kamis

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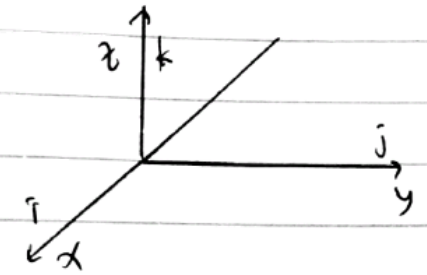
Kelistrikan dan Kemagnetan

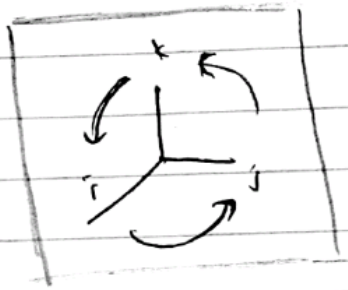
Operator dalam Fisika

(1) Analisis Vektor



$$\vec{A} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$\hat{A} = \frac{\vec{A}}{|\vec{A}|} = \frac{x\hat{i} + y\hat{j} + z\hat{k}}{\sqrt{x^2 + y^2 + z^2}}$$



$$\vec{A} = x^2y\,\hat{i} + 3yz\,\hat{j} + 2xy\,\hat{k}$$
$$\vec{B} = z\hat{i} + 2yx\,\hat{j} + 3xz\,\hat{k}$$

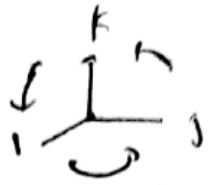
$$\vec{A} + \vec{B} = (x^2y + z)\hat{i} + (y^2z + 2yx)\hat{j} + (2x^2y + 3xz)\hat{k}$$

$$\vec{A} \cdot \vec{B} = x^2yz + 6y^2z + 6x^2yz$$

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ x^2y & 3yz & 2xy \\ z & 2yx & 3xz \end{vmatrix} \begin{matrix} \hat{i} & \hat{j} \\ x^2y & 3yz \\ z & 2yx \end{matrix}$$

$$= (3yz \cdot 3xz)\hat{i} + (2xy \cdot z)\hat{j} + (x^2y \cdot 2yx)\hat{k} - (z\,3yz)\hat{k} - (2yx \cdot 2xy)\hat{i} - (3xz\,x^2y)\hat{j}$$

$$= (9xyz^2 - 4xy^2z)\hat{i} + (2xyz - 3x^2y^2)\hat{j} + (3xz\,2yz - 3yz^2)\hat{k}$$



② Operator Nabla

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

Gradien :

$$T = x^2yz + 3y^2z$$

$$\nabla T = \frac{\hat{i}\,\partial(x^2yz + 3y^2z)}{\partial x} + \frac{\hat{j}\,\partial(x^2yz + 3y^2z)}{\partial y} + \frac{\hat{k}\,\partial(x^2yz + 3y^2z)}{\partial z}$$

$$= (2xyz)\hat{i} + (x^2z + 6yz)\hat{j} + (x^2y + 3y^2)\hat{k}$$

$$\vec{A} = 2x\hat{i} + 3y\hat{j} - yz\hat{k}$$

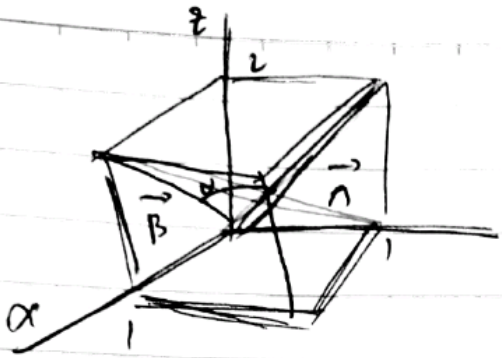
$$\nabla \cdot \vec{A} = \frac{\partial}{\partial x}(2x) + \frac{\partial}{\partial y}(3y) - \frac{\partial}{\partial z}(yz) = 2 + 3 - 4 = 1$$

$$\nabla \times \vec{A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ 2x & 3y & -yz \end{vmatrix}$$

$$= \left(\frac{\partial(-yz)}{\partial y} - \frac{\partial(3y)}{\partial z}\right)\hat{i} + \left(\frac{\partial(2x)}{\partial z} - \frac{\partial(-yz)}{\partial x}\right)\hat{j} + \left(\frac{\partial(3y)}{\partial x} - \frac{\partial(2x)}{\partial y}\right)\hat{k}$$

$$= (0-0)\hat{i} + (0-0)\hat{j} + (0-0)\hat{k}$$

$$= 0$$



$\vec{A} = 0\hat{i} + \hat{j} + 2\hat{k}$

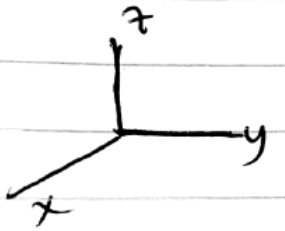
$\vec{B} = 1 + 0\hat{j} + 2\hat{k}$

$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta$

$4 = \sqrt{5}\sqrt{5}\cos\theta$

$\cos\theta = \frac{4}{5}$

$\theta = \ln v \cos \frac{4}{5}$



$\vec{A} = \hat{i} + \hat{j} + 2\hat{k}$

$\vec{B} = -\hat{i} + 0\hat{j} + 2\hat{k}$

$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta$

$2 = \sqrt{6}\sqrt{6}\cos\theta$

$\cos\theta = \frac{2}{6}$

$\theta = \ln v \cos \frac{1}{3}$