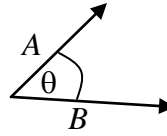


Physics 415: VECTOR OPERATIONS REVIEW

Dot Product

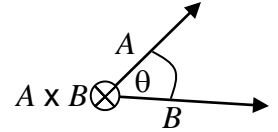
$$\vec{A} \cdot \vec{B} = AB \cos \theta = A_x B_x + A_y B_y + A_z B_z$$



Cross Product

Size : $|\vec{A} \times \vec{B}| = AB \sin \theta$

Direction: Right-hand Rule (fingers trace A into B; thumb gives direction)



$$\vec{A} \times \vec{B} = \hat{x}(A_y B_z - A_z B_y) + \hat{y}(A_z B_x - A_x B_z) + \hat{z}(A_x B_y - A_y B_x) = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

Vector Function: $\vec{A} = \hat{x}A_x(x, y, z) + \hat{y}A_y(x, y, z) + \hat{z}A_z(x, y, z)$

Scalar Function: $f = f(x, y, z)$

Del Operator: $\vec{\nabla} = \hat{x} \frac{\partial}{\partial x} + \hat{y} \frac{\partial}{\partial y} + \hat{z} \frac{\partial}{\partial z}$

Del Operating on a Vector Function

Divergence of \vec{A} $\vec{\nabla} \cdot \vec{A} = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}$

Curl of \vec{A} $\vec{\nabla} \times \vec{A} = \hat{x} \left(\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z} \right) + \hat{y} \left(\frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x} \right) + \hat{z} \left(\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} \right)$

Del Operating on a Scalar Function

Gradient of f $\vec{\nabla} f = \hat{x} \frac{\partial f}{\partial x} + \hat{y} \frac{\partial f}{\partial y} + \hat{z} \frac{\partial f}{\partial z}$

Laplacian of f $\vec{\nabla} \cdot \vec{\nabla} f = \nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$