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سكند

فيزياء 2

Physics 2

① تستخدم لحماية الاجهزة
② لتخزين الطاقة الكهربائية.

chapter (26)

Capactance and dielectrics:

العوازل الكهربائية ← المواسعة

↳ combination of 2 conductors called a (capacitor)

* capacitor (جهاز)
* capactance (المواسعة)

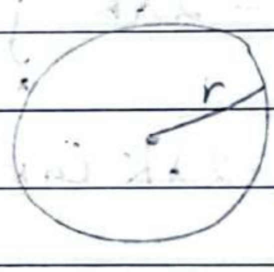
- potential difference (ΔV)
- Capacitance : ratio between the magnitude of the charge (Q) on either conductor to the magnitude of potential differencebetween them.

$$C = \frac{|Q|}{|\Delta V|} = \frac{C}{V} \rightarrow \text{الوحدة} = \text{Farad (F)}$$

يتم التعامل مع :
nF , MeF , mF , PF
10^{-9} , $\times 10^{-6}$, $\times 10^{-3}$, $\times 10^{-12}$

① capactance of an insolated charged sphere :

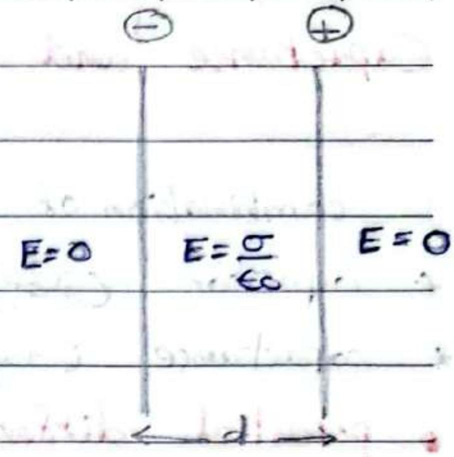
$$C = \frac{Q}{V} = \frac{Q r}{k_e Q} = \frac{r}{k_e} = 4\pi\epsilon_0 r$$



$$\boxed{C = 4\pi\epsilon_0 r = \frac{r}{k_e}}$$

$$V = \frac{k_e Q}{r}$$

② parrallel plates capacitor :



between them $E = \frac{\sigma}{\epsilon_0}$

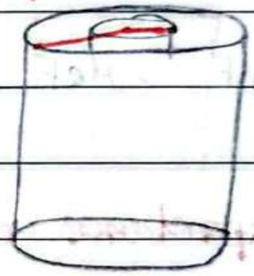
$\Delta V = Ed$

$\Delta V = \frac{\sigma}{\epsilon_0} d$

$$C = \frac{\overset{\sigma A}{Q}\,\epsilon_0}{\sigma d} = \frac{\cancel{\sigma} A \epsilon_0}{\cancel{\sigma} d} = \frac{A \epsilon_0}{d}$$

$$\boxed{C = \frac{A \epsilon_0}{d}}$$

③ Cylindrical capacitor:



$$E = \frac{K 2 \lambda}{R}$$

$$\Delta V = -\int_a^b E \cdot ds$$

$$= -2\lambda K \int_a^b \frac{1}{r} dr$$

$$= -2\lambda K \ln r \Big]_a^b = -2\lambda K (\ln b - \ln a)$$

$$= -2\lambda K \ln\left(\frac{b}{a}\right) \#$$

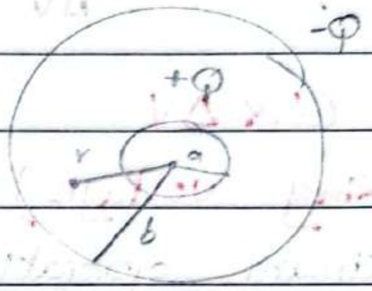
$$C = \frac{\overset{\lambda L}{Q}}{V} \rightarrow C = \frac{\cancel{\lambda} L}{2 \cancel{\lambda} K \ln\left(\frac{b}{a}\right)}$$

$$C = \frac{L}{2k \ln\left(\frac{b}{a}\right)} \quad , \quad \frac{C}{L} = \frac{1}{2k \ln\left(\frac{b}{a}\right)}$$

per unit length

④ Spherical capacitor:

$$E = \frac{kQ}{r^2}$$



$$\Delta V = -\int_a^b E \cdot ds$$

$$= -kQ \int_a^b \frac{1}{r^2}\, dr = \frac{kQ}{r}\Big]_a^b$$

$$= kQ\left(\frac{1}{b} - \frac{1}{a}\right) = kQ\left(\frac{a-b}{ab}\right)$$

$$C = \frac{ab}{k(b-a)}$$

Energy stored in capacitor :

$$U = \frac{Q^2}{2C} = \frac{1}{2} Q \Delta V = \frac{1}{2} C (\Delta V)^2 \quad (J)$$

