Civilittee

اللجنة الأكاديمية لقسم الهندسة المدنية

www.Civilittee-HU.com

دفتر

فيزياء عامة 2

إعداد : ليان سليمان

www.civilittee-hu.com Civilittee Hashemite Civilittee HU | لجنة المدني

5.4 Obtaining the Value of the electric field from the electric potential

حساب

المجال ← الجهد

إذا علم

$$\overset{\Delta V}{V_B - V_A} = -\int_A^B \vec{E}\, d\vec{s}$$

U

$$dV = -\vec{E}\, d\vec{s}$$

If the electric field has only one component, E_x

$$\vec{E} = E_x \hat{i}$$

$$d\vec{s} = dx\,\hat{i} + dy\,\hat{j} + dz\,\hat{k}$$

$$\vec{E} \cdot d\vec{s} = E_x\, dx$$

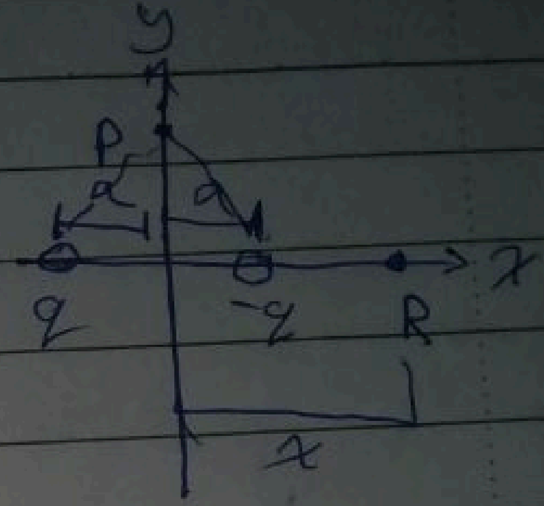
حساب المجال إذا علم الجهد

$$\boxed{E_x = \frac{-dV}{dx}} \rightarrow \text{فقط لـ } x$$

$$E_x = -\frac{\partial V}{\partial x} \qquad E_y = -\frac{\partial V}{\partial y} \qquad E_z = -\frac{\partial V}{\partial z}$$

Ex. 25.4

V_P ? $\quad y = ?$



1) $V_P = k\left(\frac{q}{r_1} + \frac{-q}{r_2}\right)$

$= kq\left(\frac{1}{\sqrt{a^2+y^2}} - \frac{1}{\sqrt{a^2+y^2}}\right)$

$\boxed{V_P = 0}$

* أي نقطة على ال y-axis ⟸ $V = 0$.

2) $V_R = k\left(\frac{q}{x+a} - \frac{q}{x-a}\right)$

$= \frac{-2kq}{(x^2-a^2)}$

Subject Date No.

[illegible] الجهد الكلي

Sec 25.5 Electric potential due to continuous charge distributions:-

- The electric potential due to a small charge element dq at point P a distance r from dq is

$$\int dV = \int k \frac{dq}{r}$$

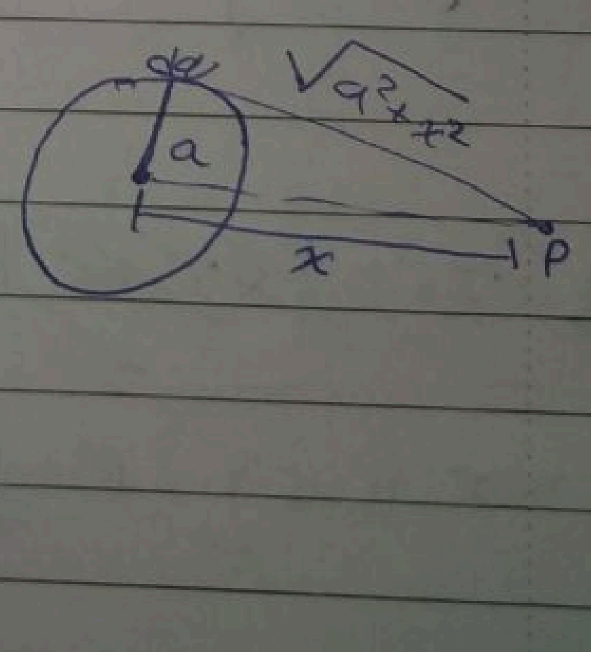
* dq: small charge element

- sum over all charge elements (integration)

$$\boxed{V = k\int \frac{dq}{r}}$$

$dq \rightarrow \lambda\, dL$	$\rightarrow$ line charge distribution.
$dq \rightarrow \sigma\, dA$	$\rightarrow$ surface charge distribution.
$dq \rightarrow \rho\, dV$	$\rightarrow$ Volume charge distribution.

