Vector Components

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Vectors – 2-D Kinematics

I. Vector Addition/Subtraction
- Graphical

II. Vector Components
- Applications

III. Vector Addition/Subtraction
- Numerical

IV. Relative Motion

V. Projectile Motion

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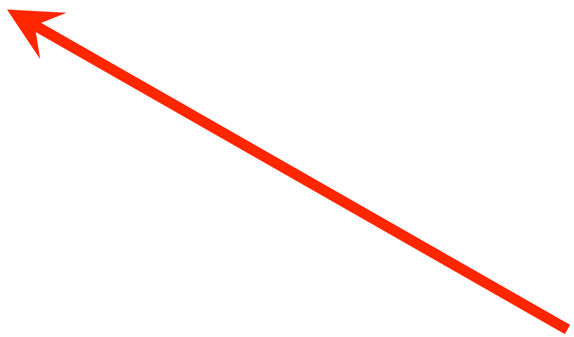
	The student will be able to:	HW:
1	Add or subtract vectors graphically and determine a vector's opposite. ✓	1, 2
2	Calculate the components of a vector given its magnitude and direction.	3, 4
3	Calculate the magnitude and direction of a vector given its components.	5 - 9
4	Use vector components as a means of analyzing/ solving 2-D motion problems.	10 - 13
5	Add or subtract vectors analytically (using trigonometric calculations).	14, 15
6	Use vector addition or subtraction as a means of solving relative velocity problems.	16 - 20
7	State the horizontal and vertical relations for projectile motion and use the same to solve projectile problems and apply vector properties to projectile motion.	21 - 38

Vector Component "Pretest"



Does this vector point more up or more down?

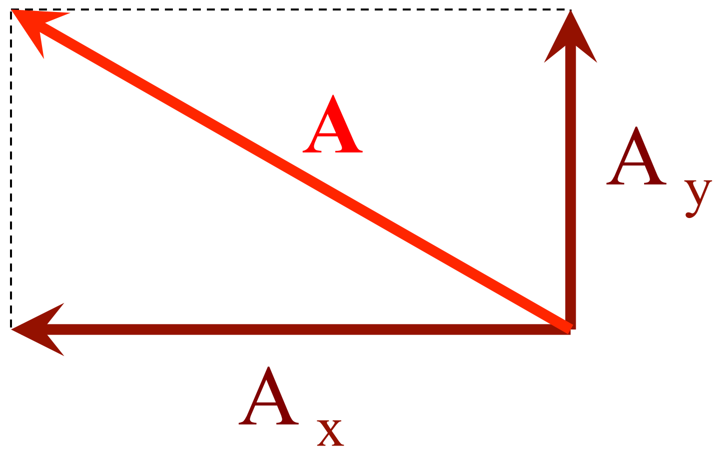
Does this vector point more left or more right?

Does this vector point more left or more up?

Components

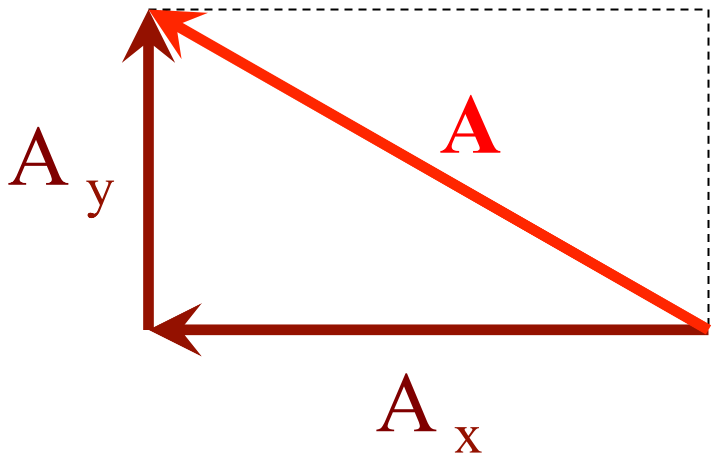
- Components are “parts that make up a whole”.
- A vector’s components indicate the partial amounts extending in perpendicular directions.
- Components indicate *how much up or down* and *how much left or right* a vector points.