الوحدة

$\hookrightarrow C = \frac{Q}{\Delta V}$

* $U \propto \Delta V$, $U \propto Q$

(Breaking voltage) :

maximum oporating voltage of the capacitors

- Parallel plate capacitor:

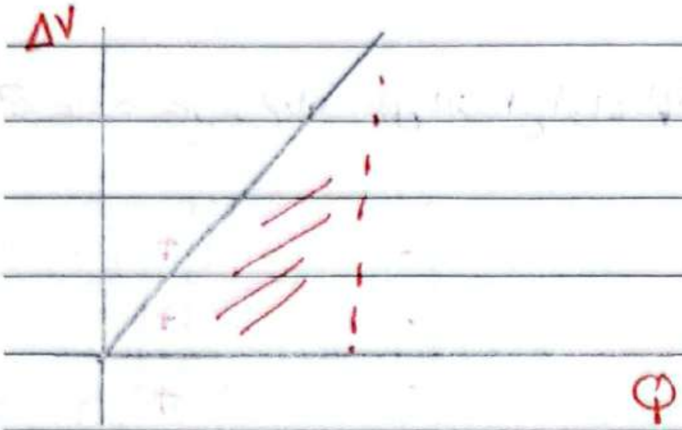
$$U = \frac{1}{2} C V^2$$

$$= \frac{1}{2} \left(\frac{A \epsilon_0}{\cancel{d}}\right) (E \cancel{d})^2 = \frac{1}{2} \underbrace{A d}_{V} \epsilon_0 E^2$$

$V \Rightarrow$ volume

$\therefore \quad U_E = \frac{1}{2} V \epsilon_0 E^2$

$\therefore \quad \frac{U_E}{V} = \frac{1}{2} \epsilon_0 E^2 \Rightarrow$ energy per volume (energy density) (J/m^3)



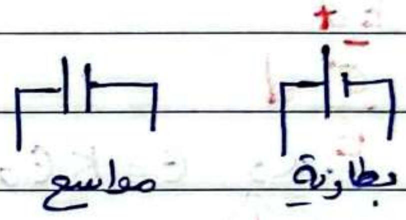
$$\text{slope} = \frac{\Delta V}{Q} = \frac{1}{C}$$

Area under the curve = energy stored (U)

- Combination in series and parallel for capacitors:

1] parallel : (التوازي)

الفرق بين البطارية والمواسع

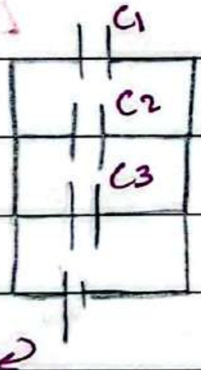


① $V_{eq} = V_1 = V_2 = V_3$

② $Q_{eq} = Q_1 + Q_2 + Q_3$

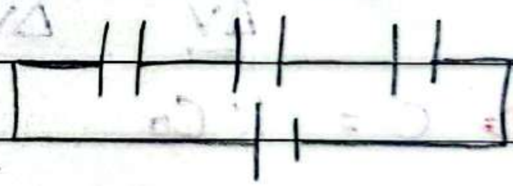
③ $C_{eq} = C_1 + C_2 + C_3$

أكبر من أكبر وحدة منهم



بطارية

2] series : (التوالي)



