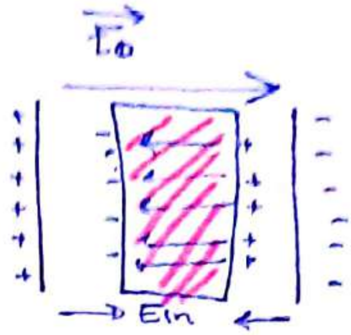


بعد فصلها بطارية

$\Rightarrow Q_f = Q_0$

$\Rightarrow V = \frac{V_0}{K}$; K: dielectric constant.

⇓ الموجودة في صفحة 791 جدول رقم 26.1

$E_{net} = \vec{E_0} - \vec{E_{in}}$ $V = Ed$

$E \downarrow \Rightarrow V \downarrow$

$$\Rightarrow C_f = \frac{Q_f}{V_f}$$

$$C_f = \frac{Q_0}{V_0/K} = K\left(\frac{Q_0}{V_0}\right)$$

$$\Rightarrow C_f = K C_0 \qquad K > 1$$

What is the energy required to insert the dielectric material inside the capacitor?

$$W = -\Delta U = -(U_f - U_i) = U_i - U_f$$

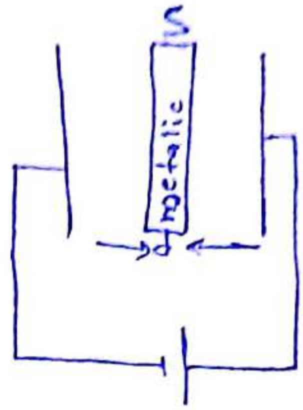
$$U_i = \frac{Q_0^2}{2C_0}$$

$$U_f = \frac{Q_f^2}{2C_f} = \frac{Q_0^2}{2KC_0}$$

$$W = \frac{Q_0^2}{2C_0} - \frac{Q_0^2}{2KC_0} = \frac{Q_0^2}{2C_0}\left(1 - \frac{1}{K}\right)$$

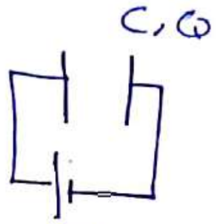
$$= U_0\left(\frac{K-1}{K}\right)$$

$$C = \frac{\epsilon_0 A}{d-s}$$



metalic slab

1/Sol



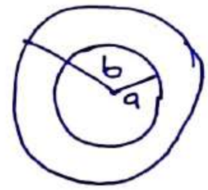
$C = 3\mu f$
$Q = 27\mu c$

sol:

a) $Q = CV$

$\Delta V = \frac{Q}{C} = \frac{27}{3} = 9V$

4/Sol



$a = 7cm$
$b = 14cm$

$$C = \frac{4\pi\epsilon_0 ab}{b-a}$$

$$C = \frac{4\pi * 8.85 * 10^{-12} * 7 * 10^{-2} * 14 * 10^{-2}}{(14-7) * 10^{-2}} \quad F$$

$C = 1556 * 10^{-15} f$

$C = 15,6 * 10^{-12} f$

$C = 15,6 * pf$

b) $Q = 4\mu c$

$Q = C\Delta V \Rightarrow \Delta V = \frac{Q}{C} = \frac{4 * 10^{-6}}{15.6 * 10^{-12}} = 0,26 * 10^{6} V$

※ $U = \frac{Q^2}{2C} = \frac{16 * 10^{-12}}{2 * 15,6 * 10^{-12}} = 0,513 J$

$$\Delta V_3 = \frac{Q_3}{C_3} = \frac{1500}{3} = 500\,V$$

$$\Delta V_6 = 250\,V$$

$\frac{21}{802}$

$C, C, C, C, \dots$

$C_p = 100\,C_s$

Series $\frac{1}{C_s} = \frac{1}{C} + \frac{1}{C} + \dots + \frac{1}{C} = \frac{n}{C}$

$$C_s = \frac{C}{n}$$

Parall

$$C_p = C + C + C + \dots + C$$

$$C_p = nC$$

$$C_p = 100\,C_s$$

$$n\cancel{C} = 100\,\frac{\cancel{C}}{n} \Rightarrow n^2 = 100$$

$$\boxed{n = 10}$$

$\frac{27}{802}$ $C_1 ; C_2$

$C_p = 9\,pF$

$C_s = 2\,pf$

sol:

$$C_p = C_1 + C_2 = 9$$

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{2}$$

$$\frac{C_1 + C_2}{C_1 C_2} = \frac{1}{2} \Rightarrow 9 * 2 = C_1 C_2$$

$$C_1 = 9 - C_2$$

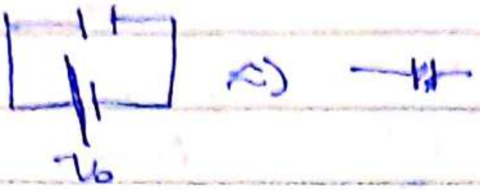
$$(9 - C_2)\,C_2 = 18$$

$$C_2^2 - 9C_2 + 18 = 0 \Rightarrow (C_2 - 3)(C_2 - 6) = 0$$

$$\Rightarrow C_2 = 3 \text{ or } 6$$

$$\Rightarrow C_1 = 6 \text{ or } 3$$

9. $\boxed{45}$



$A = 1,75\ cm^2 = 1,75 * 10^{-4}\ m^2$, $K_{Teflon} = 2.1$

$d = 0,04\ mm = 0,04 * 10^{-3}\ m$, $V_0 = 12V$

a) The capacitance in Air

Sol: $C_0 = \frac{\epsilon_0 A}{d} = \frac{8.85 * 10^{-12} * 1,75 * 10^{-4}}{0,04 * 10^{-3}} = 387,2 * 10^{-13}$

$= 38,72 * 10^{-12}$

$= 38,72\ pF$

b) The charge in Air

Sol: $Q_0 = C_0 V_0 = 38.72 * 12$

$464,64\ pC$

c) The capacitance while filled with Teflon.

Sol: $C = K C_0$

$C = 2,1 * 38,72$

$= 81,3\ pC$

Subject Date No.

d) The P.d across the Capacitor while filled with Teflon

Sol:-

$$V = \frac{V_0}{K} = \frac{12}{2,1} = 5,7\ V$$

$$Q = Q_0 = 464,64\ PC$$

e) Find the work required to insert the Dielectric matrial inside the Capacitor

sol:-

$$W = |\Delta U| = |U_1 - U_f|$$

$$U_0 - \frac{U_0}{K} = U_0\left(1 - \frac{1}{K}\right)$$

$$U_0 = \frac{Q_0^2}{2C_0} = \frac{(464,64 * 10^{-12})^2}{2 * 38,72 * 10^{-12}} = 2787,84\ PJ$$

$$= 2787.84\left(1 - \frac{1}{2.1}\right)$$

$$= 1460.3\ PJ$$

N O T E B O O K

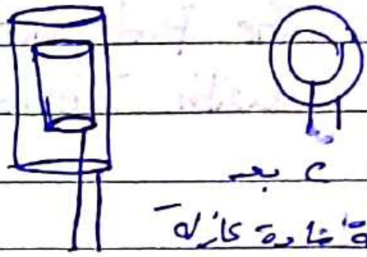
ملاحظة #

49
804

$C_0 = 2nf$

$\Delta V_1 = 100V$

$K_1 = 5$



مطلوب C بعد
اضافة مادة عازلة

$C = K C_0$

Sol:

$C = K_1 C_0$

$C = 5*2 = 10nf$

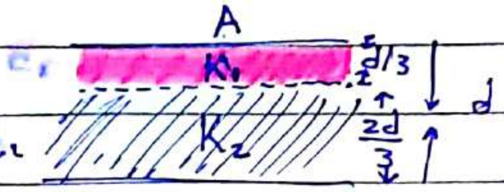
$Q = Q_0 = C_0 V_0 = 2*100 = 200nC$

$V = \frac{V_0}{K} = \frac{100}{5} = 20V$

$W = U_0\left(1 - \frac{1}{K}\right)$

$U_0 = \frac{Q_0^2}{2C_0} = \frac{200^2}{2*2} nJ = 10000 nJ$

Ex. 1



Calculate the Capacitance of the above capac.

Sol: (In series.)

$$C_1 = \frac{\epsilon_0 A}{d/3} * K_1$$

$$C_2 = \frac{\epsilon_0 A}{\frac{2d}{3}} * K_2$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{d/3}{K_1 \epsilon_0 A} + \frac{2d/3}{K_2 \epsilon_0 A} = \frac{d}{3\epsilon_0 A}\left(\frac{1}{K_1} + \frac{2}{K_2}\right)$$

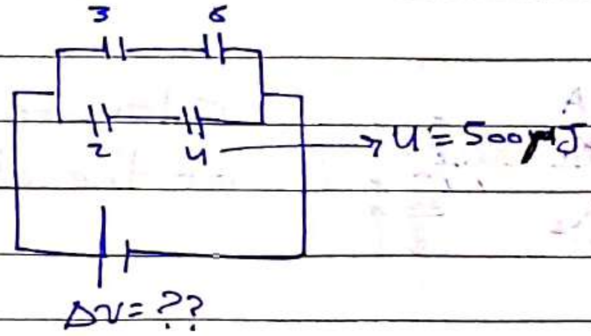
$$= \frac{d}{3\epsilon_0 A}\left(\frac{2K_1 + K_2}{K_1 K_2}\right)$$

$$C_s = \frac{3\epsilon_0 A}{d}\left(\frac{K_1 K_2}{2K_1 + K_2}\right)$$

$K_1 = 1$, $K_2 = 1$ ⟵ نختبر

$$C_s = \frac{\cancel{3}\epsilon_0 A}{d}\left(\frac{1 \times 1}{\cancel{3}}\right) = \frac{\epsilon_0 A}{d} \checkmark$$

$\frac{19}{802}$



Sol: $U = \frac{1}{2} Q \Delta V$, $Q = C \Delta V$

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

$$\Delta V = \frac{2U}{C}$$

$$\Delta U_4 = \frac{2 * 500 \times 10^{-6}}{4 \times 10^{-6}} = 250 V$$

$$Q_4 = C_4 \Delta V_4 = 4 \times 10^{-6} * 250 = 1000 \mu C = Q_2$$

$$\Delta V_2 = \frac{Q_2}{C_2} = \frac{1000}{2} = 500 V$$

$$\Delta V = \Delta V_2 + \Delta V_4 = 500 + 250 = 750 V$$

$C_{eq} = ?!$ $\Rightarrow \frac{1}{C_{eq}} = \frac{1 \times 2}{3 \times 2} + \frac{1}{6} = \frac{3}{6} = \frac{3}{6}$

$C_{eq} = 2 \mu f$ | $Q_{eq} = C_{eq} \Delta V$

$Q_{eq} = 2 * 750 = 1500 \mu C$

$\frac{5}{Sol}$ Cylinderical Cap

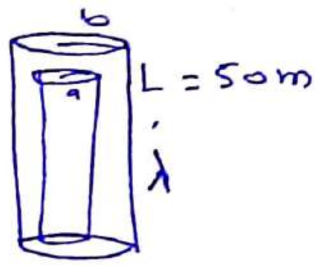
Diamter : القطر

$2a = 2.58$ mm

$2b = 7.27$ mm

$q = 8.1\ \mu c$

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



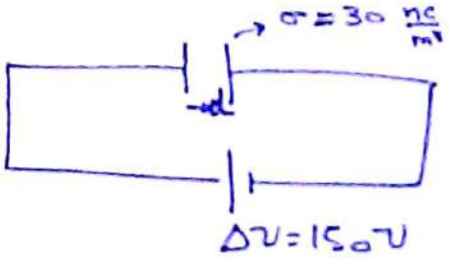
Sol : $C = \frac{2\pi \epsilon_0 L}{Ln(\frac{b}{a})}$

$$C = \frac{2\pi * 8.85 * 10^{-12} * 50}{Ln \left| \frac{7.27}{2.58} \right|} \quad f$$

$Q = C \Delta V$

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

$\frac{7}{801}$



$d = ?!$

$$E = \frac{\sigma}{\epsilon_0} = \frac{30 * 10^{-9}}{8.85 * 10^{-12}} = 3.4 * 10^{3}\ V$$

$\Delta V = Ed$

$$d = \frac{\Delta V}{E} = \frac{150}{3.4 * 10^{3}} = 44.25 \text{ mm}$$

+سؤال

$A = 5\ mm^2 = 5 * 10^{-6}\ m^2$

$$C = \frac{\epsilon_0 A}{d} = \frac{8.85 * 10^{-12} * 5 * 10^{-6}}{44.25 * 10^{-3}} =$$

Ex. A flow of charge $q(t) = 3t^2 - t + 1$

crossing a conductor between time

$t = 1\,sec$ and $t = 5\,sec$ Find

1) The averege Current

$$I_{av} = \frac{Q_f - Q_f}{t_f - t_i} = \frac{Q(5) - Q(1)}{5-1} = \frac{71-3}{4} = \frac{68}{4}\ A$$

2) The instantius current at $t = 2\,sec.$

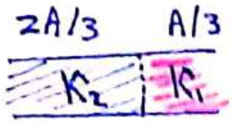
$$I = q'(t) = 6t - 1$$

$$I(2) = 6 * 2 - 1 = 11\,A$$

+# The energy stored in the capacitor

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

Ex. 2



Sol : (In Parallel)

$$C_1 = K_1 \frac{A/3}{d}$$

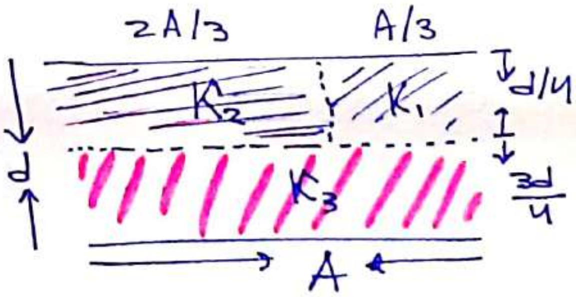
$$C_2 = K_2 \frac{2A/3}{d}$$

$$C_p = C_1 + C_2$$

$$C_p = K_1 \frac{A/3}{d} + K_2 \frac{2A/3}{d}$$

$$C_p = \frac{\epsilon_0 A}{3d}\left(K_1 + 2K_2\right)$$

H.W



$C_{eq} = ?!$

sol: (1.2) (In parallel)

$$C_1 = K_1 \epsilon_0 \frac{A/3}{d/4} \quad , \quad C_2 = K_2 \epsilon_0 \frac{2A/3}{d/4} , \quad C_3 = K_3 \epsilon_0 \frac{2A/3}{d/4}$$

$$C_{p_{12}} = C_1 + C_2 = K_1 \frac{\epsilon_0 A/3}{d/4} + K_2 \frac{\epsilon_0 2A/3}{d/4}$$