Consider vector **A** . . .



It has components A_x and A_y – these indicate how much *left* and how much *up* the vector **A** extends. These are called the *x* and *y* components of vector **A**.

Connection with Vector Addition:

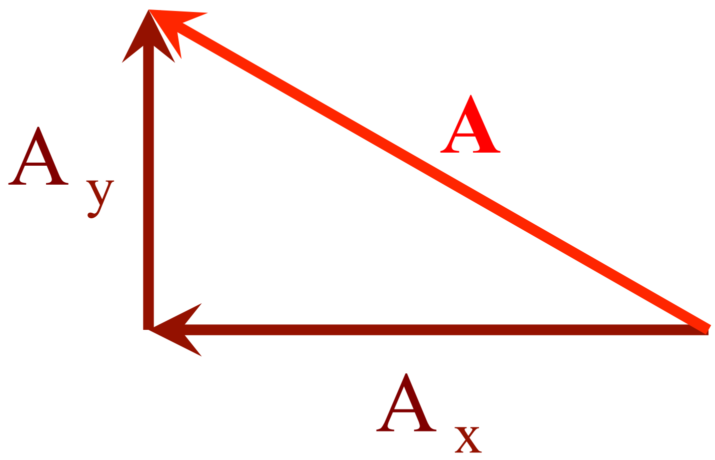


Often the components are shown head-to-tail as seen here. By the rule for vector addition the vector **A** is equal to the sum of its components, A_x and A_y.

Conventions

- The direction of a component is indicated by the *subscript* and the *sign*.
- An x-component is negative if it points left. A y-component is negative if it points down.
- A direction angle is *never* given for a component.

Example of correct notation and terminology:



$\mathbf{A}$ = 10.0 m, 150.0°

This is "the vector".

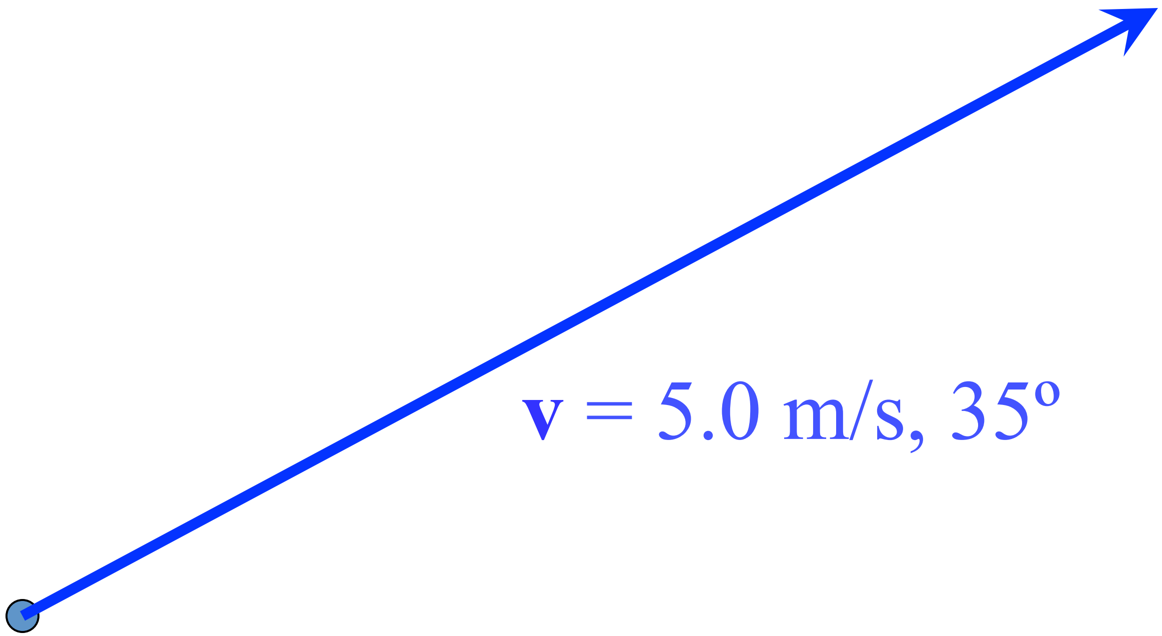
$A_x = -8.66$ m
$A_y = 5.00$ m

These are "the components" of the vector.

