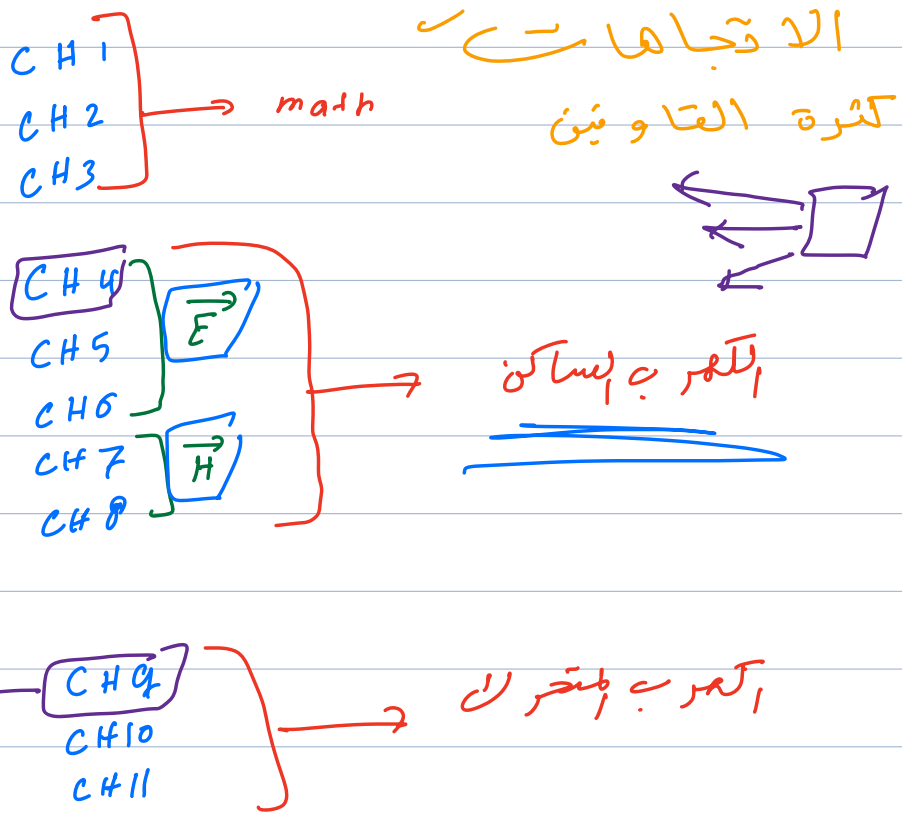
Electric field magnetic field



CH4 :-

1- Columb's law
- Explan
- Teforal's
- Extra Question

2- Gauss law and pontial

3- work and Energy and dipole

"CH 4"
Electric field

1- Total charge:- (Q) → C

- line $Q_{net} = Q = \int \rho_\ell \, dL$ (line charge C/m)

(مجموع الشحنة ← Q_{net})

- sheet $Q_{net} = Q = \iint \rho_s \, ds$ (sheet charge C/m²)
- volume $Q_{net} = Q = \iiint \rho_v \, dv$ (volume charge C/m³)

Ex:-

4/6 a) $\rho_L = 12x^2$ C/m $0 < x < 5$

$Q_{net} = ?$

$$\int \rho_L \, dL = \int_0^5 12x^2 \, dx$$

$$= 12 \left[\frac{x^3}{3} \right]_0^5 =$$

b) $\rho_s = \rho z^2$ C/m² $0 < z < 4$

$\rho = 3$

$$\iint \rho_s \, ds$$

$$= \int_0^4 \int_0^{2\pi} \rho z^2 \rho \, d\phi \, dz \qquad \times \quad ds = d\rho \, dz$$

$$\times \quad ds = d\rho \, d\phi$$

$$0 < \phi < 2\pi$$

$$= \int_0^4 \int_0^{2\pi} \rho^2 z^2 \, d\phi \, dz$$

ρ^2 → 3^2

$$\checkmark \quad ds = \rho \, d\phi \, dz$$

$$= (9)(2\pi) \int_0^4 z^2 \, dz$$

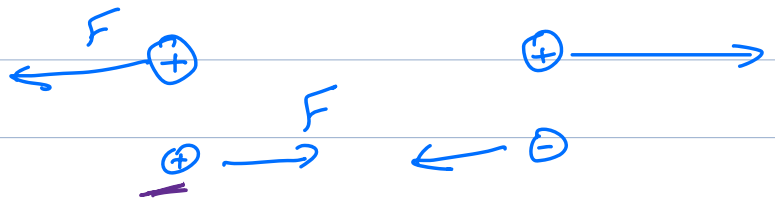
c) $\rho_v = \dfrac{10}{r \sin\theta} \qquad 0 < r < 4$