Ex. 25.5



$$\boxed{r = \sqrt{a^2+x^2}}$$

$$V = \frac{k}{\sqrt{a^2+x^2}} \underbrace{\int dq}_{Q}$$

$$V = \frac{kQ}{\sqrt{a^2+x^2}}$$

B) $V = \frac{kQ}{\sqrt{x^2+a^2}} \xrightarrow{\text{تفاضل}} E = -\frac{\partial V}{\partial x}$

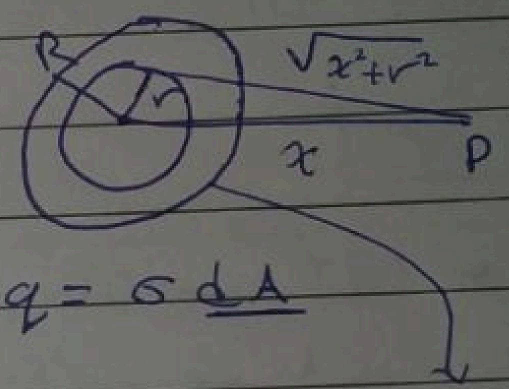
$(x^2+a^2)^{-1/2}$

$E = kQ\, \frac{x}{\cancel{2}\sqrt{(x^2+a^2)^3}}$ $\quad \to -\left(\frac{-1}{\cancel{2}} \cancel{2} x (x^2+a^2)^{-3/2}\right)$

$\to \frac{kxQ}{\sqrt{(x^2+a^2)^3}}$

$$\boxed{E = \frac{kxQ}{\sqrt{(x^2+a^2)^3}}}$$

Ex 25.6



A) $V = k\int \frac{dq}{r}$ $\quad dq = \sigma\, dA$ $\quad d_A = 2\pi r\, dr$

$= \int \frac{k}{\sqrt{x^2+r^2}}\, dq$

$= \int_0^R k \frac{(2\sigma\pi r\, dr)}{\sqrt{x^2+r^2}} = \sigma\pi k \int_0^R \frac{2r\, dr}{\sqrt{x^2+r^2}}$

$\cancel{\sigma\pi k \ln\left|\sqrt{x^2+r^2}\right| \Big|_0^R \to \sigma\pi k \ln\left|\sqrt{x^2+R^2}\right|}$

$$\boxed{V = 2\pi k\sigma\left[(R^2+x^2)^{1/2} - x\right]}$$

Subject Date No.

B) $V = 2\pi k \sigma \left((R^2+x^2)^{1/2} - x \right)$

$$E = \frac{-\partial u}{\partial x}$$

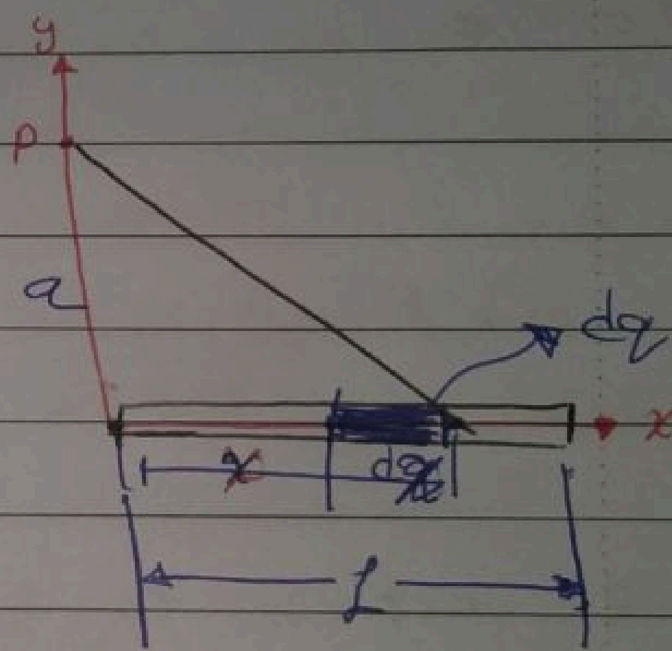
$$= -\left(2\pi k \sigma \left(\frac{1}{2} \cdot 2x \, (R^2+x^2)^{-1/2} - 1 \right) \right)$$

$$\boxed{E = 2\pi k \sigma \left(1 - \frac{x}{\sqrt{(R^2+x^2)}} \right)}$$

Ex. |25.7|

total charge $= Q$

Uniform linear charge $\rightarrow \lambda$



$V = \frac{k}{r} \int dq$

$$V = k \int_0^L \frac{\lambda \, dx}{\sqrt{x^2+a^2}}$$

$r = \sqrt{x^2+a^2}$

$dq = \lambda \, dx$

$\lambda = \frac{Q}{L}$

$$= k \frac{Q}{L} \int_0^L \frac{a \sec^2 u \, du}{\sqrt{a^2(\tan^2 u + 1)}}$$

$$= \frac{kQ}{L} \left\{ \ln[\sec u + \tan u] \right\} \Big|_0^L$$

$x = a \tan u$

$dx = a \sec^2 u \, du$

$\tan^2 u + 1 = \sec^2 u$

$$\boxed{V = \frac{kQ}{L} \ln \left[\frac{\sqrt{L^2+a^2} + L}{a} \right]}$$

25.6 Electric potential due to a charged conductor

- properties of conductors in electrostatic equilibrium:-

1) $\vec{E}_{in} = 0$ (Inside the conductor)
الموصل

2) The charge resides on the surface of a charged conductor
الشحنة تتركز على سطح الموصل

