2D and 3D motion

Position, Displacement, velocity, and acceleration were previously defined as vector quantities.

We now want to apply these descriptors of motion to the 2D and 3D spaces and look at some common notation that is used.

Notation

Position $(\vec{r})$

$$\vec{r} = x\,\vec{i} + y\,\vec{j} + z\,\vec{k}$$

Displacement $(\Delta \vec{r})$

$$\Delta \vec{r} = \vec{r}_2 - \vec{r}_1 = (x_2 - x_1)\,\vec{i} + (y_2 - y_1)\,\vec{j} + (z_2 - z_1)\,\vec{k}$$

Average Velocity $(\vec{v}_{avg})$

$$\vec{v}_{avg} = \frac{\Delta \vec{r}}{\Delta t}$$

Velocity ($\vec{v}$)

$$\vec{v} = \frac{d\vec{r}}{dt} = \frac{dx}{dt}\vec{i} + \frac{dy}{dt}\vec{j} + \frac{dz}{dt}\vec{k}$$

Average Acceleration ($\Delta \vec{a}_{Avg}$)

$$\Delta \vec{a}_{avg} = \frac{\Delta \vec{v}}{\Delta t}$$

Acceleration ($\vec{a}$)

$$\vec{a} = \frac{d\vec{v}}{dt} = \frac{dv_x}{dt}\vec{i} + \frac{dv_y}{dt}\vec{j} + \frac{dv_z}{dt}\vec{k}$$

Two Special Cases

1) Projectile motion
2) Uniform circular motion

Projectile Motion

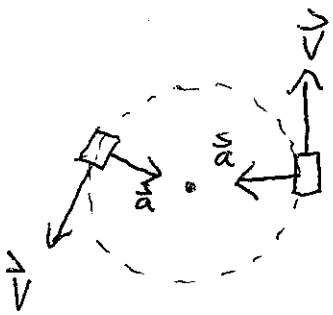
A projectile is an object that is only acted upon by gravity as it moves.

Hence $\vec{a} = -9.80\ m/s^2\ \vec{k}$

(Assuming you are using $\vec{k}$ to represent up/down)

Uniform Circular Motion

An object in uniform circular motion ~~is~~ moves through a circular path at a constant speed.



$a = \frac{v^2}{r}$ and always points toward the center of the circular path.