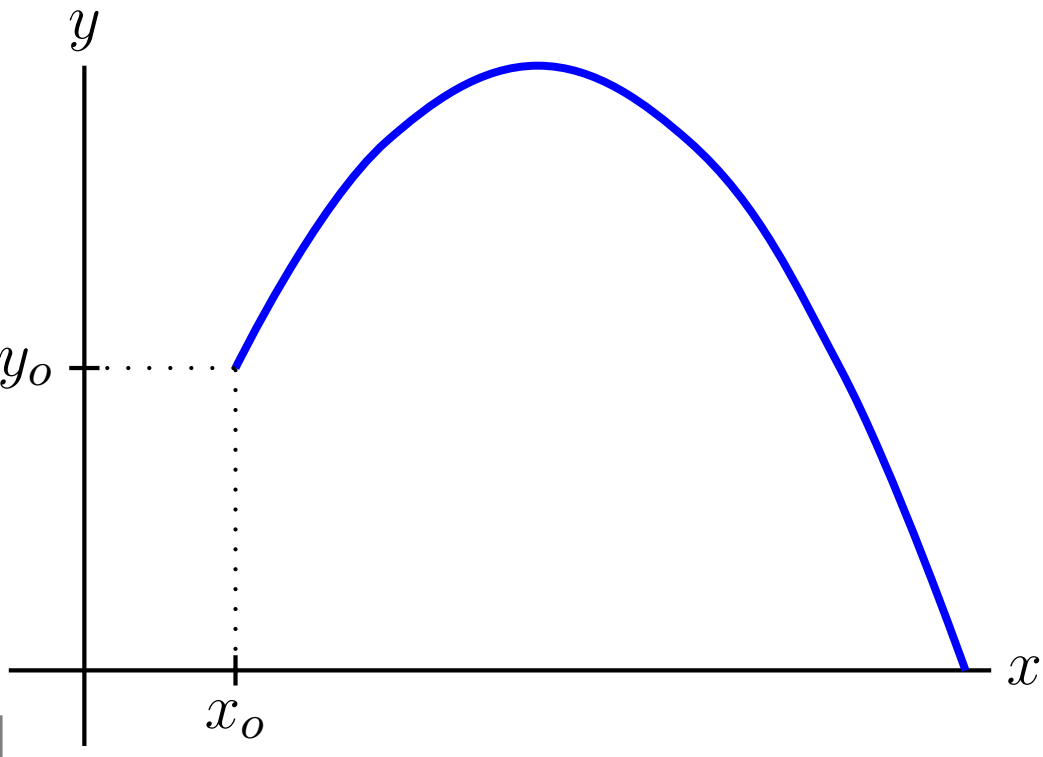

Time of flight - t_f

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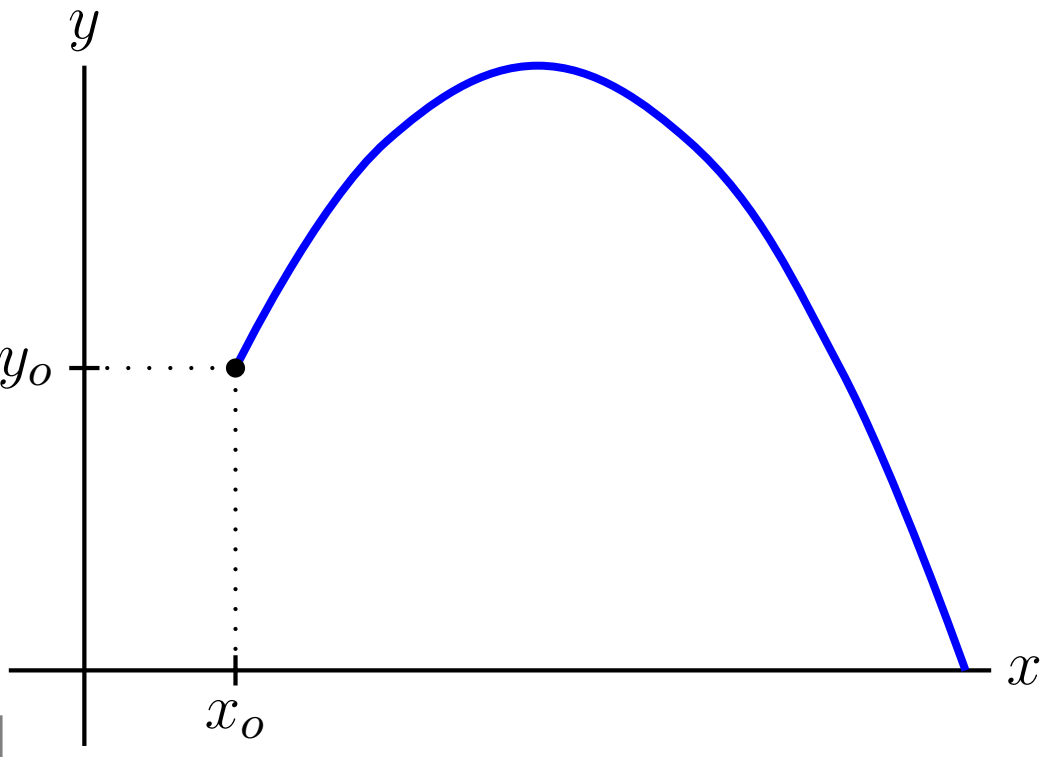

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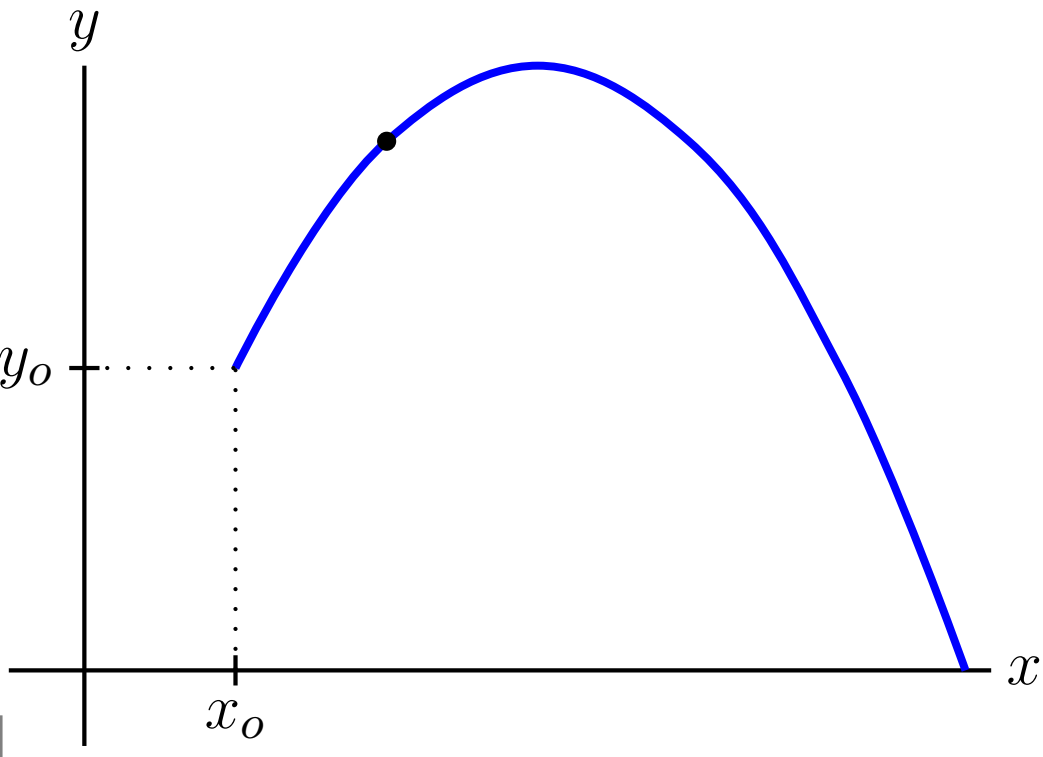

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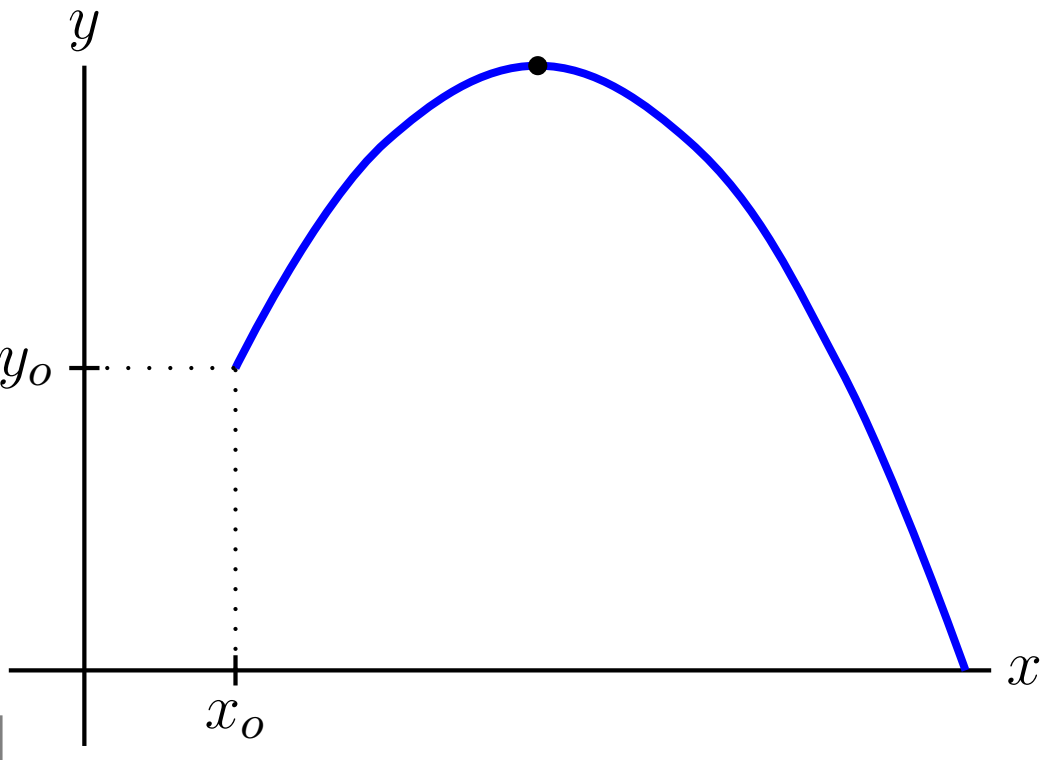