Vector **A** points 5.00 m up and 8.66 m to the left.

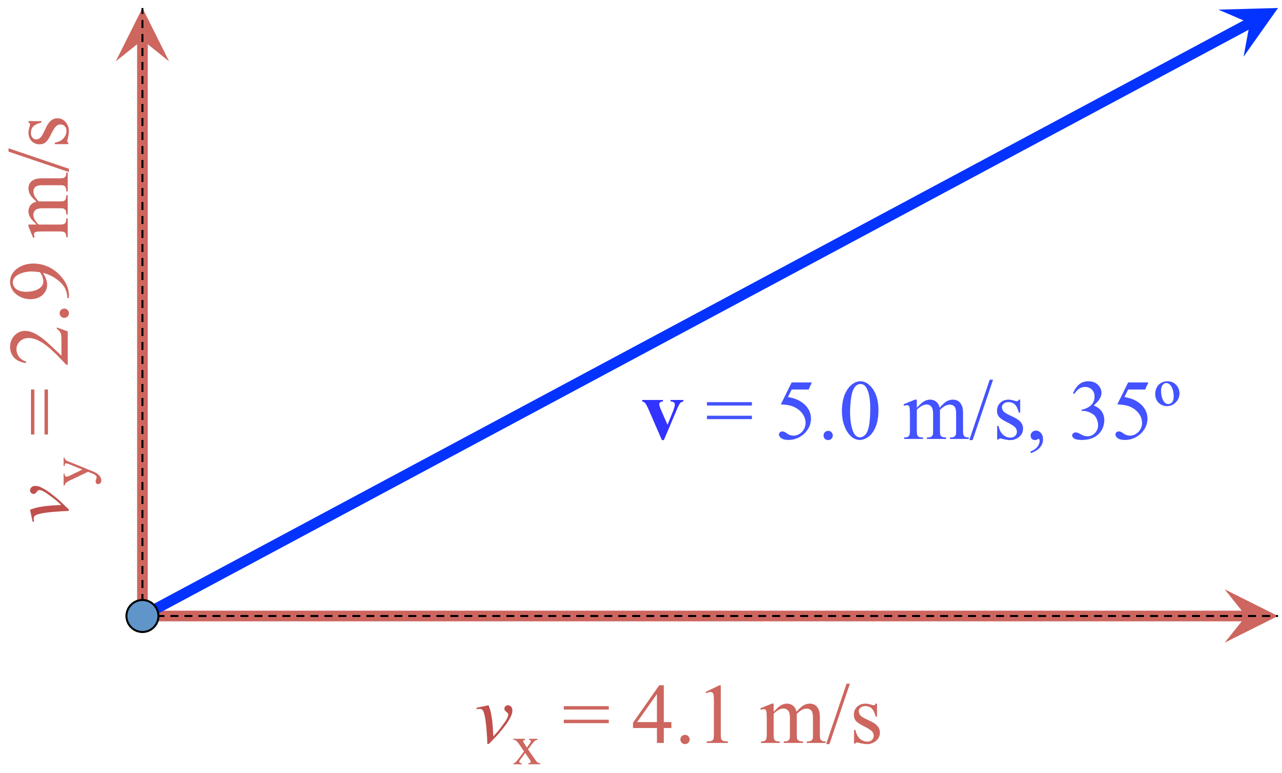
Understanding Components

Suppose an object has constant velocity 5.0 m/s, 35º



Understanding Components

The same object has velocity *components* of:
$v_x = 4.1$ m/s and $v_y = 2.9$ m/s.



It moves 4.1 m/s rightward and 2.9 m/s upward.

