

# Constant Acceleration Equations in Two Dimensions

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## If acceleration is constant, use the 2D CA equations.

- ▶ constant acceleration = constant magnitude *and* constant direction

x component

y component

- ▶ Velocity-Time Equation

$$v_x = v_{x0} + a_x t$$

- ▶ Position-Time Equation

$$x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$$

- ▶ Position-Velocity Equation

$$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$$

- ▶ Velocity-Time Equation

$$v_y = v_{y0} + a_y t$$

- ▶ Position-Time Equation

$$y = y_0 + v_{y0}t + \frac{1}{2}a_y t^2$$

- ▶ Position-Velocity Equation

$$v_y^2 = v_{y0}^2 + 2a_y(y - y_0)$$

## Meaning of symbols in 2D CA equations

$t$	the time	independent variable
$x$	$x$ component of position at time $t$	dependent variable
$y$	$y$ component of position at time $t$	dependent variable
$v_x$	$x$ component of velocity at time $t$	dependent variable
$v_y$	$y$ component of velocity at time $t$	dependent variable
$a_x$	$x$ component of the constant acceleration	parameter
$a_y$	$y$ component of the constant acceleration	parameter
$x_0$	$x$ component of position at time 0	parameter
$y_0$	$y$ component of position at time 0	parameter
$v_{x0}$	$x$ component velocity at time 0	parameter
$v_{y0}$	$y$ component velocity at time 0	parameter

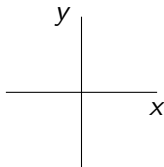
Throughout a motion, some symbols stay the same and some change.

$t$	the time	changing
$x$	$x$ component of position at time $t$	changing
$y$	$y$ component of position at time $t$	changing
$v_x$	$x$ component of velocity at time $t$	changing
$v_y$	$y$ component of velocity at time $t$	changing
$a_x$	$x$ component of the constant acceleration	constant
$a_y$	$y$ component of the constant acceleration	constant
$x_0$	$x$ component of position at time 0	constant
$y_0$	$y$ component of position at time 0	constant
$v_{x0}$	$x$ component velocity at time 0	constant
$v_{y0}$	$y$ component velocity at time 0	constant

For projectile motion, use  $a_x = 0$  and  $a_y = -g$  or  $a_y = g$  in the 2D CA equations.

For projectile motion, use one of two coordinate systems:

1. Standard coordinate system:  $a_x = 0$ ,  $a_y = -g$



2. "Down positive" coordinate system:  $a_x = 0$ ,  $a_y = g$

