

Formula Sheet for MATH 2443

The following formulae are provided without the conditions under which they apply.

• Cylindrical coordinates: $x = r \cos \theta$, $y = r \sin \theta$, $z = z$
 $dV = r dr d\theta dz$

• Spherical coordinates: $x = \rho \sin \phi \cos \theta$, $y = \rho \sin \phi \sin \theta$, $z = \rho \cos \phi$
 $dV = \rho^2 \sin \phi d\rho d\phi d\theta$

• Green's Theorem: $\oint_C P dx + Q dy = \iint_D \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} \right) dA$

Let

$\underline{F} = P \underline{i} + Q \underline{j} + R \underline{k}$ - vector field on \mathbb{R}^3

$f(x, y, z)$ - scalar function on \mathbb{R}^3

• $\text{grad } f = \nabla f = \frac{\partial f}{\partial x} \underline{i} + \frac{\partial f}{\partial y} \underline{j} + \frac{\partial f}{\partial z} \underline{k}$

• $\text{div } \underline{F} = \nabla \cdot \underline{F} = \frac{\partial P}{\partial x} + \frac{\partial Q}{\partial y} + \frac{\partial R}{\partial z}$

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

$= \left(\frac{\partial R}{\partial y} - \frac{\partial Q}{\partial z} \right) \underline{i} + \left(\frac{\partial P}{\partial z} - \frac{\partial R}{\partial x} \right) \underline{j} + \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} \right) \underline{k}$