① $Q_{eq} = Q_1 = Q_2 = Q_3$

② $V_{eq} = V_1 + V_2 + V_3$

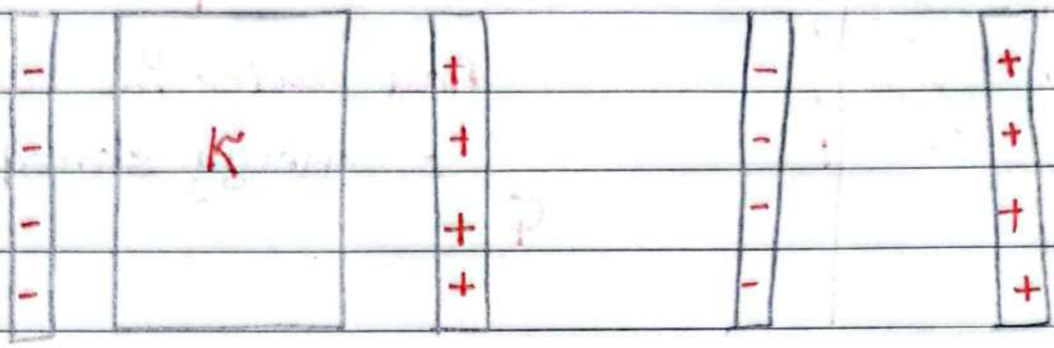
③ $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \Rightarrow C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$

في حالة مواسعين فقط

اقل من اقل وحدة منهم

* Dielectric Materials:

مادة غير موصلة مثل الزجاج أو المطاط توضع بين الصفيحتين



$V = \Delta V$ $\quad$ $\left[\begin{array}{c}\text{the same} \\ \text{after \& before}\end{array}\right]$ $\quad$ $V = \Delta V_0$

$Q = Q$ $\qquad\qquad\qquad\qquad$ $Q_0 = Q$

$\Delta V = E d$ $\qquad\qquad\qquad\qquad$ $\Delta V_0 = E_0 d$

$= \dfrac{\sigma}{\epsilon} \cdot d$ $\qquad\qquad\qquad\qquad$ $\rightarrow \Delta V_0 = \left(\dfrac{\sigma}{\epsilon_0}\right) d$

$\hookrightarrow \epsilon = K \epsilon_0$

$= \dfrac{\sigma d}{K \epsilon_0} = \dfrac{\Delta V_0}{K}$ $\qquad\qquad$ $\rightarrow C_0 = \dfrac{Q}{\Delta V_0}$

K: dielectric constant
depends on the material
type

$\Rightarrow C = \dfrac{Q}{\Delta V} = \dfrac{Q K}{\Delta V_0}$

$\Rightarrow C = K C_0$

$\boxed{Q_0 = Q}$

before	after
① ΔV_0	①' $\Delta V = \frac{\Delta V_0}{K}$
② $E_0 = \frac{\Delta V_0}{d}$	② $E = E_0 / K$
③ $C_0 = \frac{Q_0}{\Delta V_0}$	③ $C = K C_0$
④ $U_0 = \frac{Q_0^2}{2C_0}$	④ $U = \frac{U_0}{K}$ → decrease

* minimum value for k is (1) in air

(if $k=1$) $\Rightarrow$ $(\epsilon = K\epsilon_0) \rightarrow (\epsilon = \epsilon_0)$

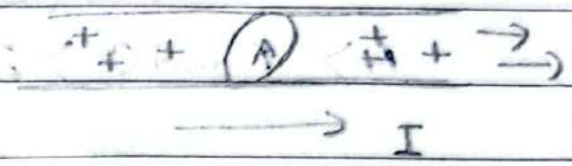
in parallel plates capactor

$$C = K \frac{\epsilon_0 A}{d}$$

chapter (27)

Current and Resistance:

Electric current: is the flow of electric charges through a conductor (عبارة حركة الشحنات)



$\Rightarrow \underline{I_{avg}} = \dfrac{\Delta Q}{\Delta t}$

↳ number of charges pass through A in unit time

الوحدة $I = \dfrac{c}{sec} = A$ (Amber)

$\Rightarrow$ instantaneous currend $I = \dfrac{dQ}{dt}$

- Microscopice model of current:

$q = \underline{n}\, q_e * \dfrac{V}{\underline{V}}$ $\qquad \dfrac{n}{V} = n^* =$ number of free carries per unit of Volume.

