$\cos\theta = \vec{a}\bullet\vec{b}/(\|\mathbf{a}\|\|\mathbf{b}\|)$

$\text{comp}_{\mathbf{b}}\mathbf{a} = \|\mathbf{a}\|\cos\theta = \mathbf{a}\cdot\hat{\mathbf{b}}$

$\text{proj}_{\mathbf{b}}\mathbf{a} = (\vec{\mathbf{a}}\cdot\hat{\mathbf{b}})\hat{\mathbf{b}}$

Area of a parallelogram = $\|\boldsymbol{a}\times\boldsymbol{b}\|$

Volume of a parallelepiped = $|\boldsymbol{a}\bullet(\boldsymbol{b}\times\boldsymbol{c})|$

Equation of a line:
$\vec{r} = \vec{r}_2 + t(\vec{r}_2 - \vec{r}_1) = \vec{r}_2 + t\vec{a}$

Equation of a plane: $a\,x + b\,y + cz + d = 0$
also: $[(\vec{r}_2-\vec{r}_1)\times(\vec{r}_3-\vec{r}_1)]\bullet(\vec{r}-\vec{r}_1) = 0$

$$\frac{d\vec{r}(s)}{dt} = \frac{d\vec{r}}{ds}\frac{ds}{dt}$$

Length of a curve : $s = \int_{t_1}^{t_2} |\vec{r}\,'(t)|\,dt$

$$\kappa = \left\|\frac{d\vec{\mathbf{T}}}{ds}\right\| = \left\|\frac{d^2\vec{\mathbf{r}}}{ds^2}\right\| = \frac{|\vec{\mathbf{T}}'|}{|\vec{\mathbf{r}}'|} = \frac{\|\mathbf{r}'(t)\times\mathbf{r}''(t)\|}{\|\mathbf{r}'(t)\|^3}$$

$$\vec{\mathbf{a}}(t) = \kappa v^2\hat{\mathbf{N}} + \frac{dv}{dt}\hat{\mathbf{T}} = a_N\hat{\mathbf{N}} + a_T\hat{\mathbf{T}}$$

$$\hat{\mathbf{N}} = \frac{d\mathbf{T}/dt}{\|d\mathbf{T}/dt\|}$$

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

The Binormal
$$\hat{\mathbf{B}} = \hat{\mathbf{T}}\times\hat{\mathbf{N}}$$

$$a_T = \frac{dv}{dt} = \frac{\|\mathbf{v}\bullet\mathbf{a}\|}{\|\mathbf{v}\|} \;\;\&\;\; a_N = kv^2 = \frac{\|\mathbf{v}\times\mathbf{a}\|}{\|\mathbf{v}\|}$$

$$\nabla = \mathbf{i}\frac{\partial}{\partial x} + \mathbf{j}\frac{\partial}{\partial y} + \mathbf{k}\frac{\partial}{\partial z}$$

$$\frac{\partial f}{\partial x} = \frac{\partial f}{\partial u}\frac{\partial u}{\partial x} + \frac{\partial f}{\partial v}\frac{\partial v}{\partial x} \;\;\&\;\; \frac{\partial f}{\partial y} = \frac{\partial f}{\partial u}\frac{\partial u}{\partial y} + \frac{\partial f}{\partial v}\frac{\partial v}{\partial y}$$

$D_u(F) = \nabla F\bullet\hat{u},\ \hat{u} = \text{unit vector}$

Equation of Tangent Plane: $\vec{n}_o\bullet(\vec{r}-\vec{r}_o) = 0,\ \vec{n}_o = \nabla F$ at P

$W = \int_C \vec{F}\bullet d\vec{r}$

equation of normal line to a surface: $\vec{n}_o\times(\vec{r}-\vec{r}_o) = 0,\ \vec{n}_o = \nabla F$ at P

$$\int_C F(x,y)ds = \int_a^b F(f(t),g(t))\sqrt{[f']^2+[g']^2}\,dt = \int_a^b F(x,f(x))\sqrt{1+[f']^2}\,dx$$

$$\oint_C \vec{F}\bullet d\vec{r} = \iint_S (curl\,\vec{F})\bullet\hat{n}dS$$

$$\oiint_S (\vec{F}\bullet\hat{n})dS = \iiint_D (div\,\vec{F})dV$$

$$\oint_C [Pdx + Qdy] = \iint_R \left[\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right]dxdy$$

$$\tilde{x} = \frac{\iiint_D x\rho(x,y,z)dV}{m},$$

$$m = \iiint_D \rho(x,y,z)dV$$

$$I_x = \iiint_D (y^2+z^2)\rho(x,y,z)dV;$$

$x = r\cos\theta,\ y = r\sin\theta;\ z = z;\ \ r = \sqrt{x^2+y^2},\ \theta = \tan^{-1}(y/x)$

$$J(u,v) = \frac{\partial(x,y)}{\partial(u,v)}$$

$x = \rho\sin\phi\cos\theta,\ y = \rho\sin\phi\sin\theta, z = \rho\cos\phi,$
$\rho = \sqrt{x^2+y^2+z^2},\ \theta = \tan^{-1}(y/x),\ \ \phi = \tan^{-1}(\sqrt{x^2+y^2}/z)$

$dV = r\ dr\,d\theta\,dz$
$dV = \rho^2\sin\phi\ d\rho d\phi\,d\theta$