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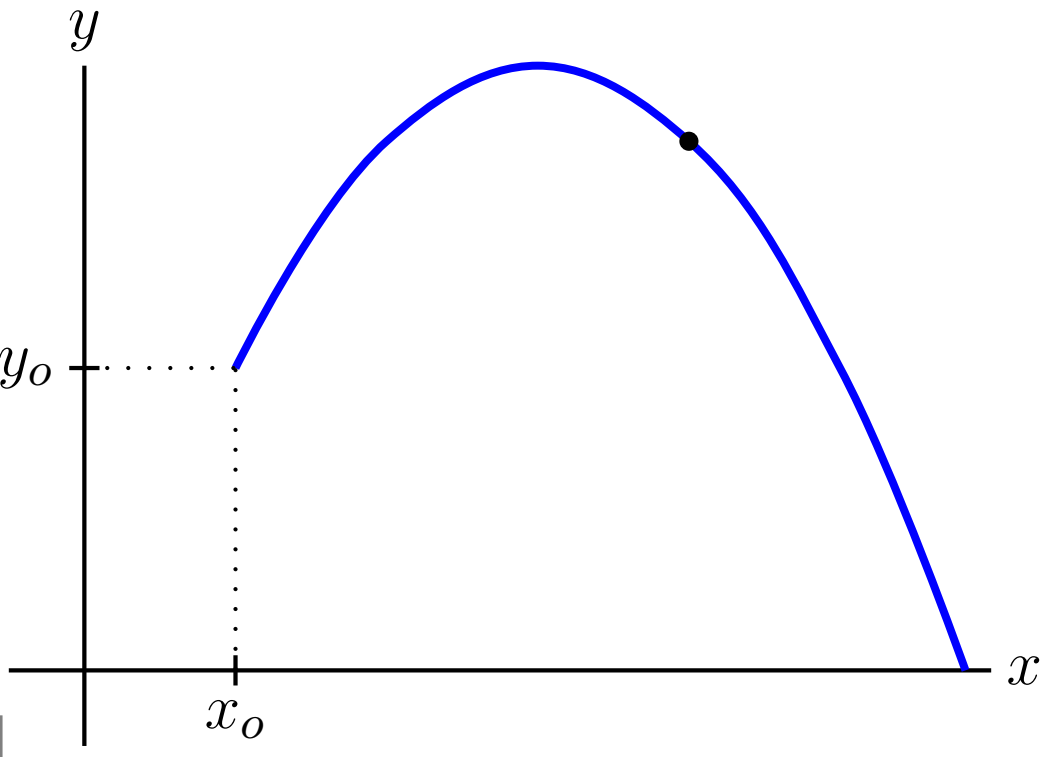

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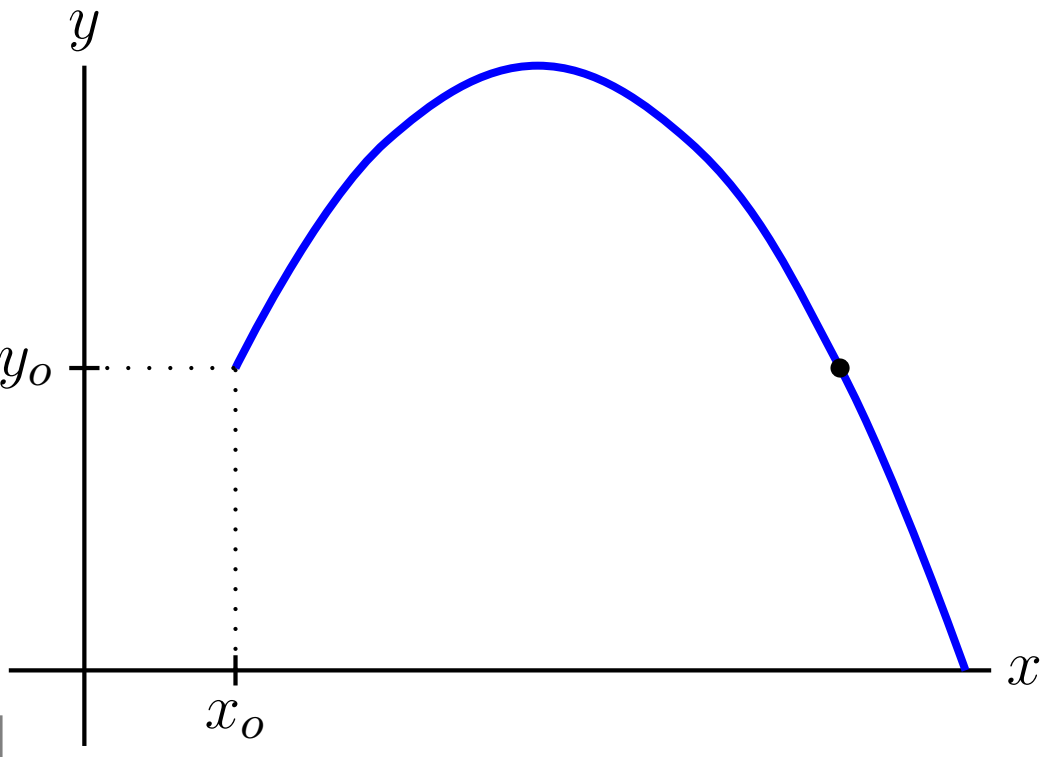

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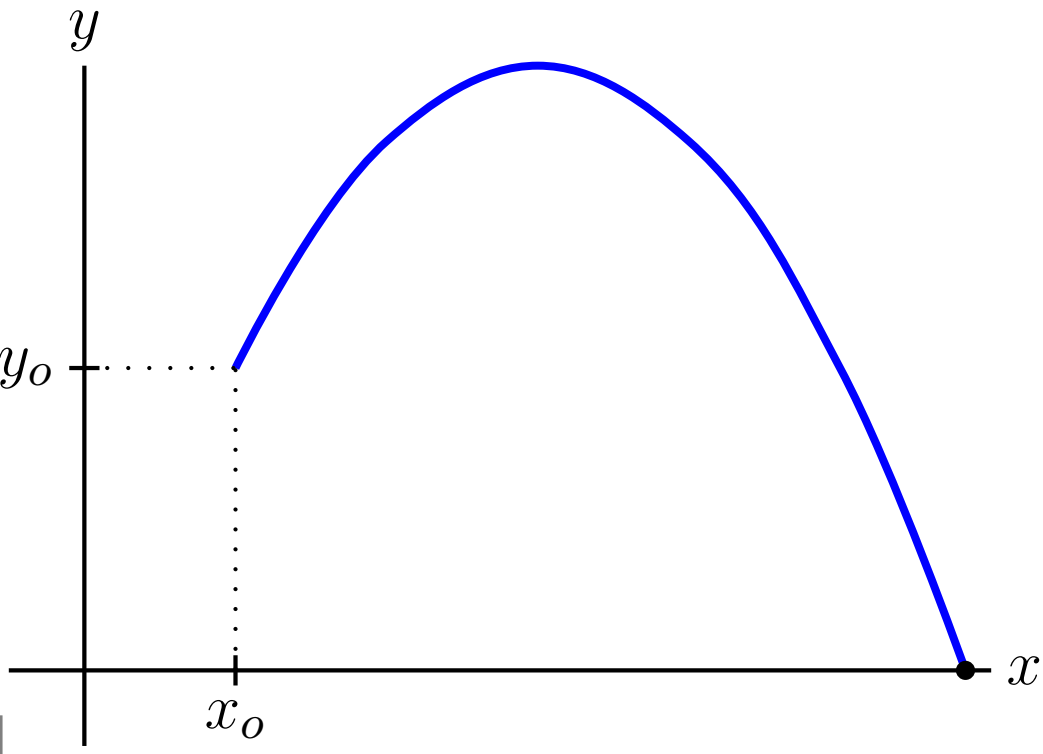

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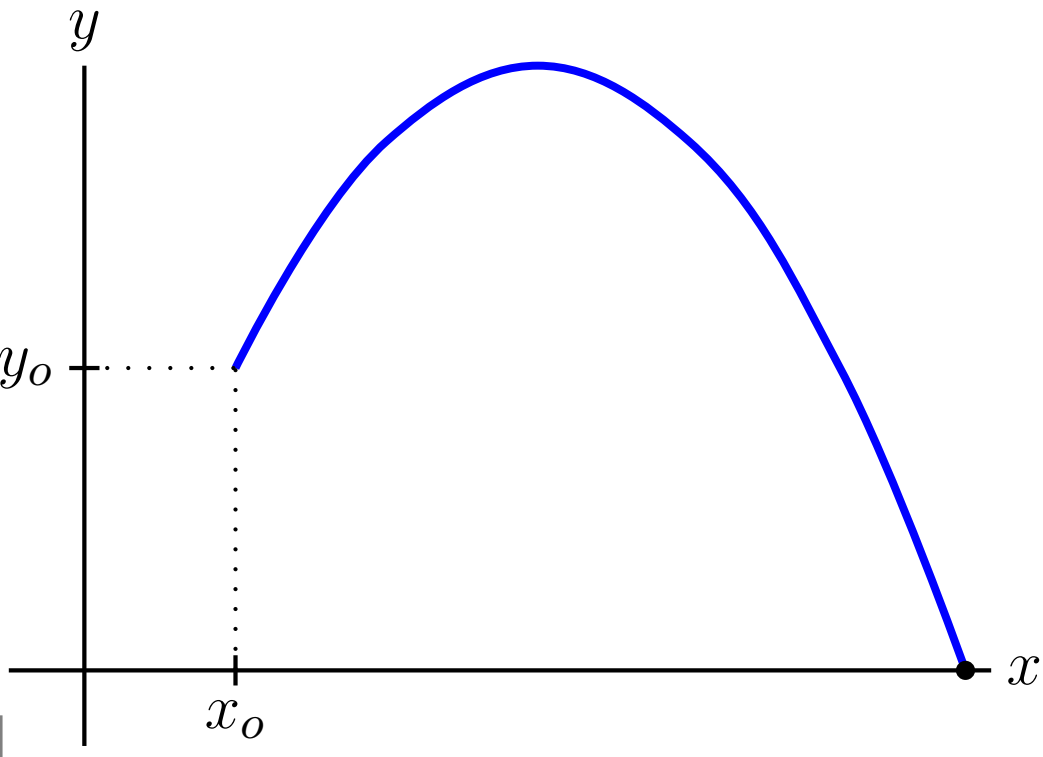

