

# Motion in a Plane with Constant Acceleration

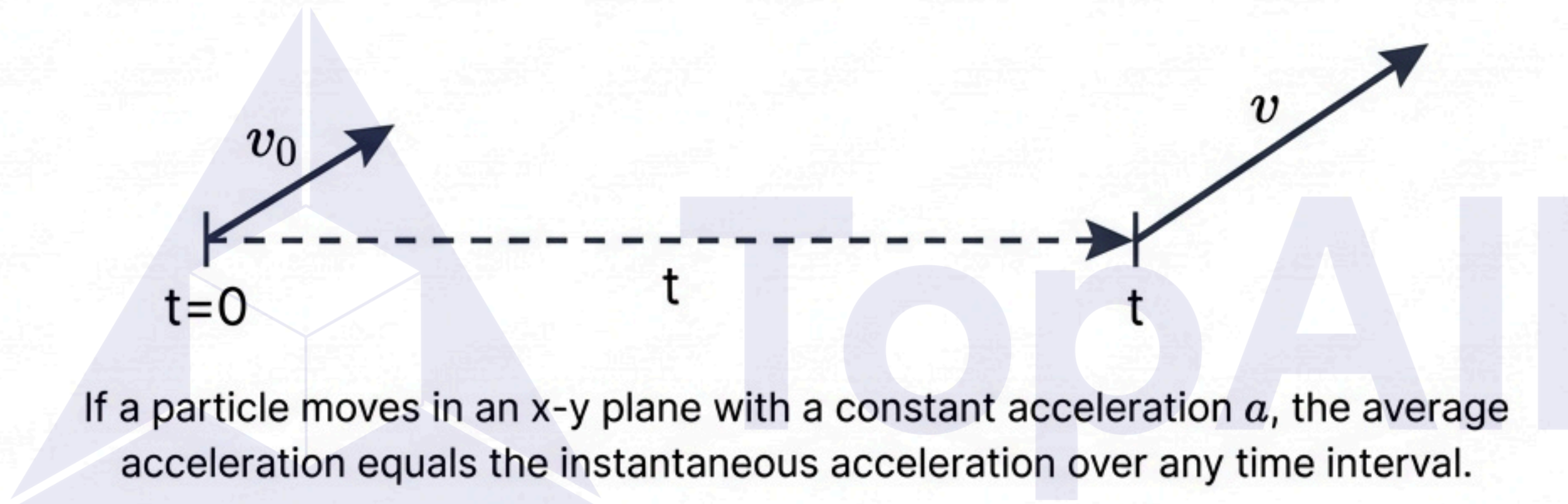
Mastering 2D kinematics for NEET using vector decomposition.

