# June 16, Week 3

Today: Chapter 3, Projectile Motion

Homework #3 is now available.

## Scalar Components

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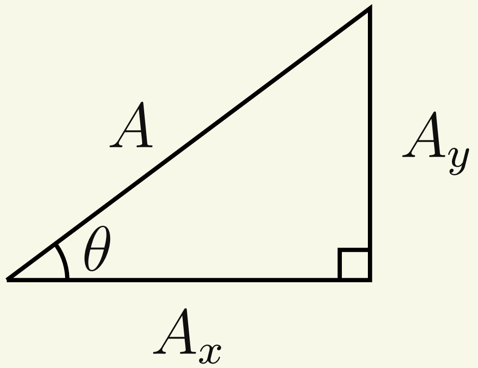

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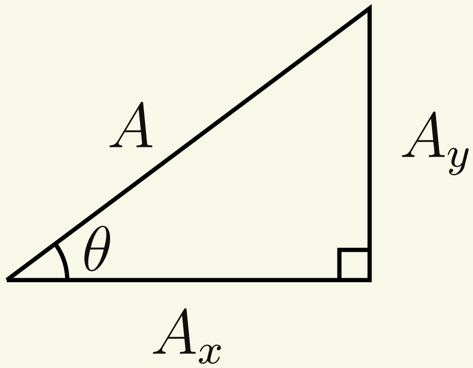


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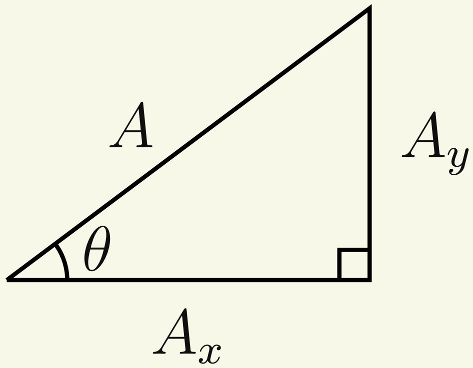


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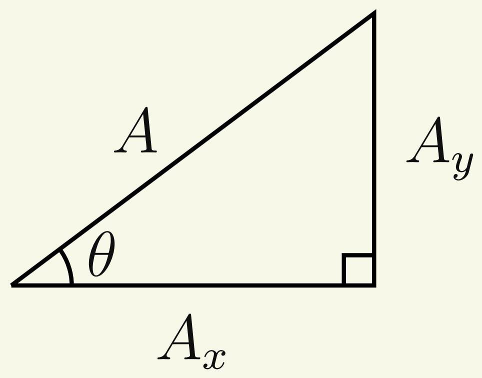


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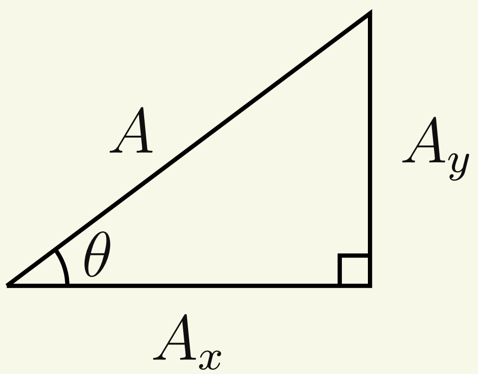


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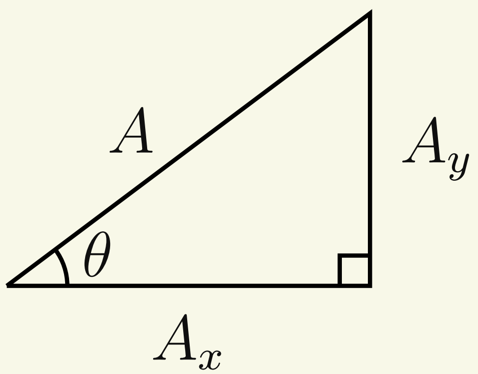


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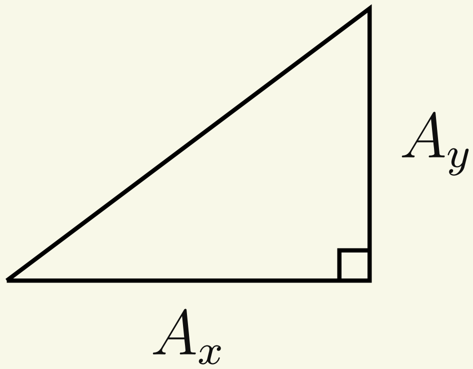
Only guaranteed to work for the standard angle

## Scalar Components II

To find the magnitude and the angle *from* the components:



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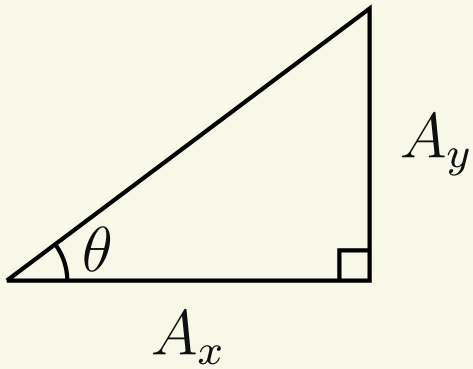


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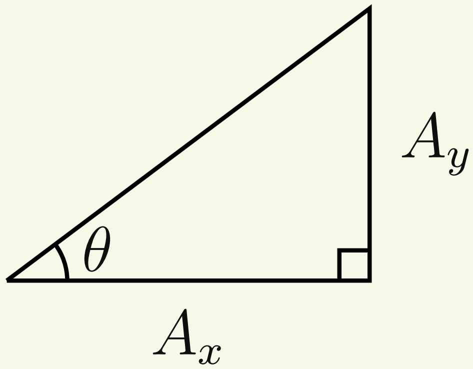


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Arctangent

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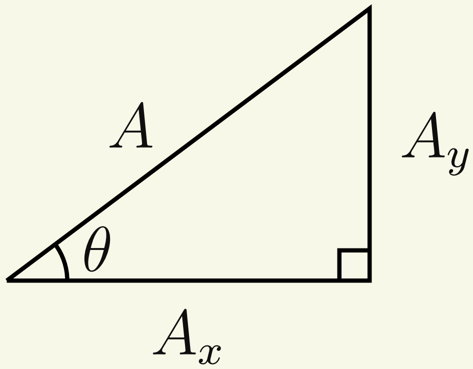


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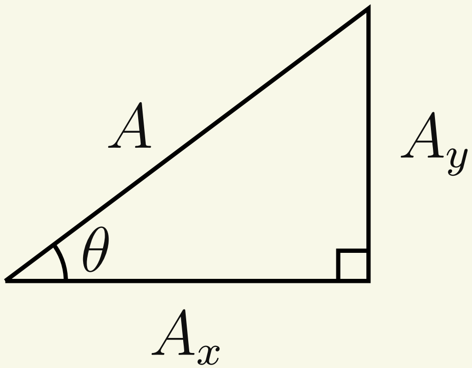


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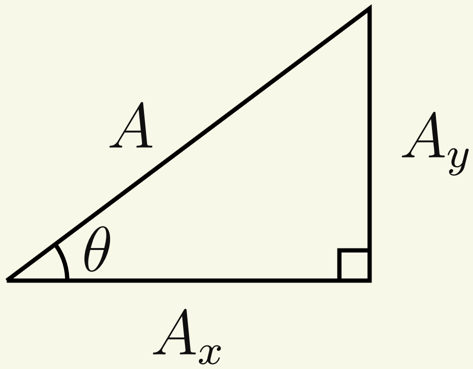


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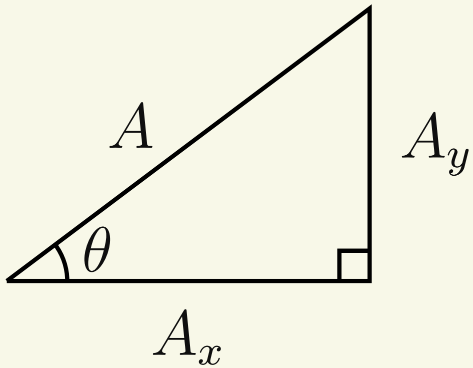


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Example: Find the magnitude and direction for the vector with components $A_x = 1\,m$ and $A_y = 1\,m$.

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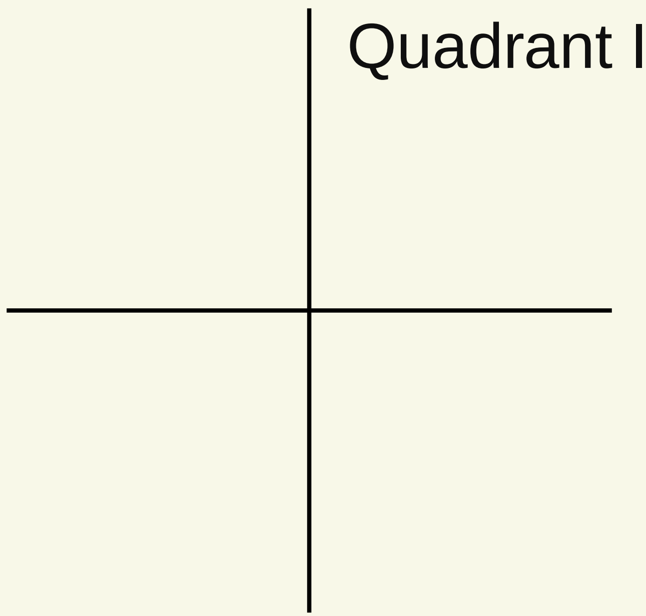

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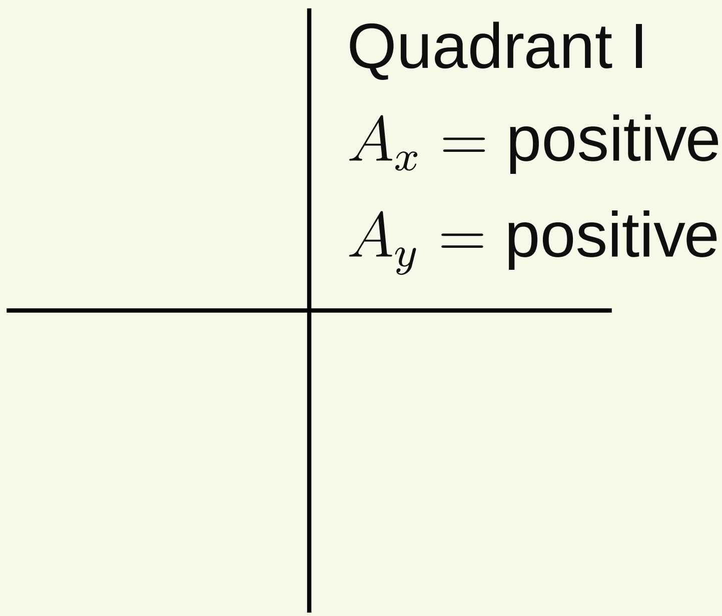

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|---|

Quadrant II

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| | |
|---|---|
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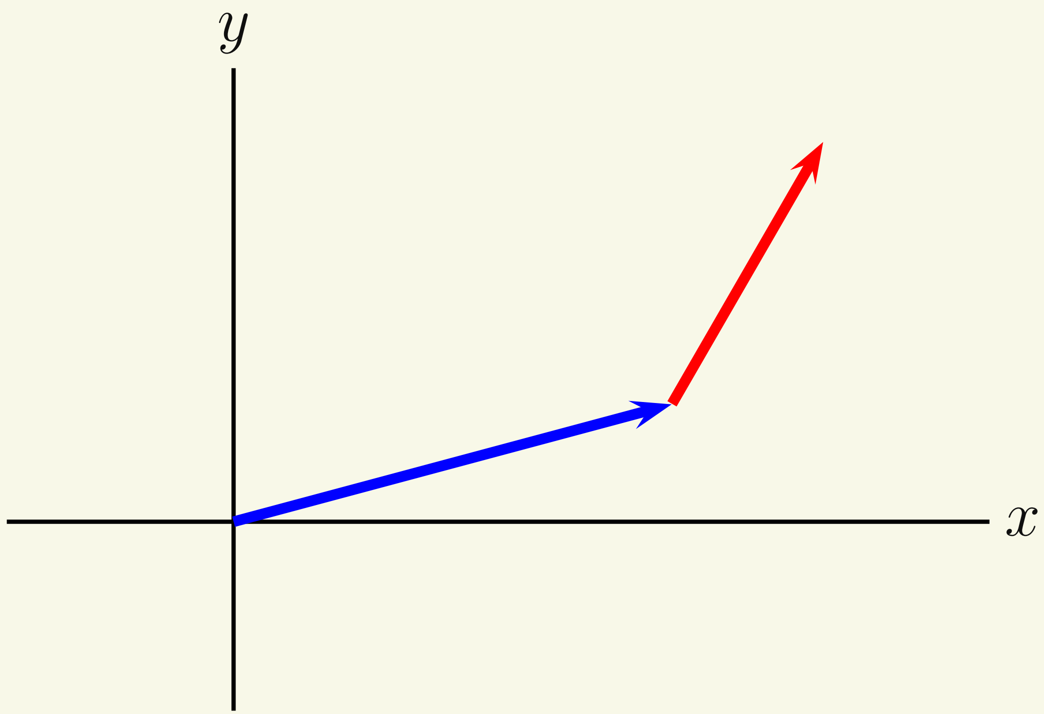


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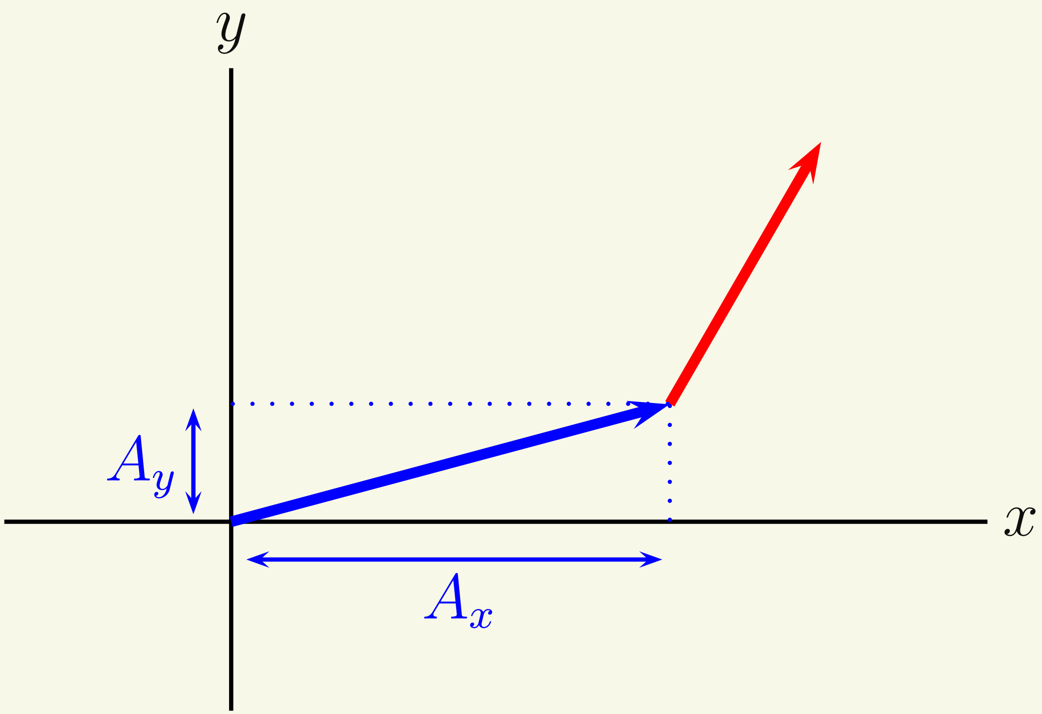