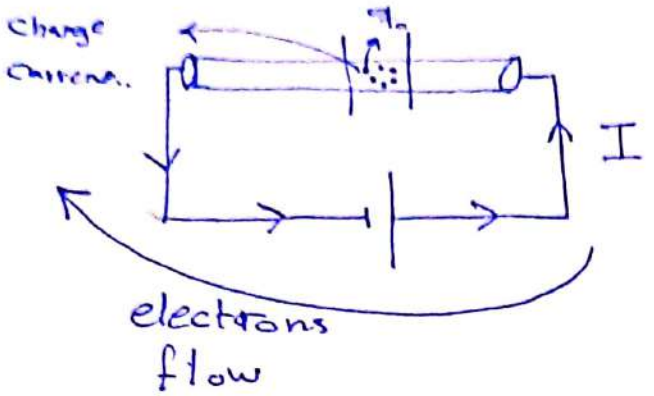
$$C_{p_{12}} = \frac{4\epsilon_0 A}{3d}\left[K_1 + 2K_2\right]$$

$$\frac{1}{C_{p_{123}}} = \frac{1}{C_{p_{12}}} + \frac{1}{C_{p_3}} = \frac{3d}{4\epsilon_0 A[K_1+2K_2]} + \frac{3d}{8K_3\epsilon_0 A}$$

$$C_{p_{123}} = \frac{3d\left(4\epsilon_0 A[K_1+2K_2] + 8K_3\epsilon_0 A\right)}{\left(4\epsilon_0 A[K_1+2K_2]\right) 8K_3\epsilon_0 A}$$

Ch. 27 The Current

1) Current Definition : I



The average current.

$$I_{av} = \frac{\Delta Q}{\Delta t} \quad , \quad v_{av} = \frac{\Delta x}{\Delta t}$$

$$I_{av} = \frac{Q_f - Q_i}{t_f - t_i}$$

$$[I] = \frac{[Q]}{[t]} = \frac{C}{s} = \text{Ampr} = A.$$

$\frac{1}{2}$ min = 30 sec. , 2 min = 120 sec.

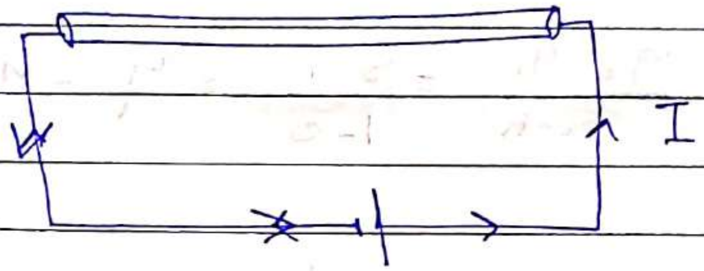
$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \dot{x}(t) = \frac{dx}{dt}$$

Instantions current

$$I = \lim_{\Delta t \to 0} \frac{\Delta Q}{\Delta t} = \frac{dQ(t)}{dt}$$

CamScanner المسوحة ضوئيا بـ

Ch. 27 Current Resistance



The average Current

$$I_{av} = \frac{\Delta Q}{\Delta t}$$

$$[I] = \frac{[Q]}{[t]} = \frac{C}{s} = \text{Amper} \equiv A$$

Instantions Current

$$I = \lim_{\Delta t \to 0} \frac{\Delta Q}{\Delta t} = \frac{dQ}{dt}(t)$$

$I(t) = \frac{dQ}{dt}$

$10t - 1$

Subject   Date   No.

~~$I(5) = 29A.$~~

$q(t) = 5t^2 - t + 1$ Find

(1) The average current between $t = 0$ & $t = 1$ sec

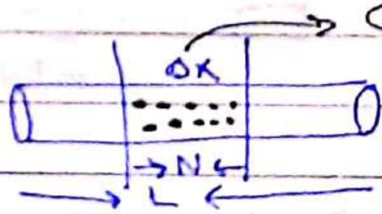
$$I_{av} = \frac{q_2 - q_1}{t_2 - t_1} = \frac{5-1}{1-0} = \frac{4}{1} = 4A.$$

(2) The Current at $t = 3$ sec

$$I_{av} = \frac{q_f - q_i}{t_f - t_i} = \frac{5-1}{1-0} = 4A$$

Microscopic picture of the Current

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



Charge Carriers.

$Q =$

$Q = Ne$

N: number of charge Carrier

n: number density

$$n = \frac{N}{\text{Volume}} \Rightarrow N = n * \text{Volume}$$

$\text{Volume} = A * \Delta X$

A: Cross-sectional area مساحة مقطع

$= \pi r^2$

$N = nA\Delta X$, $\Delta Q = Ne$

~~ΔQ~~ $=$

N O T E B O O K

$$\Delta Q = (n A \Delta x) e \Rightarrow I = \frac{n A e \Delta x}{\Delta t}$$

$$I = n A e v_d$$

when: v_d is the electron drift velocity (سرعة الانسياق)

n: number density $\left[\frac{e}{m^3}\right]$

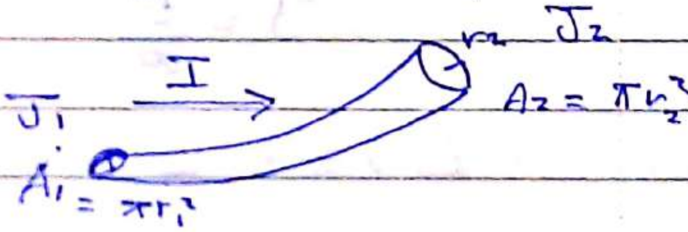
Ex. 27.1 $\Rightarrow$ $n \rightarrow$ copper للنحاس

$$n_{cu} = 8.49 * 10^{28} \ e/m^3$$

$$I = n e A v_d$$ مهم

$$A = \pi r^2$$

Ohm's law and Resistance (مقاومة)



$$v_1 > v_2$$

Current density:

$$J = \frac{I}{A} \left(\frac{A}{m^2}\right)$$

$$\frac{I_i}{v_i}$$

$$J_1 = \frac{I}{A_1} \quad , \quad J_2 = \frac{I}{A_2}$$

$$I = A_1 J_1 = A_2 J_2 \quad , \quad J = \frac{I}{A} = \frac{n e v_d \cancel{A}}{\cancel{A}}$$

$$\boxed{\vec{J} = n e \vec{v_d}}$$

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Ohm's Law

$$\vec{J} \propto \vec{E}$$

$$\vec{J} = \sigma \vec{E}$$

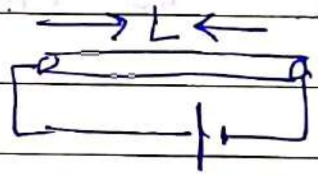
σ : Conductvite (الموصلية)