7-Part Quick-Revision Module



## THE CORE IDEA

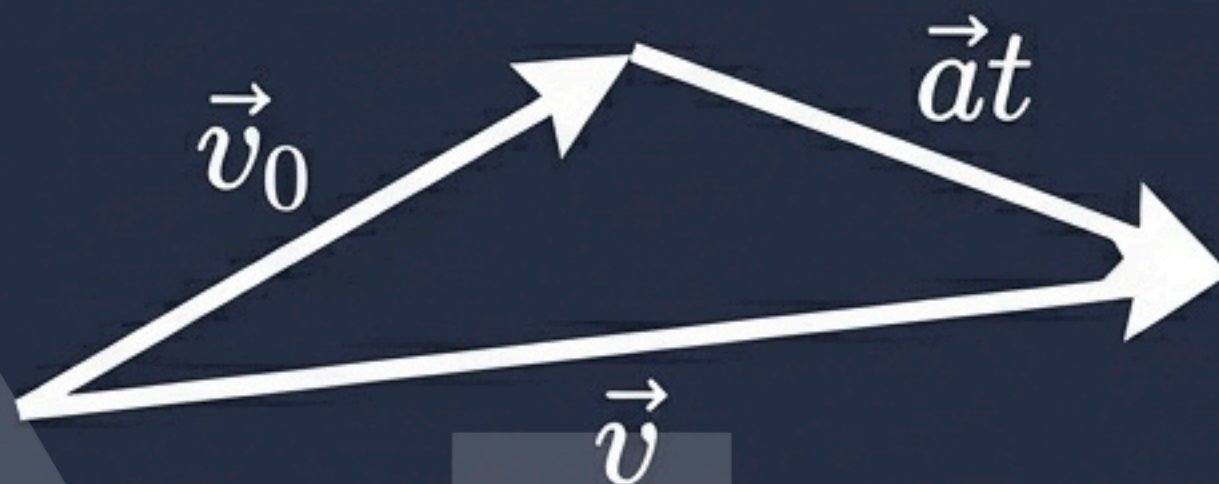
## Defining Constant Acceleration in 2D



$$a = \frac{v - v_0}{t}$$

**[Concept Check]** Acceleration in 2D changes both magnitude AND direction of velocity.

# The Velocity Equation



Rearranging our basic definition gives us the master equation for velocity at any time  $t$ . It is identical to the 1D equation, but fully in vector form.

**[High-Yield]** This single vector equation contains two hidden scalar equations.

$$\vec{v} = \vec{v}_0 + \vec{a}t$$



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$$E=mc^2$$



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# Splitting Velocity into X and Y

To solve actual exam numericals, we resolve the master vector equation into orthogonal (perpendicular) components.

→ X-Axis

Horizontal velocity changes only due to horizontal acceleration.

$$v_x = v_{0x} + a_x t$$

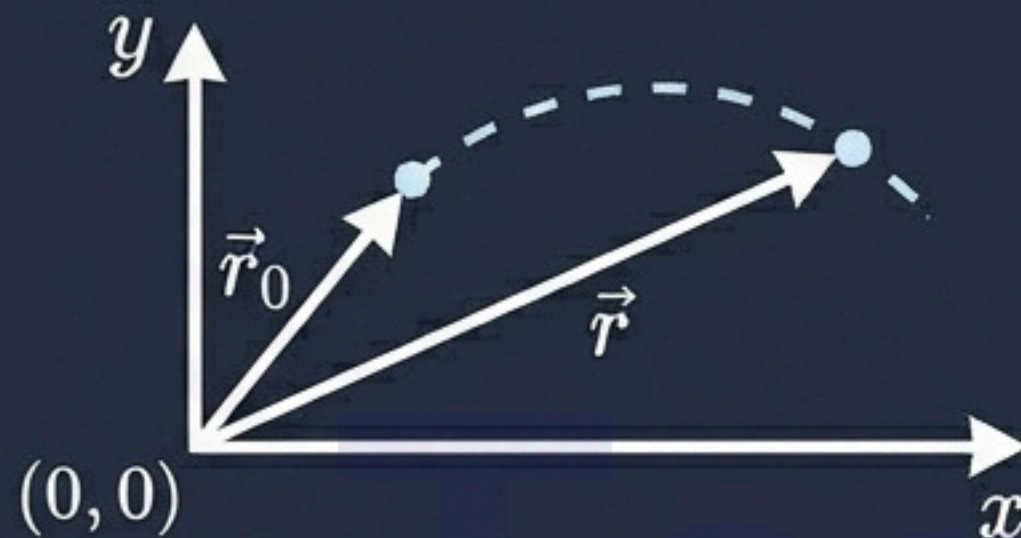
↑ Y-Axis

Vertical velocity changes only due to vertical acceleration.

$$v_y = v_{0y} + a_y t$$

**Time (t)** is the only scalar that links these two independent equations.

# The Position Equation



Just as in 1D motion, the displacement is the average velocity multiplied by the time interval. Adding the initial position vector  $\vec{r}_0$  gives the final position  $\vec{r}$ .

$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2$$

Valid only when acceleration  $\vec{a}$  is strictly constant in both magnitude and direction.

