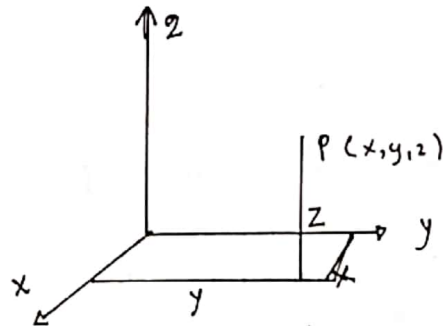


1) Koordinat Kartesius

Gambar :



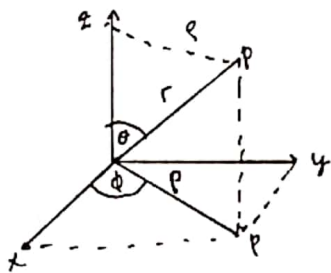
- Gradien : $\nabla t = \hat{i} \frac{\partial t}{\partial x} + \hat{j} \frac{\partial t}{\partial y} + \hat{k} \frac{\partial t}{\partial z}$

- Divergensi : $\nabla \cdot \vec{V} = \frac{\partial V_x}{\partial x} + \frac{\partial V_y}{\partial y} + \frac{\partial V_z}{\partial z}$

- Rotasi : $\nabla \times \vec{V} = \hat{i} \left(\frac{\partial V_z}{\partial y} - \frac{\partial V_y}{\partial z} \right) + \hat{j} \left(\frac{\partial V_x}{\partial z} - \frac{\partial V_z}{\partial x} \right) + \hat{k} \left(\frac{\partial V_y}{\partial x} - \frac{\partial V_x}{\partial y} \right)$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ V_x & V_y & V_z \end{vmatrix}$$

2) Koordinat bola (r, θ, φ)



$$x = r \sin \theta \cos \phi$$

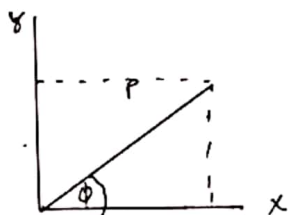
$$y = r \sin \theta \sin \phi$$

$$z = r \cos \theta$$

$$x = r \sin \theta \cos \phi$$

$$z = r \cos \theta$$

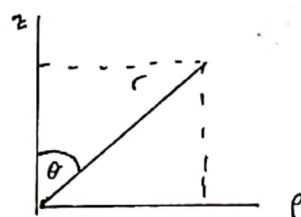
- Analisis bidang x dan y



$$\sin \phi = \frac{y}{r}, \quad y = r \sin \phi$$

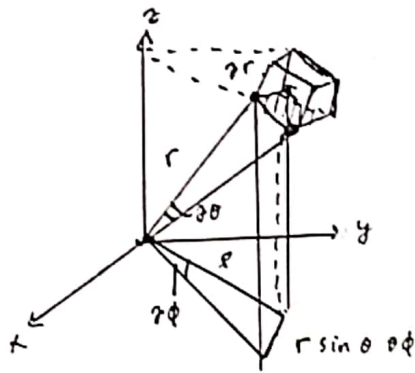
$$x = r \cos \phi$$

- Analisis z dan r



$$z = r \cos \theta$$

$$r = \frac{z}{\cos \theta}$$



$$\sin \theta \cos \phi = \frac{x'}{r}$$

$$\cos \phi = \frac{x'}{r \sin \theta}$$

$$x' = r \sin \theta \cos \phi$$

$$\sin \theta \sin \phi = \frac{y'}{r}$$

$$y' = r \sin \theta \sin \phi$$

$$dv = dr \cdot r \cdot d\theta \cdot r \sin \theta \cdot d\phi$$

$$\partial v = r^2 \sin \theta \partial r \partial \theta \partial \phi$$

$$dv = r^2 \sin \theta dr d\theta d\phi$$

$$\partial A = r \partial \theta \cdot r \sin \theta \partial \phi$$

$$\partial A = r^2 \sin \theta d\theta d\phi$$

$$\partial c^2 = \partial r^2 + r^2 \partial \theta^2 + r^2 \sin^2 \theta \partial \phi^2$$

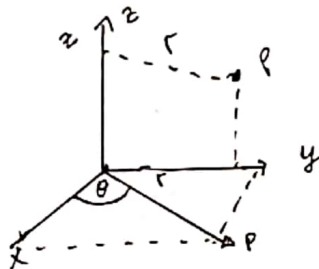
Jadi,

1) Elemen Volume : $\partial v = r^2 \sin \theta \partial r \partial \theta \partial \phi$

2) Elemen luas : $dA = r^2 \sin \theta \partial \theta \partial \phi$

3) Elemen panjang : $dc^2 = \partial r^2 + r^2 \partial \theta^2 + r^2 \sin^2 \theta \partial \phi^2$

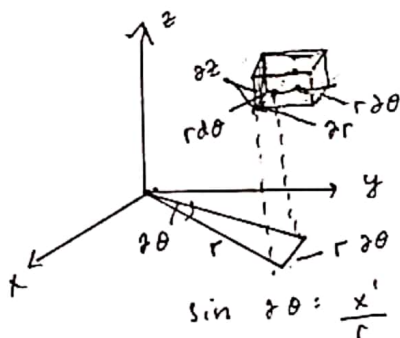
1) Koordinat Silinder (r, θ, z)



$$\sin \theta = \frac{y}{r}, \quad y = r \sin \theta$$

$$x = r \cos \theta \quad \left\{ \begin{array}{l} \text{sama dengan koordinat polar} \end{array} \right.$$

$$z = z \quad (\text{tidak dipengaruhi } \theta \text{ atau } r)$$



$$\sin \theta = \frac{y'}{r}$$

$$x' = r \cos \theta$$

$$y' = r \sin \theta$$

1) Elemen Volume

$$dv = \partial r \cdot r \partial \theta \cdot \partial z$$

$$dv = r \partial r \partial \theta \partial z$$

2) Elemen permukaan bidang tertentu (yang diarsir)

$$dA = r \partial \theta \partial z$$

3) Elemen panjang

$$\partial r^2 = \partial r^2 + r^2 \partial \theta^2 + \partial z^2$$