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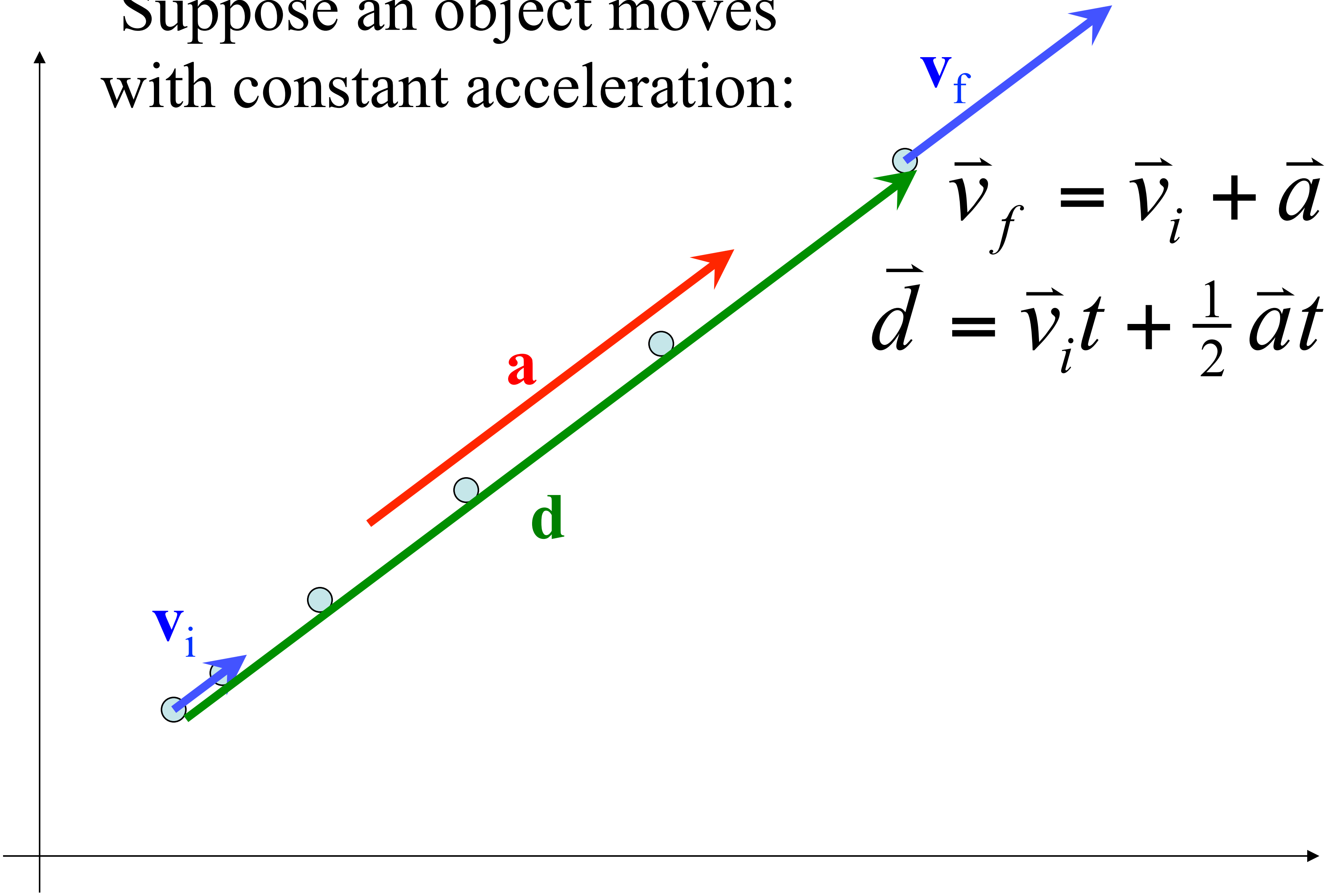
Using Components

- General rule: what is true for the vector is true for the components of the vector.
- Any equations involving vectors can be "broken up" into separate equations for the components.