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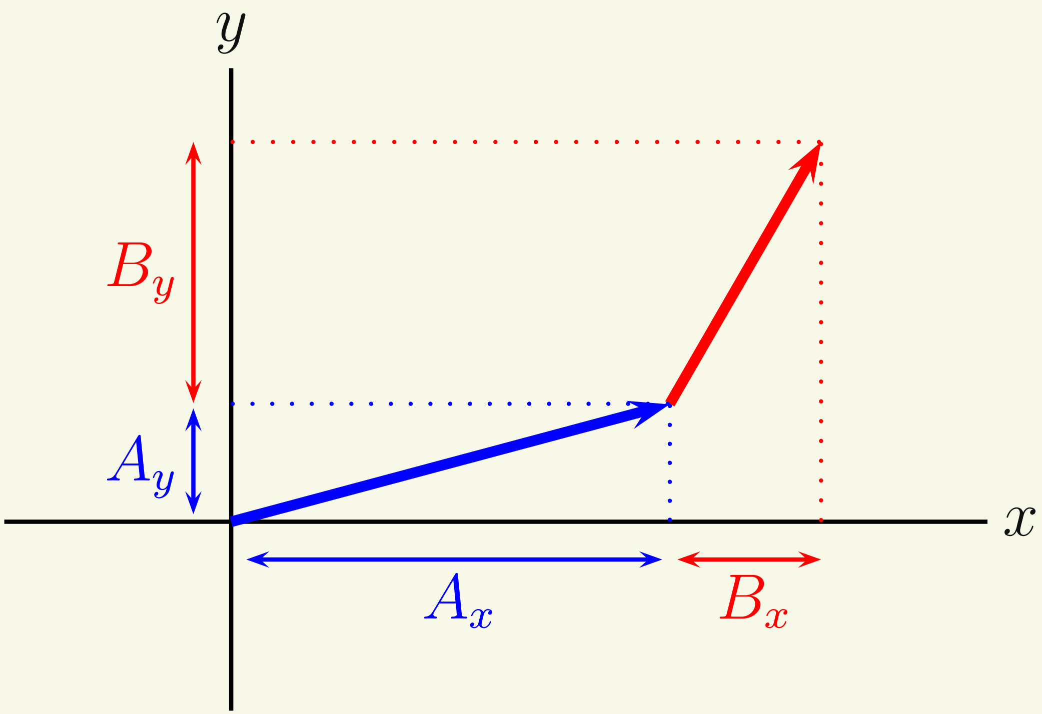


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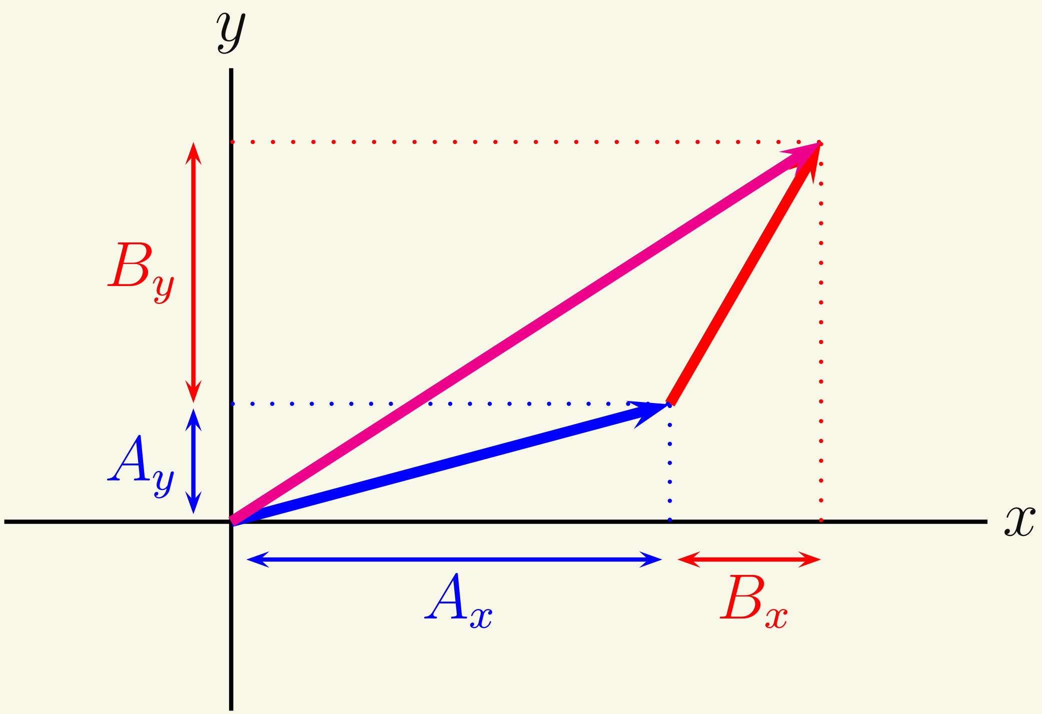


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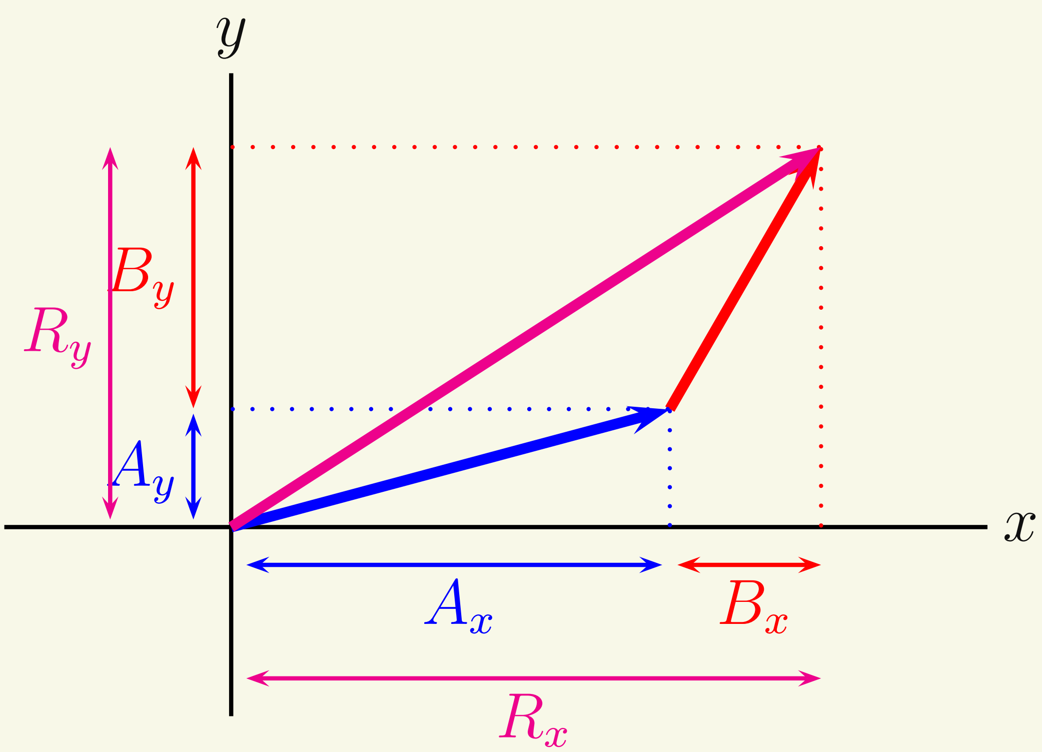


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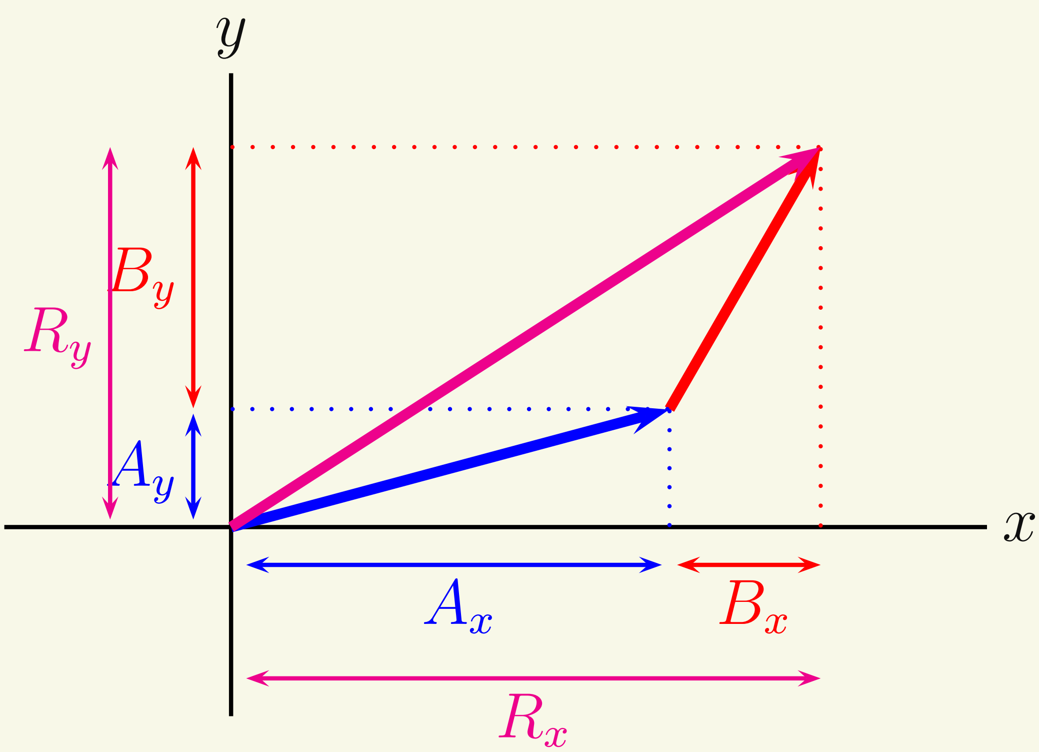


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The components of $\overrightarrow{\mathbf{R}}$:

$\boxed{R_x = A_x + B_x}$ $\boxed{R_y = A_y + B_y}$

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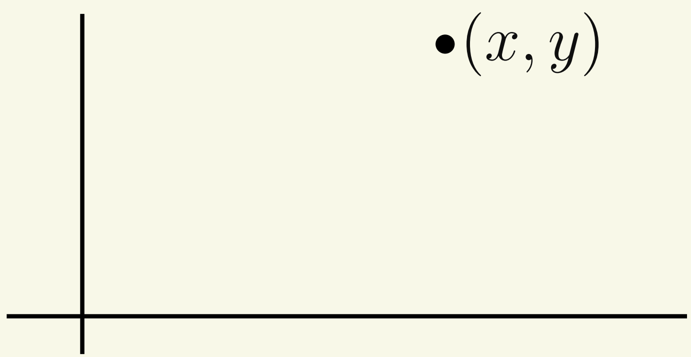

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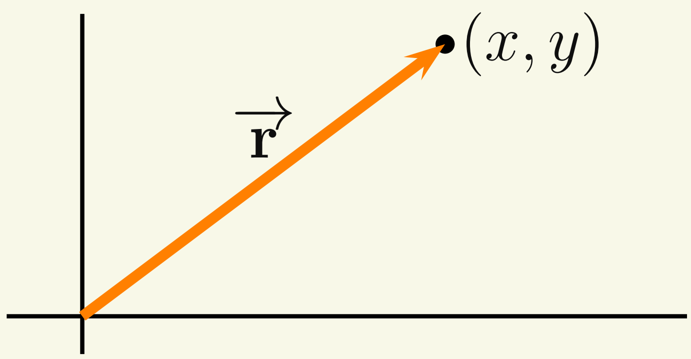

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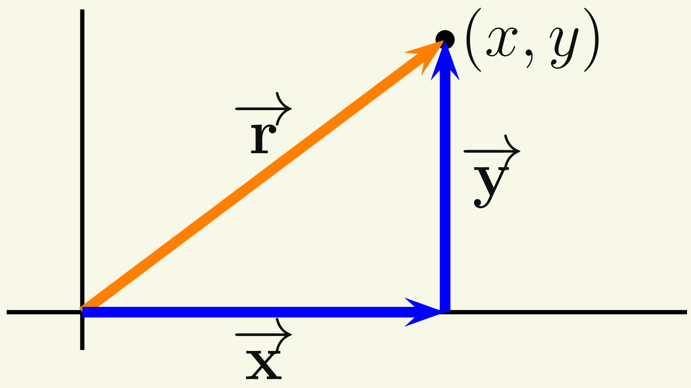
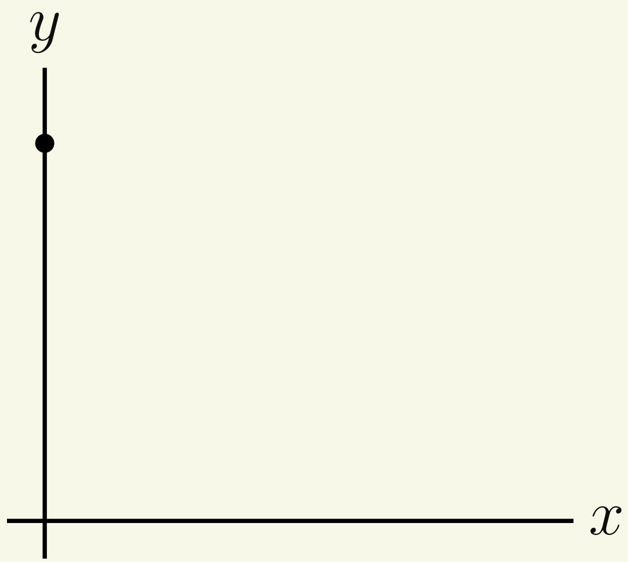


## Velocity Components

In curved motion, the path taken by a moving object is called its trajectory



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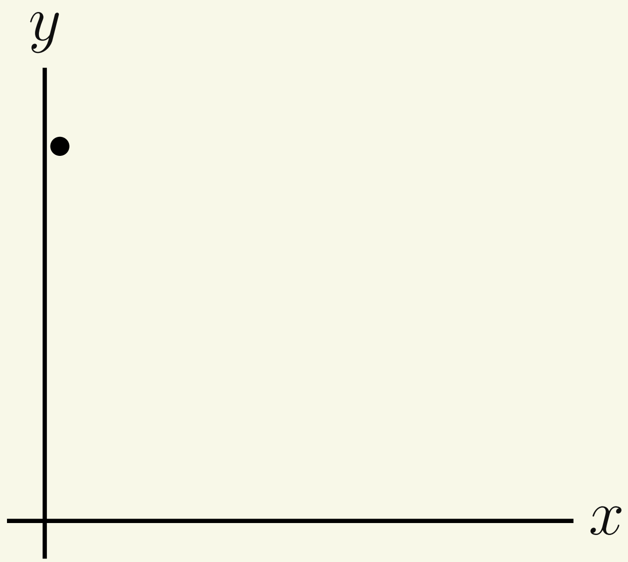

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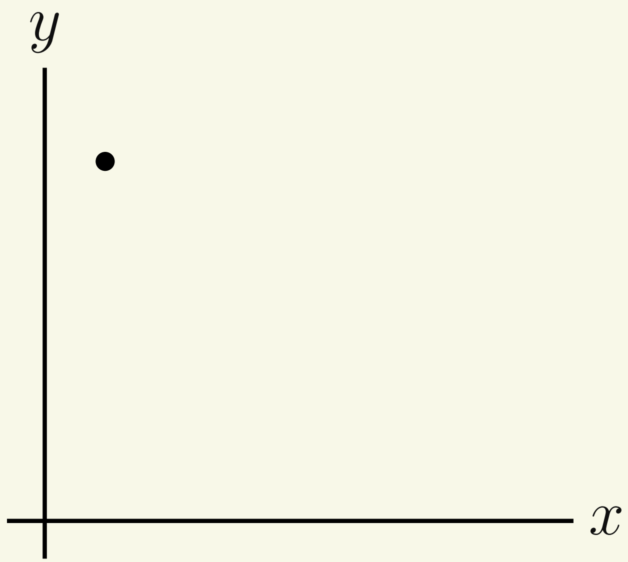

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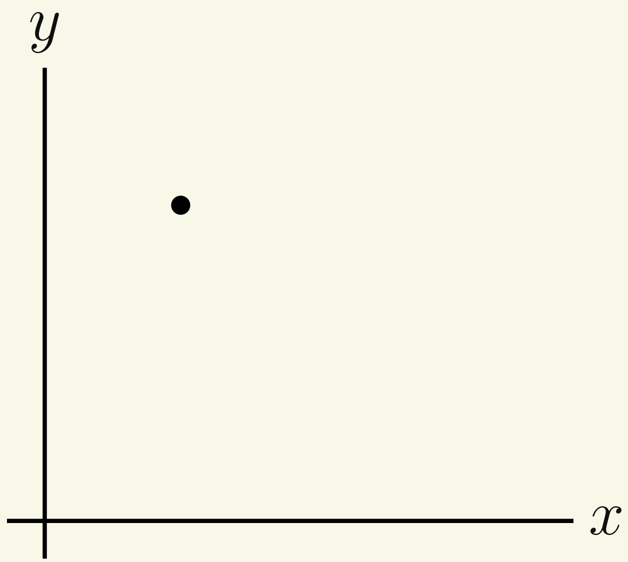

