

Dot Product

$$a \cdot b = |a| |b| \cos \theta$$

Scalar Projection

$$\text{Comp}_a b = \frac{a \cdot b}{|a|}$$

Vector Projection

$$\text{Proj}_a b = \left(\frac{a \cdot b}{|a|^2} \right) a = \frac{a \cdot b}{|a|^2} a$$

$$a \times (b \times c) = (a \cdot c)b - (a \cdot b)c$$

Volume of a parallelepiped

$$V = |a \cdot (b \times c)|$$

Symmetric Equations

$$\frac{x-x_0}{a} = \frac{y-y_0}{b} = \frac{z-z_0}{c}$$

Vector Equation of a Line

$$n \cdot r = n \cdot r_0$$

Scalar Equation of a Plane

$$a(x-x_0) + b(y-y_0) + c(z-z_0) = 0$$

Distance From a Point to a Plane

$$D = |\text{comp}_n b| = \frac{|n \cdot b|}{|n|} = \frac{|ax_1 + by_1 + cz_1 + d|}{\sqrt{a^2 + b^2 + c^2}}$$

Unit Tangent Vector

$$T(t) = \frac{r'(t)}{|r'(t)|}$$

Arc length

$$L = \int_a^b |r'(t)| dt$$

Unit Normal Vector

$$N(t) = \frac{T'(t)}{|T'(t)|}$$

Binomial Vector

$$B(t) = T(t) \times N(t)$$

Curvature

$$K = \left| \frac{dT}{ds} \right| = \left| \frac{T'(t)}{r'(t)} \right| = \frac{|r'(t) \times r''(t)|}{|r'(t)|^3}$$

Acceleration

$$a = v^2 T + kv^2 N$$

Torque

$$\tau = |r \times F| = kr |F| \sin \theta$$