

$$\cos^2 \theta = \frac{1+\cos 2\theta}{2} \quad \sin^2 \theta = \frac{1-\cos 2\theta}{2} \quad \sin 2\theta = 2 \sin \theta \cos \theta$$

$$\Delta = \begin{vmatrix} f_{xx} & f_{xy} \\ f_{xy} & f_{yy} \end{vmatrix}$$

$\Delta > 0$ and $f_{xx} > 0 \rightarrow$ Local Minimum

$\Delta > 0$ and $f_{xx} < 0 \rightarrow$ Local Maximum

$\Delta < 0 \rightarrow$ Saddle Point

$\Delta = 0 \rightarrow$ No Info

$$m = \iint_R \delta(x, y) dA$$

$$\bar{x} = \frac{1}{m} \iint_R x \delta(x, y) dA$$

$$\bar{y} = \frac{1}{m} \iint_R y \delta(x, y) dA$$

$$I_x = \iint_R y^2 \delta(x, y) dA$$

$$I_y = \iint_R x^2 \delta(x, y) dA$$

$$I_0 = \iint_R (x^2 + y^2) \delta(x, y) dA$$

$$m = \iiint_Q \delta(x, y, z) dV$$

$$\bar{x} = \frac{1}{m} \iiint_Q x \delta(x, y, z) dV$$

$$\bar{y} = \frac{1}{m} \iiint_Q y \delta(x, y, z) dV$$

$$\bar{z} = \frac{1}{m} \iiint_Q z \delta(x, y, z) dV$$

$$I_x = \iiint_Q (y^2 + z^2) \delta(x, y, z) dV$$

$$I_y = \iiint_Q (x^2 + z^2) \delta(x, y, z) dV$$

$$I_z = \iiint_Q (x^2 + y^2) \delta(x, y, z) dV$$

Polar $x = r \cos \theta$ $y = r \sin \theta$ $dA = r dr d\theta$

Cylindrical $x = r \cos \theta$ $y = r \sin \theta$ $z = z$ $dV = r dr d\theta dz$

Spherical

$x = \rho \sin \phi \cos \theta$ $y = \rho \sin \phi \sin \theta$ $z = \rho \cos \phi$ $dV = \rho^2 \sin \phi d\rho d\phi d\theta$

$$dS = \sqrt{1 + (z_x)^2 + (z_y)^2} dA$$

$$dS = \|\mathbf{r}_u \times \mathbf{r}_v\| du dv$$

$$\frac{\partial(x,y)}{\partial(u,v)} = \begin{vmatrix} x_u & x_v \\ y_u & y_v \end{vmatrix} \quad \frac{\partial(u,v)}{\partial(x,y)} = \begin{vmatrix} u_x & u_y \\ v_x & v_y \end{vmatrix}$$

Divergence $\nabla \cdot \mathbf{F} = \frac{\partial P}{\partial x} + \frac{\partial Q}{\partial y} + \frac{\partial R}{\partial z}$

Curl $\nabla \times \mathbf{F} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ P & Q & R \end{vmatrix}$

$$ds = \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{dz}{dt}\right)^2} dt$$

Green's Theorem $\oint_C (Pdx + Qdy) = \iint_R \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right) dA$

Vector Form of Green's Theorem $\oint_C \mathbf{F} \cdot \mathbf{n} ds = \iint_R \nabla \cdot \mathbf{F} dA$

Divergence Theorem $\oiint_S \mathbf{F} \cdot \mathbf{n} dS = \iiint_Q \nabla \cdot \mathbf{F} dV$

Stokes' Theorem $\oint_C \mathbf{F} \cdot \mathbf{T} ds = \iint_S (\nabla \times \mathbf{F}) \cdot \mathbf{n} dS$