3) Just outside the conductor
$\vec{E} \perp$ surface
$E = \sigma / \varepsilon_0$

- The potential difference between any two points, A and B, on the surface of a charged conductor is →

$V_B - V_A = 0$

$= -\int_A^B \vec{E} \cdot d\vec{s} = 0$

$V_B = V_A$

$\boxed{\Delta V = 0}$

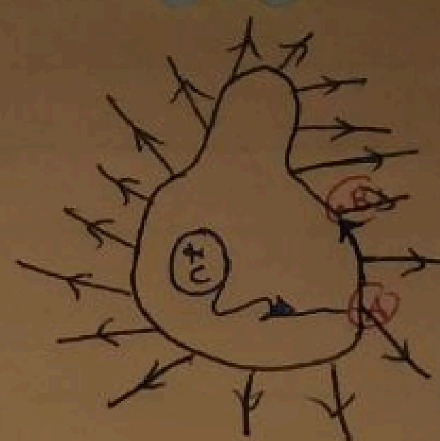
$\Delta V = 0$. between any two points on the surface.

$V_{\text{الموصل}} = V_{\text{لأي نقطة داخله}}$ V → constant
على طول السطح

- The work required to move a charge between any two points on the surface of a charged conductor is zero

الشغل
$W = \Delta U = q\,\underbrace{\Delta V}_{0} = 0$
طاقة

The potential difference between a point inside the conductor (C), and a point on the surface (A).



$$V_C - V_A = -\int_A^C \underbrace{\vec{E}}_{E_{in}=0} \cdot d\vec{s} = 0$$

$V_C - V_A = 0$

$V_C = V_A = V_{surface}$

$$\boxed{V_{in} = V_{surface}}$$

- The potential inside a charged conductor is constant and equals to the potential on the surface.

- conducting sphere :-

for a conducting sphere of radius R, the excess charge is uniformly distributed on its surface.

Inside the sphere	On the sphere	outside the sphere
$E_{in} = 0$ $V_{in} = V_s = \frac{KQ}{R}$	$E_s = \frac{KQ}{R^2} = \frac{\sigma}{\epsilon_0}$ $V_s = \frac{KQ}{R}$	$E_{out} = \frac{KQ}{r}$ $V_{out} = \frac{KQ}{r}$

* The charge density (σ) and the electric field ($\vec{E}$) on the surface of a conductor are high where the radius of curvature is small and low where the radius of curvature is high.

$r\uparrow$ → إذا كان مسطح $E\downarrow \sigma\downarrow$

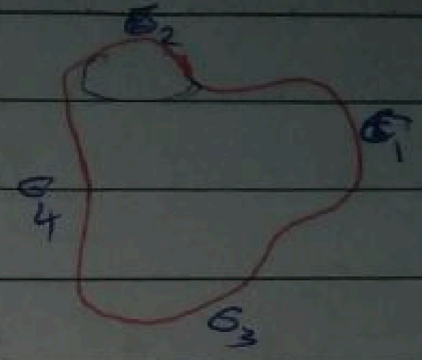
$r\downarrow$ → إذا مدبب $E\uparrow \sigma\uparrow$

$r_1 < r_2 < r_3 < r_4$

$\sigma_1 > \sigma_2 < \sigma_3 < \sigma_4$

$E_1 > E_2 > E_3 > E_4$

↳ $E = \frac{\sigma}{\epsilon_0}$



$\boxed{Ex\ 25.8}$

two connected charged sphere:-

$$E_1 = \frac{KQ_1}{r_1^2} \qquad E_2 = \frac{KQ_2}{r_2^2} \qquad \boxed{\frac{q_1}{q_2} = \frac{r_1}{r_2}}$$

$$\frac{E_1}{E_2} = \frac{\cancel{KQ_1}}{r_1^2} * \frac{r_2^2}{\cancel{KQ_2}} = \frac{r_2^2 q_1}{r_1^2 q_2}$$

$$\frac{E_1}{E_2} = \frac{r_2^{\cancel{2}}}{r_1^{\cancel{2}}} * \frac{\cancel{r_1}}{\cancel{r_2}} = \frac{r_2}{r_1} \qquad \boxed{\therefore \frac{E_1}{E_2} = \frac{r_2}{r_1}}$$