$$\iiint \rho_v \, dv \qquad dv = r^2 \sin\theta \, dr \, d\theta \, d\phi$$

$$= \int_0^{2\pi} \int_0^{\pi} \int_0^4 \frac{10}{r \sin\theta} r^2 \sin\theta \, dr \, d\theta \, d\phi \qquad 0 < \theta < \pi \qquad 0 < \phi < 2\pi$$

$$= 160\pi^2$$

2- Coulomb's law :-



$$\vec{F} = \frac{1}{4\pi\varepsilon_0} \times \frac{Q_1 Q_2}{r^2} \hat{r}$$

$\frac{10^{-9}}{36\pi}$ ← ε_0 → shift 7 → 32

- $$\vec{F} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q_1 Q_2}{|r_1 - r_2|^3} \cdot \langle r_1 - r_2 \rangle$$

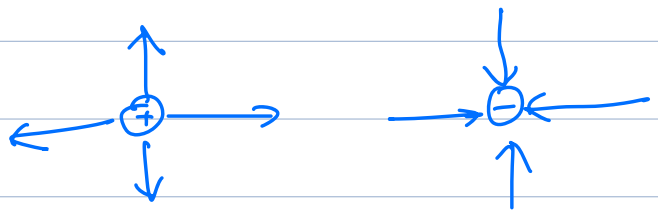
$$\vec{F} = Q\vec{E}$$

$$\vec{E} = \frac{\vec{F}}{Q}$$

$$F = mg$$

3 - Electric field:- $\vec{E}$ N/C

1 - due to point charge:-



$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{r^2} \hat{a}_r$$

- $$\vec{E}_A = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{|r_A - r|^3} (r_A - r)$$

r_A: مكان النقطة التي مطلوب عندها حساب $\vec{E}$

r: مكان الشحنة

Ex:-

4/2 $Q_1 = (4, 0, -3) \rightarrow -2\,nc$

$Q_2 = (2, 0, 1) \rightarrow 4\,nc$

a) find $\vec{E}$ at point A (5, 0, 6)

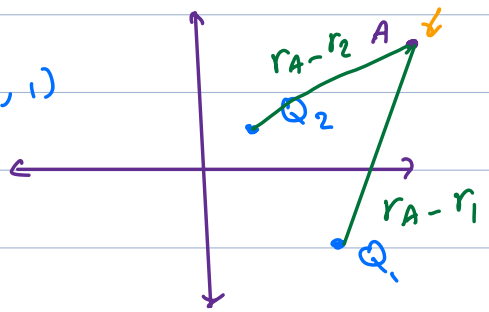
$r_A - r_2 = (5,0,6) - (2,0,1)$

$r_A - r_2 = (3,0,5)$

$|r_A - r_2| = \sqrt{34}$

$r_A - r_1 = (1,0,7)$

$|r_A - r_1| = \sqrt{82}$



$$E_A = \frac{1}{4\pi\varepsilon_0} \cdot \frac{-2\times10^{-9}}{82^{3/2}} \cdot \langle 1, 0, 7 \rangle + \frac{1}{4\pi\varepsilon_0} \cdot \frac{4\times10^{-9}}{34^{3/2}} \cdot \langle 3,0,5 \rangle$$

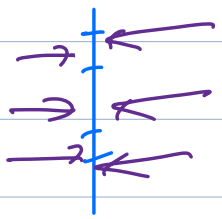
$$\vec{E}_A = \frac{1}{4\pi\varepsilon} \left[\frac{-2\times10^{-9}}{82^{3/2}} \cdot \langle 1, 0, 7 \rangle + \frac{4\times10^{-9}}{34^{3/2}} \cdot \langle 3,0,5 \rangle \right]$$

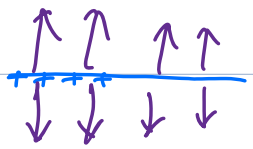
$a_x \quad a_y \quad a_z \qquad a_x \quad a_y \quad a_z$

$$= \frac{1}{4\pi\varepsilon} \left[\left\langle \frac{-2\times10^{-9}}{82^{3/2}}, 0, \frac{(7)(-2\times10^{-9})}{82^{3/2}} \right\rangle + \cdots \right]$$