$q = n^* q_e \underline{V}$

$\left(q = n^* q_e (A \underline{\Delta x})\right) \div \underline{\Delta t}$ $\qquad v_d =$ drift velocity (speed)

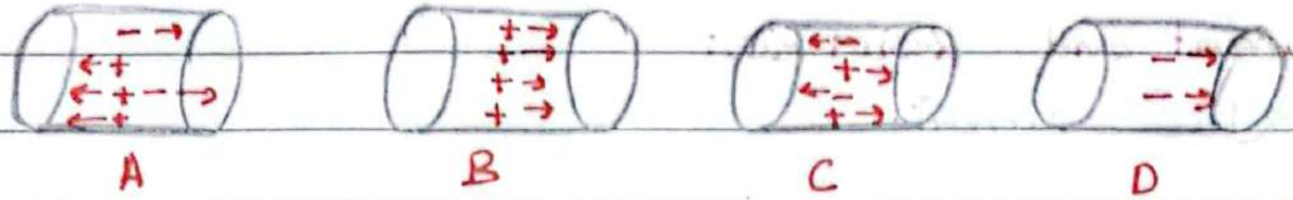
$I = n^* q_e A v_d$

A: cross Section

$\Rightarrow \left[\; I = n^* A q_e v_d \;\right]$ $\qquad q_e = 1.6 \times 10^{-19} C$

I يعتمد على عدد الشحنات

Vd تكون صغيرة بسبب حركة الشحنات zigzag وهذا بسبب التصادمات.

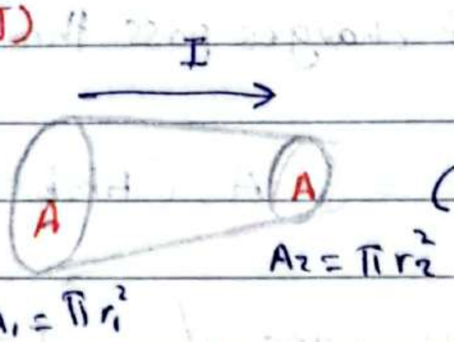


* لو بدي ارتبهم حسب الـ (I) (current)

A > B and C > D

الترتيب حسب عددهم مش نوعهم .

* Current density: (J)



I is constant .

في السلك كله)

[non-uniform conductor]

$\Rightarrow J = \frac{I}{A}$ (A/m^2)

$J_1 = \frac{I}{\pi r_1^2}$, $J_2 = \frac{I}{\pi r_2^2}$

$\left[I = n^* q_e A v_d \Rightarrow J = n^* q_e v_d \right]$ * *

$J \propto E$

* $\frac{I}{A} = \underbrace{\sigma}_{A/m \cdot Volt} \frac{\Delta V}{l}$

$\boxed{J = \sigma E}$

σ electric conductivity

$\Delta V = \frac{I L}{\sigma A} = \frac{\rho L}{A} I$

$\Delta V = \underbrace{R}_{\text{resistance}} I$

$\rho = \frac{1}{\sigma}$ (resistivity)

$\frac{m \cdot v}{A}$

$\Delta V = R \; I$ ohm's law

↳ volt ↳ Ω ↳ A

* $R = \frac{\rho L}{A} = \frac{\cancel{m}\cdot V}{A} \cdot \cancel{m} / \cancel{m^2} = \frac{V}{A} = \Omega$ ohm

* $\rho = \frac{RA}{L} = \frac{\Omega \cdot m^2}{m} = \Omega \cdot m$

* $\sigma = \frac{1}{\rho} = (\Omega \cdot m)^{-1}$

* R depends on ρ, L, A (Type and Shape of material)
* R independent on V and I

Power : (P) (القدرة)

* what is the power deliverd in the resistor.
* what is the Heat power dissipated in the resistor

$$\left[P = I \Delta V \quad , \quad P = I^2 R \quad , \quad P = \frac{\Delta V^2}{R} \right] \Rightarrow \text{watt}$$

- Resistance and Temprature :-

ρ : depends on T & shape of material

$$\left[R(t) = R_0 (1 + \alpha \underbrace{\Delta T}_{T - T_0}) \right] \quad ↳ 20C°$$

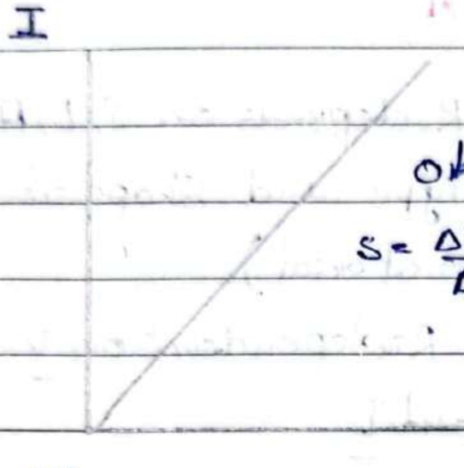
↳ resistance at Temp (T)