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

المقاومية

$[\rho] = \Omega.m$, $[\sigma] = (\Omega.m)^{-1}$

$$J = \frac{E}{\rho}$$



$\Delta V = E L$. L: conductor length.

$$E = \frac{\Delta V}{L}$$

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

$$\Delta V = \left(\frac{\rho L}{A}\right) I$$

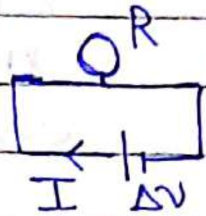
$\Delta V = R I$ قانون اوم

$R = \frac{\rho L}{A}$, R: resistance مقاومة

ρ : resistivity مقاومية .

N O T E B O O K

$$\text{Power} = I^2 R \ [W]$$
$$= \frac{\Delta V^2}{R} = I \Delta V$$



Resistance and Temp.

$$R(T) = R_0 \left(1 + \alpha (T - T_0)\right)$$

T: temprture. , $T_0 = 20^\circ C$

R(T) is the resistance at $T > T_0$, R_0 = resistance at $T_0 = 20 C^\circ$

α : temperture cofficient of resistivity

توكلت على الله

$\frac{3}{826}$ Cu wire

$n = 8.49 * 10^{28}\ e/m^3$

Cross-sectional area:

$A = 4 * 10^{-6}\ m^2$

$I = 5\ A$, v_d : drift velocity = ?!

Sol: $v_d = \frac{I}{neA} = \frac{5}{8.49 * 10^{28} * 1.6 * 10^{-19} * 4 * 10^{-6}}$

$v = 10^{-3}\ m/s$

$\frac{6}{826}$ Cu  $r = 1.25\ mm$

$I = 3.7\ A$

$v_d = ?!$

$n = 8.49 * 10^{28}\ e/m^3$.

Sol: $A = \pi r^2$

$A = \pi (1.25 * 10^{-3})^2$

$A = 4.9 * 10^{-6}\ m^2$

$I = neAv_d \Rightarrow v_d = \frac{I}{neA}$

$v_d =$

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$\frac{7}{826}$ $I(t) = I_0 e^{-\frac{t}{a}}$ $I_0, a > 0$

(a) $\Delta Q = ?!$ $0 \leq t \leq a$

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

$\int dq = \int I\,dt$

$\Delta Q = \int_0^a I_0 e^{-\frac{t}{a}} dt$

$= I_0 (-a) e^{-\frac{t}{a}} \Big]_0^a$

$= -a I_0 [e^{-1} - 1]$

$= a I_0 (1 - e^{-1})$

(b) ΔQ $0 \leq t \leq 10a$

$\Delta Q = -a I_0 [e^{-\frac{t}{a}}]^{10a}$

$= -a I_0 [e^{-10} - 1]$

$= a I_0 (1 - \frac{1}{e})$

(c) $\Delta Q = ?$ $0 \leq t < \infty$

$\Delta Q = -a I_0 e^{-\frac{t}{a}} \Big|_0^\infty = -a I_0 [e^{-\infty} - 1]$

$= a I_0$

NOTEBOOK

Subject   Date   No.

$\frac{14}{827}$

$R = 240\,\Omega$

$\Delta V = 120\,V$

Sol:

$$\Delta V = RI$$

$$120 = 240\,I$$

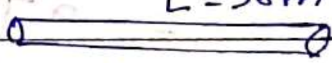
$$\Rightarrow \quad I = \frac{120}{240} = 0{,}5\,A$$

$$P = \Delta V I$$

$$P = 240 * \frac{1}{2} = 120\,W$$

$\frac{15}{827}$

$L = 50\,m$



Area.

Diameter $= 2mm$

القطر

$\Downarrow$

$r = 1\,mm$

$\Delta V = 9.11$

$I = 36\,A$

[illegible]

$Area = \pi r^2$

$$\Delta V = RI \quad ; \quad R = \frac{\rho L}{A}$$

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

$$\Delta V A = \rho L I$$

$$\rho = \frac{\Delta V A}{L I} = \frac{9.11 * \pi * 10^{-6}}{50 * 9{,}11}\ \Omega.m.$$

$\frac{8}{826}$

$$J = \frac{I}{A} \quad , \quad J_1 = \frac{I_1}{A_1}$$

$$J_2 = \frac{I}{A_2}$$

$$I = A_1 J_1 = A_2 J_2$$

$$J_1 = \frac{I}{A_1} = \frac{5}{\pi (0,4)^2} \ A/m^2$$

$$I\Big|_{A_1} = I\Big|_{A_2} = 5A$$

c) $A_2 = 4A_1$

$$\cancel{\pi} r_2^2 = 4(\cancel{\pi}(0,4)^2)$$

$$r_2 = 2 * 0,4 = 0,8 \ m.$$

$$I\Big|_{r_2} = 5A$$

$$\vec{J_2} = \frac{I}{A_2} = \frac{5}{\pi(0,8)^2} \ A/m^2$$

Subject Date No

$\frac{26}{827}$

$T_0 = 20C^\circ \rightsquigarrow R_0 = 19\,\Omega$

$R(T) = 140\,\Omega$

$T = ??$

$\omega \Rightarrow \rho_0 \Rightarrow R_0 = \frac{\rho_0 L}{A}$

$\alpha = 4.5 * 10^{-3}\ C^{\circ -1}$

$R(T) = R_0 (1 + \alpha \Delta T)$

$1 + \alpha\Delta T = \frac{R(T)}{R_0} \Rightarrow \alpha\Delta T = \frac{R(T)}{R_0} - 1$

$\Delta T = \left(\frac{R(T)}{R_0} - 1\right) / \alpha$

$\Delta T = \left(\frac{140}{19} - 1\right) / (4.5 * 10^{-3})$

$\Delta T = 1415\ C^\circ$

$T - T_0 = 1415$

$T = 1435\ C^\circ$

N O T E B O O K

Subject Date No.