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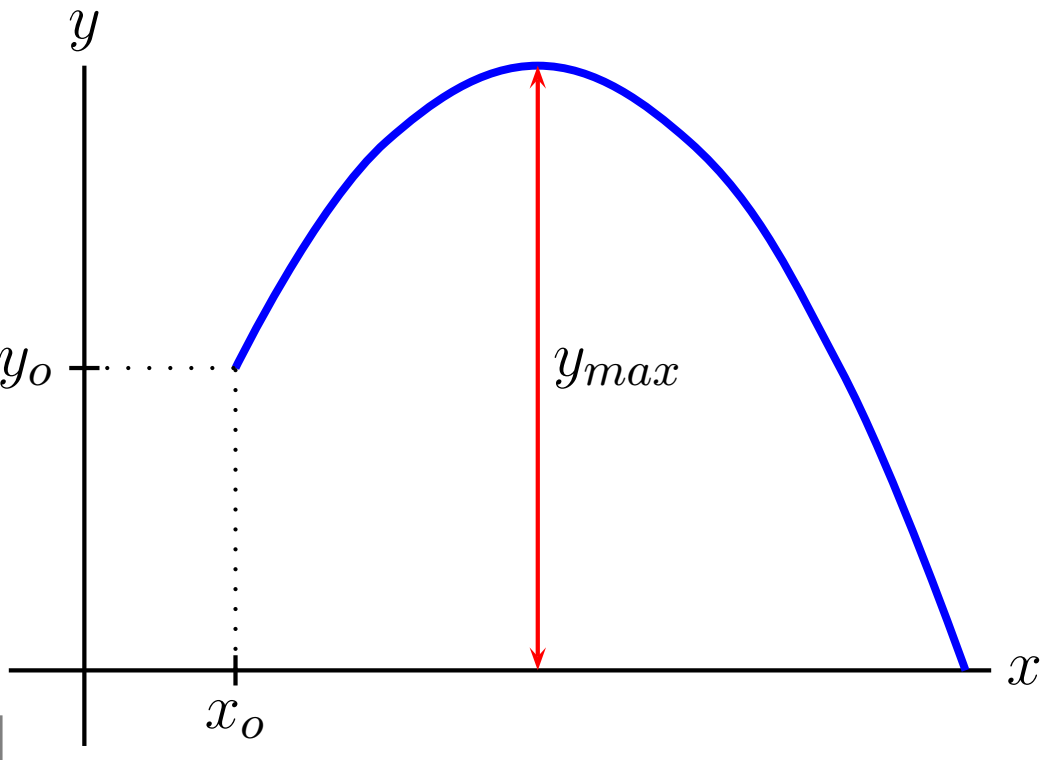

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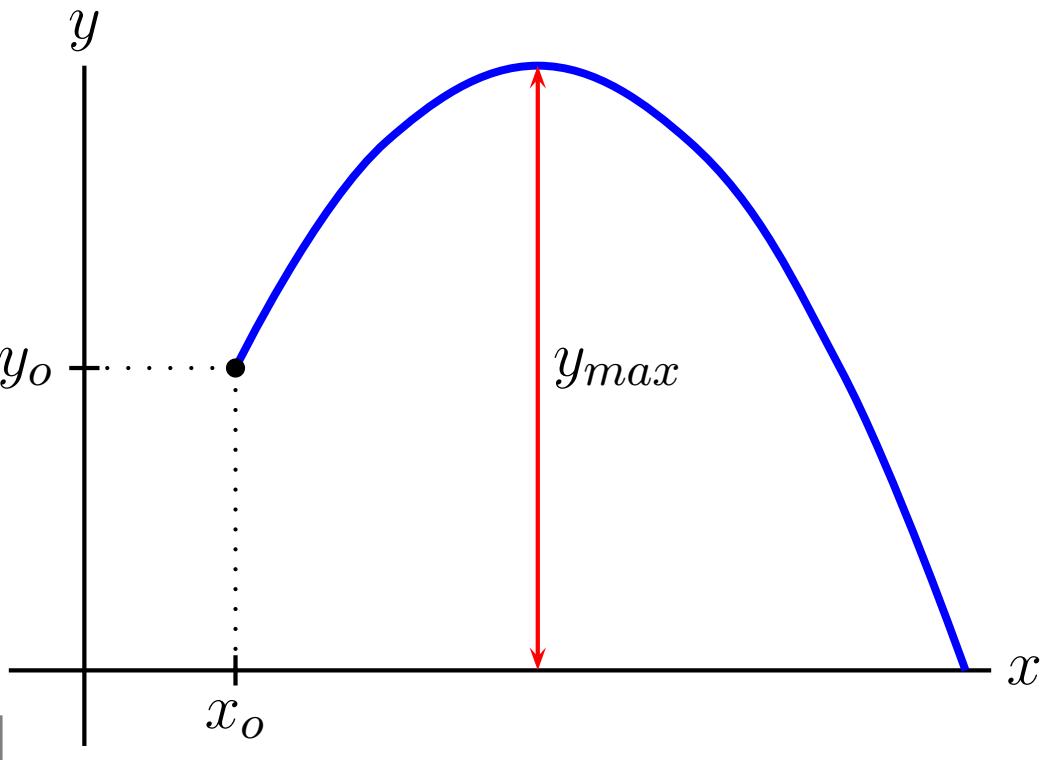

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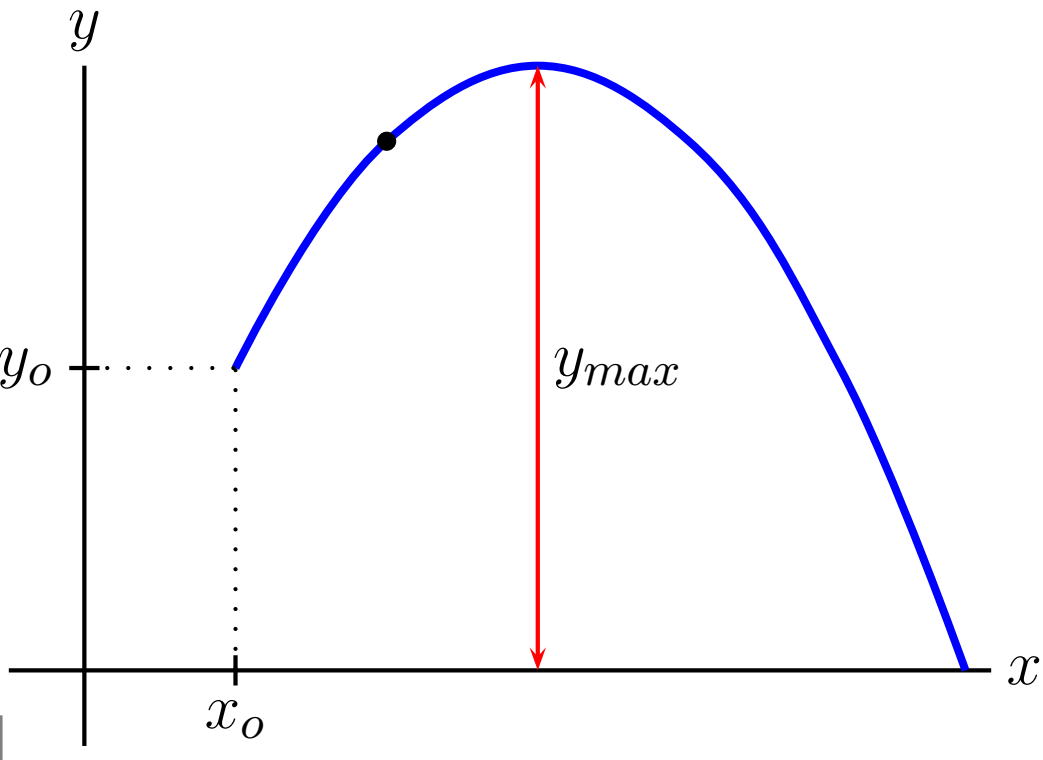

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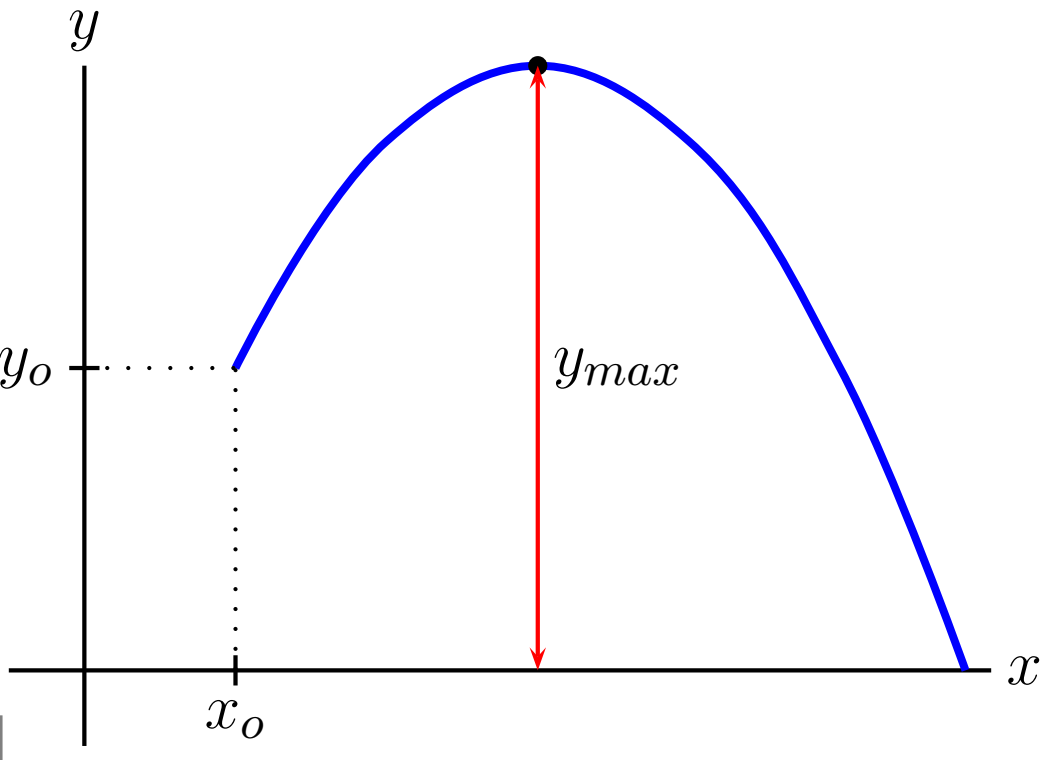