[illegible] ①

$$V_{s1} = V_{s2}$$

$$\frac{\cancel{K}q_1}{r_1} = \frac{\cancel{K}q_2}{r_2}$$

$$\boxed{\frac{q_1}{q_2} = \frac{r_1}{r_2}} \text{ —— } ①$$

$$E_1 = \frac{\sigma_1}{\epsilon_0} \qquad E_2 = \frac{\sigma_2}{\epsilon_0}$$

$$\boxed{\frac{E_1}{E_2} = \frac{\sigma_1}{\sigma_2} = \frac{r_2}{r_1}}$$

E_1, σ_1

Ch.26 Capacitance and Dielectrics

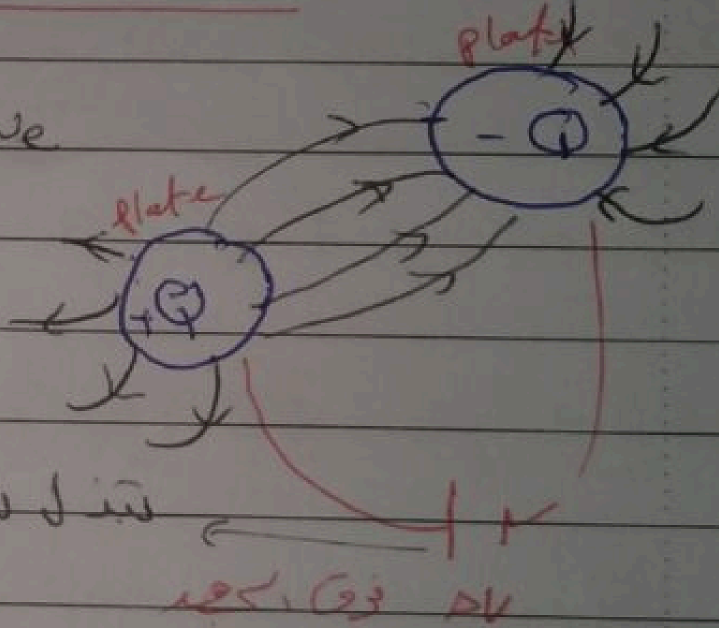
(سعة كهربائية) العوازل

1.1 Capacitance:-

موصلين

A capacitor consists of two conductors.

* The capacitor is used to store electric charge (or energy)
  الشحنة الكهربائية



* When the capacitor is charged the charges on the two plates تساوي
  are of equal mangnetude and opposite sign

سعة المكثف

* The capacitance C of a capacitor is defined as the ratio of the charge Q on either plate to the magnitude of the potential difference (ΔV) between the plates.

$$\boxed{C = \frac{Q}{|\Delta V|}}$$

سعة المكثف

Subject Date No.

SI ~~unit~~ of C is Farad (F)

$1\,F = 1\,C/V$

1- $C > 0$ (C is positive)

2- C = constant → تعتمد على الشكل الهندسي (size + shape)

3- Measure the ability of capacitor to store electric charge

4- farad is large unit → we use μF / nF

---

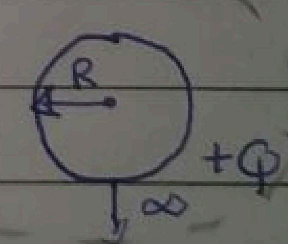
* calculating the capacitance 25.2

Ex. spherical conductor
1

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

$$\Delta V = V_+ - V_-$$
$$= V_R - \cancel{V_\infty}^{\,0}$$
$$= \frac{kQ}{R}$$

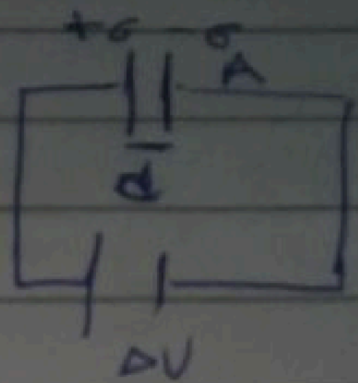
$$\rightarrow C = \frac{Q}{\Delta V} = \frac{\cancel{Q}}{\frac{k\cancel{Q}}{R}}$$



$$\boxed{C = \frac{R}{k}}$$

$$\boxed{C = 4\pi\epsilon_0 R}$$ → spherical conductor

Ex 1 parallel plates capacitor



منشا مجال E بين الصفيحتين

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

$$E = \frac{\sigma}{\epsilon_0} \qquad \sigma = \frac{Q}{A}$$

$$\boxed{E = \frac{Q}{\epsilon_0 A}} \qquad \Delta V = Ed$$

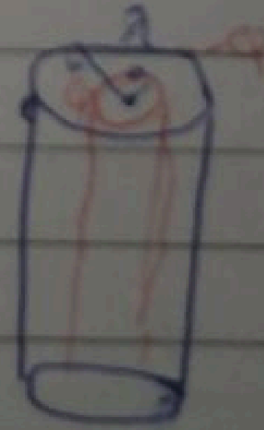
$$\Delta V = \frac{Qd}{\epsilon_0 A}$$

$$C = \cancel{Q} \times \frac{\epsilon_0 A}{\cancel{Q} d} = \frac{\epsilon_0 A}{d}$$

$$\boxed{C = \frac{\epsilon_0 A}{d}}$$ parallel plate capacitor

---

Ex 26.1 cylindrical capacitor



$$\oint E\, dA = \frac{q_{in}}{\epsilon_0}$$

$$E(2\pi r h) = \frac{\lambda h}{\epsilon_0}$$

$$E = \frac{1}{2\pi\epsilon_0}\frac{\lambda}{r} = \frac{2k\lambda}{r} \qquad \lambda = \frac{Q}{l}$$

$$\Delta V = V_+ - V_-$$

Subject Date No.