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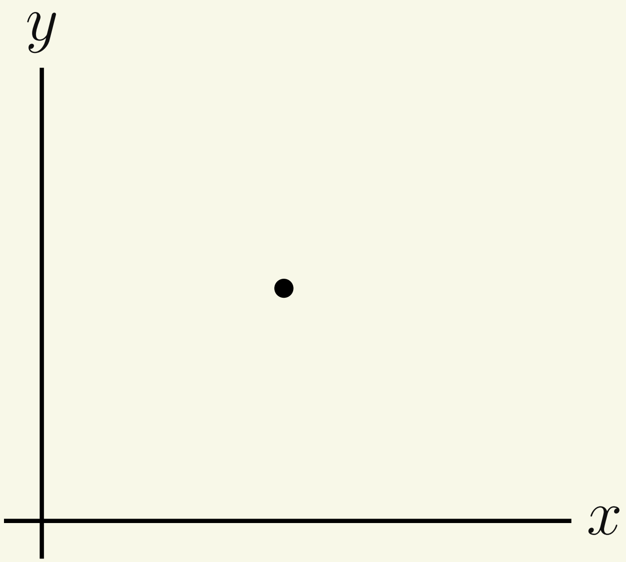

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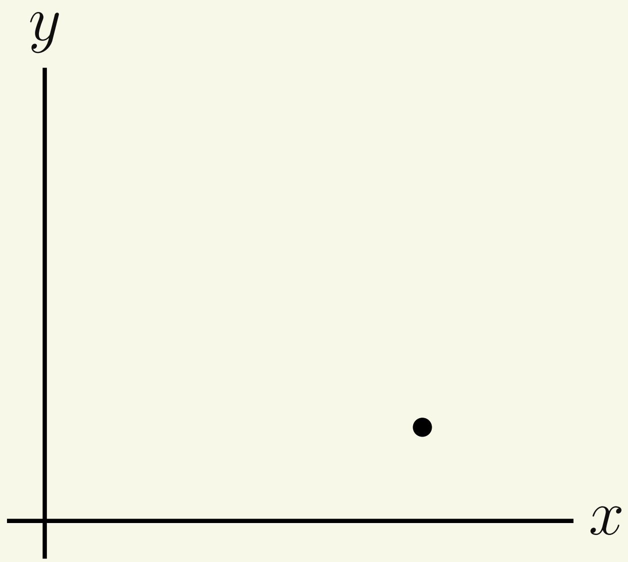

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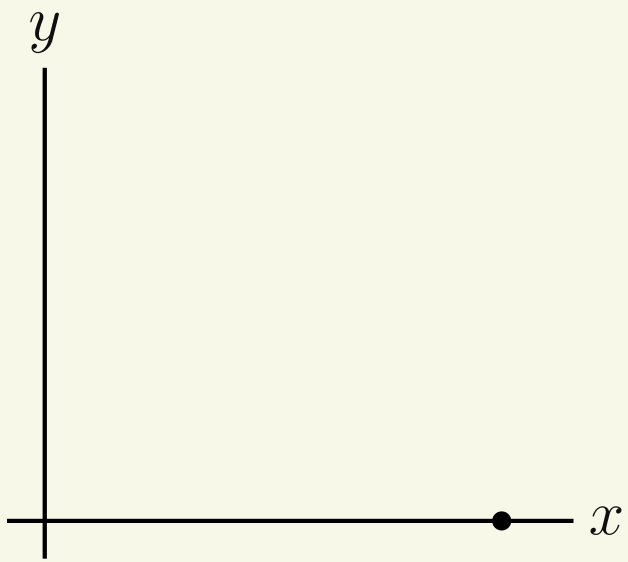

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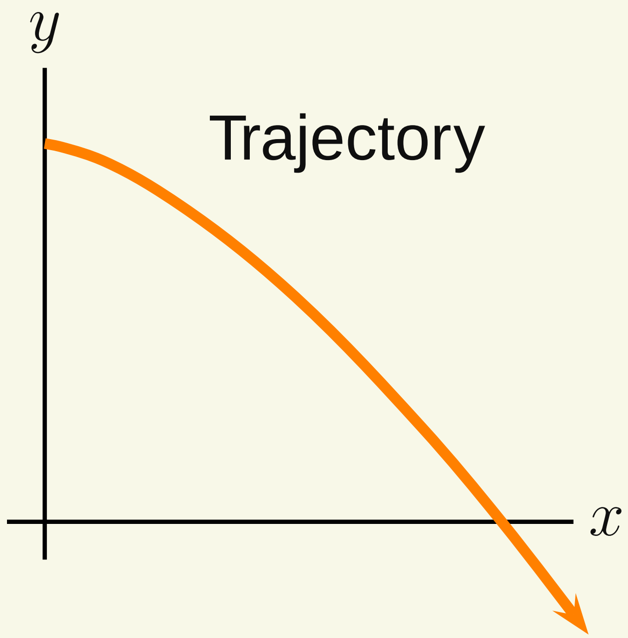

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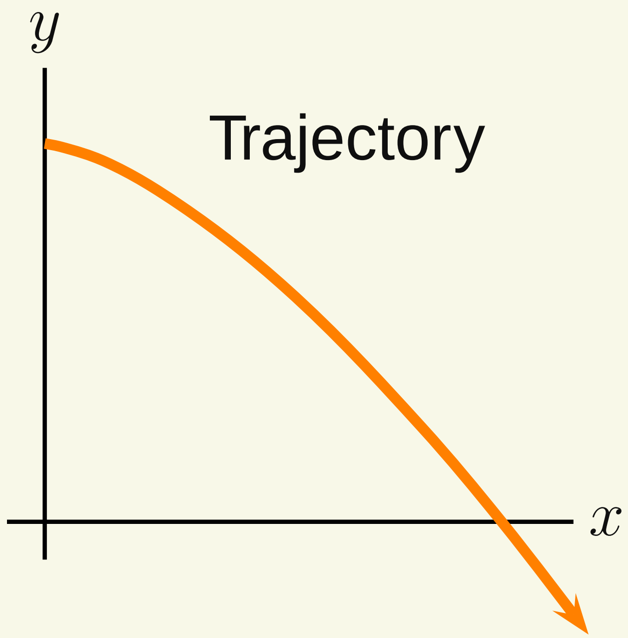
There are two separate position plots which give the velocity vector's components



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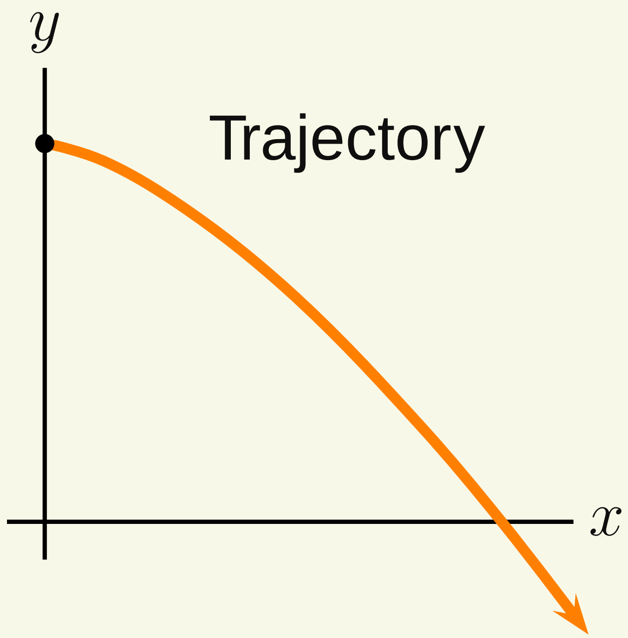


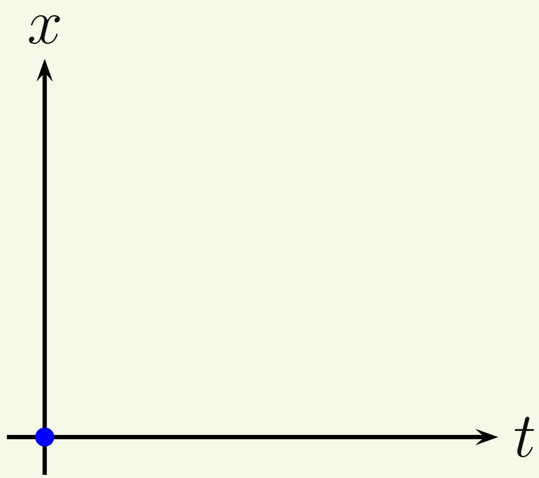


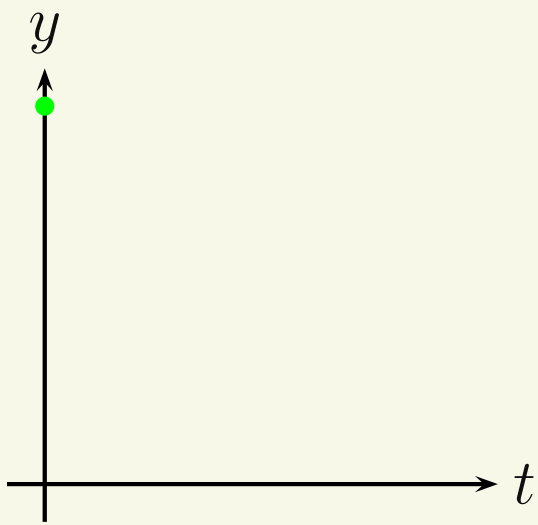

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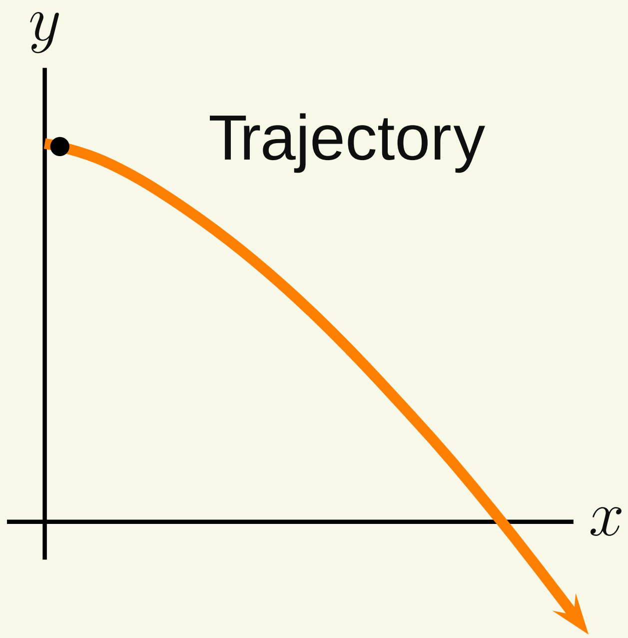


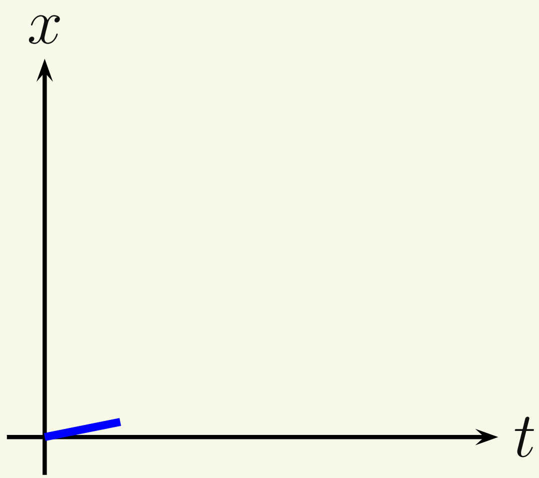


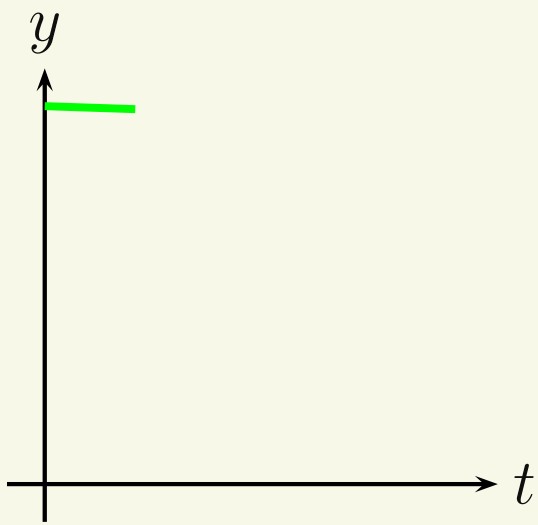

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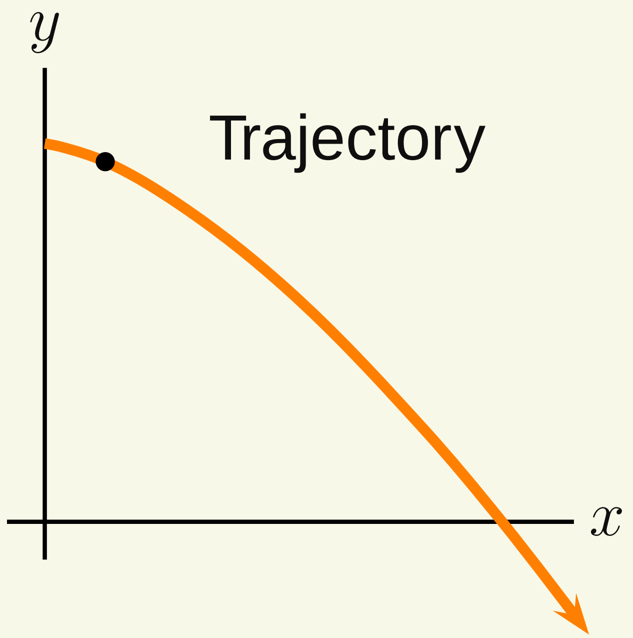


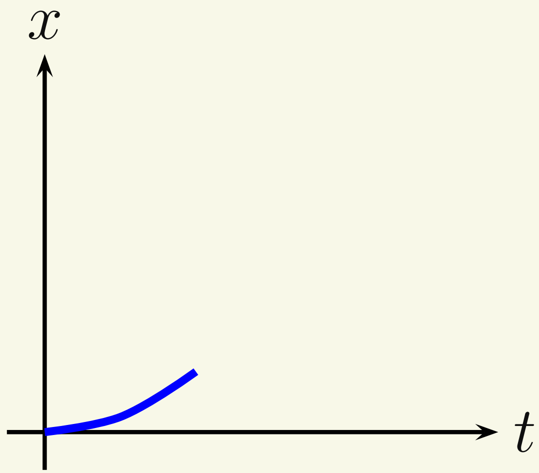


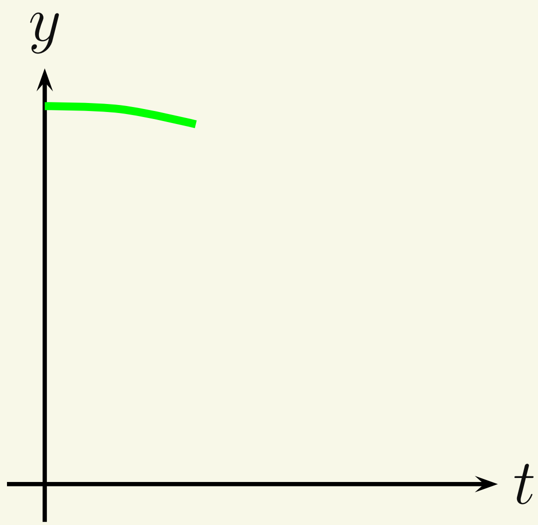

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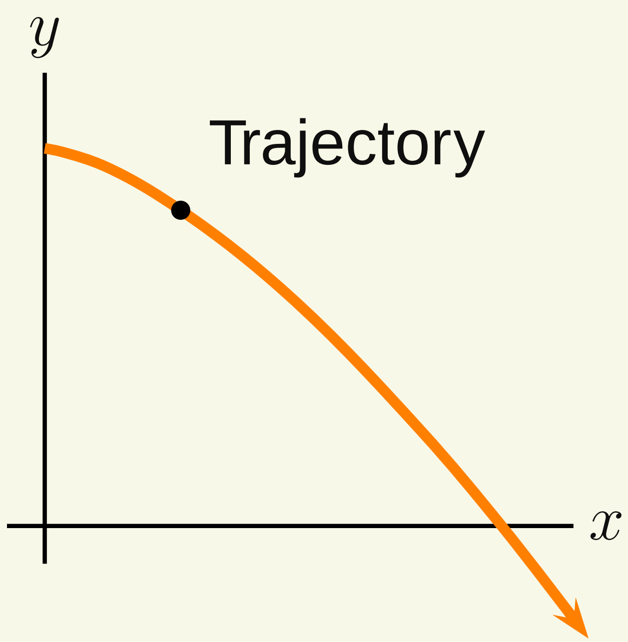