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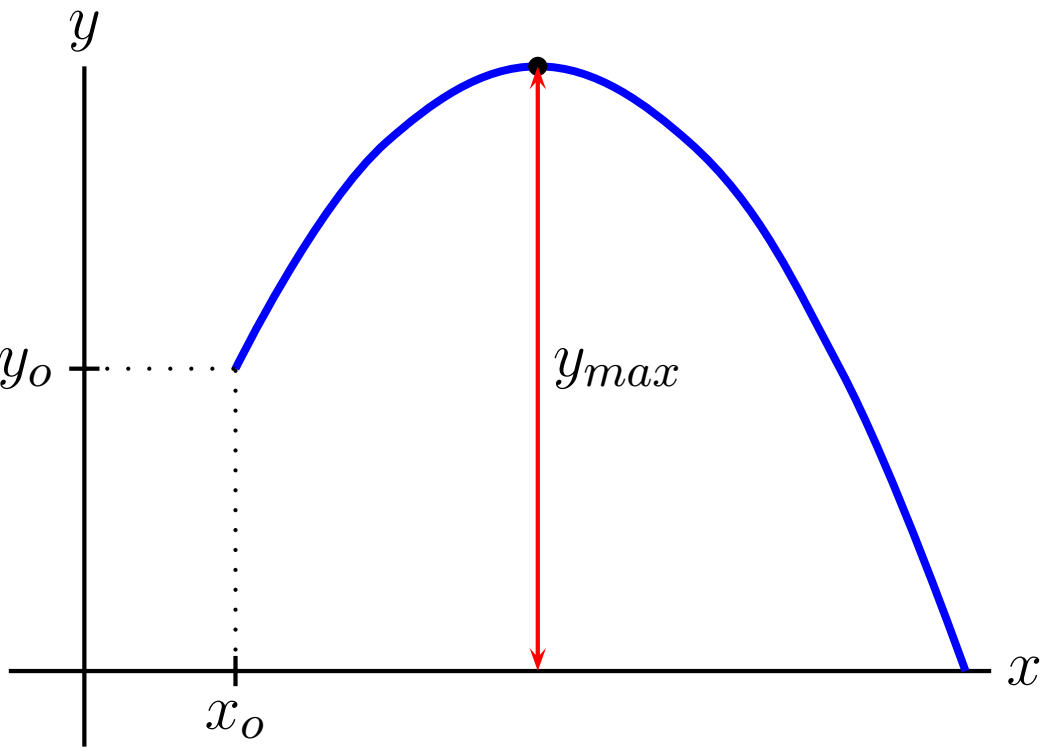
Clicker Quiz

At a projectile's maximum height, which of the following is a true statement?



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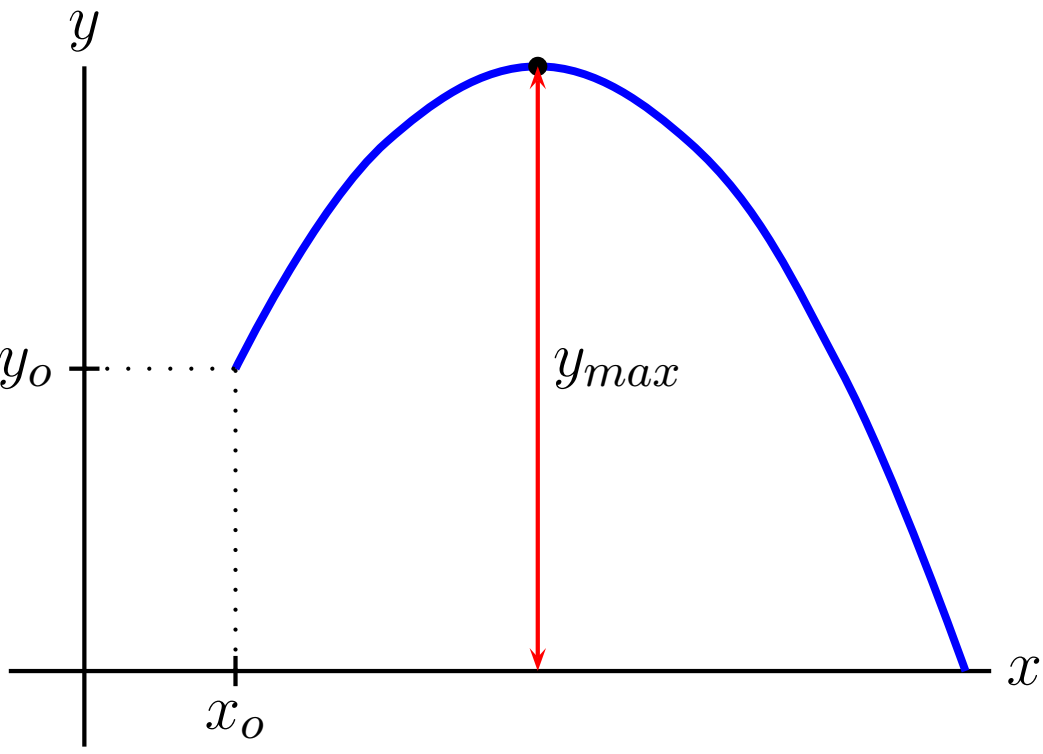

(a) $v = 0$

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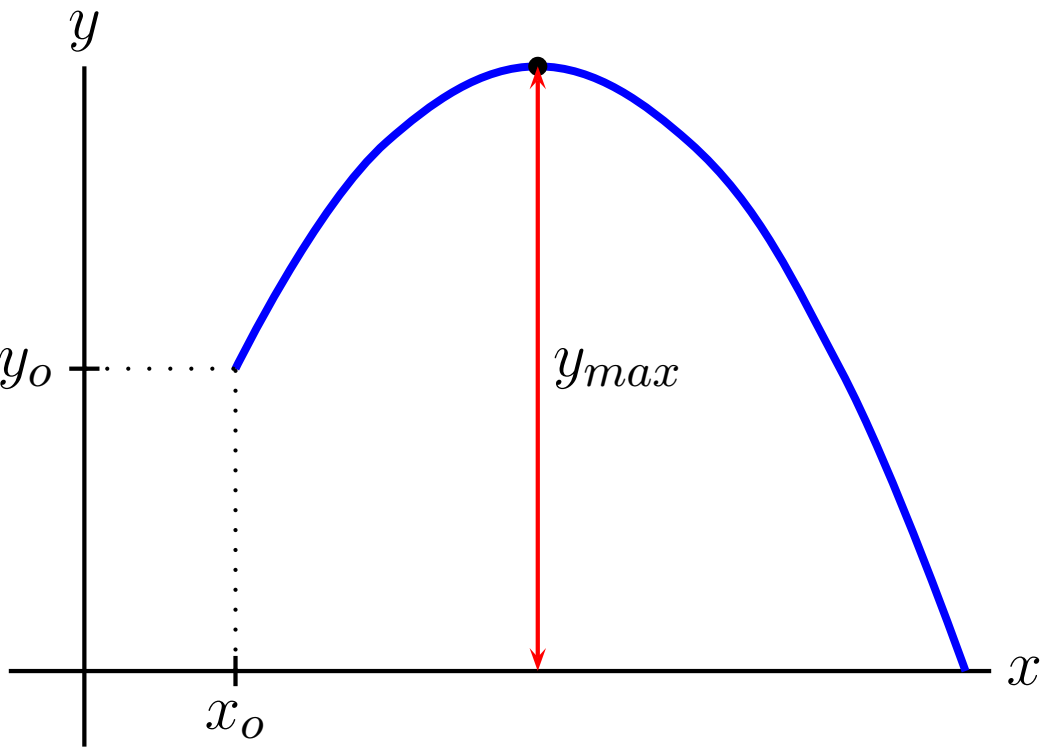

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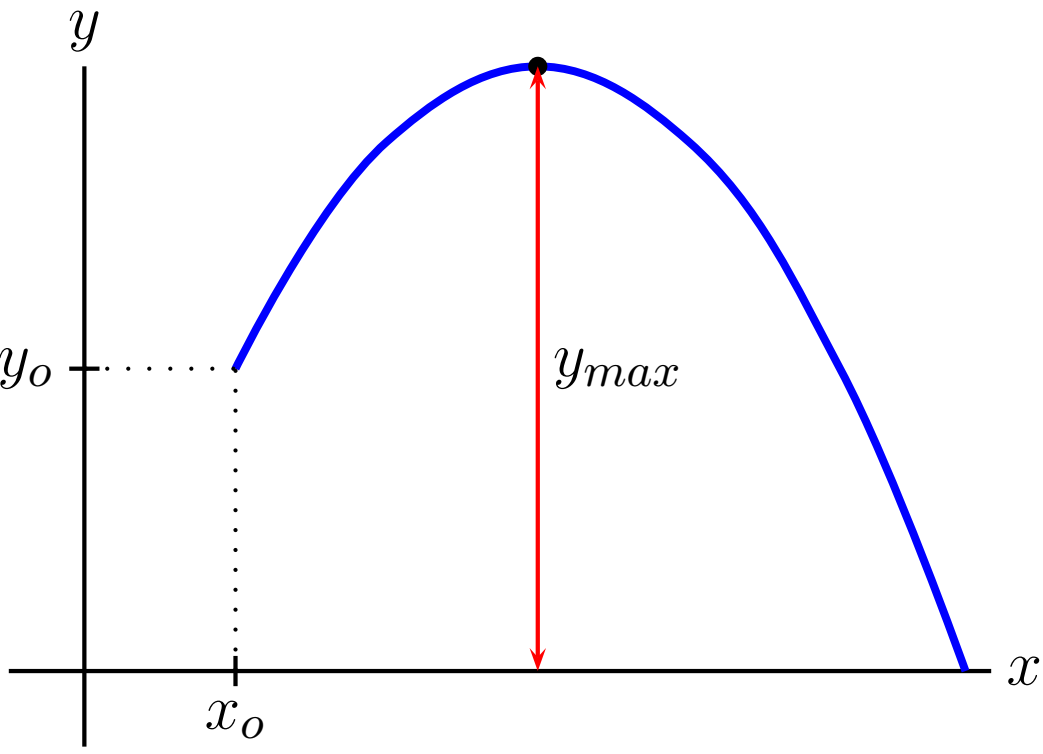