α : from Tables. (thermal Resistance coefficient) ($C^{\circ -1}$)

R_0 resistance at $T_0 = 20C°$

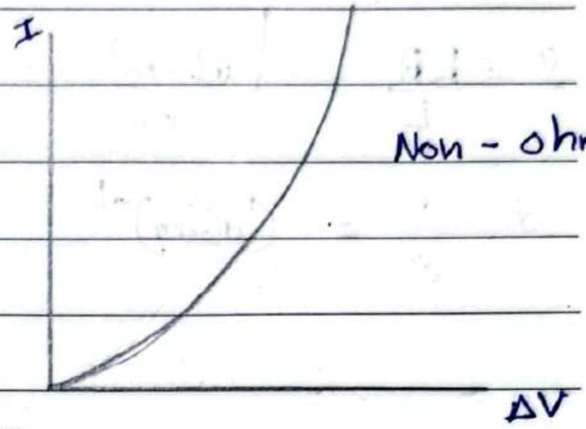
$$\rho = \rho_0 (1 + \alpha \Delta T) \quad \cdots \text{(*)}$$

$$\alpha = \frac{1}{\rho_0} \frac{\rho}{\Delta T} \quad (c^{-1})$$ [Temp. coefficient of resistivity]

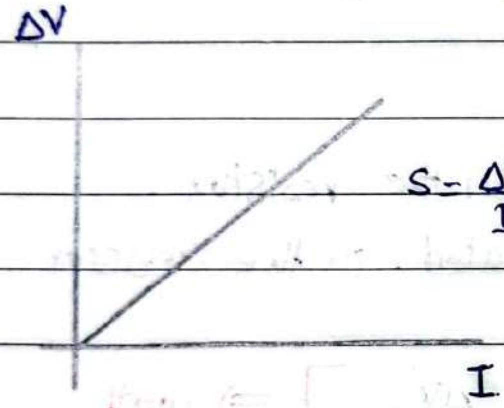


ohmic

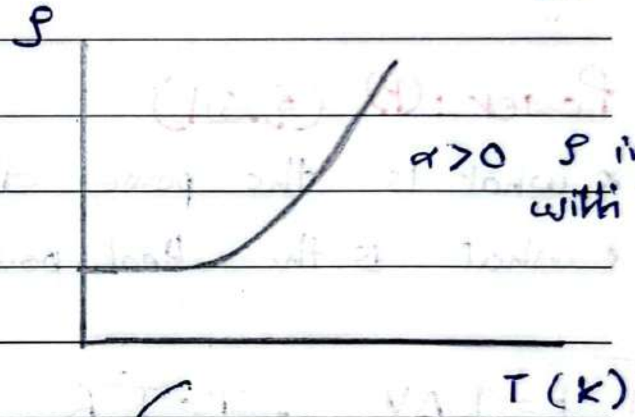
$$S = \frac{\Delta I}{\Delta V} = \frac{1}{R}$$



Non - ohmic

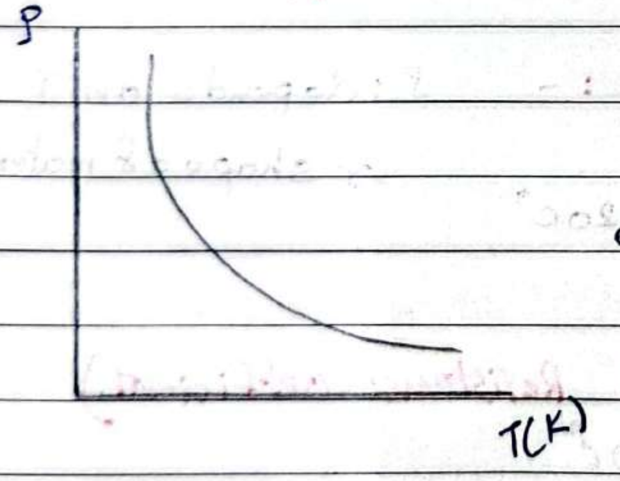


$$S = \frac{\Delta V}{I} = R$$



$\alpha > 0$ ρ increase with T

metals



$\alpha < 0$ ρ decrease with increasing T

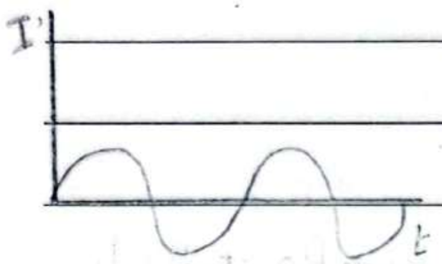
semiconductors.