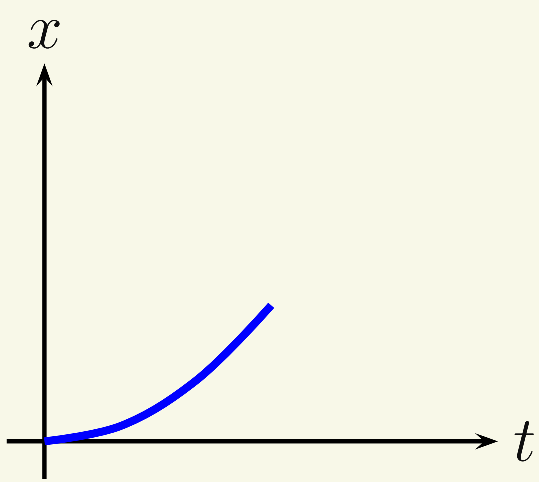


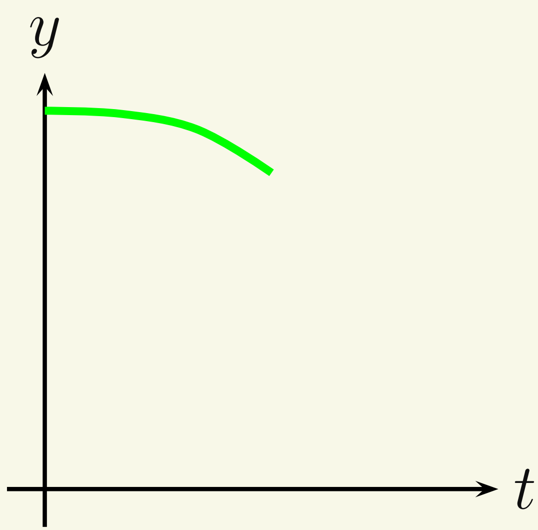

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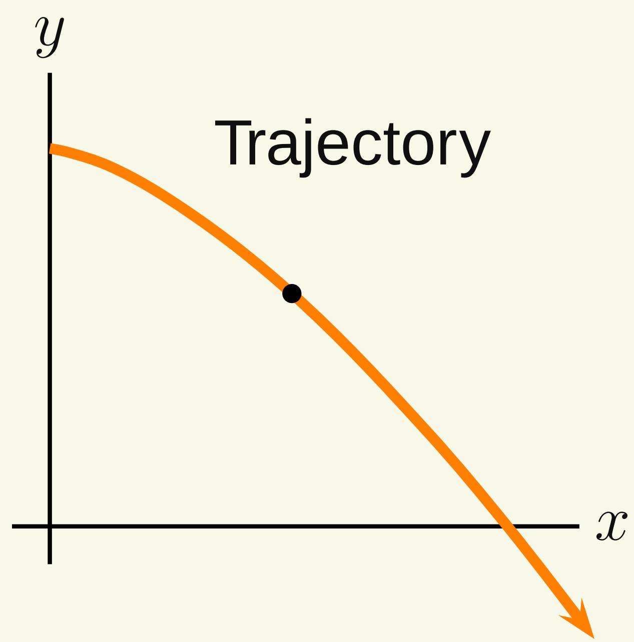


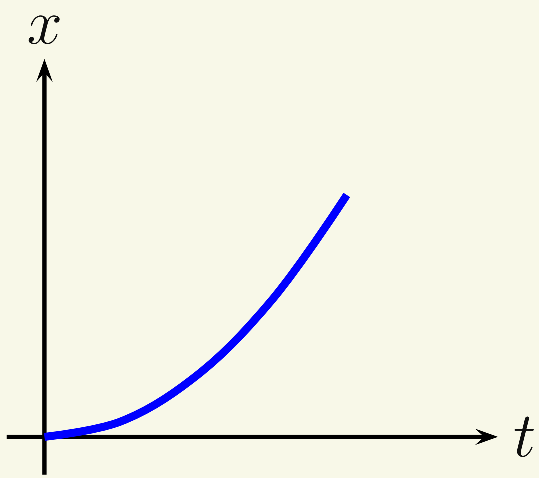


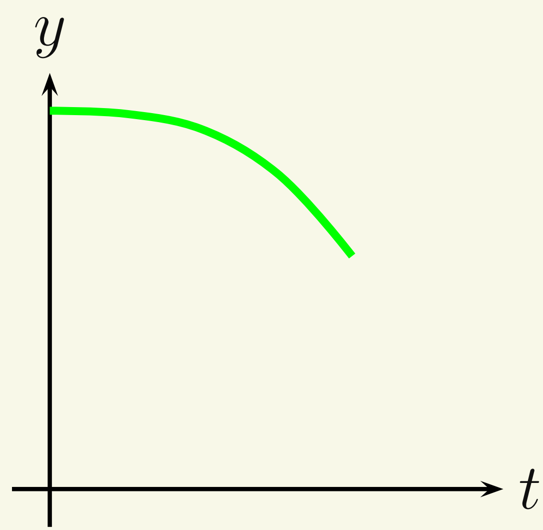

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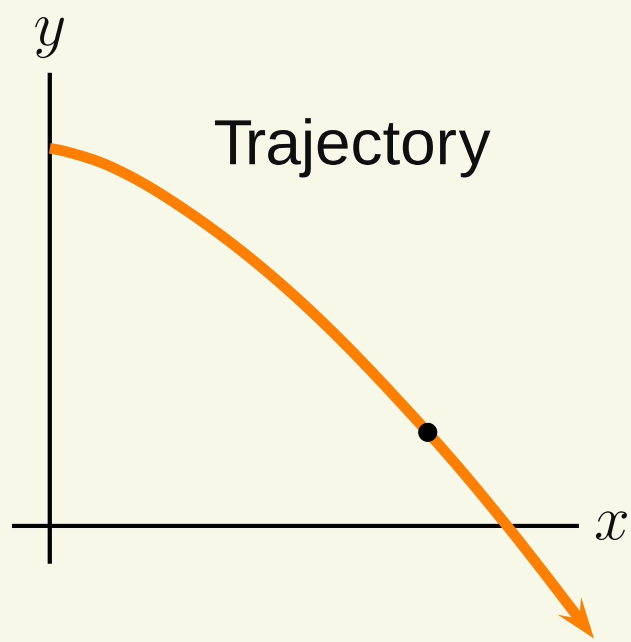


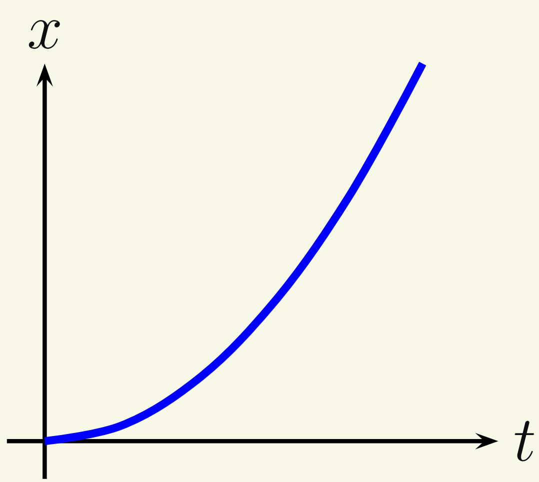


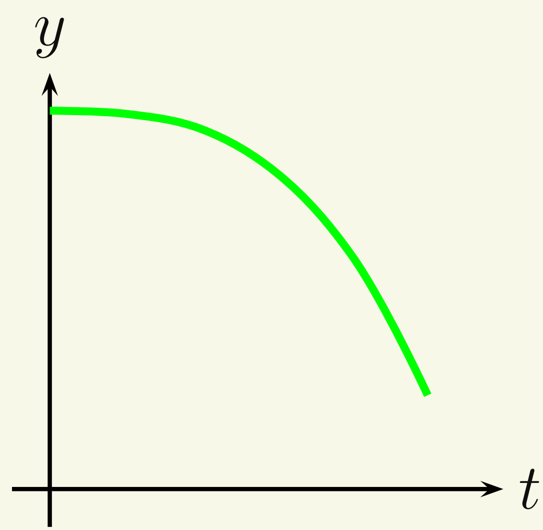

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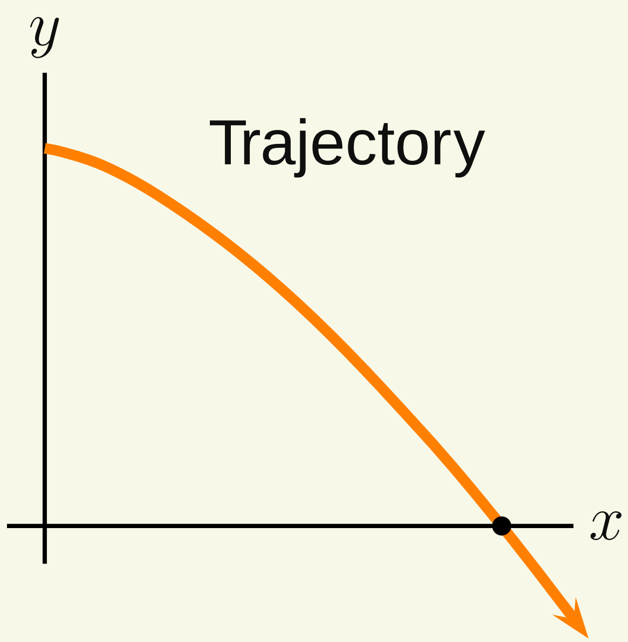


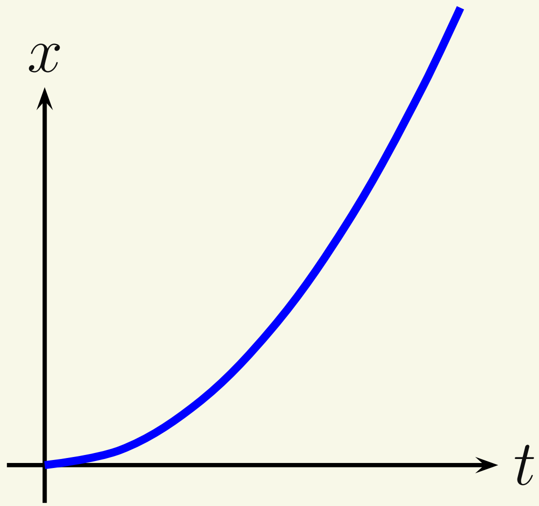


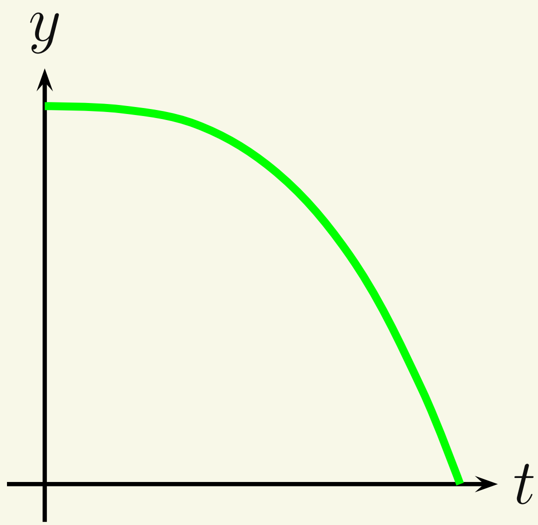

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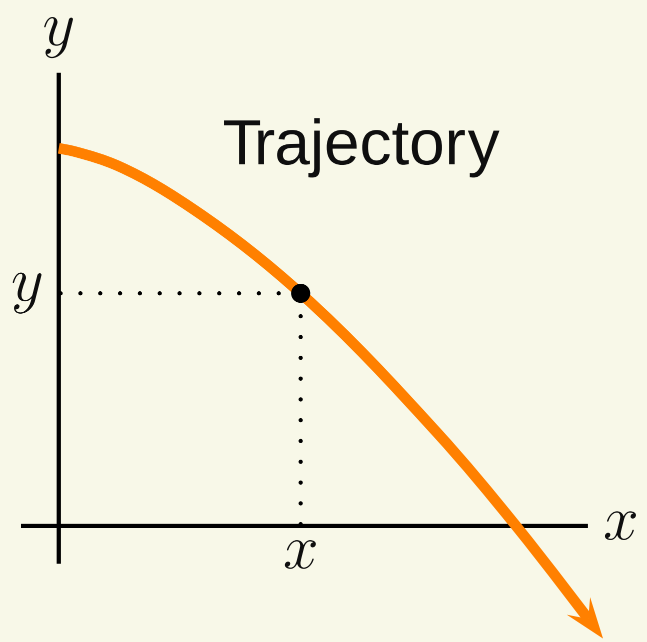


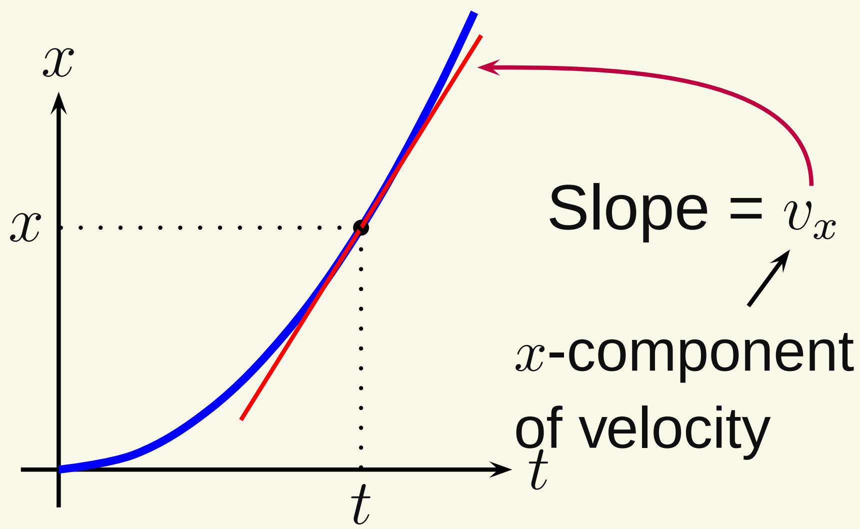


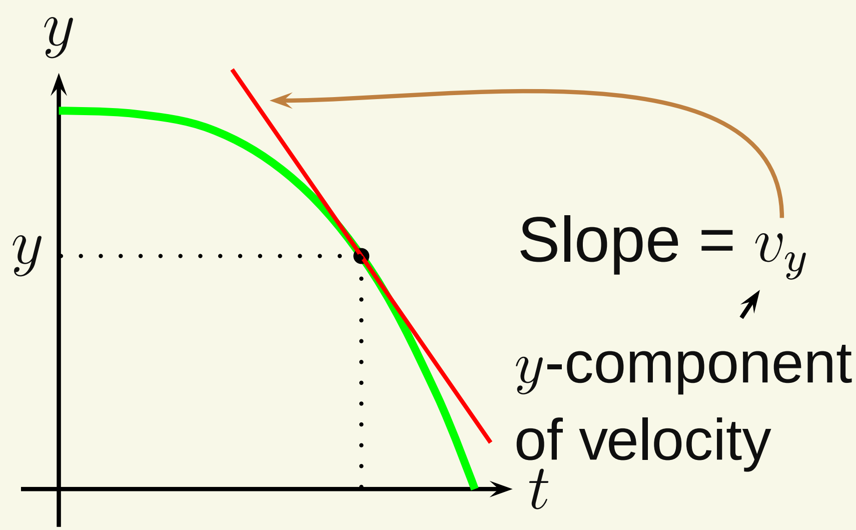

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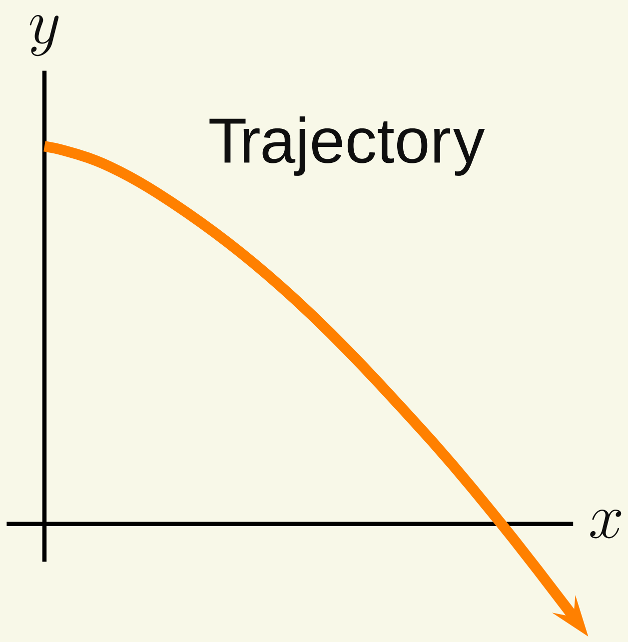

