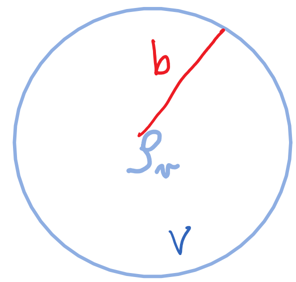
$$dV = R^2 \sin\theta \, dR \, d\theta \, d\phi$$

$$[\rho_v] = \frac{kg}{m^3}$$

$$M = \int_V \rho_v \, dV = \rho_v \int_{R=0}^{b} \int_{\theta=0}^{\pi} \int_{\phi=0}^{2\pi} \sin\theta \, R^2 \, dR \, d\theta \, d\phi$$

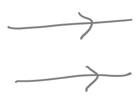


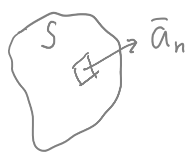
$$\int_{\phi=0}^{2\pi} d\phi = 2\pi \qquad \int_{\theta=0}^{\pi} \sin\theta \, d\theta = \Big|_0^{\pi} -\cos\theta = -(-1) - (-1) = 2$$

$$\int_{R=0}^{b} R^2 \, dR = \Big|_0^{b} \frac{1}{3} R^3 = \frac{1}{3} R^3$$

$$M = \rho_v \frac{4\pi}{3} R^3$$

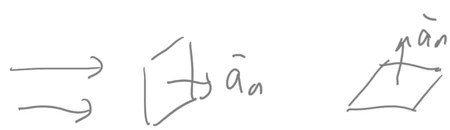
$$[\bar{J}] = \frac{A}{m^2}$$

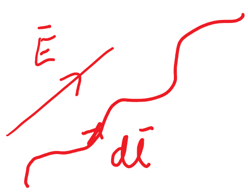




$$d\bar{S} = \bar{a}_n \, dS$$

$$I = \int \bar{J} \cdot d\bar{S}$$





$$\int \bar{E} \cdot d\bar{l}$$

$\frac{V}{m}$ m

$$\nabla = \bar{a}_x \frac{\partial}{\partial x} + \bar{a}_y \frac{\partial}{\partial y} + \bar{a}_z \frac{\partial}{\partial z}$$

$f(x,y,z)$

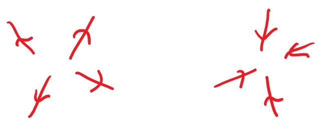
$$\nabla f = \bar{a}_x \frac{\partial f}{\partial x} + \bar{a}_y \frac{\partial f}{\partial y} + \bar{a}_z \frac{\partial f}{\partial z}$$ (GRADIENT)

$\bar{G}(\overbrace{x,y,z}^{\bar{R}})$

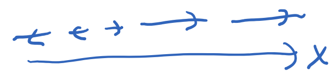
$$\nabla \cdot \bar{G} = \cdot = \frac{\partial G_x}{\partial x} + \frac{\partial G_y}{\partial y} + \frac{\partial G_z}{\partial z}$$ (DIVERGENCE)

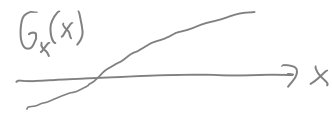
$$\bar{G} = \bar{a}_x G_x + \bar{a}_y G_y + \bar{a}_z G_z$$

$$G_x = \bar{a}_x \cdot \bar{G}$$



$\bar{G} = \bar{a}_x G_x(x)$

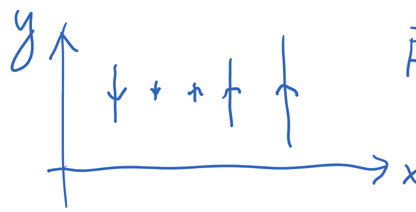




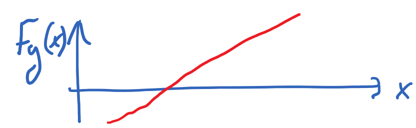
$$\nabla \cdot \bar{G} = \frac{\partial G_x}{\partial x} > 0$$

$$\text{CURL}: \quad \nabla \times \bar{F} = \begin{vmatrix} \bar{a}_x & \bar{a}_y & \bar{a}_z \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ F_x & F_y & F_z \end{vmatrix}$$

$$\begin{vmatrix} \bar{a}_x & \bar{a}_y & \bar{a}_z \\ \partial/\partial x & \cancel{\partial/\partial y} & \cancel{\partial/\partial z} \\ 0 & F_y(x) & 0 \end{vmatrix} = \bar{a}_z \frac{\partial F_y}{\partial x}$$



$\bar{F} = \bar{a}_y F_y(x)$



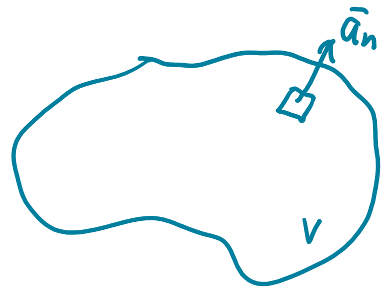
$$\bar{A}\times\bar{B} = \begin{vmatrix} \bar{a}_x & \bar{a}_y & \bar{a}_z \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix} = \bar{a}_x\left(A_yB_z - A_zB_y\right) + \cdots$$

$$\int_a^b f'(x)\,dx = f(b) - f(a)$$

$d\bar{S} = \bar{a}_n\, dS$

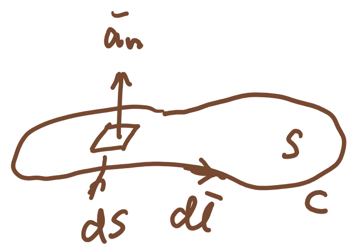
GAUSS' THEOREM (DIVERGENCE TH.)

$$\int_V \nabla\cdot\bar{D}\, dv = \oint_S \bar{D}\cdot d\bar{S}$$



STOKES' LAW

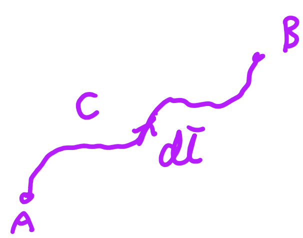
$$\int_S \nabla\times\bar{H}\cdot d\bar{S} = \oint_C \bar{H}\cdot d\bar{l}$$



(2D)

GRADIENT THEOREM

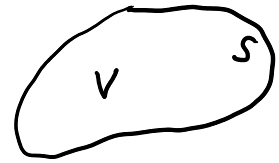
$$\int_C \nabla V\cdot d\bar{l} = V(B) - V(A)$$



NULL IDENTITIES

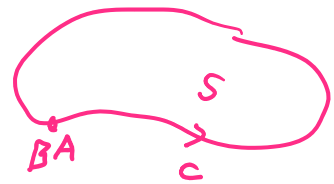
$$\int_V \underbrace{\nabla\cdot(\nabla\times\bar{F})}_{=0}\, dV = \oint_S \nabla\times\bar{F}\cdot d\bar{S} = \oint_C \bar{F}\cdot d\bar{l}$$

$$= 0 \;\; !$$



$$\int_S \underbrace{\nabla\times(\nabla H)}_{=0}\cdot d\bar{S} = \oint_C \nabla H\cdot d\bar{l} = H(B) - H(A)$$

$$= 0$$



$$\nabla\times(\nabla\times\bar{G}) = \nabla(\nabla\cdot\bar{G}) - \nabla^2\bar{G}$$