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# Tracking Position in 2D Space

We track the exact coordinates  $(x, y)$  of the particle by breaking the position vector into its horizontal and vertical shadows.



$$x = x_0 + v_{0x}t + \frac{1}{2}a_xt^2$$

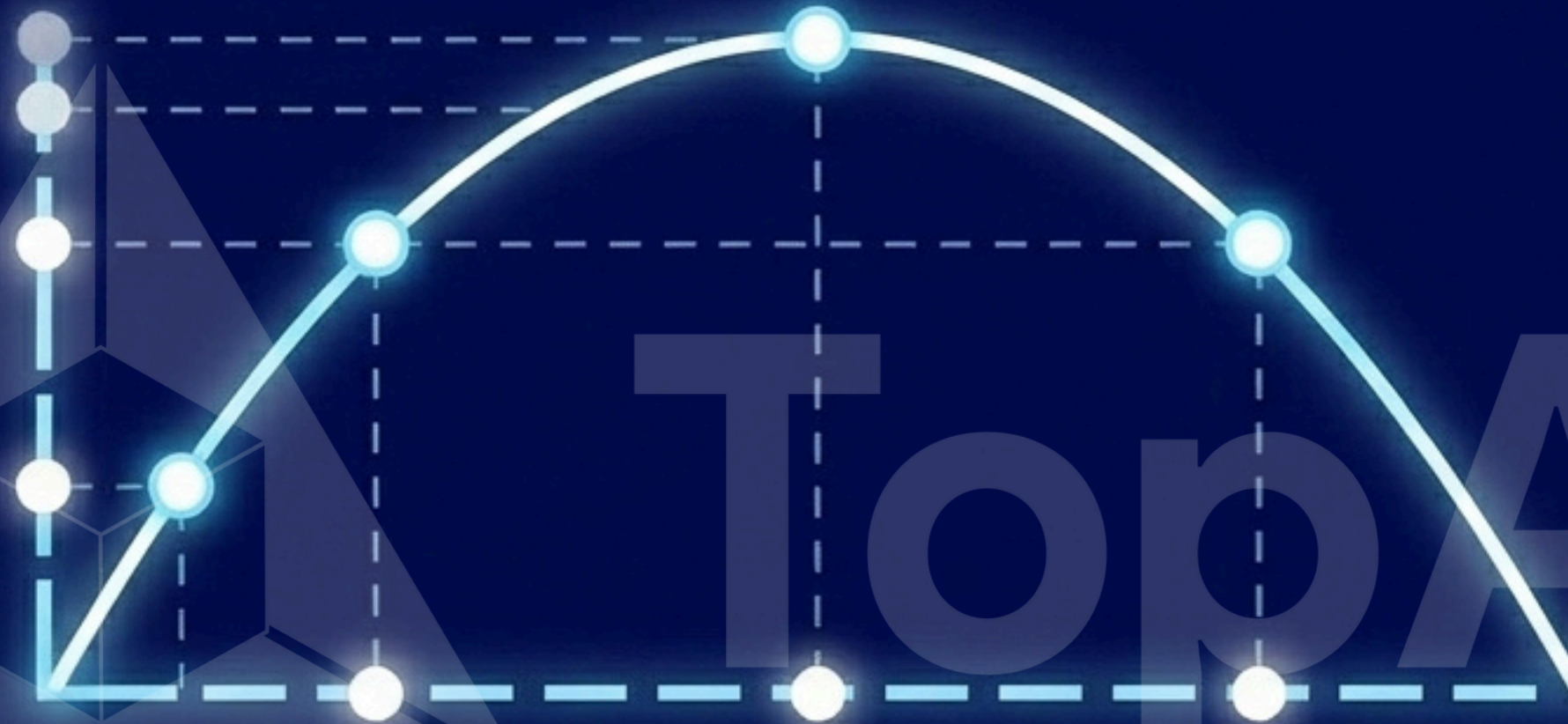


$$y = y_0 + v_{0y}t + \frac{1}{2}a_yt^2$$

If the particle starts at the origin,  $x_0 = 0$  and  $y_0 = 0$ .

## THE GOLDEN RULE OF KINEMATICS

# 2D Motion = Two 1D Motions



Motion in a plane can be treated as two separate, simultaneous one-dimensional motions with constant acceleration along two perpendicular directions.

**[Pro-Tip]** Always choose your X and Y axes wisely. Align one axis with the acceleration (e.g., gravity) to make the other axis have zero acceleration ( $a = 0$ ), turning half your complex 2D math into basic constant-velocity math!



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