$$\Delta V = -\int_b^a \frac{2k\lambda}{r}\, dr$$

$$= -2k\lambda \int_b^a \frac{1}{r}\, dr = -2k\lambda \ln\left(\frac{a}{b}\right) = 2k\lambda \ln\left(\frac{a}{b}\right)$$

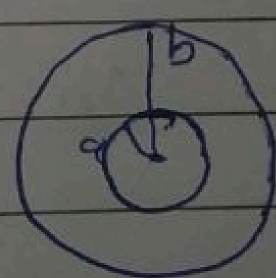
$$\Delta V = 2k\lambda \ln\left(\frac{b}{a}\right) = \frac{2kQ}{\ell} \ln\left(\frac{b}{a}\right)$$

$$C = \frac{Q}{\Delta V} = \frac{Q}{\frac{2kQ}{\ell}\ln(b/a)}$$

$$\boxed{C = \frac{\ell}{2k\ln(b/a)}} \longrightarrow \text{cylinderical capacitor}$$

$$\boxed{\frac{C}{\ell} = \frac{1}{2k\ln(b/a)}} \longrightarrow \text{capacitance per unit length}$$

Ex 26.2 spherical capacitor



$$\oint \vec{E} \cdot d\vec{A} = \frac{q_{in}}{\epsilon_0}$$

$$E(4\pi r^2) = \frac{Q}{\epsilon_0}$$

$$E = \frac{1}{4\pi\epsilon_0}\frac{Q}{r^2} = \frac{kQ}{r^2}$$

NOTEBOOK

$$\Delta V = V_+ - V_- = -\int_-^+ E \cdot ds$$

$$\Delta V = -\int_b^a \frac{kQ}{r^2}\, dr = -kQ\left(\frac{-1}{r}\right)\Big|_b^a = kQ\left(\frac{1}{a} - \frac{1}{b}\right)$$

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

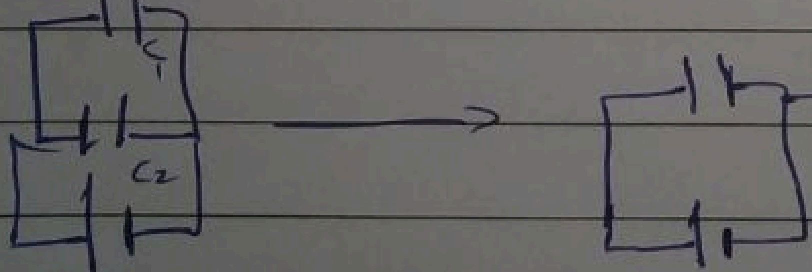
$$C = \frac{Q}{\Delta V} = \frac{\cancel{Q}}{k\cancel{Q}\left(\frac{1}{a} - \frac{1}{b}\right)} = \frac{1}{k\left(\frac{1}{a} - \frac{1}{b}\right)}$$

$$\boxed{C = \frac{1}{k\left(\frac{1}{a} - \frac{1}{b}\right)} = \frac{ab}{k(b-a)}} \rightarrow \text{spherical capacitor}$$

26.3 combinations of capacitors

1) parallel combination   توصيل على التوازي

$$\Delta V_1 = \Delta V_2 = \Delta V$$



$\rightarrow C_1 + C_2 = C_{eq}$

$$\boxed{C_{eq} = C_1 + C_2}$$

$$Q = Q_1 + Q_2 \rightarrow C_{eq}\cancel{\Delta V} = C_1\cancel{\Delta V} + C_2\cancel{\Delta V}$$

$$Q = C_{eq}\,\Delta V \qquad Q_1 = C_1\,\Delta V$$

$$Q_2 = C_2\,\Delta V$$

Subject　　　　　　　　　　　　　　　　Date　　　　　　　　No.

$$C_{eq} = C_1 + C_2 + C_3 + \cdots$$

Parallel combination

C_{eq} is greater than $\longleftrightarrow$ من أكبر
وحدة في الـC

2) series combination

$$\Delta V = V_1 + V_2$$

$$\frac{Q}{C_{eq}} = \frac{Q_1}{C_1} + \frac{Q_2}{C_2}$$

$$\frac{\cancel{Q}}{C_{eq}} = \frac{\cancel{Q_1}}{C_1} + \frac{\cancel{Q_2}}{C_2}$$

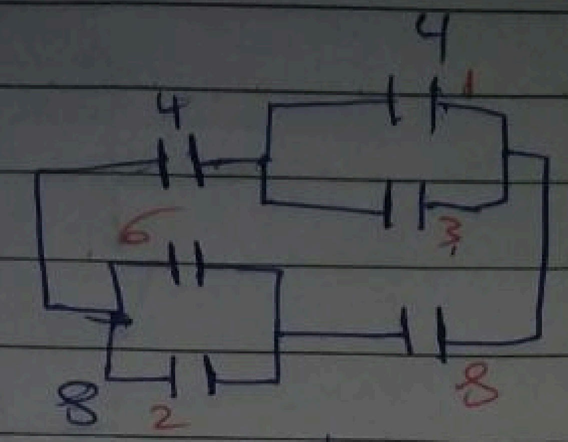
$$\boxed{\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} \Longrightarrow C_{eq} = \frac{C_1 C_2}{C_1 + C_2}}$$

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

$C_{eq} \rightarrow$ أصغر من
أصغر وحدة في الـC

Subject Date No.