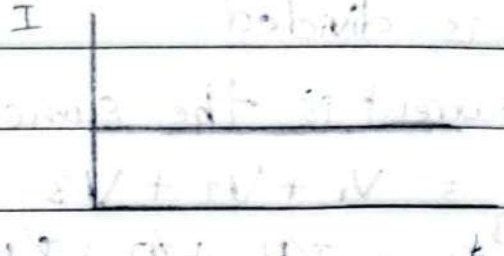
chapter (28)

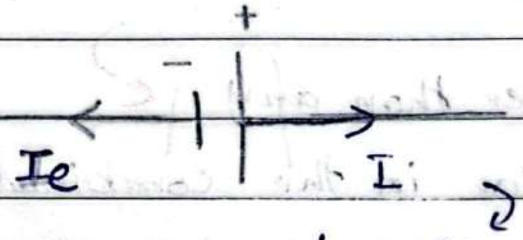
Direct current circuits:

AC — Alternating current

DC — Direct current



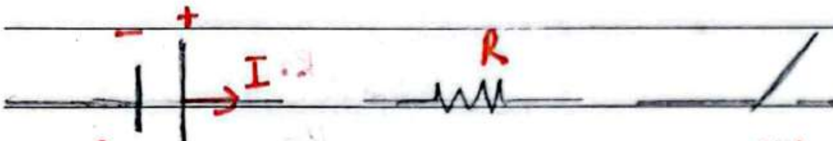




($\mathcal{E}$) → electromotive force [volt]

القوة الدافعة الكهربائية

التيار الاصطلاحي (وبنشتغل عليه)



بطارية switch wire

* Electromotive force (emf) ($\mathcal{E}$):

ناتج عن المقاومة Vr

$$[\Delta V = \mathcal{E} - Ir]$$

$$\mathcal{E} = Ir + IR$$

$$\hookrightarrow I = \frac{\mathcal{E}}{r+R}$$

$$P_{totak} = P_r + P_R$$

$$= I^2 r + I^2 R$$

$$\{= I^2 (r+R)\}$$

Resistors in series and parallel:

① Series: (توالي)

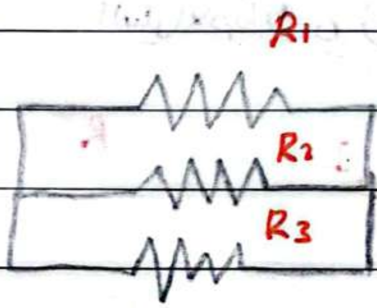
* V is divided
* current is the same in all R

$V_{eq} = V_1 + V_2 + V_3$

$\cancel{I} R_{eq} = \cancel{I} R_1 + \cancel{I} R_2 + \cancel{I} R_3 \Rightarrow \boxed{R_{eq} = R_1 + R_2 + R_3}$

greater than any resistor in the combination

② Parallel



* I is divided
* V is the same in all R

$I_{eq} = I_1 + I_2 + I_3$

$\frac{\cancel{\Delta V}}{R_{eq}} = \frac{\cancel{V_1}}{R_1} + \frac{\cancel{V_2}}{R_2} + \frac{\cancel{V_3}}{R_3} \Rightarrow \boxed{\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$

smaller than any R

$\boxed{R_{eq} = \frac{R_1 \times R_2}{R_1 + R_2}}$ only Two R chapter (25) (مادة السكشن)

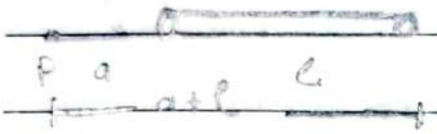
(25.5) Electric potential due to contineous charge distribution :

$$\rho = \frac{Q}{V} \quad , \quad \sigma = \frac{Q}{A} \quad , \quad \lambda = \frac{Q}{L}$$

$$V_p = K_e \int \frac{dq}{r} \rightarrow dV = k_e \frac{dq}{r}$$

rod

[1]