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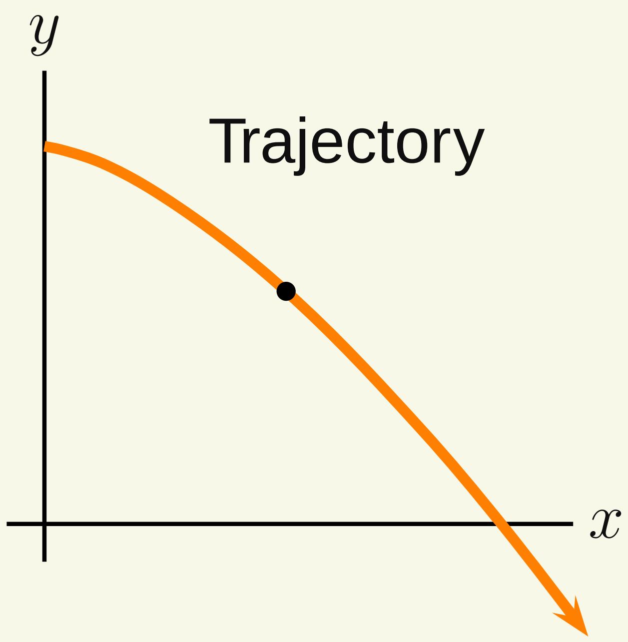

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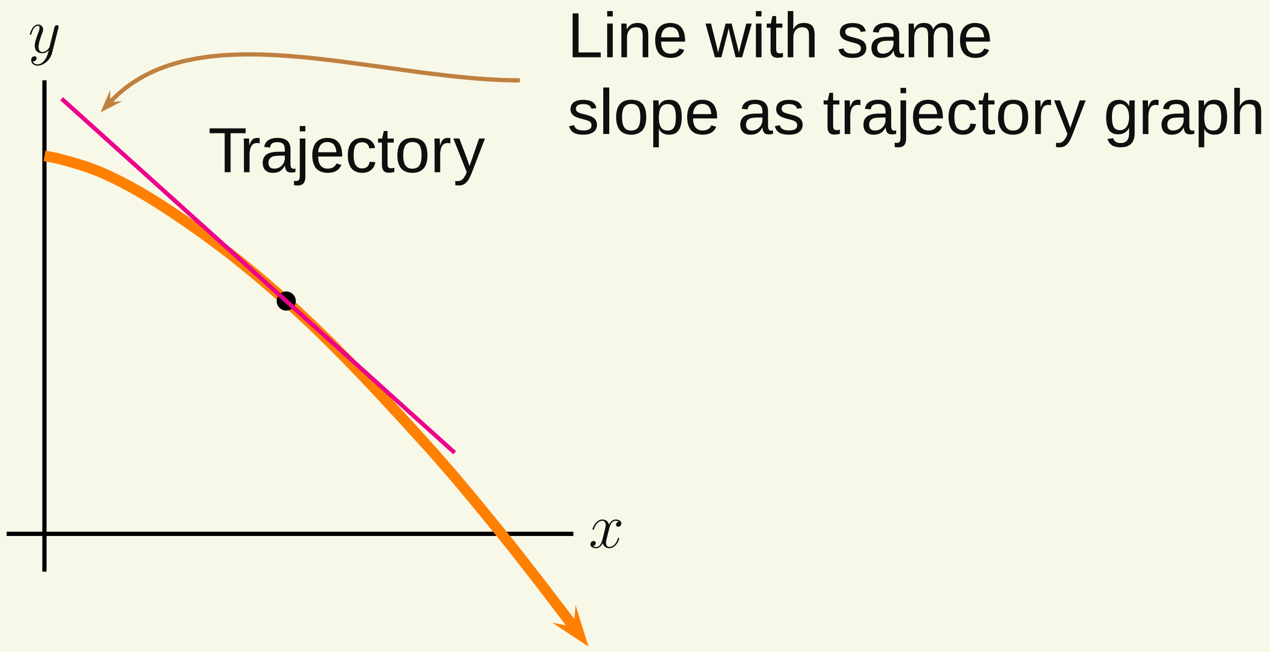

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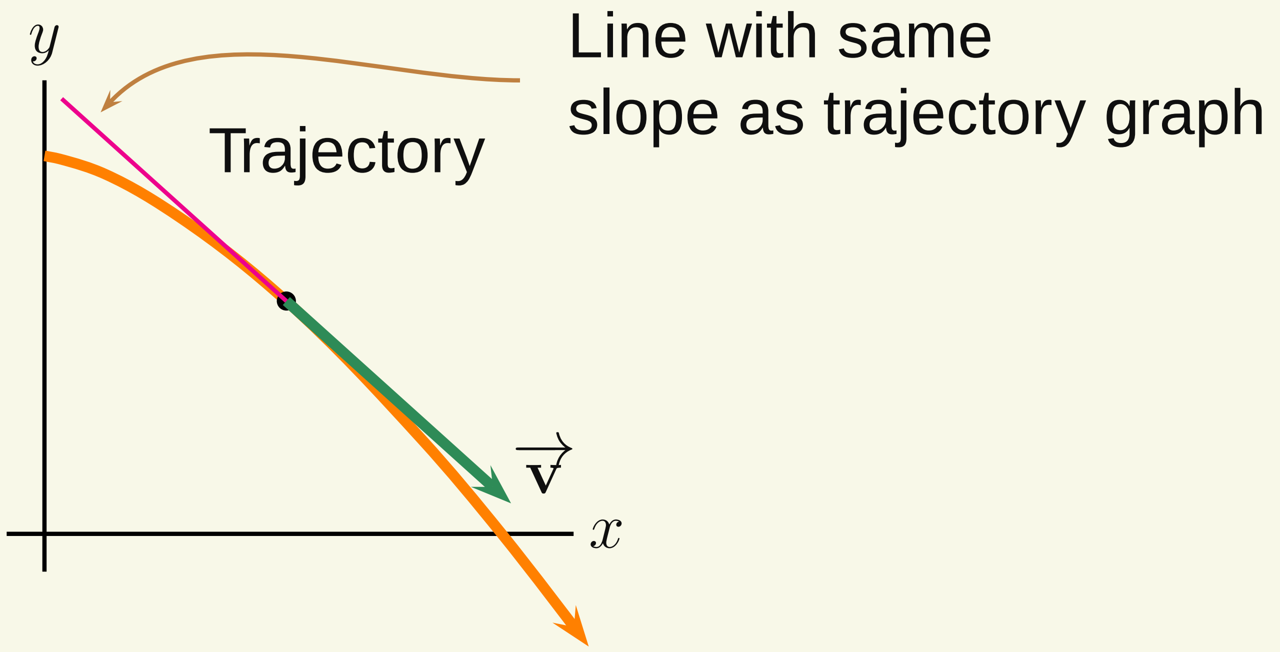

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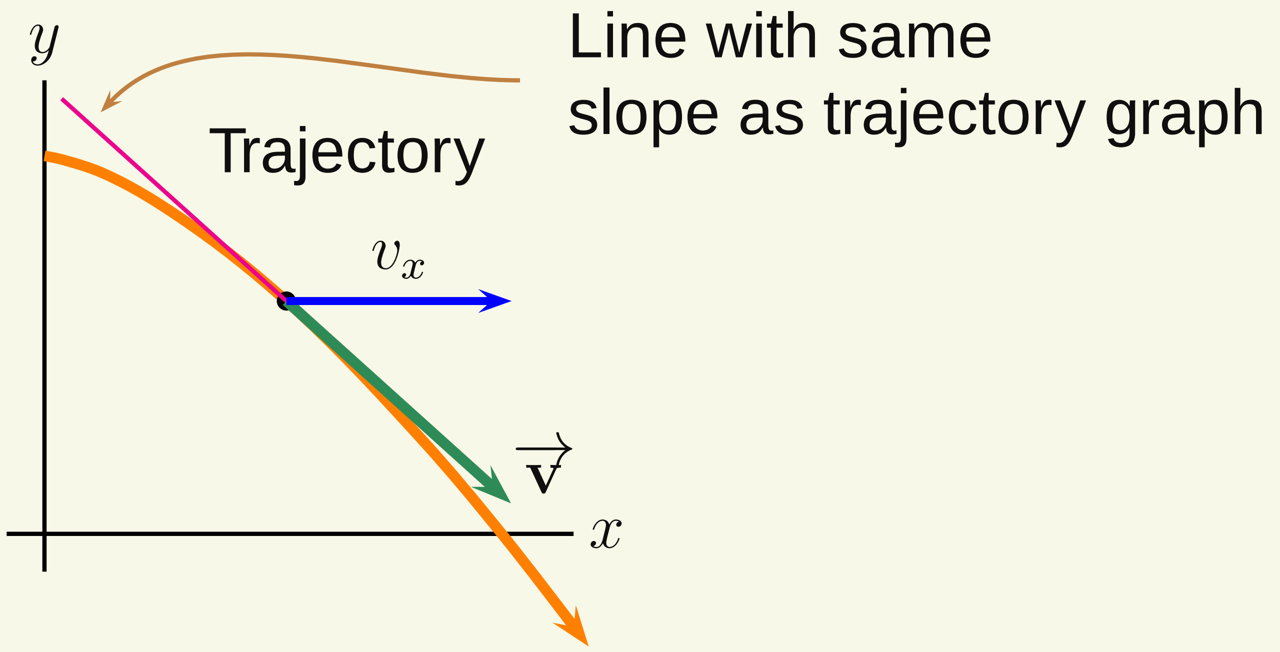

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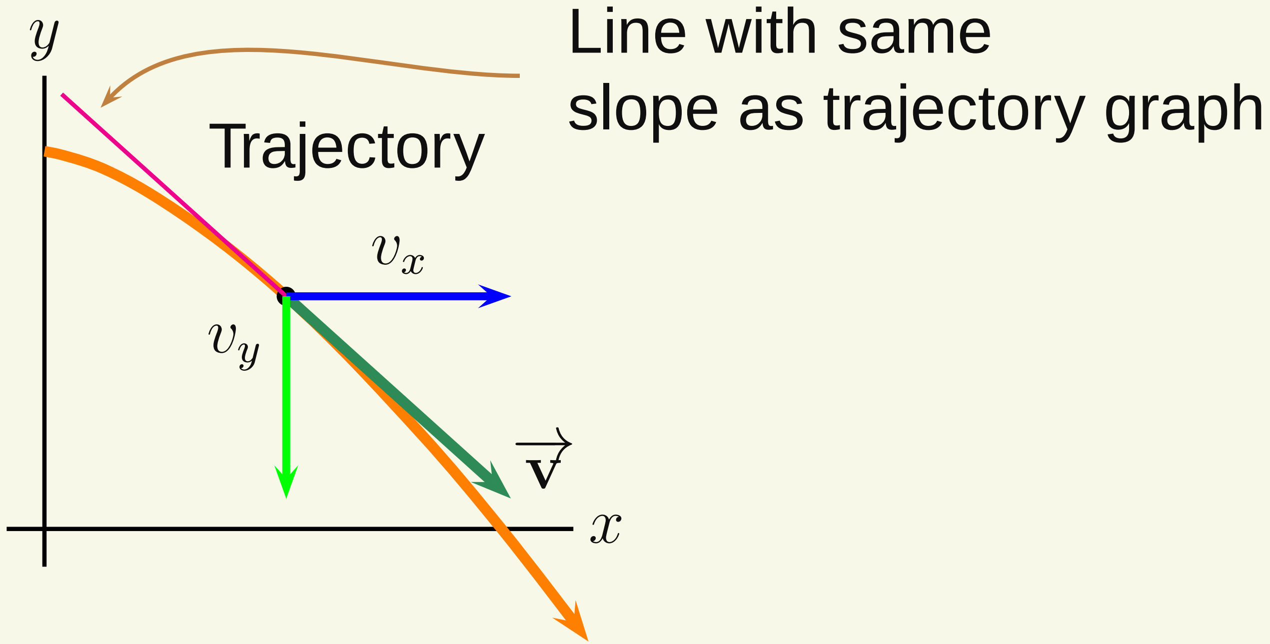

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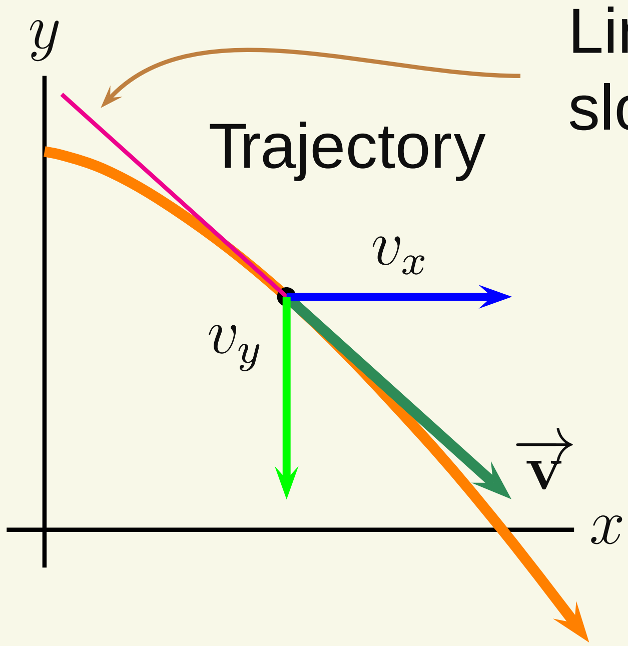


Line with same slope as trajectory graph

Speed is the magnitude of the velocity vector

$$\Rightarrow \boxed{v = \sqrt{v_x^2 + v_y^2}}$$

# Acceleration Components

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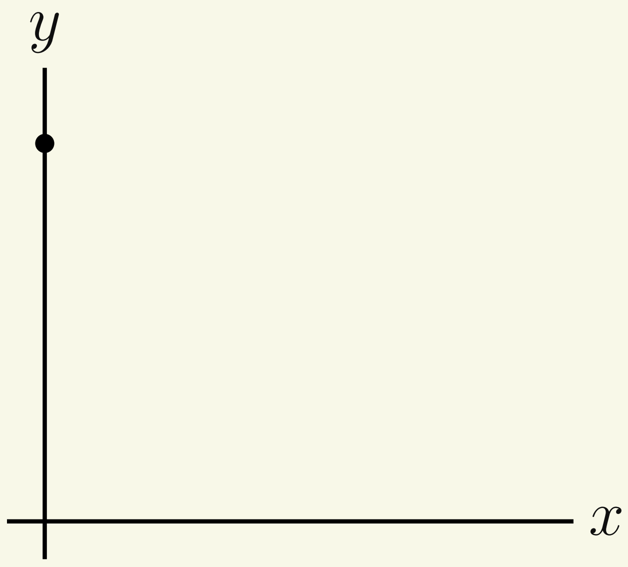

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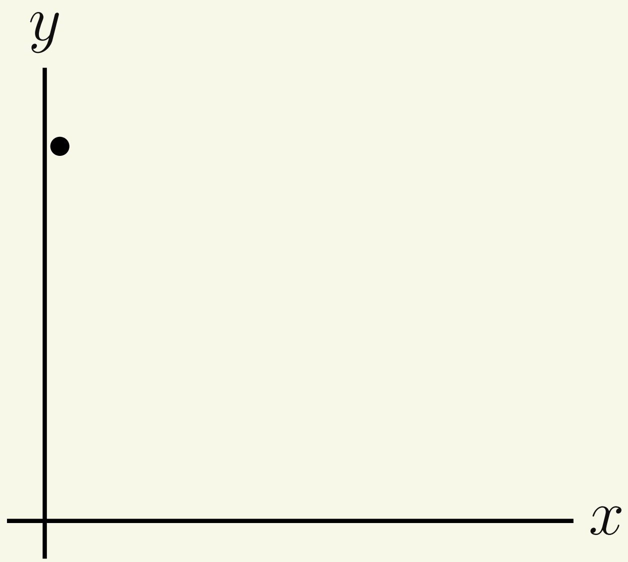

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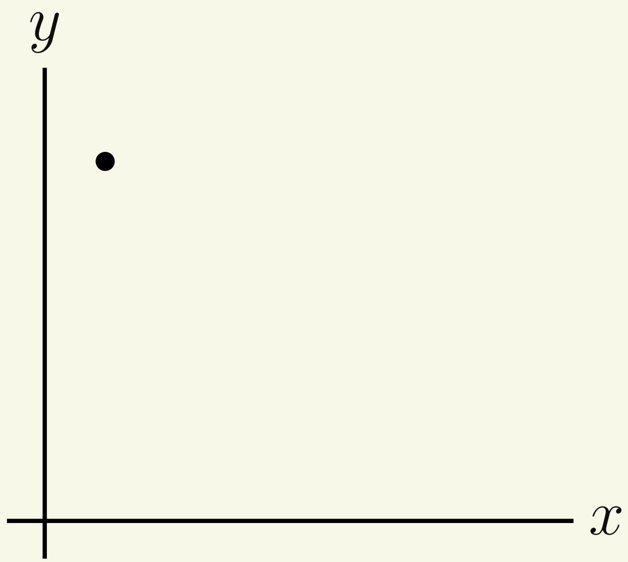