Ex 26.3



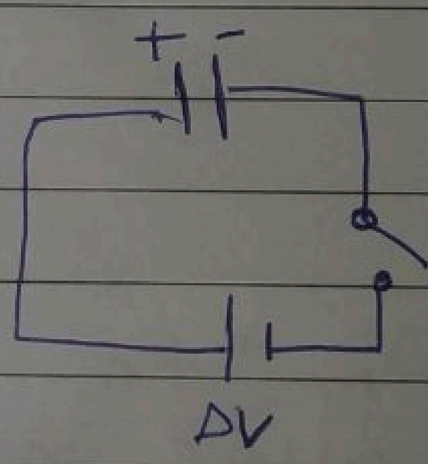
$c_{eq} = \frac{16}{8} = 2$

$c_{eq} = \frac{64}{16} = 4$

$\boxed{c_{eq} = 6 \, \mu F}$

26.4 Energy stored in a capacitor.

الشغل لنقل شحنة من الموجب للسالب أو
المحس (dq) من خلال وجود ΔV
Potential difference



$dW = \Delta V \, dq$

$\boxed{\int dW = \int_0^q \frac{q}{C} \, dq} \longrightarrow W = \frac{1}{C} \int_0^q q \, dq = \frac{Q^2}{2C}$

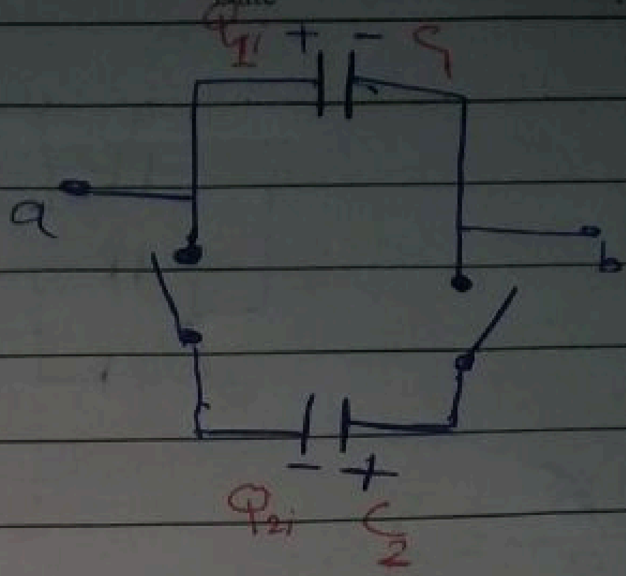
$\boxed{W = U = \frac{Q^2}{2C}}$

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

$C = \frac{Q}{\Delta V} \rightarrow U = \frac{1}{2} Q \Delta V$

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

Ex 26.4



$C_1 > C_2$

$\Delta V_1 = \Delta V_2$

$Q_1 = C_1 \Delta V_i$

$Q_{2i} = -C_2 \Delta V_i$

$\cancel{Q_i = Q_1 \Delta V + Q_2 \Delta V}$

$\cancel{Q_i = \Delta V (C_1 + C_2)}$

$=$

$\cancel{\Delta V = \frac{Q_i}{C_1 + C_2}}$

$\cancel{\Delta V_f = \Delta V_i = \frac{Q_i}{C_1 + C_2} + \frac{\Delta V_i (C_1 + C_2)}{C_1 + C_2}}$

A) $\cancel{\Delta V_f =}$

$\Delta V_f = ?$

$Q_i = Q_{1i} + Q_{2i}$

$\boxed{Q_i = \Delta V (C_1 - C_2)}$

after close $\boxed{S_1 + S_2}$ الشحنة تتوزع $\rightarrow$ Q_{1f} Q_{2f} حسب السعة

$Q_F = Q_{1f} + Q_{2f}$

$= C_1 \Delta V_f + C_2 \Delta V_f$

$\boxed{Q_F = \Delta V_f (C_1 + C_2)}$.

$Q_f = Q_i \rightarrow$ حفظ الشحنة

Subject Date No.

$$(C_1 + C_2)\,\Delta V_f = (C_1 - C_2)\,\Delta V_i$$

$$\boxed{\Delta V_f = \left(\frac{C_1 - C_2}{C_1 + C_2}\right)\Delta V_i}$$

B) $\frac{U_f}{U_i}$

$$U_i = \frac{1}{2} C_1 \Delta V_i^2 + \frac{1}{2} C_2 \Delta V_i^2 = \frac{1}{2}\Delta V_i^2 (C_1 + C_2)$$

$$U_f = \frac{1}{2} C_1 \Delta V_f^2 + \frac{1}{2} C_2 \Delta V_f^2 = \frac{1}{2}\Delta V_f^2 (C_1 + C_2)$$

$$\cancel{\frac{U_f}{U_i} = \frac{1}{2}\Delta V_i^2 (C_1 + C_2}$$

$$U_f = \frac{1}{2}(C_1 + C_2)\left[\frac{(C_1 - C_2)^2 \Delta V_i^2}{(C_1 + C_2)^2}\right]$$

$$\frac{U_f}{U_i} = \frac{\cancel{\frac{1}{2}}\,\cancel{(C_1 + C_2)}\left[\left(\frac{C_1 - C_2}{C_1 + C_2}\right)^2 \cancel{\Delta V_i^2}\right]}{\cancel{\frac{1}{2}}\,\cancel{(C_1 + C_2)}\,\cancel{\Delta V_i^2}} = \left(\frac{C_1 - C_2}{C_1 + C_2}\right)^2 < 1$$