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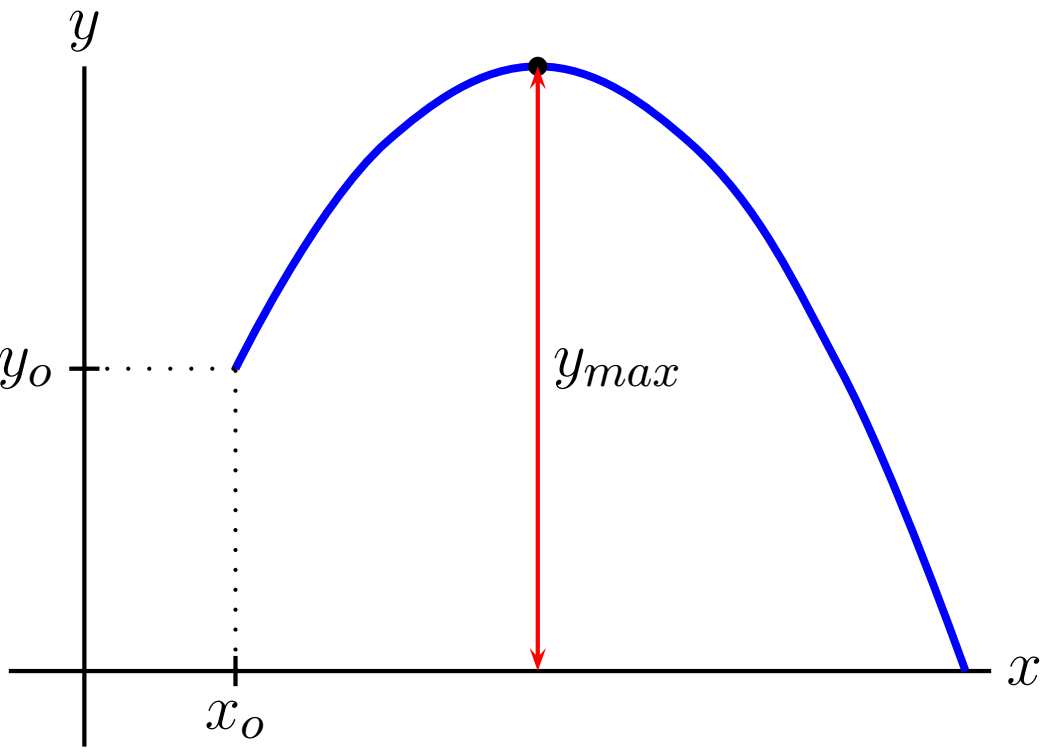

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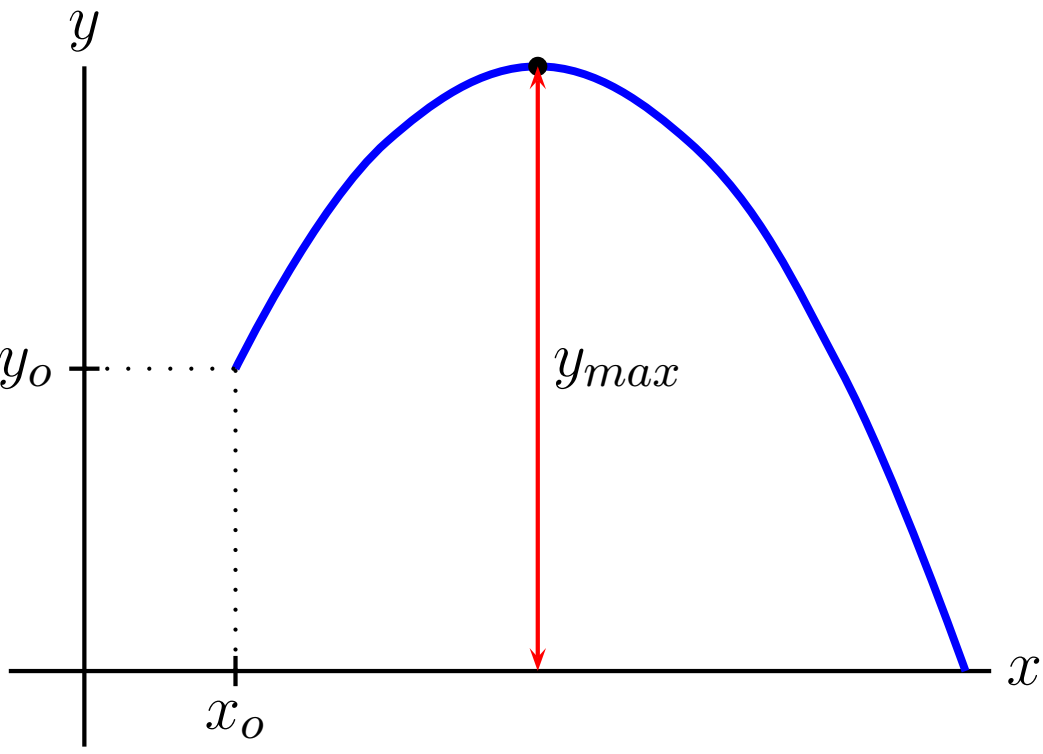

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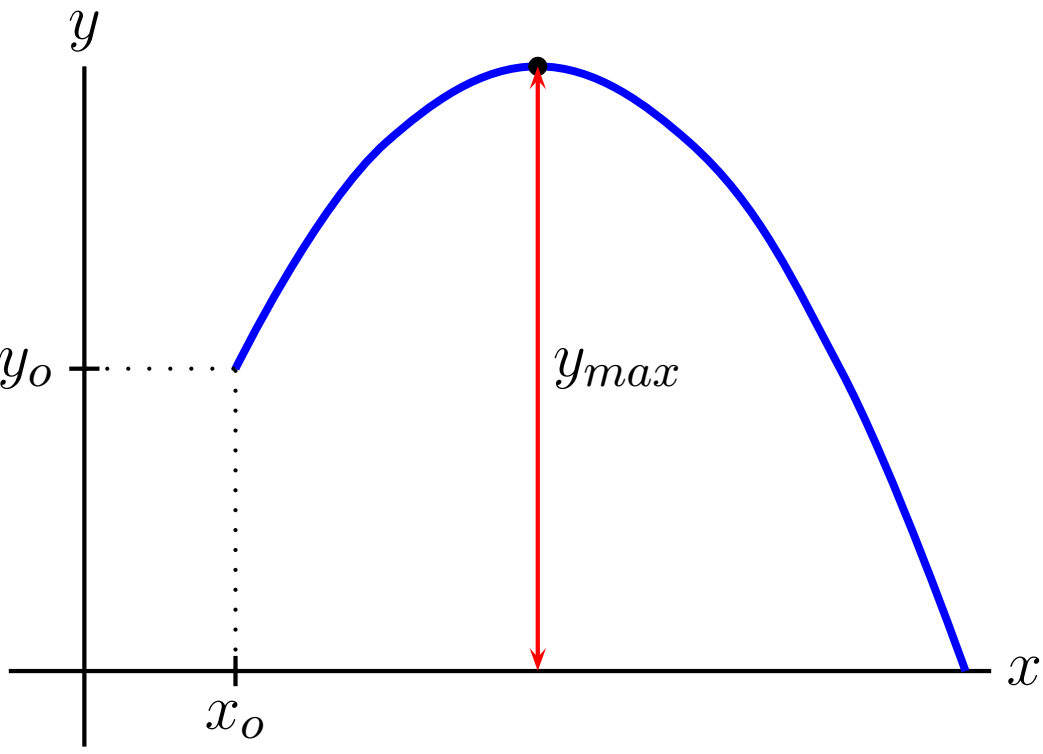

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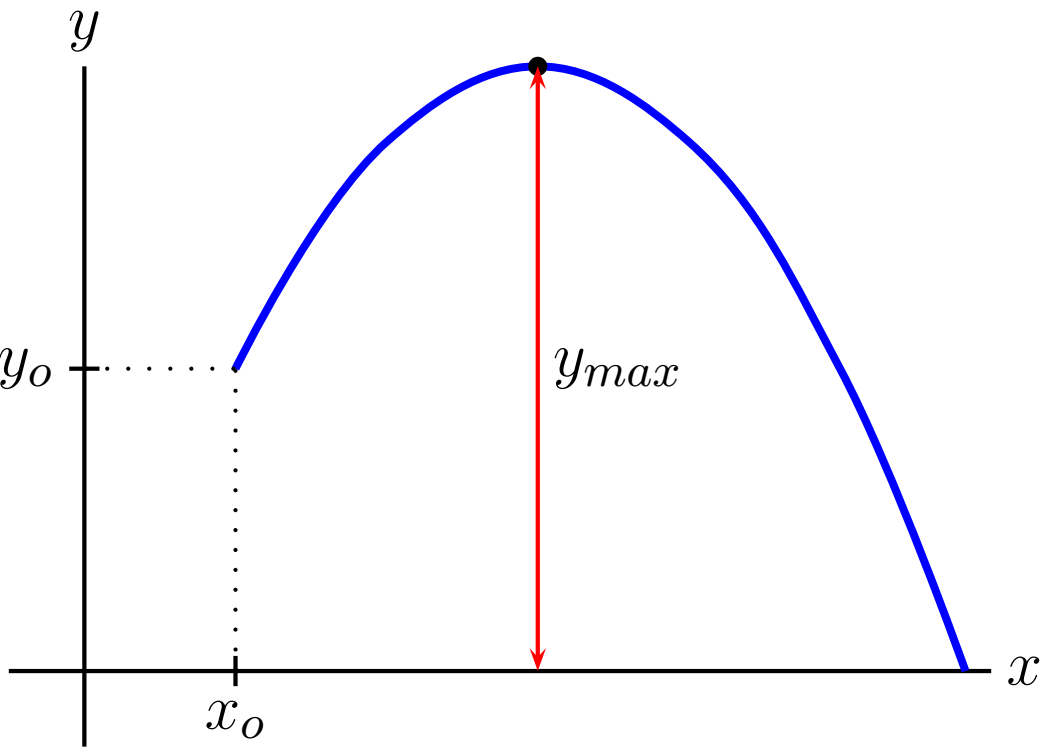