31 $L = 34.5\ m$
$R = 0,25\ mm$. $\Delta V = 9V$ } $T_0 = 20°C$

Sol:-

$\rho = 1,7 * 10^{-8}\ \Omega.m.$

$$R = \frac{\rho L}{A}\ \Omega.m.$$

$$R_0 = \frac{1,7*10^{-8} * 34,5}{\pi (0,25*10^{-3})^2} \cong 300 * 10^{-2} = 3\ \Omega.$$

$$I = \frac{\Delta V}{R} = \frac{9}{3} = 3A.$$

$\Delta T = T - T_0 = 30 - 20 = 10$

$$R(T) = R_0(1 + \alpha \Delta T) = 3(1 + 3.9 * 10^{-3}(10))$$
$$= 3(1 + 3.9 * 10^{-2})$$
$$= 3.117\ \Omega$$

$$I = \frac{9}{3.117} = 2.89\ A.$$

N O T E B O O K

43 $P = 100W$, $\Delta V = 120$

$$P = I^2 R = I \Delta V \Rightarrow I = \frac{P}{\Delta V} = \frac{100}{120} = 0{,}833\ A$$

$$\Delta V = RI \Rightarrow 120 = R(0{,}833) \Rightarrow R = \frac{120}{0{,}833}\ \Omega$$

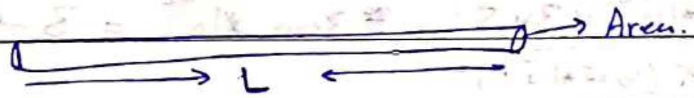
تذكر

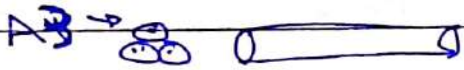
$$I = nevA$$

$$\Delta V = EL = RI$$

اسئلة مهمة

1



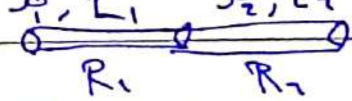


$$R_N = \frac{\rho L_N}{A_N} = \frac{\rho L/3}{3A} = \frac{\rho L}{3^2 A} = \frac{R_0}{3^2}$$

$$= \frac{R_0}{N^2}$$

عدد القطع.

2)

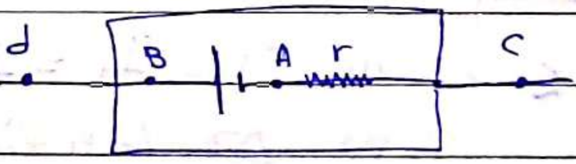


$$R_T = R_1 + R_2$$

$$R_T = \frac{\rho_1 L_1}{A} + \frac{\rho_2 L_2}{A}$$

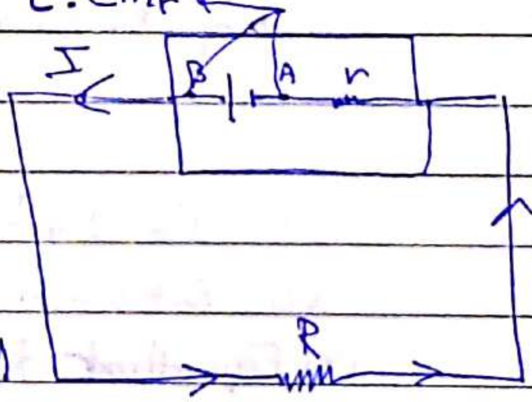
Subject Ch. 28 Direct Current Circuits. Date No.

* Electromotive force (القوة الدافعة الكهربائية) ← emf



فرق جهد البطارية عندما يكون عند استثناء المقاومة الداخلية ويقاس بالفولتميتر بين (AB)

ε : emf



r: internal resestance.

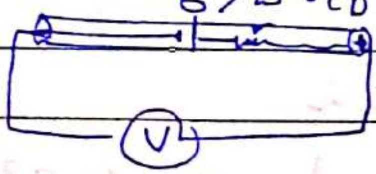
R: Load (external resistance)

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

$$\Delta V_{CD} = IR = \mathcal{E} - Ir$$: terminal voltage

خارج البطارية

$\mathcal{E} > \Delta V_{CD}$



$\mathcal{E} = 1,7\,V$

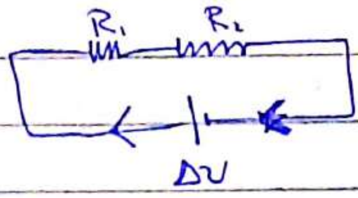
$1,5\,V = \Delta V_{CD}$

N O T E B O O K

Subject Date No.

Resistors in series and Parallel

series.



(1) $I = I_1 = I_2$

(2) $\Delta V = \Delta V_1 + \Delta V_2$

(3) Equvillint Resistance

$R_{eq} = R_1 + R_2$

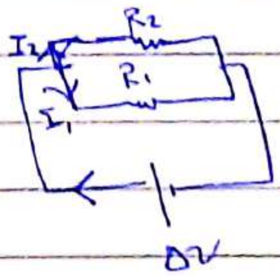
Parallel

(1) $I = I_1 + I_2$

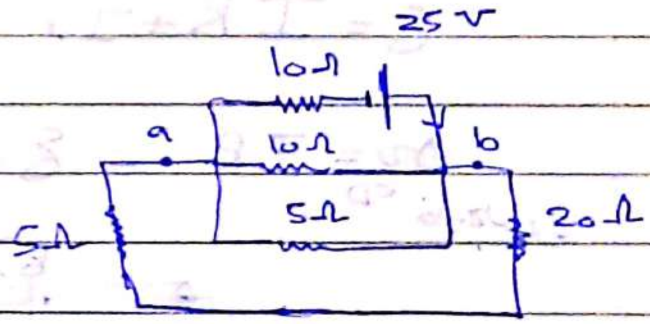
(2) $\Delta V = \Delta V_1 = \Delta V_2$

(3) Equvillint Resistance.

R



$\frac{9}{858}$



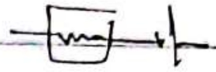
$R_1 = 5 + 20 = 25\ \Omega$

$\frac{1}{R_2} = \frac{1}{5} + \frac{1}{10} + \frac{1}{25} \Rightarrow R_2 = 2.94\ \Omega$

$R_T = 10 + 2.94 = 12.94\ \Omega$

NOTEBOOK

$$I = \frac{\Delta v}{R_T} = \frac{25}{\ } = 1,93\ A$$



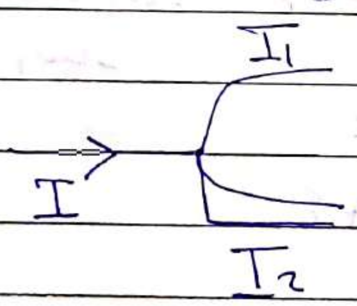
$$\Delta v_{10} = 10 * 1,93 = 19,3\ v$$

$$\Delta v_{R_2} = 25 - 19,3 \Rightarrow \Delta v_{R_2} = 5,68\ v = \Delta v_{ab}$$

$$I_5 = I_{25} = \frac{\Delta v_{25}}{25} = \frac{5,68}{25} = 0,227\ A$$
$$= 227\ mA.$$

* Kirchhoff's Rules:

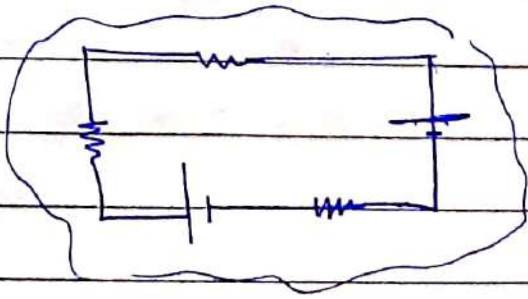
1. Kirchhoff's 1st Rule



$$I = I_1 + I_2$$
$$\sum I_{in} = \sum I_{out}$$
[Conservation of Charge]
$$I = \frac{\Delta Q}{\Delta t}$$

2. Kirchhoff's 2nd Rule
[Conservation energy]

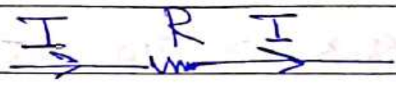
$\sum \Delta v = zero$
closed loop.