خسران في الطاقة

العوازل

26.5 Capacitors With dielectrics

* مادة غير موصلة توضع بين الصفيحتين للمكثف تزيد السعة

- الشحنة ثابتة لا تتغير لكن تقلل ΔV تزيد من capacity

* لو كان في بطارية بتتغير الشحنة

$\Delta V = \frac{\Delta V_0}{K}$ → بعدم وجود مادة عازلة

ΔV ↓ بعد إضافة العازل

K: constant (يعتمد على نوع المادة)

$K > 1$

$$C_0 = \frac{Q_0}{\Delta V_0} \longrightarrow C = \frac{Q_0}{\Delta V} = \frac{Q_0}{\Delta V_0 / K} = \frac{K Q_0}{\Delta V_0}$$

$$\boxed{C = K C_0}$$

تزيد السعة بزيادة K

- For parallel plates capacitor

$$C_0 = \frac{\varepsilon_0 A}{d} \longrightarrow C = K C_0$$

$$\boxed{C = K \frac{\varepsilon_0 A}{d}}$$

إيجابيات العوازل :-

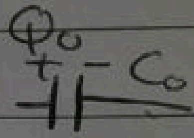
1) زيادة سعة المكثف

2) زيادة أقصى جهد تشغيل

3) إمكانية توفير دعم ميكانيكي بين الصفائح

الله يسعدني !!

Ex 26.5



$U = ?$

$$U_0 = \frac{Q_0^2}{2C_0}$$

$$\boxed{C = K C_0}$$

$$U = \frac{Q_0^2}{2 \cancel{C}} \rightarrow U = \frac{1}{K}\frac{Q_0^2}{2C_0}$$

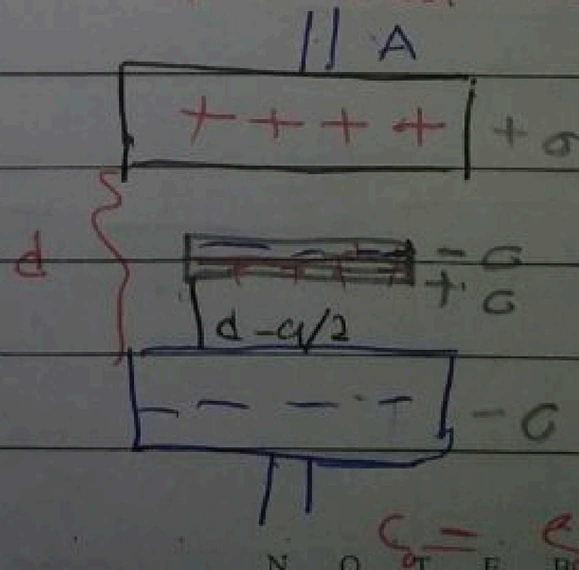
$$\boxed{U = \frac{U_0}{K}}$$

$$\frac{U}{U_0} = \frac{1}{K} < 1$$

26.7 An Atomic Description of Dielectrics

$$C_1 = \frac{\varepsilon_0 A}{d - a/2}$$

$$C_2 = \frac{\varepsilon_0 A}{d - a/2}$$



$C = \varepsilon A$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$C_1 = \frac{\varepsilon_0 A}{d - a/2} = \frac{2\varepsilon_0 A}{d-a}$$

$$C_2 = \frac{2\varepsilon_0 A}{d-a}$$

$$\frac{1}{C} = \frac{d-a}{2\varepsilon_0 A} + \frac{d-a}{2\varepsilon_0 A}$$

$$\boxed{C = \frac{\varepsilon_0 A}{d-a}}$$

Ex 26.8

$$C_1 = \frac{\kappa \epsilon_0 A}{f d}$$

لا يوجد عازل (الفراغ) $\kappa \epsilon$

$$C_2 = \frac{\epsilon_0 A}{(1-f) d}$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{f d}{\kappa \epsilon_0 A} + \frac{\kappa (1-f) d}{\kappa \epsilon_0 A}$$

$$\frac{1}{C} = \frac{f d + \kappa d (1-f)}{\kappa \epsilon_0 A}$$

$$C = \frac{\kappa \epsilon_0 A}{f d + \kappa d (1-f)} = \left(\frac{\kappa}{f + \kappa(1-f)}\right) \frac{\epsilon_0 A}{d}$$

$$\boxed{C = \frac{\kappa}{f + \kappa(1-f)} C_0}$$

Ch 27 Current and Resistance

$$I = \frac{\Delta Q}{\Delta t}$$

$$I = \frac{dq}{dt}$$

$$\boxed{1\,\Omega = \frac{V}{A}}$$

$$\boxed{1\rho = \Omega . m}$$

$J = \sigma E$
$\Delta V = IR$] → Ohm's law

$$\boxed{R = \frac{\rho L}{A} = \frac{L}{\sigma A}}$$

$$\boxed{\rho = \frac{1}{\sigma}}$$ → conductivity

↓ المقاومية

Ex. 27.2

$0.32\,mm \rightarrow * 10^{-3} m$

A) $\frac{R}{L} = \frac{\rho}{A} = \frac{1.* 10^{-6}\ \Omega . m}{\pi (0.32 * 10^{-3})^2} = \frac{10^{-6}}{10^{-4}}$