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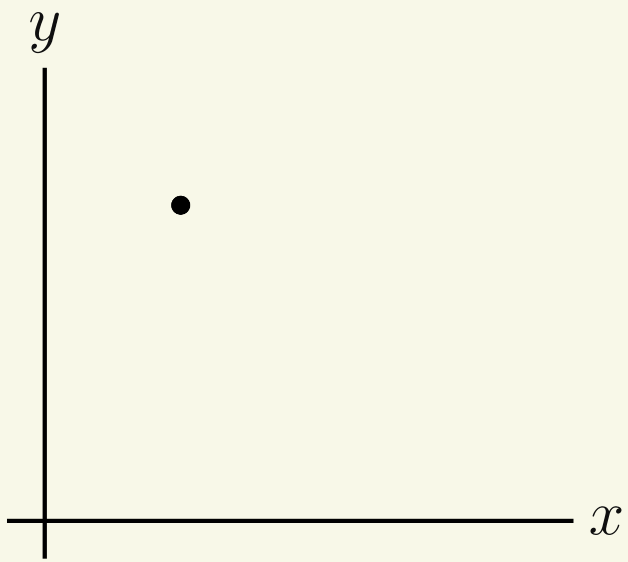

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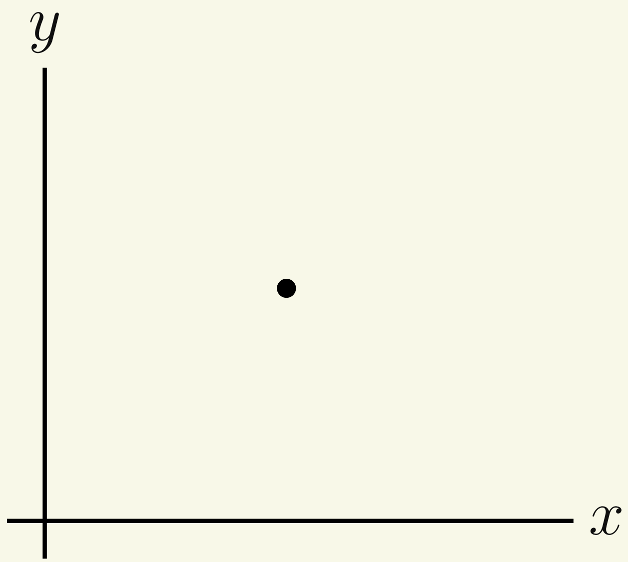

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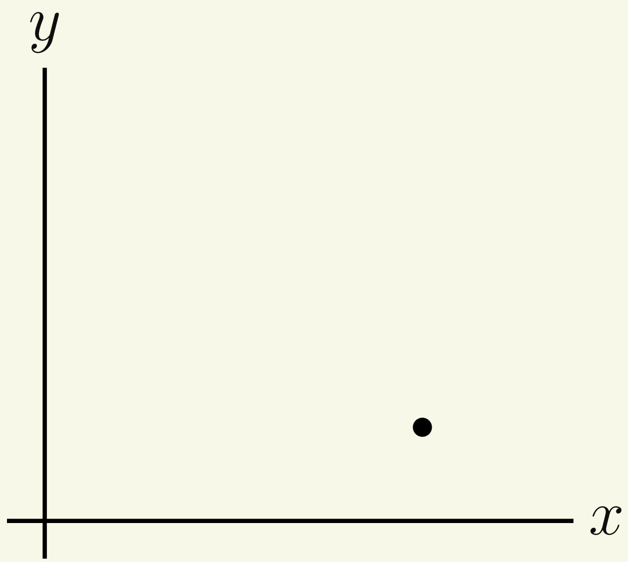

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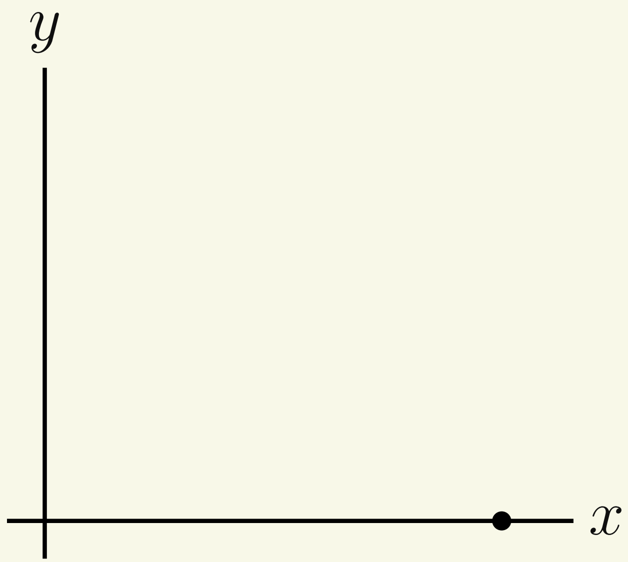

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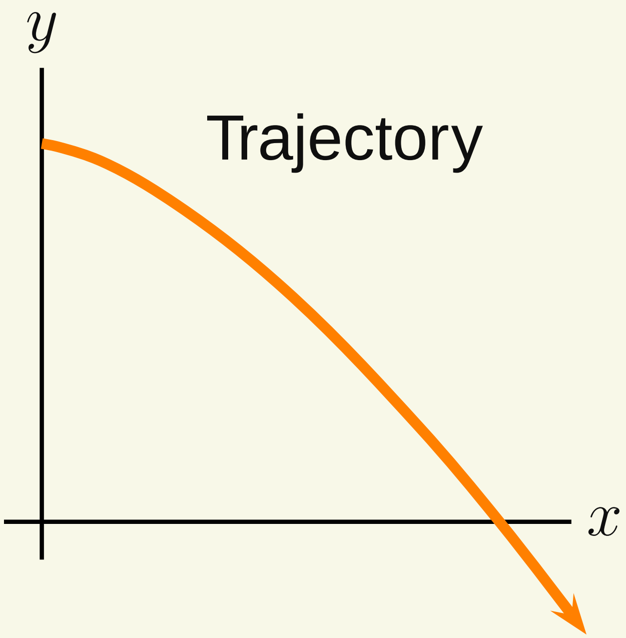

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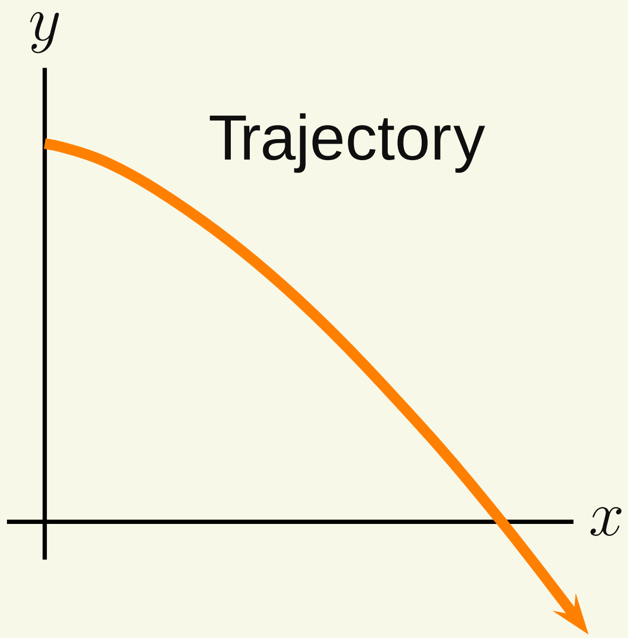

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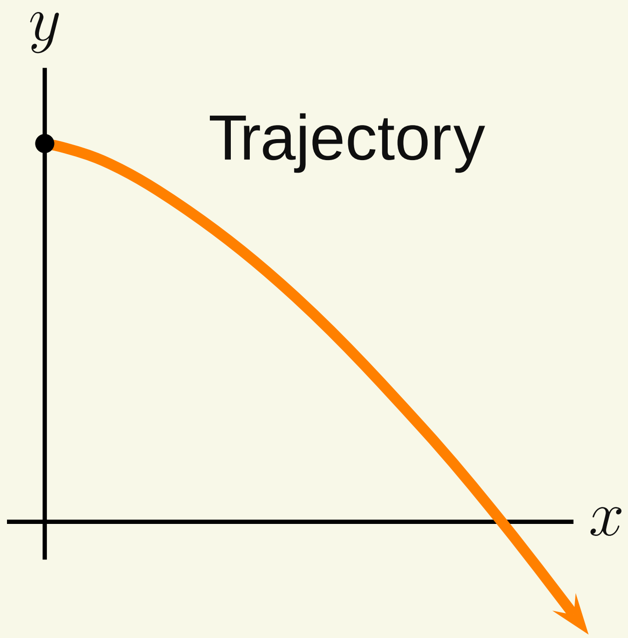


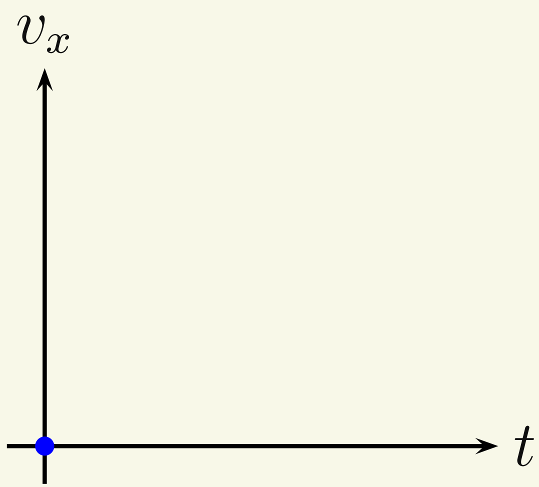


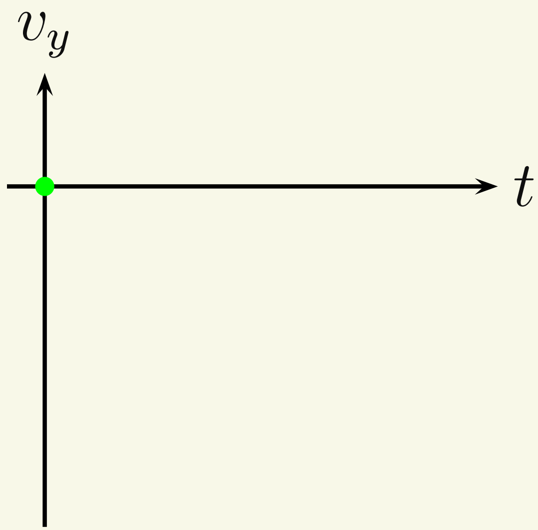

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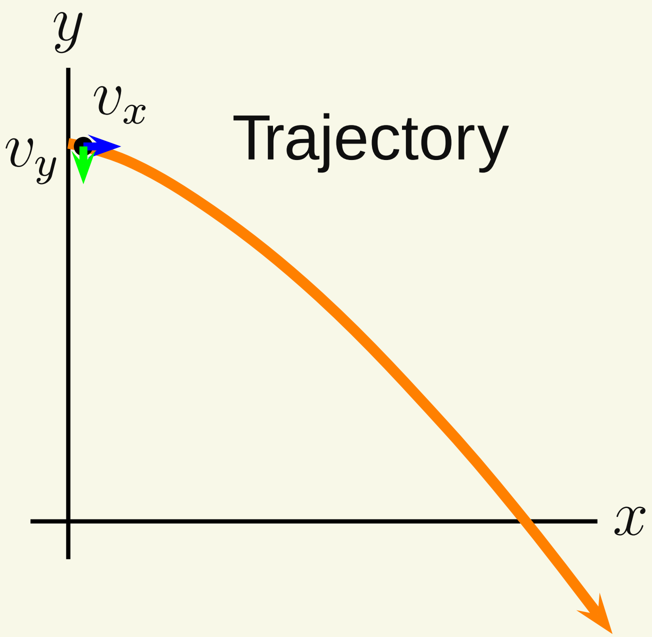


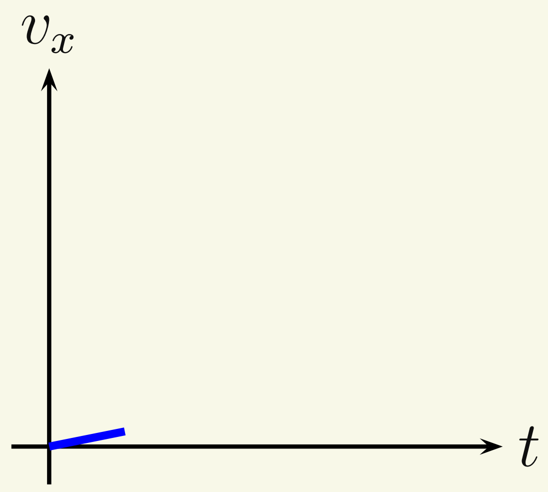


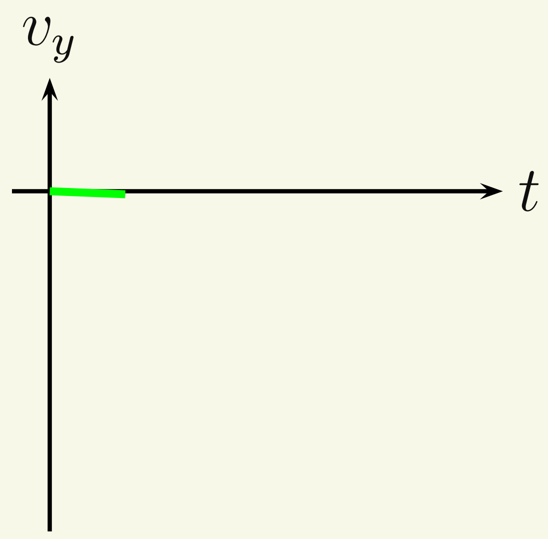

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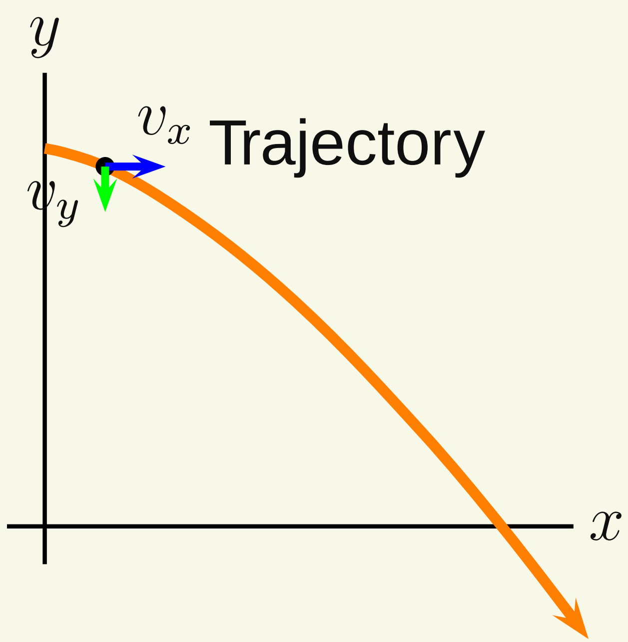


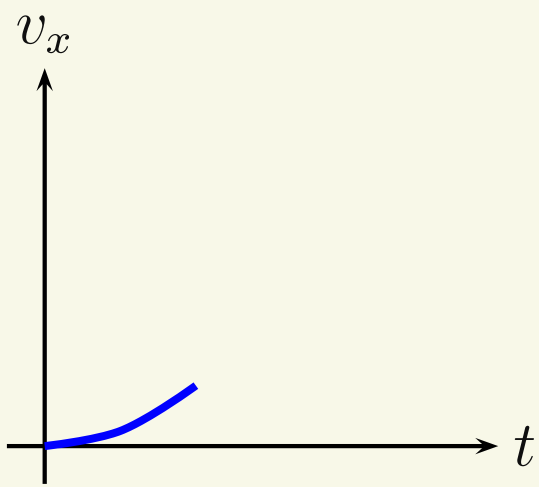


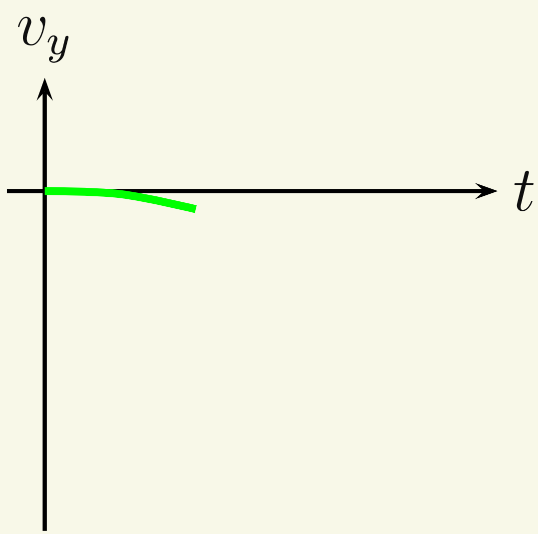

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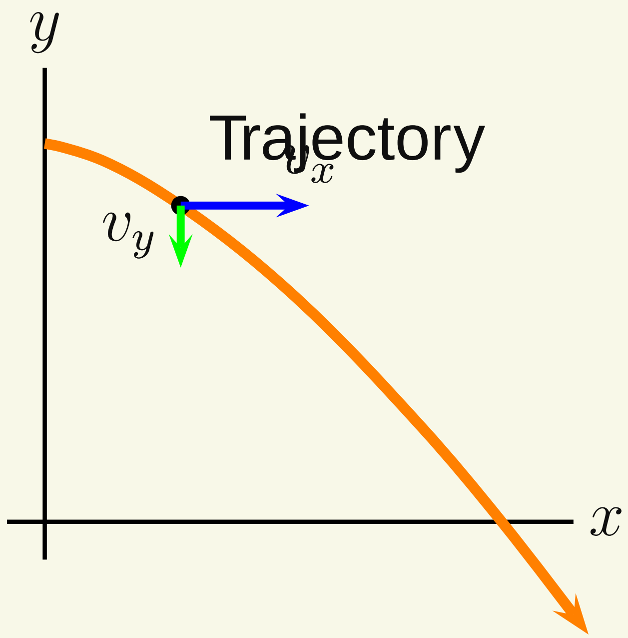