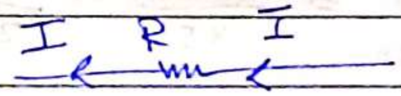
Kirchhoff's Convention

+ve direction

Resistor

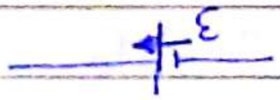
(1)  تيار مع الاتجاه موجب

$\Delta V = -RT$

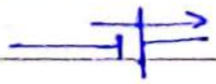
(2)  تيار مع الاتجاه السالب

$\Delta V = +RI$

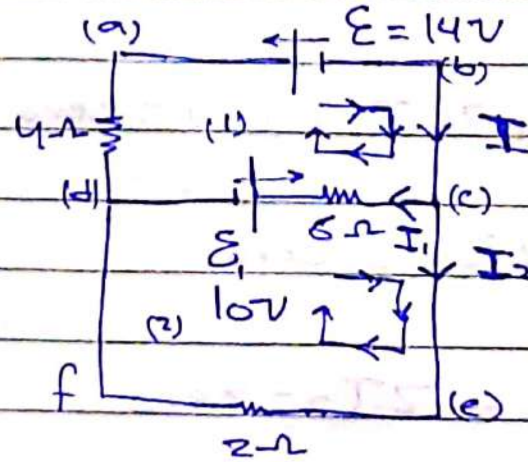
Battery

(1) 

$\Delta V = -\varepsilon$ # ننسى وجود التيار.

(2) 

$\Delta V = +\varepsilon$



$I = I_1 + I_2$ ...... (1)

$\sum V = zero$
closed (abcda) loop

$-14 + (-6I_1) + (-10) + (-4I) = zero.$

$-24 - 6I_1 - 4I_2 = 0$

$12 + 3I_1 + 2I = zero$ ....(2)

$\sum V = zero$
closed (dcefd) loop

$+10 + (6I_1) + (-2I_2) = zero$

$5 + 3I_1 - I_2 = zero$ ..... (3)

$I = I_1 + I_2$

$12 + 3I_1 + 2I = 0$

$5 + 3I - I_2 = 0$

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(1) in (2)

$$12 + 3I_1 + 2(I_1 + I_2) = zero$$

$$12 + 5I_1 + 2I_2 = zero$$

$$10 + 6I_1 - 2I_2 = zero$$

$$22 + 11I_1 = zero \rightarrow I_1 = -2A$$

اذا طلع العدد موجب يعني ان الاتجاه صحيح اما اذا سالب فهو خاطئ.
والاتجاه لا يتغير من الرسمة و يعوض بنفس الاشارة في
باقي المعادلات.

$$-1 - I_2 = 0$$

$$I_2 = -1A$$

$$I_3 = -3A$$

Find $v_b - v_e = ?$

$$v_b + \sim\sim\sim = v_e$$

$$v_e + (-2 * -1) + (-4 * -3) + (-14) = v_b$$

$$v_e + \cancel{2} + 12 - \cancel{14} = v_b$$

$$v_b - v_e = zero$$

NOTEBOOK

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Find $v_b - v_d = ?$

$v_b + ------ = v_d$

$v_b + (-6 * -2) + (-10) = v_d$

$v_b + 12 - 10 = v_d$

$v_b + 2 = v_d$

$v_b - v_d = -2$

$v_d + ------ = v_b$

$v_d + (-4 * -3) + (-14) = v_b$

$v_d + 12 - 14 = v_b$

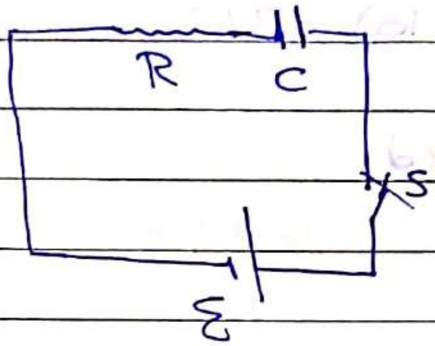
$v_d - 2 = v_b$

$-2 = v_b - v_d.$

Subject Date No.

RC - Circuits

→ Charging a Capacitor :-



$$\Delta V_{\mathcal{E}} = \Delta V_R + \Delta V_C$$

$$\mathcal{E} = R\,I(t) + \frac{q(t)}{C}$$

$$I(t) = \frac{dq}{dt}$$

$$R\frac{dq}{dt} + \frac{1}{C}q(t) = \mathcal{E}$$

$$\frac{dq}{dt} + \frac{1}{RC}q = \frac{\mathcal{E}}{R}$$

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The RC- Circuit time Constant

$\Rightarrow \tau = RC$

$$\frac{dq}{dt} + \frac{q}{\tau} = \frac{\varepsilon}{R}$$

$$q(t) = C\varepsilon\left(1 - e^{-\frac{t}{\tau}}\right)$$

$$= Q_{max}\left(1 - e^{-\frac{t}{\tau}}\right)$$

$$\Rightarrow q(t) = Q_{max}\left(1 - e^{-\frac{t}{\tau}}\right)$$

$$I(t) = \frac{dq}{dt} = \frac{Q_{max}}{RC}\, e^{-\frac{t}{RC}}$$

$$= \frac{\varepsilon}{R}\, e^{\frac{t}{\tau}}$$

$$\Rightarrow I(t) = I_0\, e^{\frac{t}{\tau}}$$

$$\Delta v_c(t) = \frac{q(t)}{C} = \varepsilon\left(1 - e^{-\frac{t}{\tau}}\right)$$

$$\Delta v_o(t) = RI^2$$

$$= \frac{\varepsilon^2}{R}\, e^{-\frac{2t}{\tau}}$$

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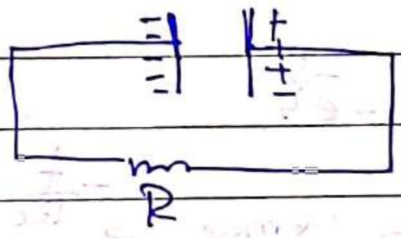
$$U_C(t) = \frac{Q^2}{2C} = \frac{\mathcal{E}^2 C}{2}\left(1 - e^{-\frac{t}{\tau}}\right)^2$$

$$P(R) = R I^2$$

$$R\frac{\mathcal{E}^2}{R^2} e^{-\frac{2t}{\tau}} = \mathcal{E}^2 e^{\frac{-2t}{\tau}}$$

