

Position vector	$\vec{r}(t) = x(t)\hat{i} + y(t)\hat{j} + z(t)\hat{k} \rightarrow (t) = x(t)\hat{i} + y(t)\hat{j} + z(t)\hat{k}$
Displacement vector	$\Delta \vec{r} = \vec{r}(t_2) - \vec{r}(t_1) \Delta \vec{r} \rightarrow \vec{r}(t_2) - \vec{r}(t_1)$
Velocity vector	$\vec{v}(t) = \lim_{\Delta t \rightarrow 0} \frac{\vec{r}(t + \Delta t) - \vec{r}(t)}{\Delta t} = \frac{d\vec{r}}{dt} \rightarrow (t) = \lim_{\Delta t \rightarrow 0} \frac{\vec{r}(t + \Delta t) - \vec{r}(t)}{\Delta t} = \frac{d\vec{r}}{dt}$
Velocity in terms of components	$\vec{v}(t) = v_x(t)\hat{i} + v_y(t)\hat{j} + v_z(t)\hat{k} \rightarrow (t) = v_x(t)\hat{i} + v_y(t)\hat{j} + v_z(t)\hat{k}$
Velocity components	$v_x(t) = \frac{dx(t)}{dt} v_y(t) = \frac{dy(t)}{dt} v_z(t) = \frac{dz(t)}{dt} \vec{v}(t) = \frac{dx(t)}{dt}\hat{i} + \frac{dy(t)}{dt}\hat{j} + \frac{dz(t)}{dt}\hat{k}$
Average velocity	$\vec{v}_{avg} = \frac{\vec{r}(t_2) - \vec{r}(t_1)}{t_2 - t_1} \vec{v} \rightarrow \vec{v}_{avg} = \frac{\vec{r}(t_2) - \vec{r}(t_1)}{t_2 - t_1}$
Instantaneous acceleration	$\vec{a}(t) = \lim_{\Delta t \rightarrow 0} \frac{\vec{v}(t + \Delta t) - \vec{v}(t)}{\Delta t} = \frac{d\vec{v}}{dt} \rightarrow (t) = \lim_{\Delta t \rightarrow 0} \frac{\vec{v}(t + \Delta t) - \vec{v}(t)}{\Delta t} = \frac{d\vec{v}}{dt}$
Instantaneous acceleration, component form	$\vec{a}(t) = \frac{dv_x(t)}{dt}\hat{i} + \frac{dv_y(t)}{dt}\hat{j} + \frac{dv_z(t)}{dt}\hat{k} \rightarrow (t) = \frac{dv_x(t)}{dt}\hat{i} + \frac{dv_y(t)}{dt}\hat{j} + \frac{dv_z(t)}{dt}\hat{k}$
Instantaneous acceleration as second derivatives of position	$\vec{a}(t) = \frac{d^2x(t)}{dt^2}\hat{i} + \frac{d^2y(t)}{dt^2}\hat{j} + \frac{d^2z(t)}{dt^2}\hat{k} \rightarrow (t) = \frac{d^2x(t)}{dt^2}\hat{i} + \frac{d^2y(t)}{dt^2}\hat{j} + \frac{d^2z(t)}{dt^2}\hat{k}$
Time of flight	$T_{tof} = \frac{2(v_0 \sin \theta)}{g} T_{tof} = \frac{2(v_0 \sin \theta)}{g}$
Trajectory	$y = (\tan \theta_0)x - \frac{g^2(v_0 \cos \theta_0)^2}{2} x^2 y = (\tan \theta_0)x - \frac{g^2(v_0 \cos \theta_0)^2}{2} x^2$
Range	$R = \frac{v_0^2 \sin 2\theta_0}{g} R = \frac{v_0^2 \sin 2\theta_0}{g}$
Centripetal acceleration	$a_C = \frac{v^2}{r} a_C = \frac{v^2}{r}$
Position vector, uniform circular motion	$\vec{r}(t) = A \cos \omega t \hat{i} + A \sin \omega t \hat{j} \rightarrow (t) = A \cos \omega t \hat{i} + A \sin \omega t \hat{j}$
Velocity vector, uniform circular motion	$\vec{v}(t) = \frac{d\vec{r}}{dt} = -A\omega \sin \omega t \hat{i} + A\omega \cos \omega t \hat{j} \rightarrow (t) = \frac{d\vec{r}}{dt} = -A\omega \sin \omega t \hat{i} + A\omega \cos \omega t \hat{j}$
Acceleration vector, uniform circular motion	$\vec{a}(t) = \frac{d\vec{v}}{dt} = -A\omega^2 \cos \omega t \hat{i} - A\omega^2 \sin \omega t \hat{j} \rightarrow (t) = \frac{d\vec{v}}{dt} = -A\omega^2 \cos \omega t \hat{i} - A\omega^2 \sin \omega t \hat{j}$
Tangential acceleration	$a_T = \frac{d \vec{v} }{dt} a_T = \frac{d \vec{v} }{dt}$
Total acceleration	$\vec{a} = \vec{a}_C + \vec{a}_T \vec{a} \rightarrow \vec{a} = \vec{a}_C + \vec{a}_T$
Position vector in frame S is the position vector in frame S'S' plus the vector from the origin of S to the origin of S'S'	$\vec{r}_{PS} = \vec{r}_{PS'} + \vec{r}_{S'S} \rightarrow \vec{PS} = \vec{r} \rightarrow \vec{PS'} + \vec{r} \rightarrow \vec{S'S}$
Relative velocity equation connecting two reference frames	$\vec{v}_{PS} = \vec{v}_{PS'} + \vec{v}_{S'S} \rightarrow \vec{PS} = \vec{v} \rightarrow \vec{PS'} + \vec{v} \rightarrow \vec{S'S}$
Relative velocity equation connecting more than two reference frames	$\vec{v}_{PC} = \vec{v}_{PA} + \vec{v}_{AB} + \vec{v}_{BC} \rightarrow \vec{PC} = \vec{v} \rightarrow \vec{PA} + \vec{v} \rightarrow \vec{AB} + \vec{v} \rightarrow \vec{BC}$
Relative acceleration equation	$\vec{a}_{PS} = \vec{a}_{PS'} + \vec{a}_{S'S}$