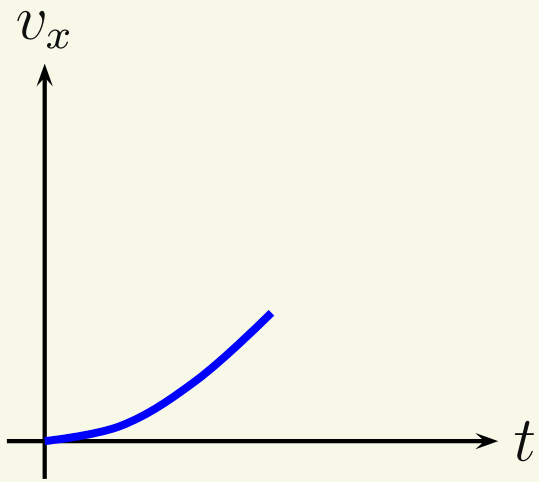


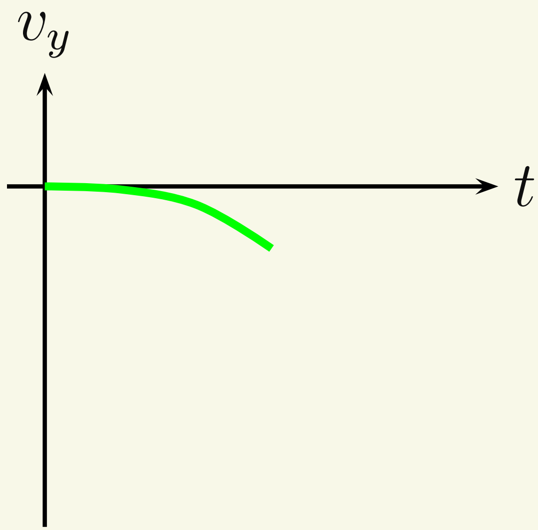

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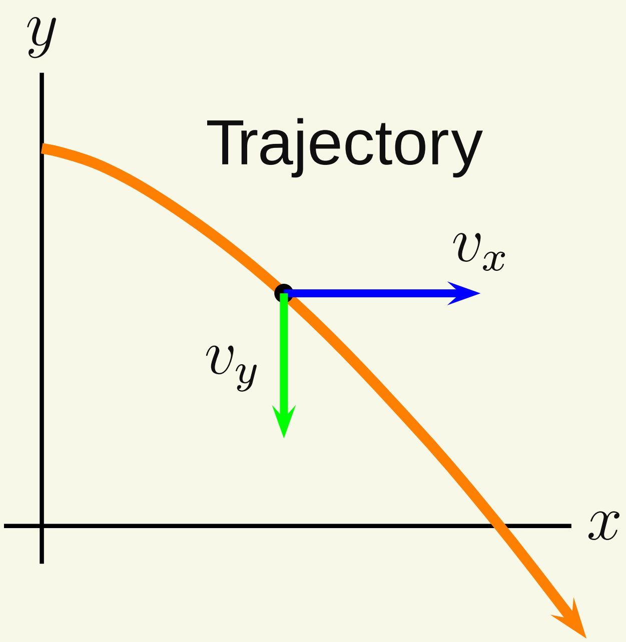


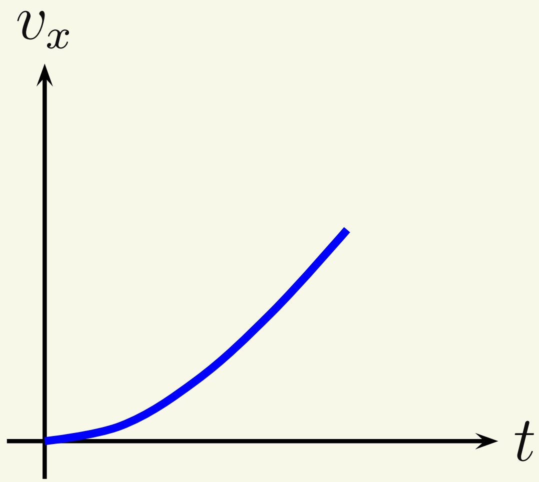


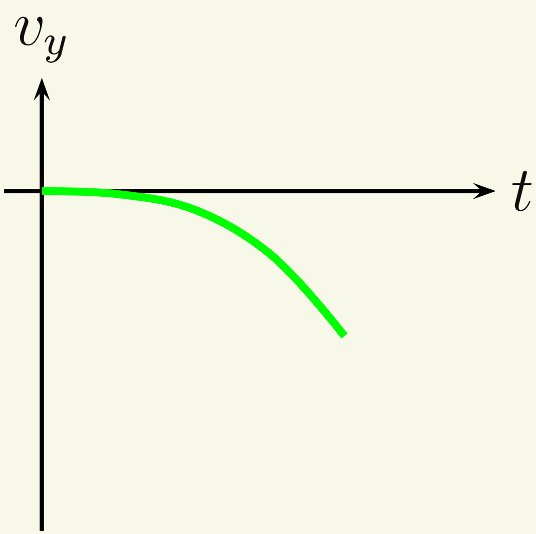

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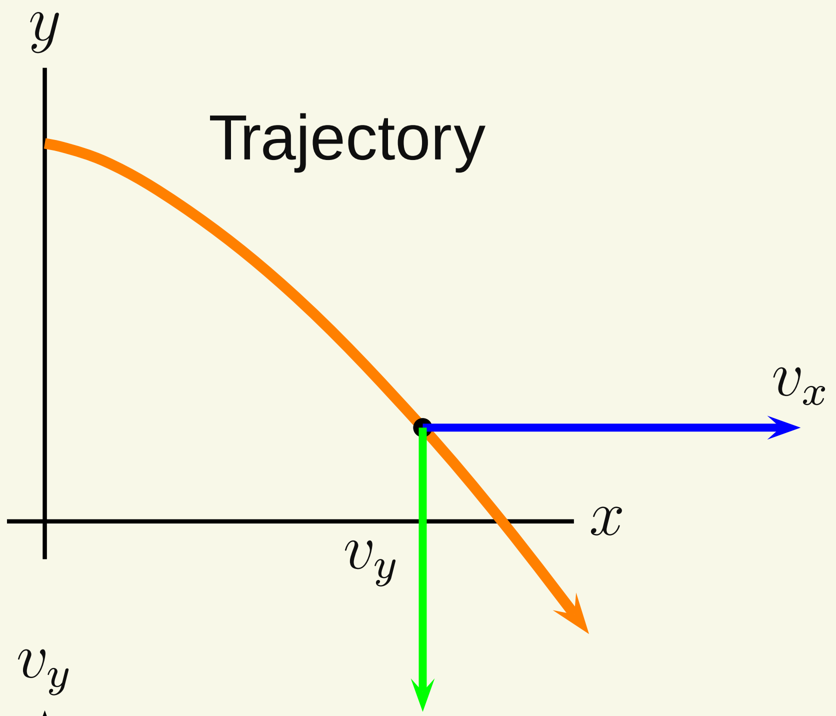


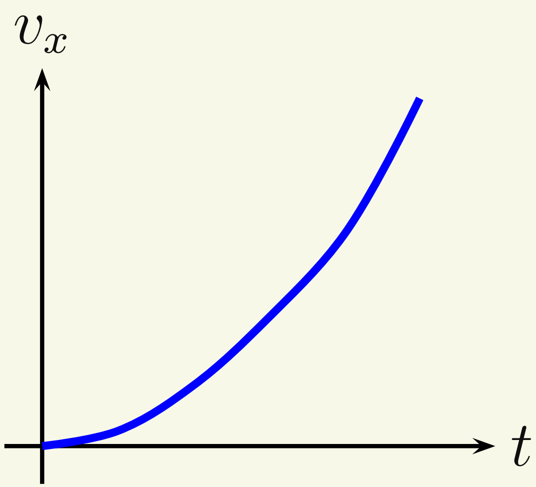


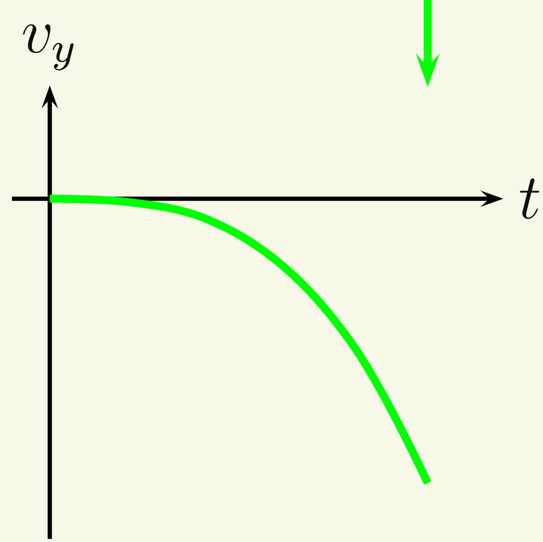

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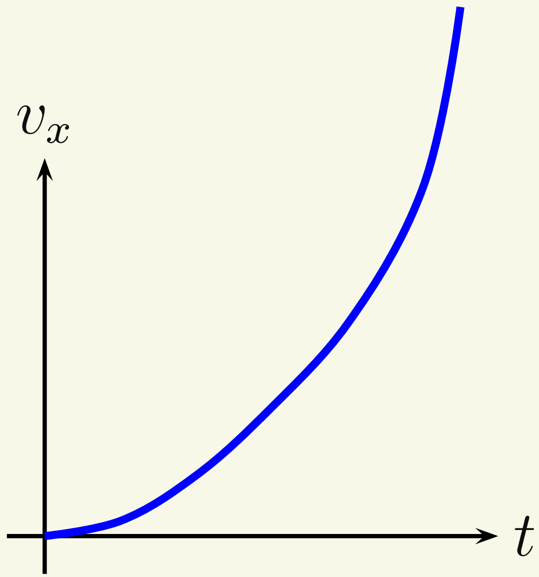


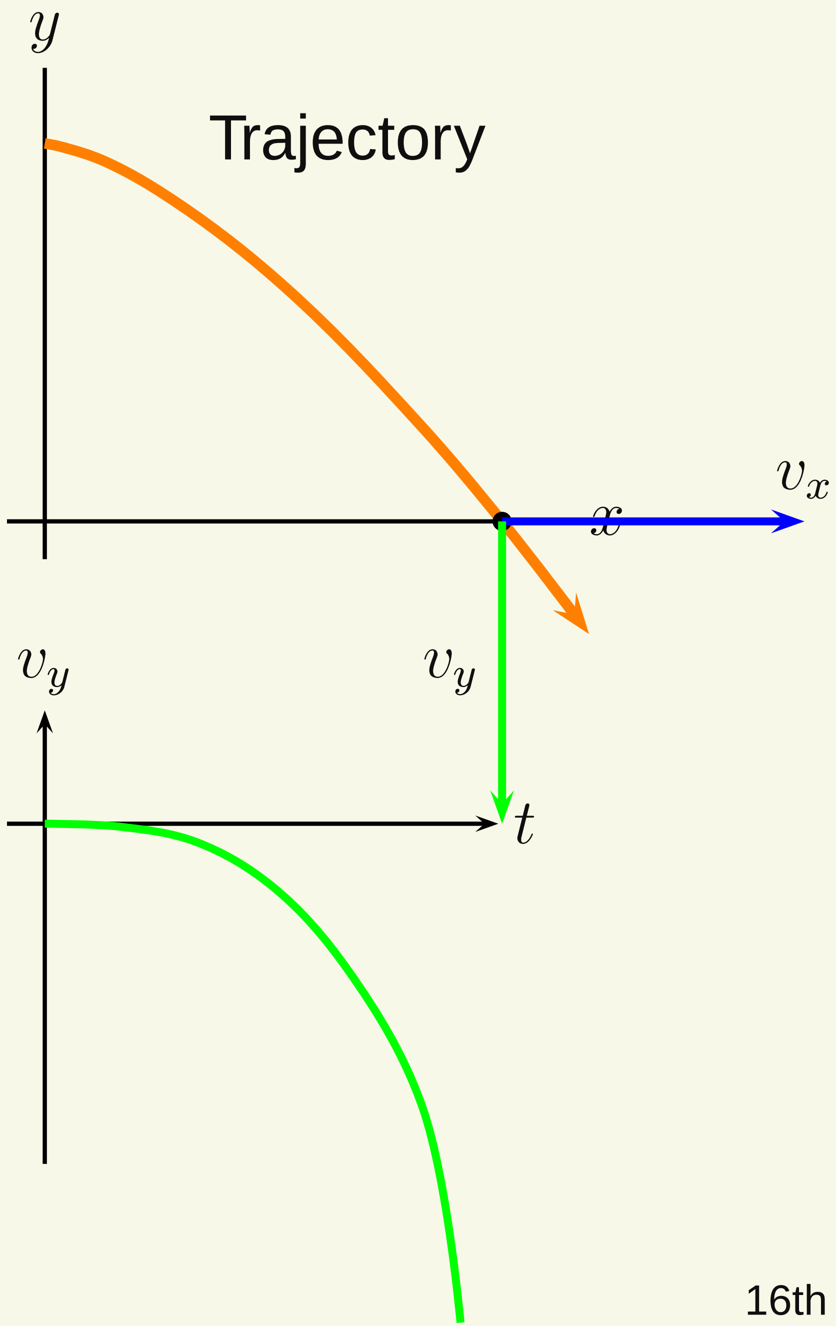

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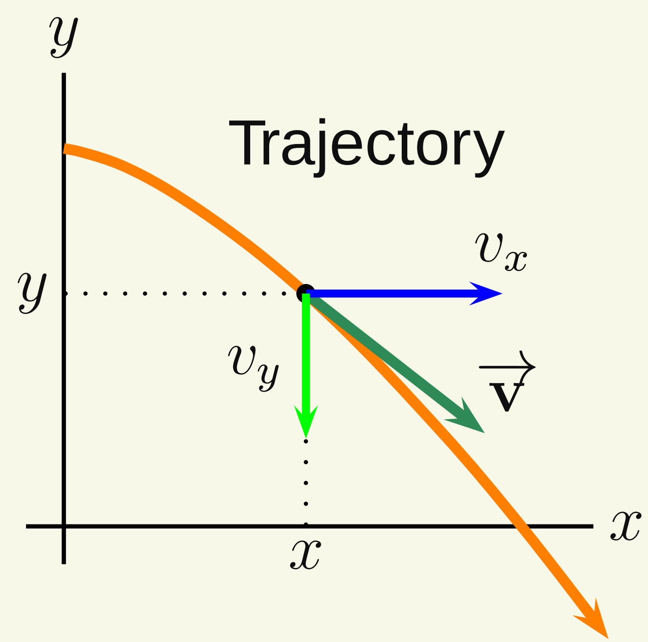