Discharging the Capacitor



$$\Delta V_R(t) + \Delta V_C(t) = 0$$

$$R\, I(t) + \frac{q(t)}{C} = \text{zero}$$

$$\frac{dq(t)}{dt} + \frac{1}{RC} q(t) = 0$$

$$\frac{dq}{dt} + \frac{q}{\tau} = 0$$

$$q(t) = Q_0 e^{-\frac{t}{\tau}} \quad *$$

$$I(t) = -\frac{Q_0}{RC} e^{-t/\tau}$$

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$$\Delta V_C(t) = \frac{q(t)}{C} = \frac{Q_0}{C} e^{-t/\tau}$$

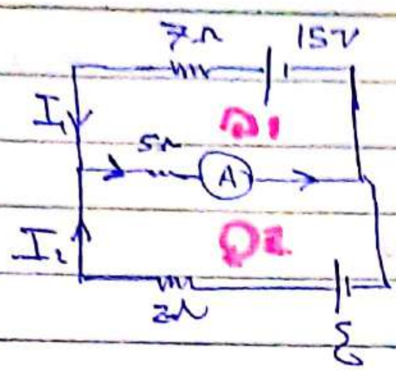
$$U_C(t) = \frac{1}{2} q\,\Delta V(t) = \frac{Q_0^2}{2C} e^{-2t/\tau}$$

$$\Delta V_R(t) = R\,I(t) = -R\,\frac{Q_0}{RC} e^{-t/\tau}$$

$$= -\frac{Q_0}{C} e^{-t/\tau}$$

$$P(t) = R I^2 = R\,\frac{Q_0^2}{R^2 C^2} e^{-2t/\tau}$$

29
550



$$I = I_1 + I_2$$

$$I_1 + I_2 = 2$$

$$\sum_{\substack{\text{closed}\\ \text{loop}}} V^{abcda} = \text{zero}$$

$$+7I_1 + (-15) + (5*2) = 0$$

$$7I - 15 + 10 = 0 \Rightarrow 7I_1 - 5 = 0$$

$$I_1 = \frac{5}{7}\ A.$$

$$I_2 = 2 - I_1 \Rightarrow 2 - \frac{5}{7} = \frac{9}{7}\ A$$

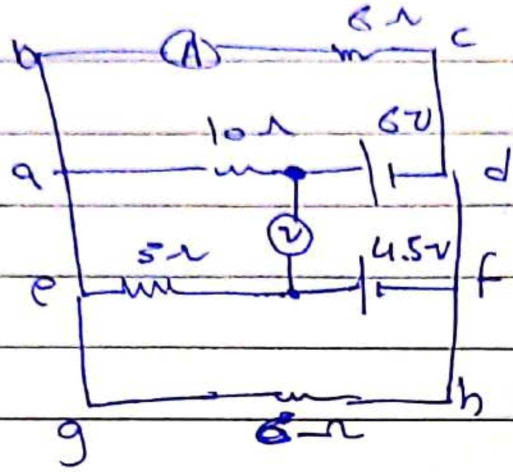
$$\sum_{\substack{\text{closed}\\ \text{loop}}} V_{fadef} = \text{zero}$$

$$-5*2 + (+\varepsilon) + \left(-2*\frac{9}{7}\right) = \text{zero}$$

$$-10 + \varepsilon - \frac{18}{7} = \text{zero}$$

$$\varepsilon = 10 + \frac{18}{7} \approx \frac{88}{7}\ V$$

25
560



$V_A + \_\_\_\_ = V_B$

$V_A + (-6) + (4,5) = V_B$

$V_A - 1.5 = V_B$

$V_A - V_B = 1,5V$

RC – circuits

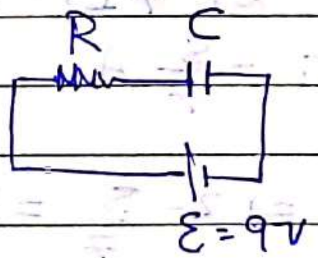
شحن
charging → R, C, E

C: un charge

تفريغ
discharging → R, C

C: initially Charge.

37
861



$C = 20\mu f$

$R = 100\Omega$

a: time Constant.

$\tau = RC$

$\tau = 100 * 20 * 10^{-6} = 2000 * 10^{-6} \cong 2 * 10^{-3}$ sec

$= 2$ msec.

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b: max Charge.

$$q(t) = Q_{max}(1 - e^{-t/\tau})$$

b: $Q_{max} = \mathcal{E} C = 9 * 20 \mu F = 18 \mu C$

c: $t = 1\tau$, $t = 2\tau$, 3τ

$$q(t) = Q_{max} \cdot (1 - e^{-1\tau/\tau}) \Rightarrow Q_{max}(1 - e^{-1})$$

$$= 180(1 - \frac{1}{e}) = 113,8 \mu C$$

d: p.d $\Delta V_c (t = 6 \, msec)$

$$q(t) = Q_{max}(1 - e^{-t/\tau})$$

$$\Delta V_c(t) = \frac{\mathcal{E} C}{C}(1 - e^{(-t/\tau)})$$

$$= 9(1 - e^{-6/2}) = 9(1 - e^{-3}) \, V$$

e: Find the time at which the charge on the capacitor is 70% of it's maxm value.

sol:

$$\frac{q(t)}{Q_{max}} ; \frac{V_c(t)}{\mathcal{E}} , \frac{U(t)}{U_{max}} = 0,7$$

$$0,7 = 1 - e^{-t/\tau}$$

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$$e^{-t/\tau} = 0,3$$

$$\frac{-t}{\tau} = \ln(0,3) \Rightarrow t = -\tau \ln(0,3) = 1,2\,\tau$$

$$\because \tau = 2\,msec$$

$$= 2,4 \text{ msec}$$

Ex:

Find the time at which the energy on the Capacitor is one fourth of it's maxm value.

Sol: $$u(t) = u_{max}(1 - e^{-t/\tau})^2$$

$$\frac{u(t)}{u_{max}} = \frac{1}{4} = (1 - e^{-t/\tau})^2$$

$$1 - e^{-t/\tau} = \pm 0,5$$

$$e^{-t/\tau} = 1 \pm 0,5 = 0,5 \text{ (or) } 1,5$$

$$e^{-t/\tau} = 0,5 \Rightarrow \frac{-t}{\tau} = \ln 0,5 \Rightarrow t = -\tau \ln 0,5 = 1,39 \text{ msec}$$

or

$$\frac{-t}{\tau} = \ln 1,5 \Rightarrow t = -0,4\,\tau \ (X)$$ الزمن ليس بالسالب.