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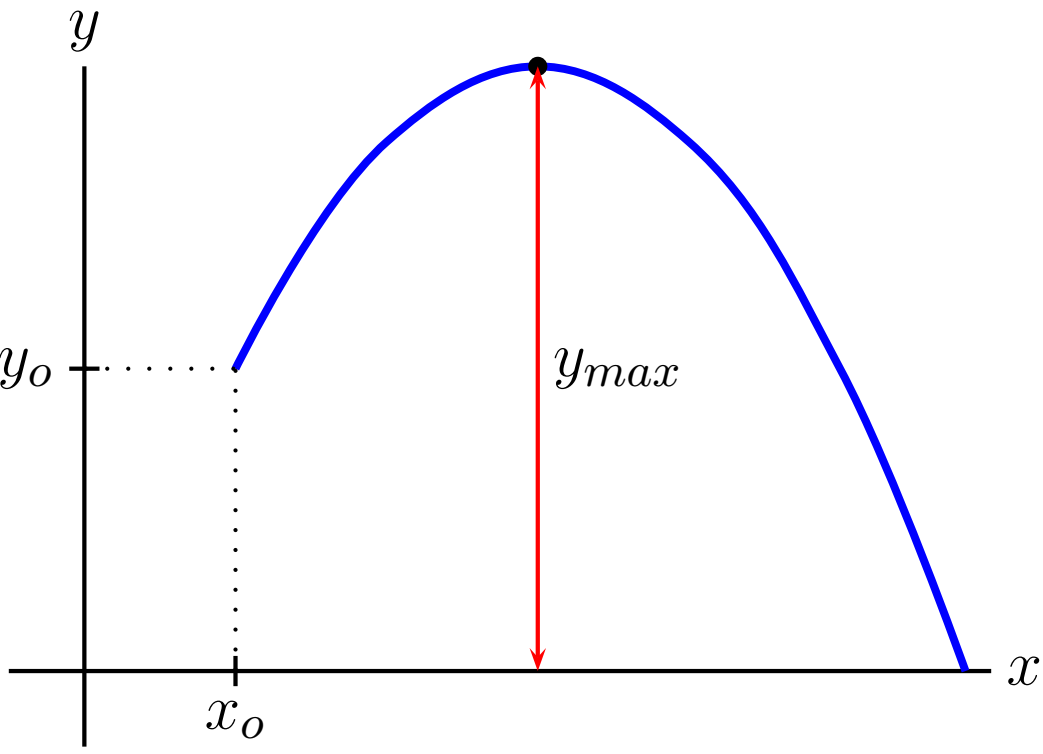

(a) ~~$v = 0$~~ $v = \sqrt{v_x^2 + v_y^2} \neq 0$

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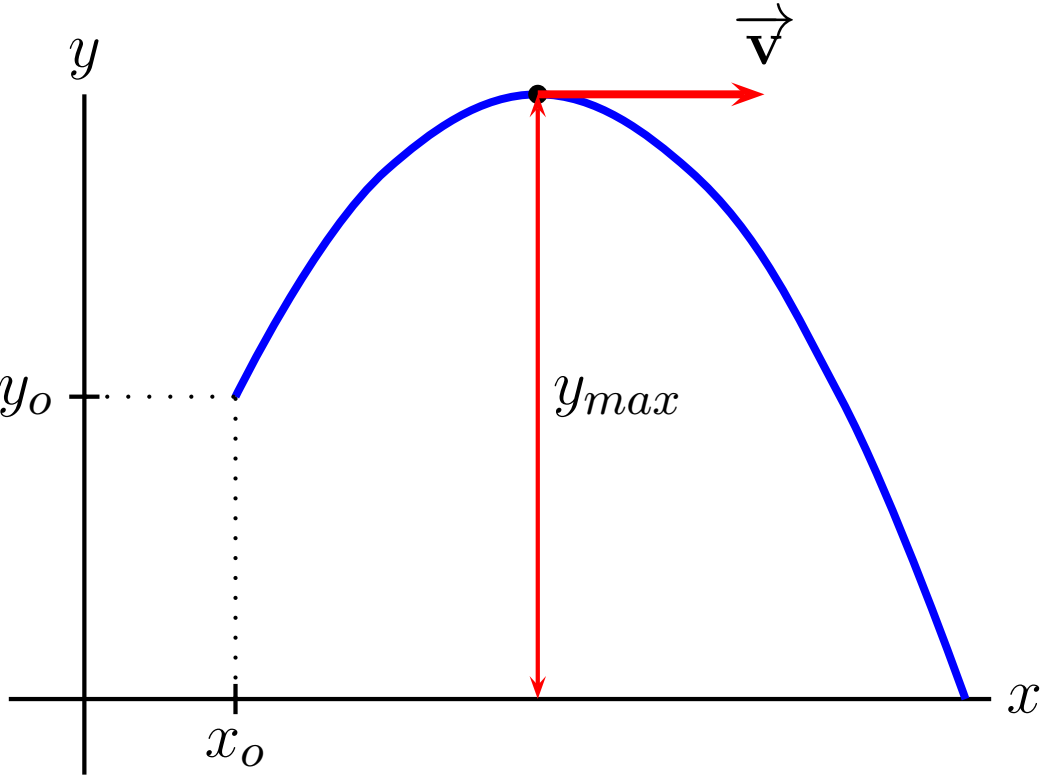

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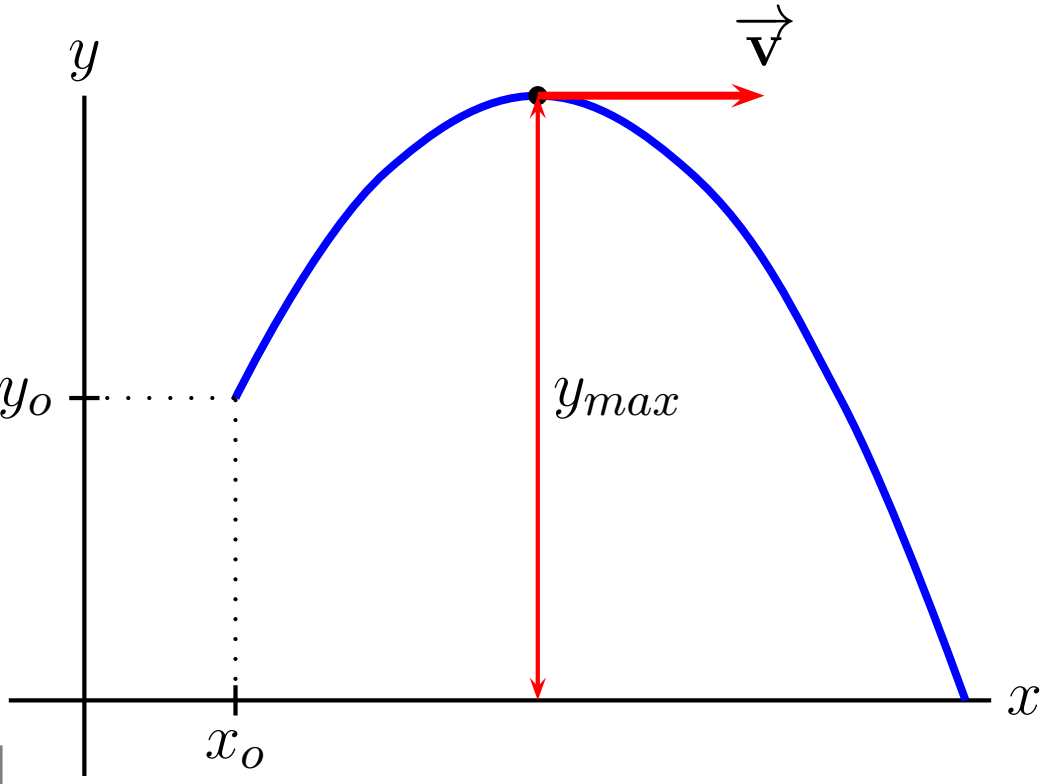

Time of flight - t_f

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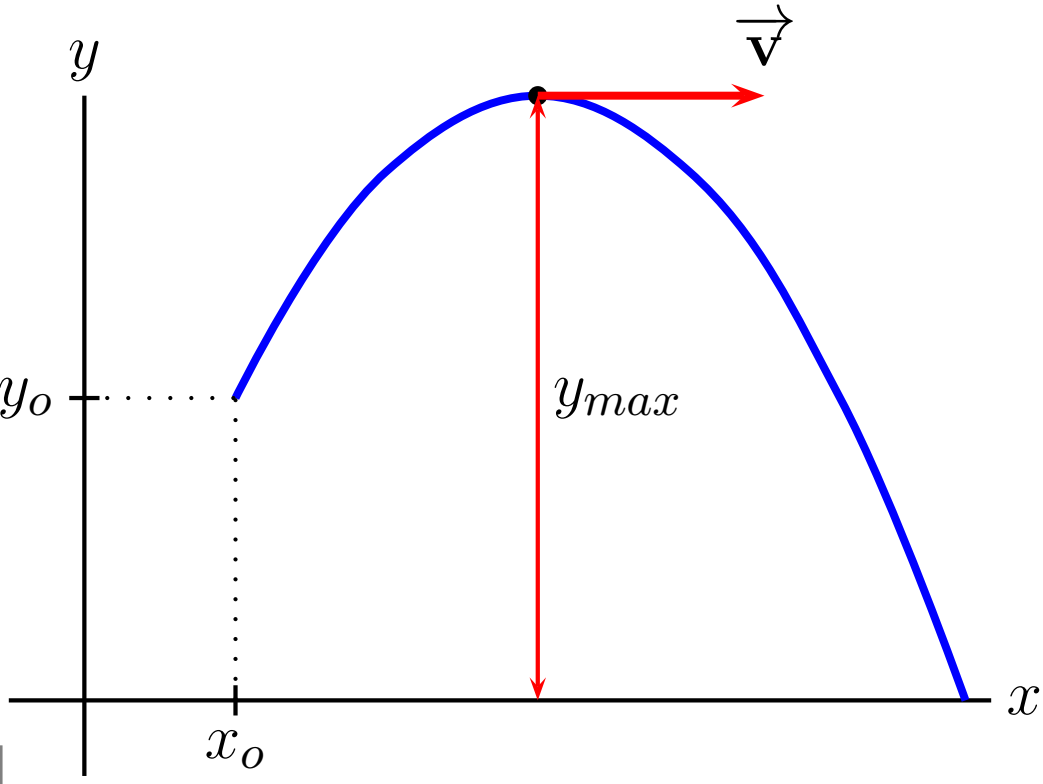