N/C

2- due to line :-





$$\vec{E} = \int \frac{\rho_L \, dl}{4\pi \varepsilon_0 R^2} \hat{aR}$$

• infinite line :- شحنة على شكل خط لا يعرف طولها

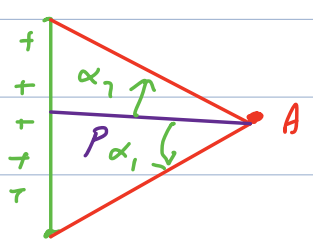
$$\vec{E} = \frac{\rho_L}{2\pi \varepsilon_0 \rho} \hat{a\rho}$$

• finite line :- خط شحنة يعرف طولها غير مهم

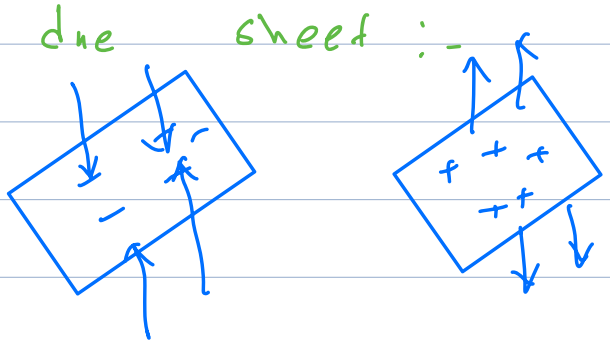
$$\vec{E} = \frac{\rho_L}{4\pi \varepsilon_0 \rho} \left[-(\sin\alpha_2 - \sin\alpha_1) \hat{a\rho} + (\cos\alpha_2 - \cos\alpha_1) \hat{a}_{line} \right]$$

counter c.w (+)

c.w (-)



3- due sheet :-



- $\vec{E} = \iint \frac{\rho_s \, ds}{4\pi \varepsilon_0 R^2} \hat{a}_R$

- in finite sheet :-

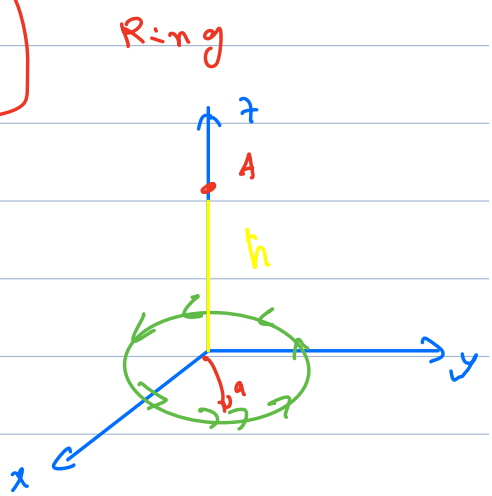
$$\vec{E} = \frac{\rho_s}{2\varepsilon_0} \hat{a}_N$$

4- Special Cases:-

- **Ring**

$$\vec{E} = \frac{\rho_L \, a \, h}{2\varepsilon_0 (a^2+h^2)^{3/2}} \hat{a}_z$$

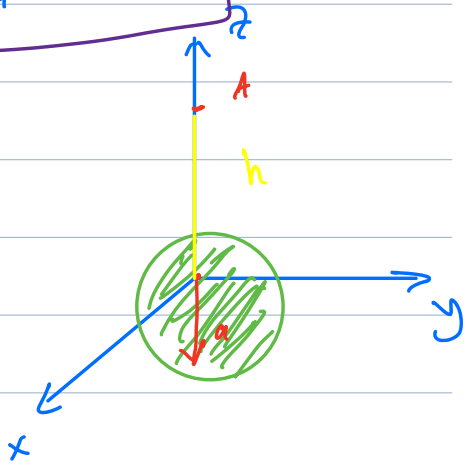
عنير صم



- **Desk** → **Sheet**

$$\vec{E} = \frac{\rho_s}{2\varepsilon_0}\left[1 - \frac{h}{\sqrt{h^2+a^2}}\right]\hat{a}_z$$

عنير صم



Total charge

$\vec{F} = Q\vec{E}$

Columb's law

1- Force

2- Electric field :-

1- for point

2- for line

- infinite line
- finite line

3- for sheet

- infinite sheet

4- Spetcal Casses

- ring
- desk