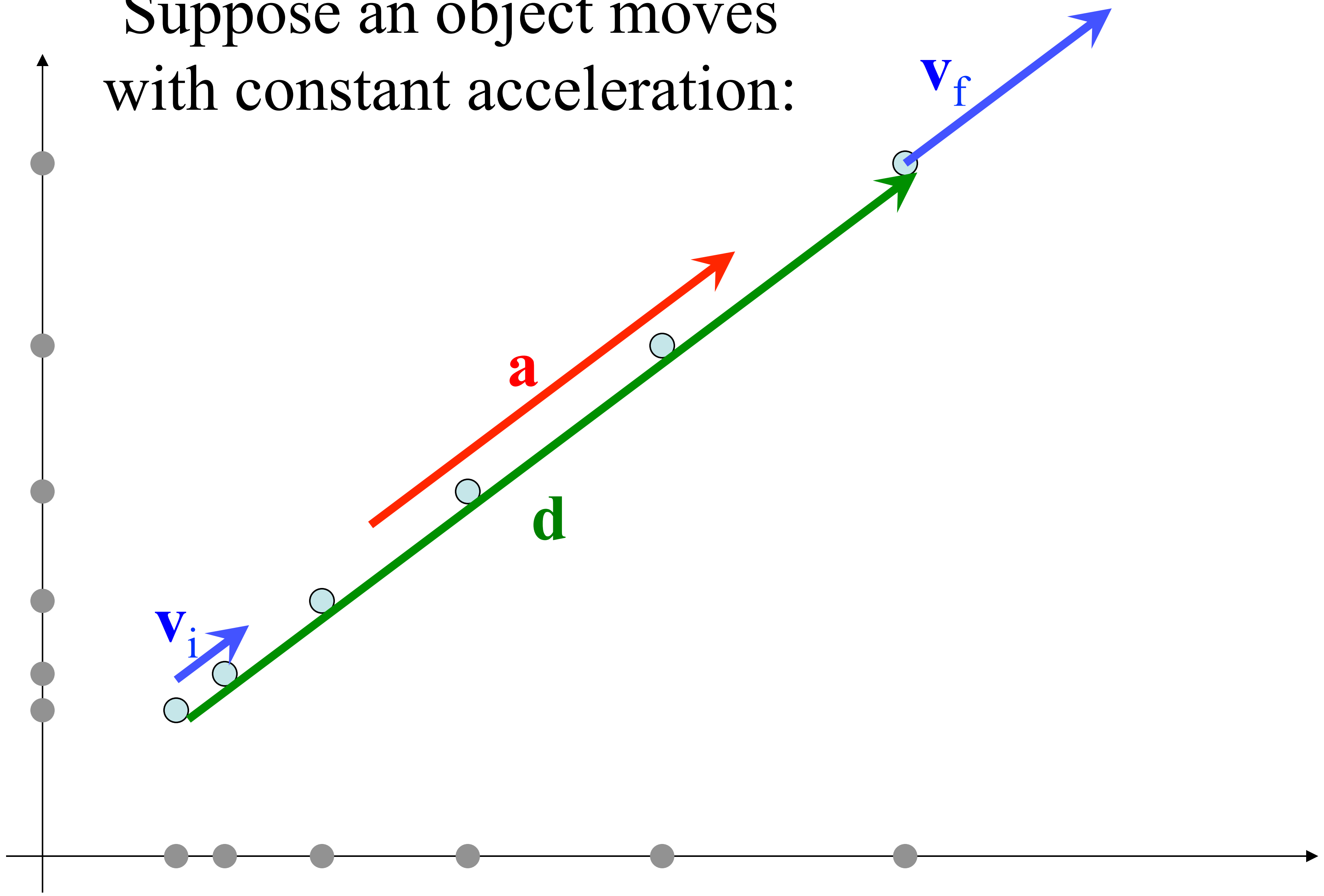
Suppose an object moves with constant acceleration:



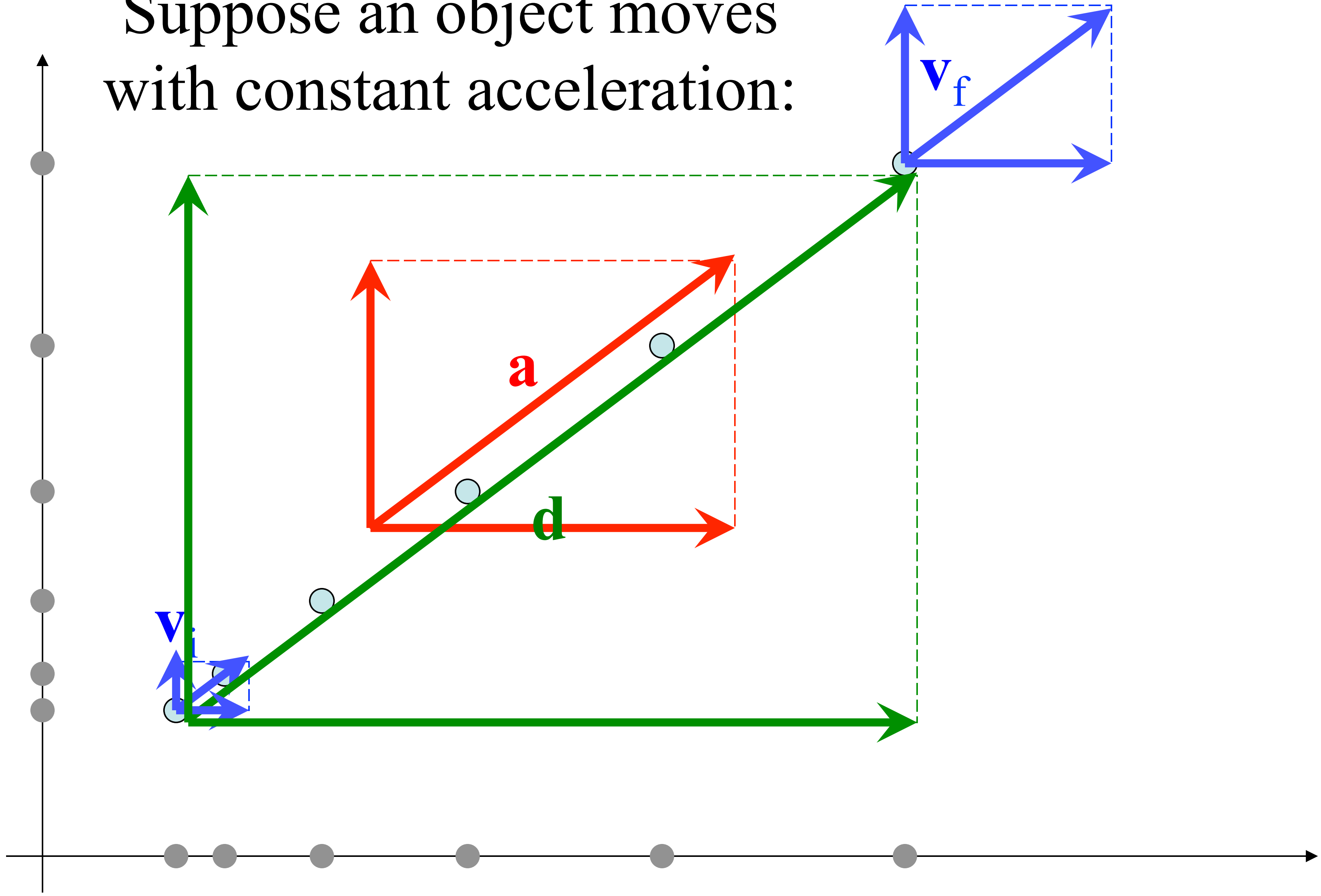
$$\vec{v}_f = \vec{v}_i + \vec{a}t$$

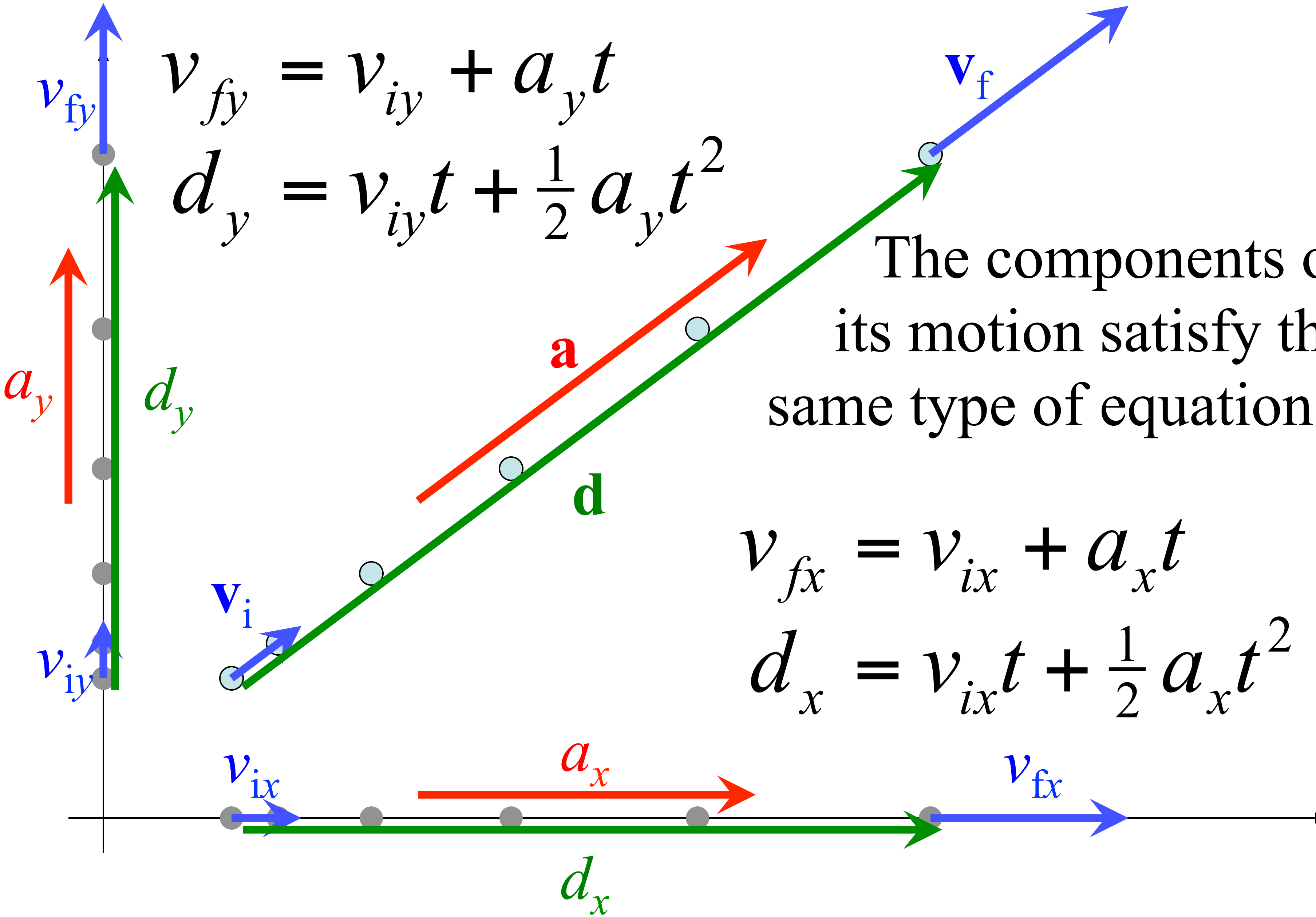
$$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$$

Suppose an object moves with constant acceleration:



Suppose an object moves with constant acceleration:





$$v_{fy} = v_{iy} + a_y t$$

$$d_y = v_{iy} t + \tfrac{1}{2} a_y t^2$$

The components of its motion satisfy the same type of equations.

$$v_{fx} = v_{ix} + a_x t$$

$$d_x = v_{ix} t + \tfrac{1}{2} a_x t^2$$