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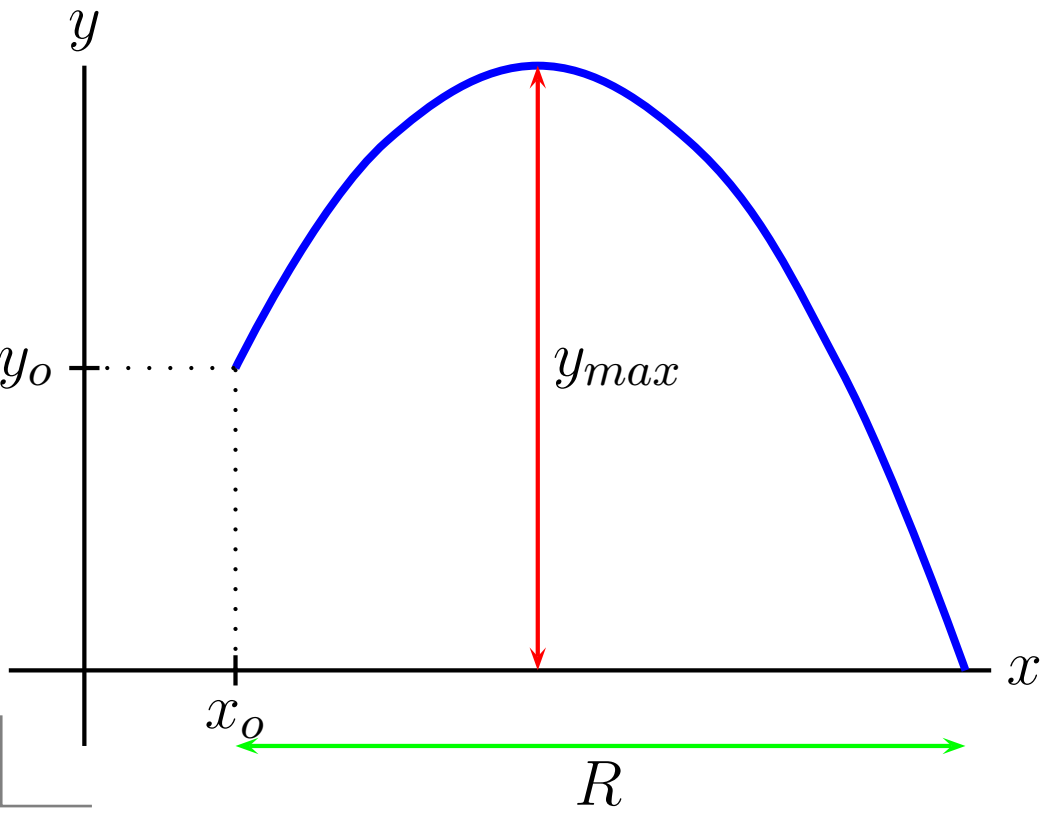

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Range - R

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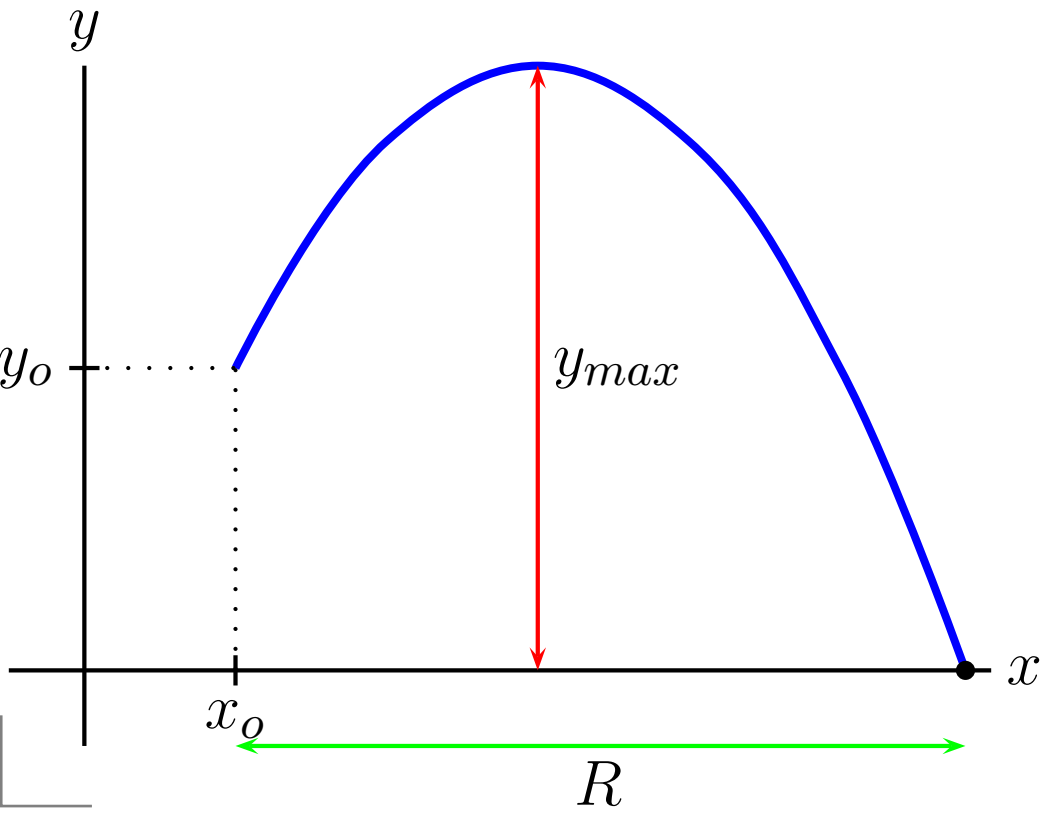

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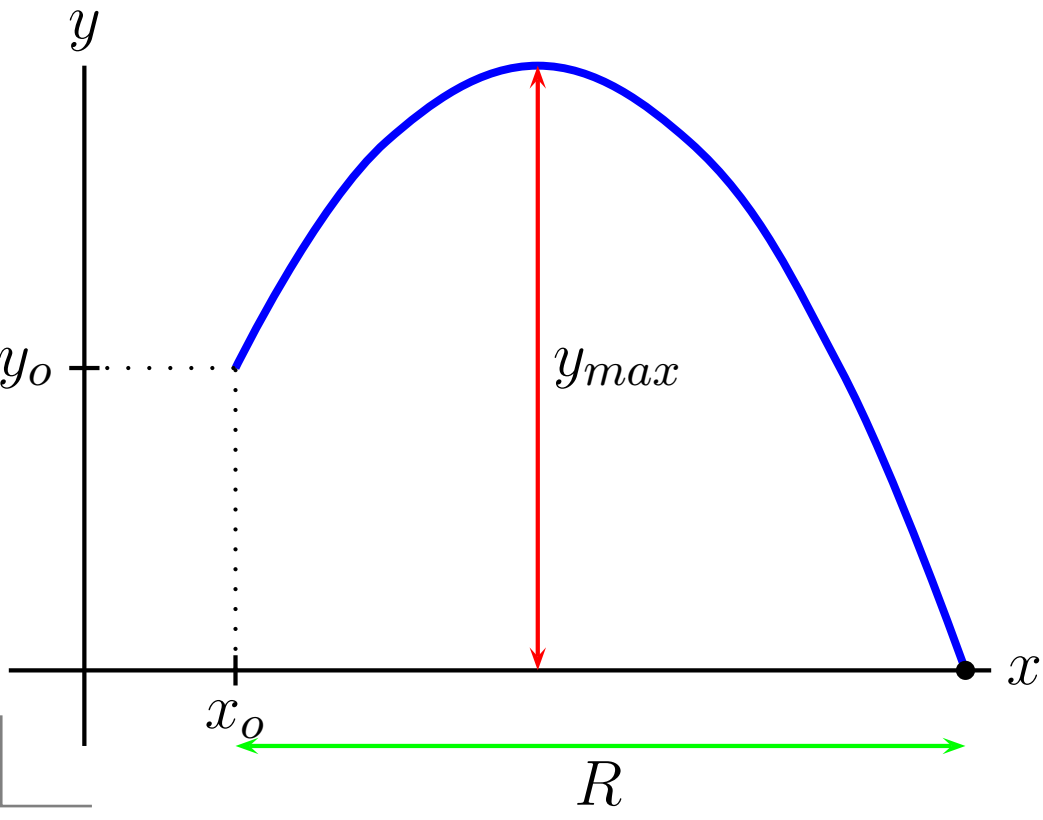

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$\Rightarrow x = ?, t = t_f$