$A \rightarrow \pi r^2$

$3.1 * 10^{-2}\ \Omega / m$

B) $\Delta V = 10 \quad L = 1$

$$I = \frac{\Delta V}{R} = \frac{10}{\frac{1 * 10^{-6} * 1}{\pi (0.32 * 10^{-3})^2}} = 3.2\,A$$

N O T E B O O K

ance and temperature

ρ تعتمد على الحرارة

$$\boxed{\rho = \rho_0 \left[1 + \alpha (T - T_0) \right]}$$

$$\boxed{\alpha = \frac{1}{\rho_0} \frac{\Delta \rho}{\Delta T}}$$

ثابت

$\alpha \rightarrow {}^{\circ}C^{-1}$

$$R = \frac{\rho L}{A}$$

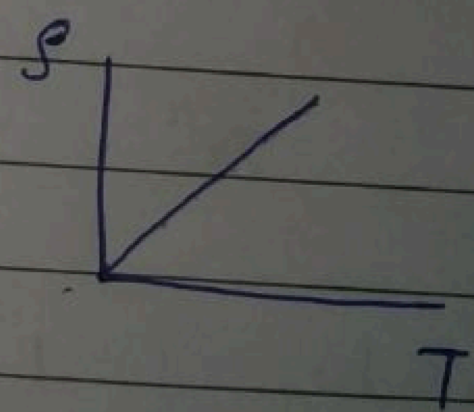
$$\frac{\rho L}{A} = \frac{\rho_0 L}{A} \left[1 + \alpha (T - T_0) \right]$$

$$\boxed{R = R_0 \left[1 + \alpha (T - T_0) \right]}$$

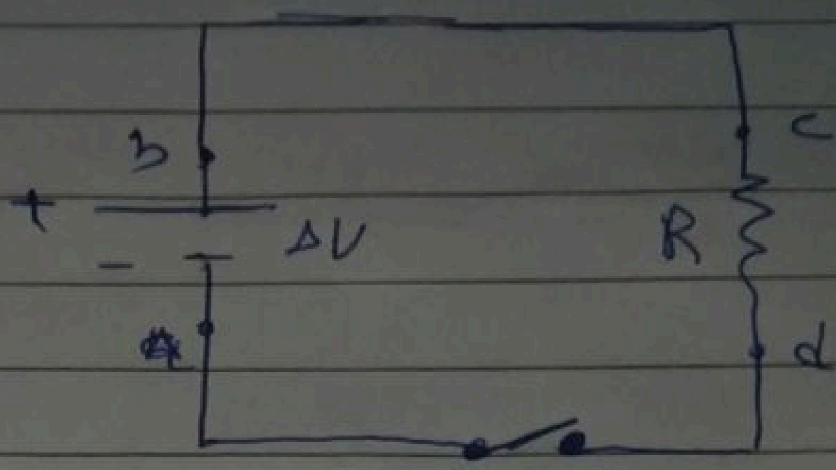
عند T

المقاومة عند T_0

خطية العلاقة



27.6 Electrical power — القدرة الكهربائية



نكتسب طاقة وضع من a إلى b ونستهلك في R

- The energy a when charged ΔQ moved from a to b

تكتسب طاقة وضع خلال فرق جهد معين

watt
2000 J/s

$$\boxed{\Delta U = (\Delta Q)(\Delta V)} \longrightarrow R \text{ تستهلك في}$$

$$\boxed{\underset{\text{Power}}{P} = \frac{\Delta U}{\Delta t} = \frac{\Delta Q}{\Delta t} * \Delta V = I \Delta V}$$

$\Delta V = R I$

watt $\boxed{J/s}$

$$\boxed{P = I^2 R} \qquad \boxed{P = \frac{\Delta V^2}{R}}$$

$$\boxed{\Delta U = P \Delta t}$$

Subject Date No.

EX 27.4

$I \rightarrow$ current

$\Delta V = 120$ $R = 8$ $\Delta V = IR$

1) $I = \frac{\Delta V}{R} = \frac{120}{8} = 15A$

2) $P = \frac{\Delta V^2}{R} = 1800W = 1.8KW$

EX 27.5

$m = 1.5kg$ $T_1 = 10$ $T_2 = 50$ $T = 10min$

$\Delta V = 110V$

$R = \frac{(110)^2(600)}{(1.5)(4186)(50-10)} = 28.9\Omega$