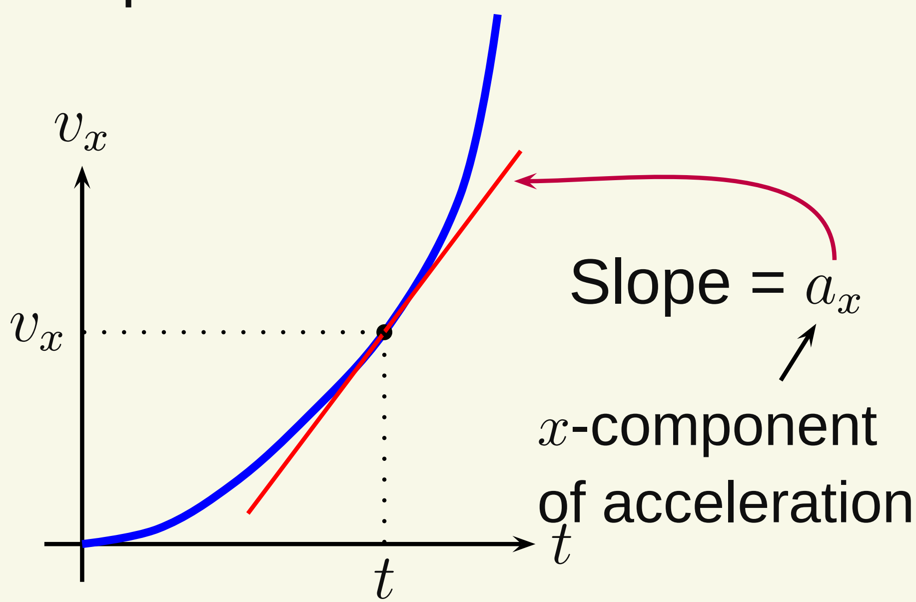


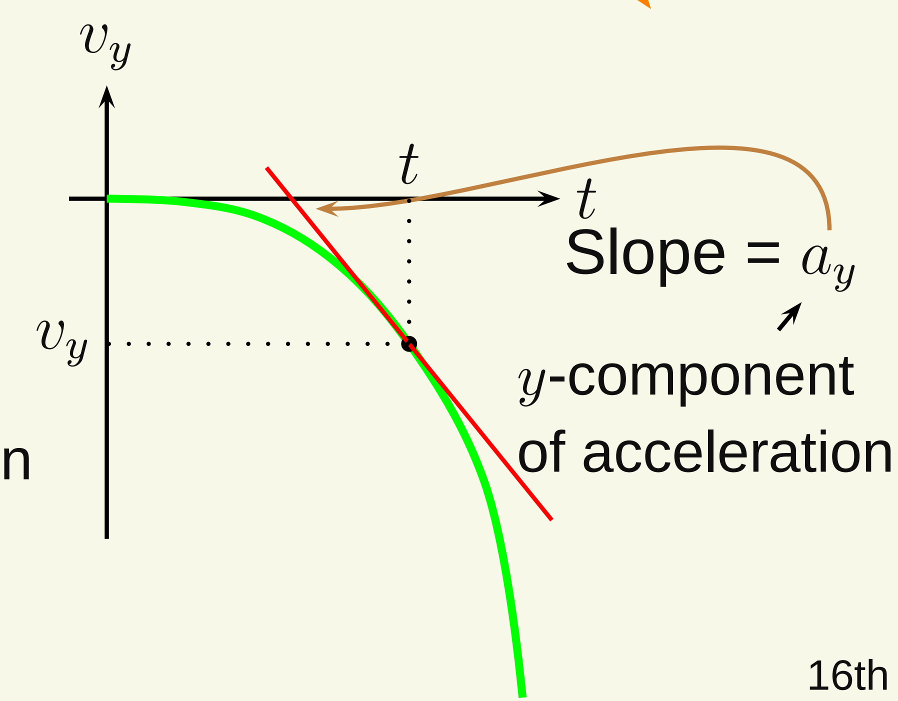

## Projectile Motion

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Ignore air resistance again.

Gravity pulls straight down, so it causes acceleration in the $y$-direction only.

$$a_x = 0, a_y = -g \quad (\text{Down is negative })$$

# Projectile Equations

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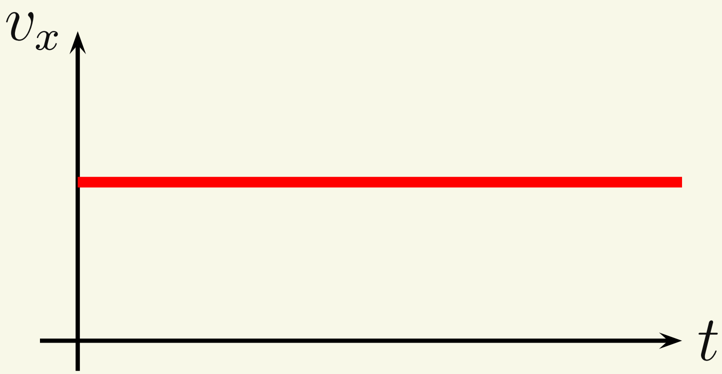

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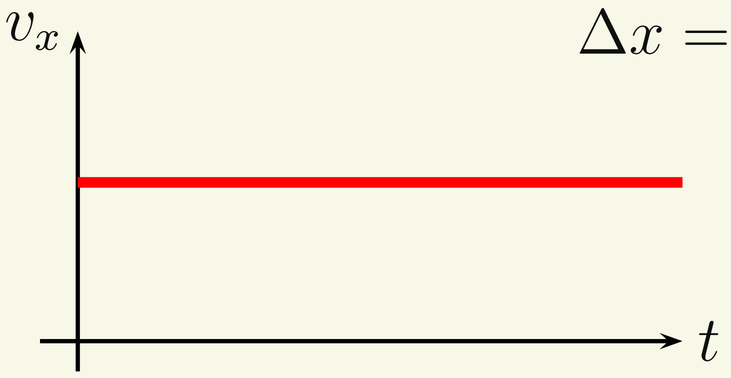


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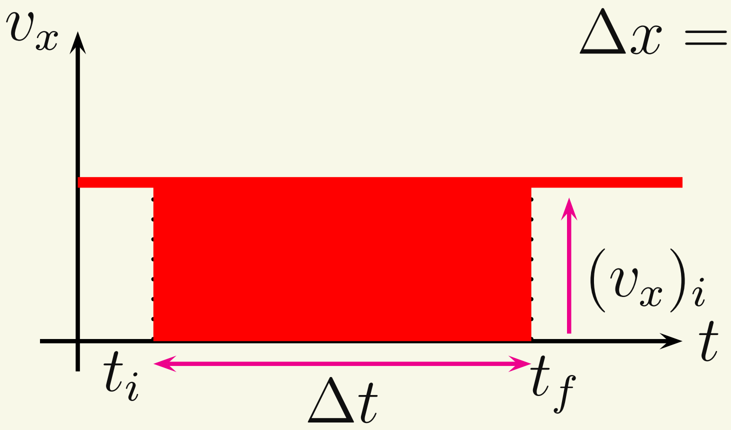


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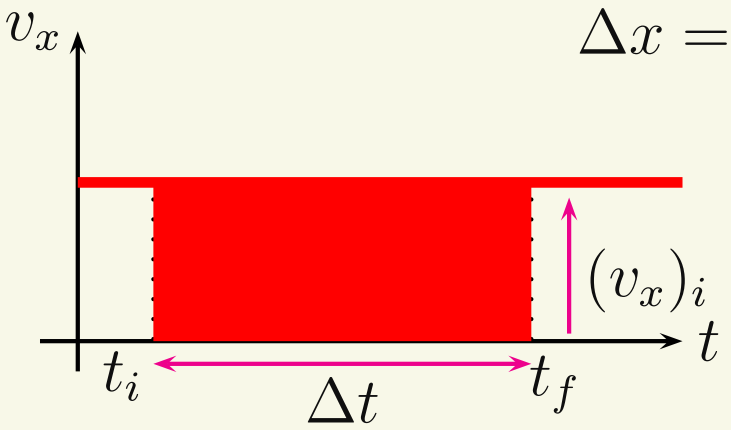


$$\Delta x = \text{Area} \Rightarrow \boxed{x_f = x_i + (v_x)_i \Delta t}$$

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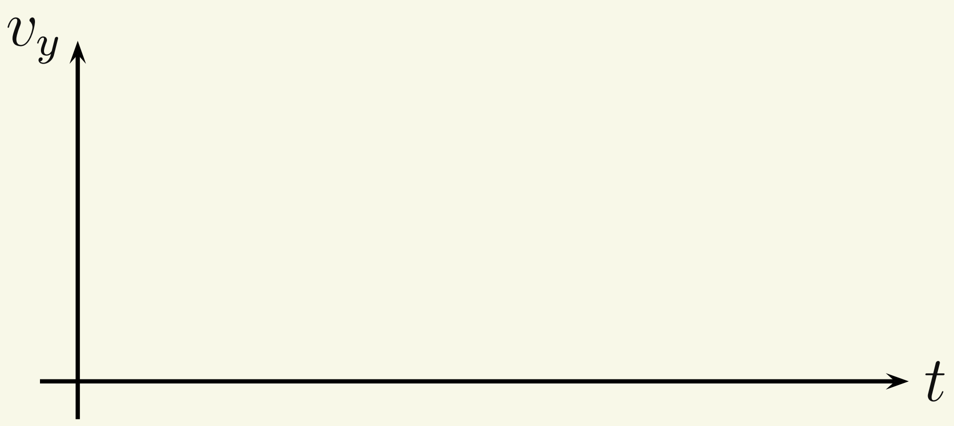

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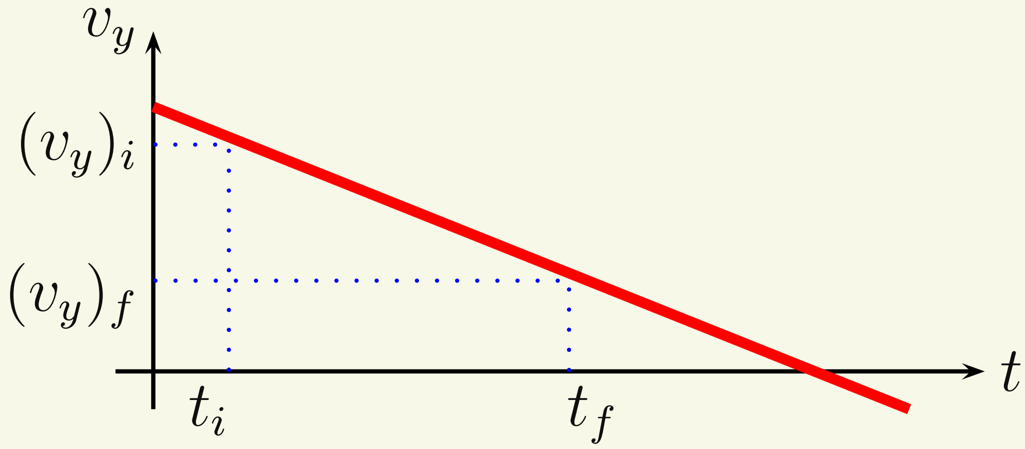

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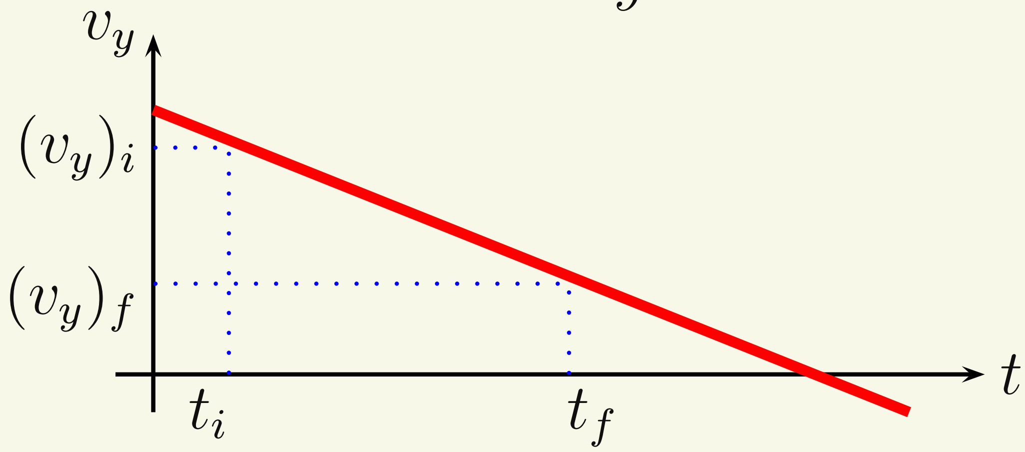

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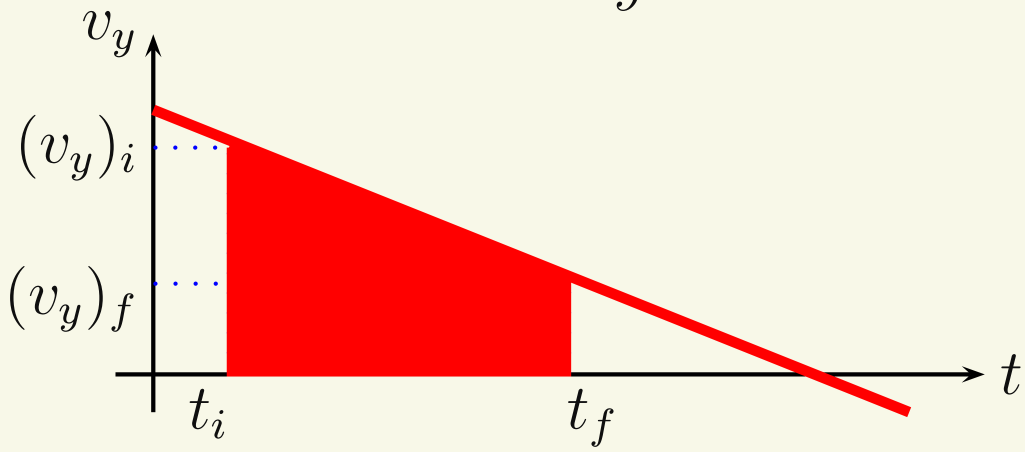

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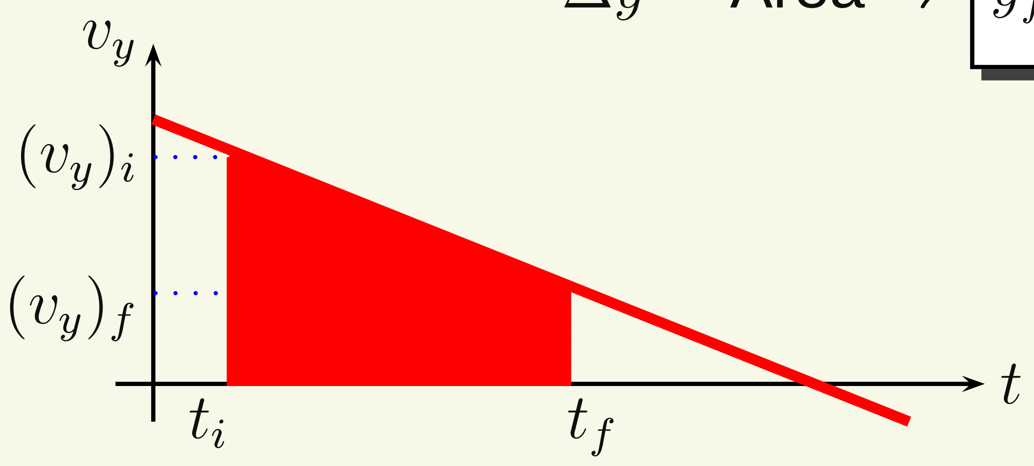

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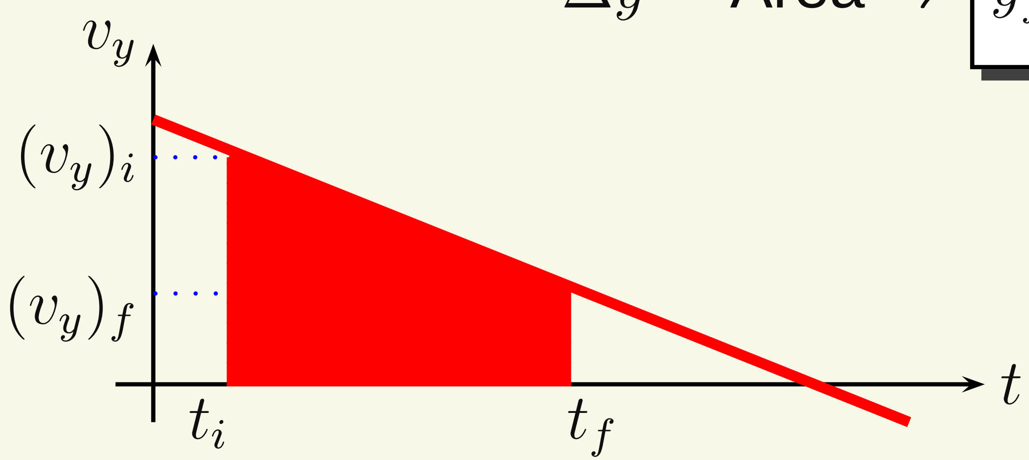


In both of these equations $g = +9.8\,m/s^2$.