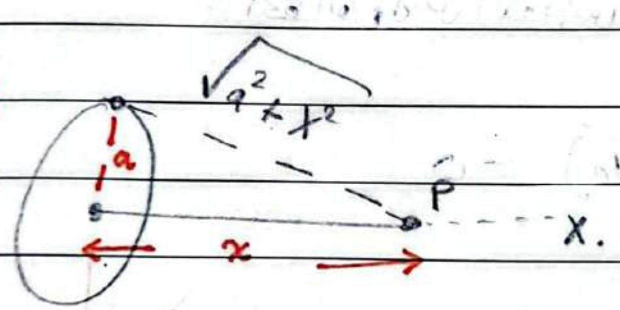


$$\left[V = k\lambda \ln\left(\frac{a+l}{a}\right) \right]$$

constant (λ)

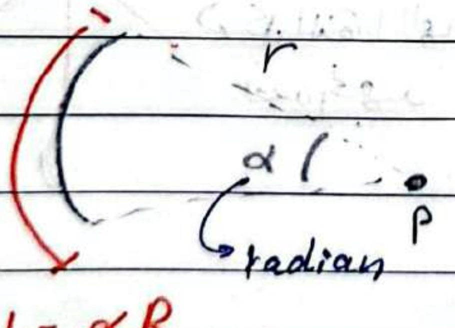
$$\left[V_p = k\lambda_0 l \right] \rightarrow \lambda \text{ not cont.}$$

[2] ring



$$\left[V = \frac{k_e Q}{\sqrt{x^2+a^2}} \right]$$

[3] arc



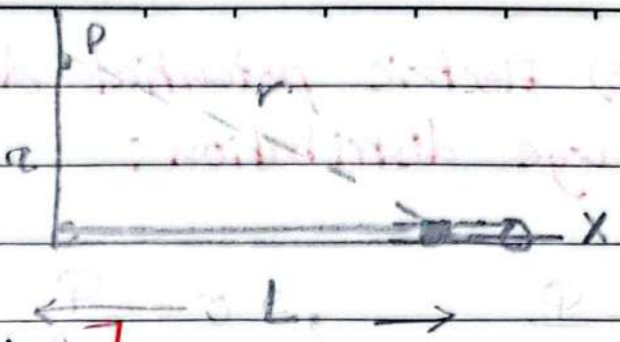
$L = \alpha R$

$$\left[V = k_e \lambda \alpha \right]$$

(or)

$$\left[V = k\frac{Q}{R} \right] \rightarrow Q = \lambda \alpha R$$

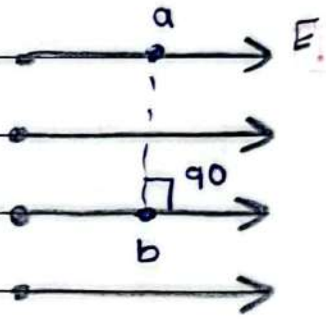
$\boxed{4}$ rod (حالة ثانية)



$$\boxed{V = k_e \lambda \left(\frac{L + \sqrt{a^2 + L^2}}{a^2} \right)}$$

(25.6) Equipotential surfaces:

↳ surfaces with the same (V)



$$\Delta V = -Ed \cos\theta$$

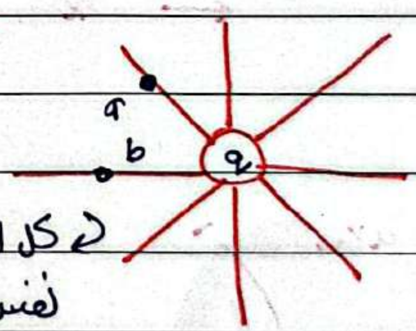
$$V_{ab} = V_b - V_a = -\cancel{Ed\cos 90}$$

$$V_b - V_a = 0 \Rightarrow \boxed{V_b = V_a}$$

الخط الواصل بين النقطتين يصنع زاوية 90 مع $\underline{\underline{E}}$

$$U_{a\to b} = q\,\cancel{(V_b - V_a)} = 0$$

(صفر).



$$V = K\frac{q}{r}$$

كل النقاط لها نفس الجهد

$$U_{a\to b} = 0$$

$$W_{a\to b} = 0$$