KINEMATICS

* $[Dimensions] \xrightarrow{\text{SI units}}$ $[L] \to m$, $[M] \to kg$, $[T] \to s$

Mathematical representation

Position $[L] \equiv \vec{r} = \langle x, y, z \rangle$

Displacement $[L] \equiv \Delta\vec{r} = \vec{r}_f - \vec{r}_i$
$= \langle x_f - x_i, y_f - y_i, z_f - z_i \rangle$

Distance $[L] \equiv |\vec{r}| = \sqrt{x^2 + y^2 + z^2}$

Velocity $\frac{[L]}{[T]} \equiv \vec{v} = \langle v_x, v_y, v_z \rangle$

Change in velocity $\frac{[L]}{[T]} \equiv \Delta\vec{v} = \vec{v}_f - \vec{v}_i$
$= \langle v_{fx} - v_{ix}, v_{fy} - v_{iy}, v_{fz} - v_{iz} \rangle$

Speed $\frac{[L]}{[T]} \equiv |\vec{v}| = \sqrt{v_x^2 + v_y^2 + v_z^2}$

Average velocity $\frac{[L]}{[T]} \equiv \bar{\vec{v}} = \frac{\Delta\vec{r}}{\Delta t}$
$= \left\langle \frac{x_f - x_i}{\Delta t}, \frac{y_f - y_i}{\Delta t}, \frac{z_f - z_i}{\Delta t} \right\rangle$

Acceleration $\frac{[L]}{[T]^2} \equiv \vec{a} = \langle a_x, a_y, a_z \rangle$

Magnitude of acceleration $\frac{[L]}{[T]^2} \equiv |\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}$

average acceleration $\frac{[L]}{[T]^2} \equiv \bar{\vec{a}} = \frac{\Delta\vec{v}}{\Delta t}$
$= \left\langle \frac{v_{fx} - v_{ix}}{\Delta t}, \frac{v_{fy} - v_{iy}}{\Delta t}, \frac{v_{fz} - v_{iz}}{\Delta t} \right\rangle$

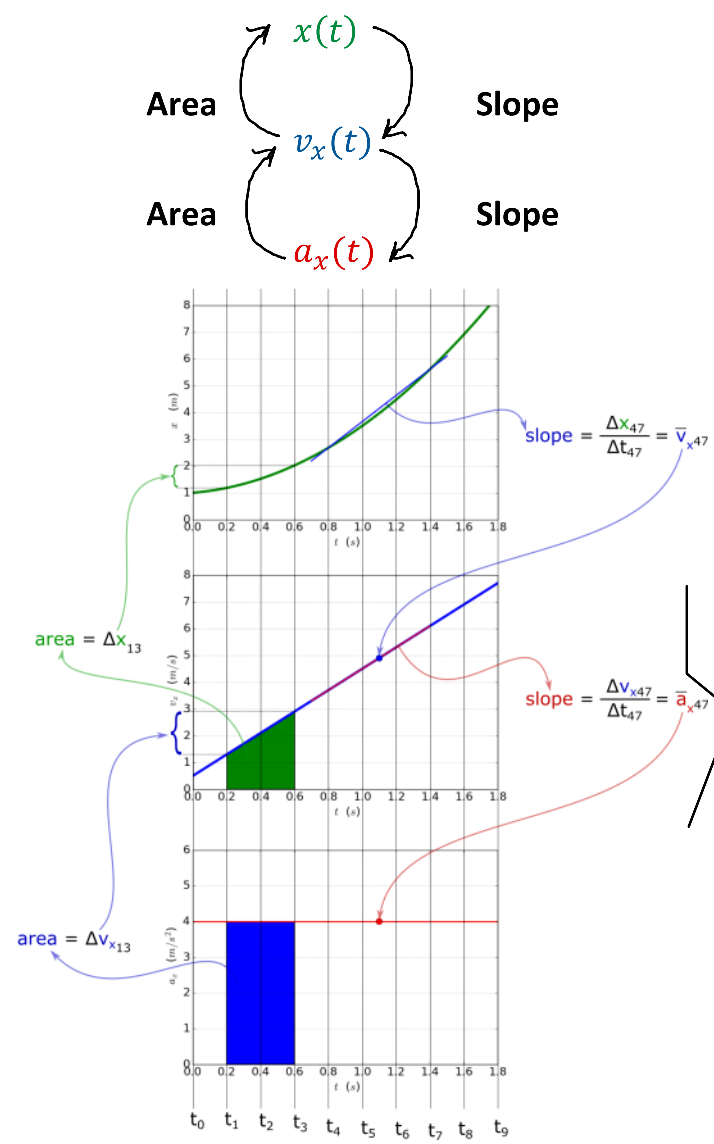
KINEMATIC EQUATIONS *CONSTANT $\vec{a}$

$$\vec{r}_f = \vec{r}_i + \vec{v}_i \Delta t + \frac{1}{2}\vec{a}\,\Delta t^2$$
$$\vec{v}_f = \vec{v}_i + \vec{a}\,\Delta t$$
$$v_{fx}^2 = v_{ix}^2 + 2\,a_x\,\Delta x$$

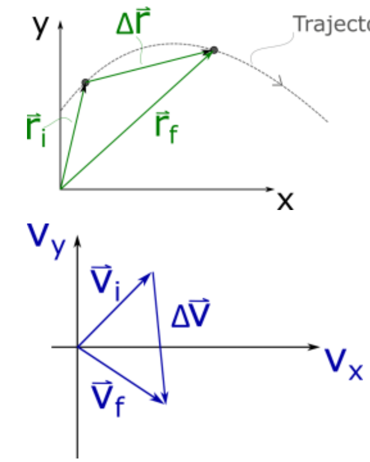
Vector form
(3 equations each)
Example:

$$x_f = x_i + v_{ix}\,\Delta t + \frac{1}{2} a_x\,\Delta t^2$$
$$v_{fx} = v_{ix} + a_x\,\Delta t$$
$$v_{fx}^2 = v_{ix}^2 + 2\,a_x\,\Delta x$$

Graphical representation



Physical representation



Motion diagrams

*Position updated with dots on a spatial plane (e.g. x vs y) at equal time intervals.