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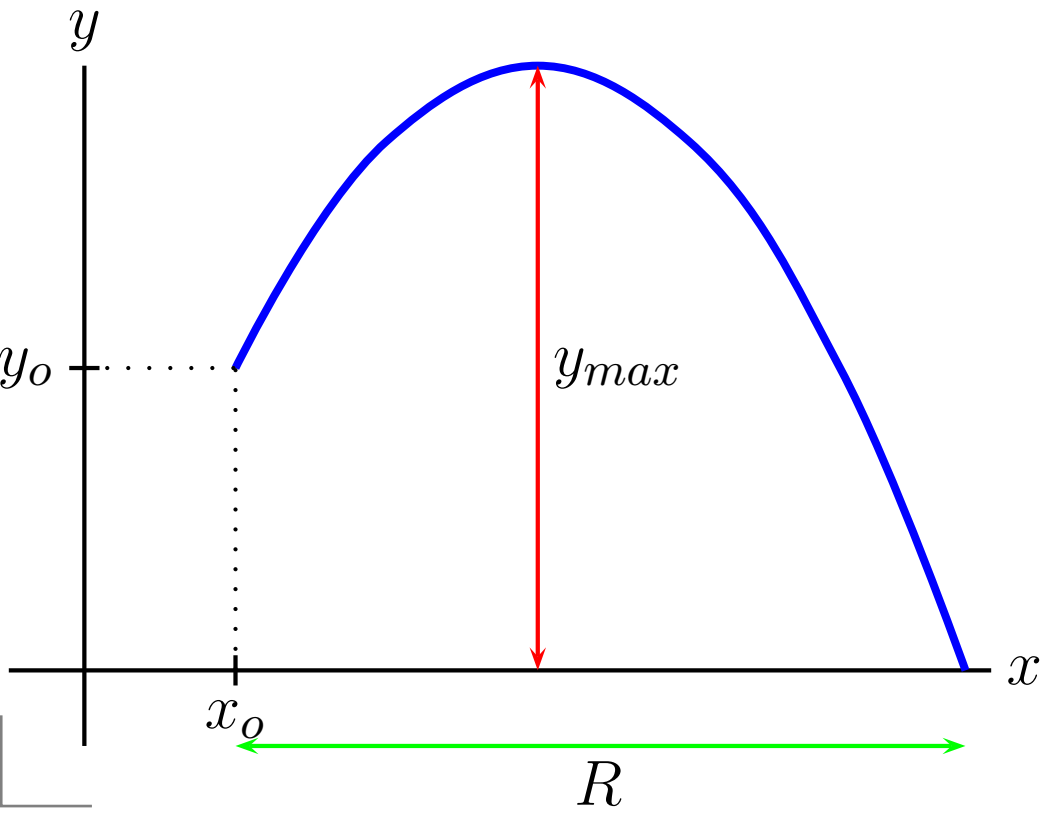

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$\Rightarrow y = ?, v_y = 0$

Range - R

$\Rightarrow x = ?, t = t_f$

Warning: Book Equations only for $y_o = y = 0$

Dynamics

Dynamics - Why objects move.

Dynamics

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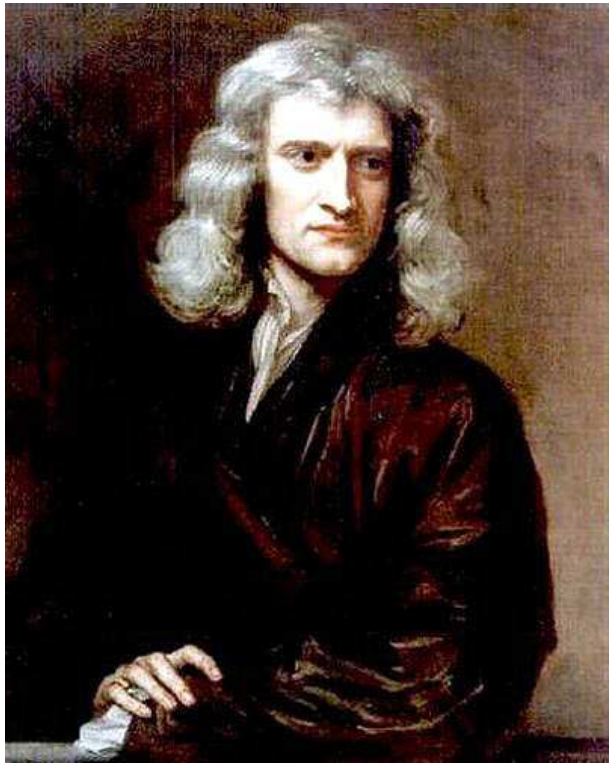

Sir Isaac Newton (1642-1727) British Physicist, In 1687 he published the *Philosophiæ Naturalis Principia Mathematica*. The *Principia* details how all motion can be explained by one of three simple statements = Newton's Three Laws of Motion.

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These three laws are still in use; however, they need modification in two situations:

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- When an object's velocity approaches the speed of light - Einstein's theory of relativity.

- Motion of atomic-sized objects - Quantum Mechanics (Also started by Einstein).

Force

Underlying all three of Newton's Laws is the concept of force.

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Force - Push or Pull

Force

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Two types of forces:

Force

Underlying all three of Newton's Laws is the concept of force.

Force - Push or Pull

Two types of forces:

- Contact Forces - Two objects in contact.

Force

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Two types of forces:

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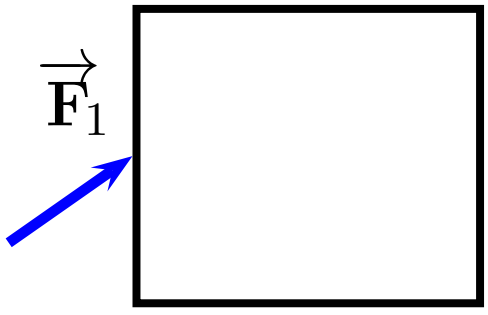

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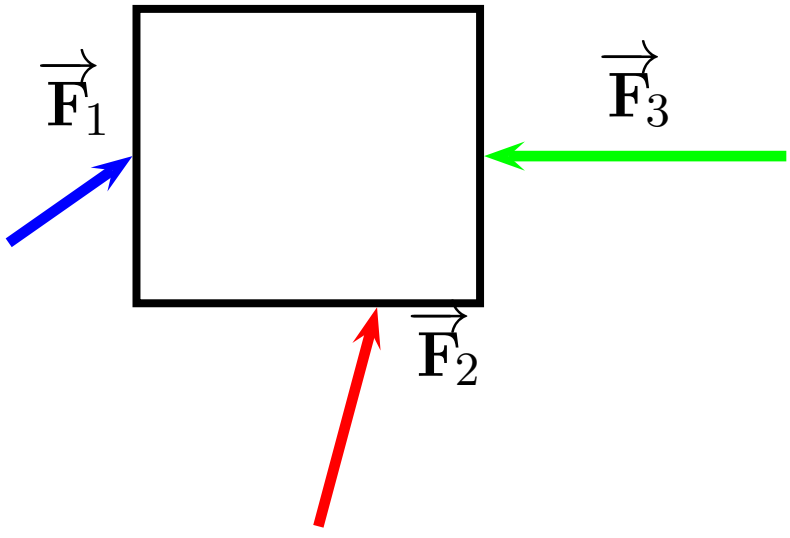

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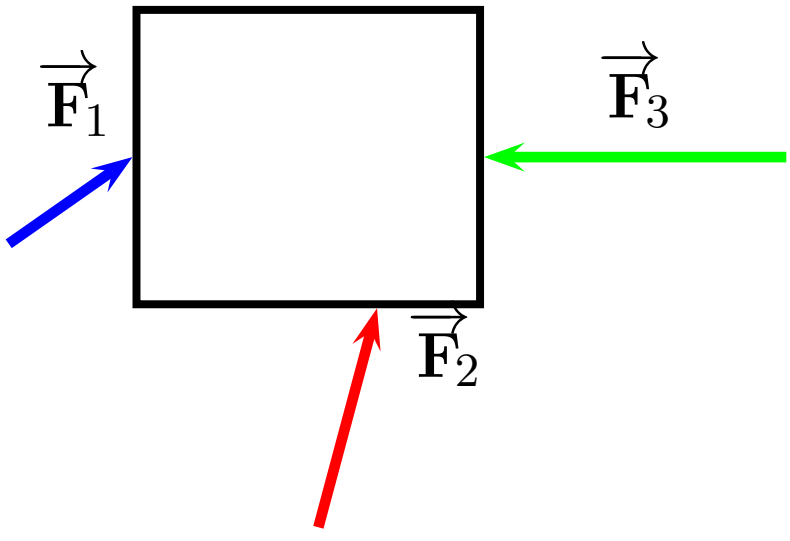

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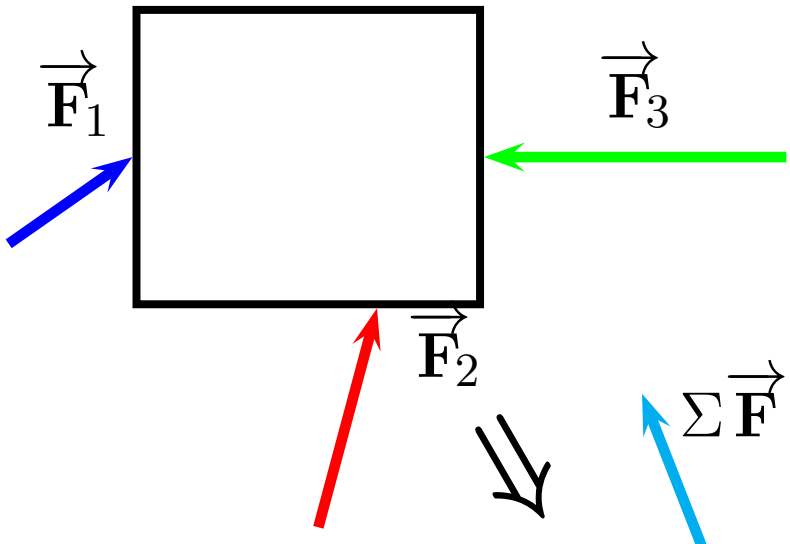

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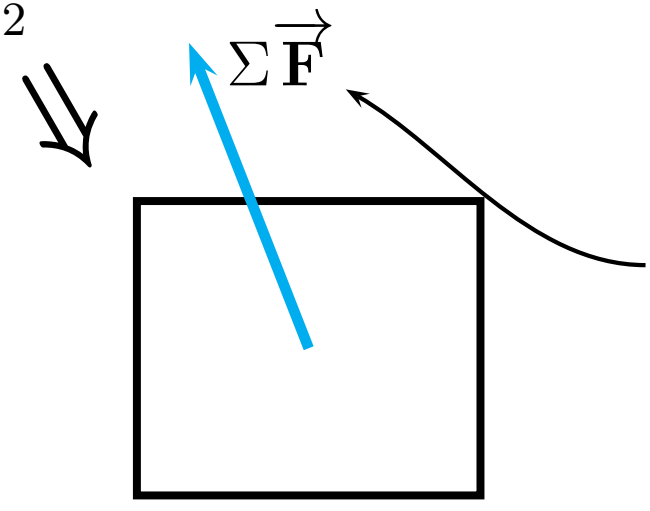

One single force.

Applied at the center

to avoid rotation.