Find the time at which the power on the resistor is on fifth of it's maxm value

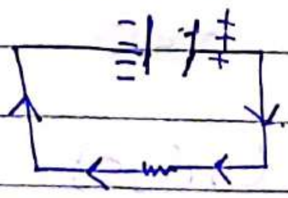
$$P(t) = P_{max}\, e^{-2t/\tau}$$

$$\frac{P(t)}{P_{max}} = \frac{1}{5} = e^{-2t/\tau}$$

$$\frac{-2t}{\tau} = \ln\left(\frac{1}{5}\right) = 1,6 \text{ msec.}$$

39 intial charged discharged (R, C)

$C = 2nF$, $Q_0 = 5.1 \mu C$, $R = 1,3\ K\Omega$



$$q(t) = Q_0\, e^{-t/\tau} \Rightarrow I(t) = -\frac{Q_0}{\tau} e^{-t/\tau}$$

$$\tau = RC = 1,3 * 10^3 * 2 * 10^{-9} = 2.6 \mu \text{sec.}$$

a) $I(t)\Big|_{t=9\mu s} = ?$ $\Rightarrow$ $I(t=9\mu s) = -\frac{5.1}{2.6} e^{-9/2.6}$

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b) $q(t)|_{t=8\mu sec} = ?$

$$q(t) = Q_0 e^{-t/\tau} = 5.1\, e^{-8/2.6}\ \mu C$$

c) $I = I_0 e^{-t/\tau} = I_0$

$$I_{max} = I_0 = \frac{Q_0}{\tau} = \frac{5.1}{2.6}\ A$$

d) Find the time at which the remaining Charge on the Capacitor is 50% of it's inial Value?

sol: $q(t) = Q_0 e^{-t/\tau}$

$$\frac{q(t)}{Q_0} = e^{-t/\tau} = 0.5$$

$$t = -\tau \ln(0.5)$$

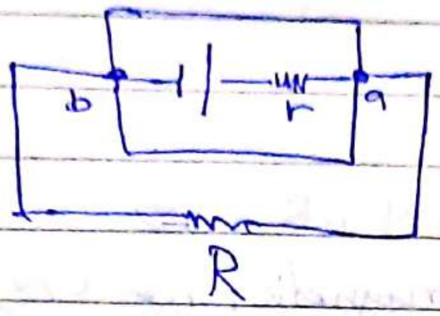
e) Power on resistor is 30% of it's initial value

sol: $p(t) = P_0 e^{-2t/\tau} \Rightarrow 0.3 = e^{-2t/\tau}$

$$\frac{-2t}{\tau} = \ln 0.3 \Rightarrow t = \frac{-\tau}{2} \ln(0.3)$$

Subject   Date   No.

$\frac{L}{857}$ EMF (emf)



emf $= \varepsilon = 15\,V$

$\Delta V_{ab} = 11.6$

Power $= 20W \longrightarrow R$

a) $P_R = \frac{(\Delta V)^2}{R} \Rightarrow 20 = \frac{11.6^2}{R}$

$R = \frac{11.6^2}{20} = 6.728\,\Omega$

$\Delta V = RI \Rightarrow I = \frac{\Delta V}{R} = \frac{11.6}{6.728} = 1.72A$

c) $r = ?$

$\varepsilon = IR + Ir \Rightarrow I(R+r)$

$Ir = \varepsilon - IR$

$Ir = 15 - 11.6 \Rightarrow 1.72\,r = 3.4$

$r = \frac{3.4}{1.72} = 1.97\,\Omega$

CH.29 Magnetic field

(1) magnetic force.

m, q

$$F_B = q v B \sin\theta$$

F_B : magnetic force (N)
B : magnetic field
[B] : Tesla = T

$F_B| =$ zero
$\theta = 0, \pi$
Parallel , antiparallel //

$F_B^{max}| = qvB$
$\theta = \frac{\pi}{2}, 3\pi$
Perpendicular $\perp$

$$F_B = qvB \sin\theta$$

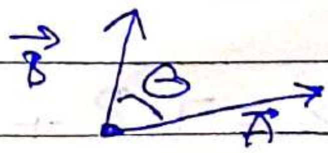
Cross - Product :

$$\text{Dot. product} = \vec{A} \cdot \vec{B} = |A||B| \cos\theta$$

$$|\vec{A} \times \vec{B}| = |A||B| \sin\theta$$

$$\vec{F_B} = q \vec{v} \times \vec{B}$$

$$\vec{C} = \vec{A} \times \vec{B} = - \vec{B} \times \vec{A}$$

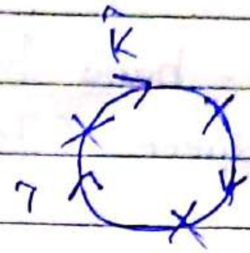


$$\vec{A} = a\hat{i} + b\hat{j} + c\hat{k}$$

$\hat{i} \times \hat{j} = \hat{k}$ | $\hat{j} \times \hat{i} = -\hat{k}$

$\hat{j} \times \hat{k} = \hat{i}$ | $\hat{k} \times \hat{j} = -\hat{i}$

$\hat{k} \times \hat{i} = \hat{j}$ | $\hat{i} \times \hat{k} = -\hat{j}$



Ex.1 Find the magnetic force on an electron in magnetic field

$$\bar{B} = 2\hat{i} - \hat{k} \quad (mT)$$

$T: \Rightarrow mT = 10^{-3}\,T$

$\mu T = 10^{-6}\,T$

swite a velocity

$$\vec{v} = 3\hat{k} + \hat{j} \quad (m/s)$$

$$\vec{F} = q\,\vec{v} \times \vec{B}$$

$$\vec{v} = 0\hat{i} + 1\hat{j} + 3\hat{k} \quad , \vec{B} = 2\hat{i} + 0\hat{j} - \hat{k}$$

$$\vec{F_B} = q_0 \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 1 & 3 \\ 2 & 0 & -1 \end{vmatrix} = q_0 \left[(-1-0)\hat{i} - (0-6)\hat{j} + (0-2)\hat{k} \right]$$

$$= q_0 \left[-\hat{i} + 6\hat{j} - 2\hat{k} \right]$$

$$\bar{F} = q_0 [-\hat{i} + 6\hat{j} - 2\hat{k})$$

$$|F| = q_0 \sqrt{(-1)^2 + (6)^2 + (-2)^2} = q_0 \sqrt{41} = 1{,}6$$

$$(1{,}6 \times 10^{-19}) \times \sqrt{41} \ N$$

Right-hand Rule : Find the magnetic force direct (Particle deflection الانحراف)

velocity : $\vec{v}$ → الاصابع

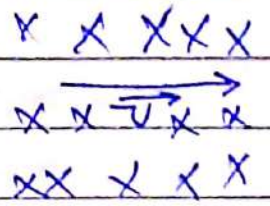
magnetic field : $\vec{B}$ → باطن اليد

$\vec{F}_B$: → الابهام

⊗ → away ; into page.

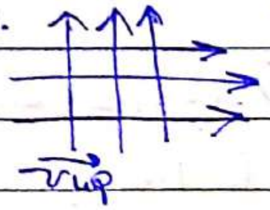
⊙ → out page.

+ve Particle (α, P)



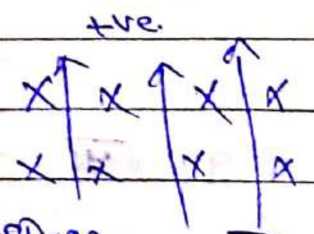
$\vec{F}_{up}$

electron.



$\vec{F}_{up}$

+ve.



$v = ?!$ ⟹ $\vec{v}$ left

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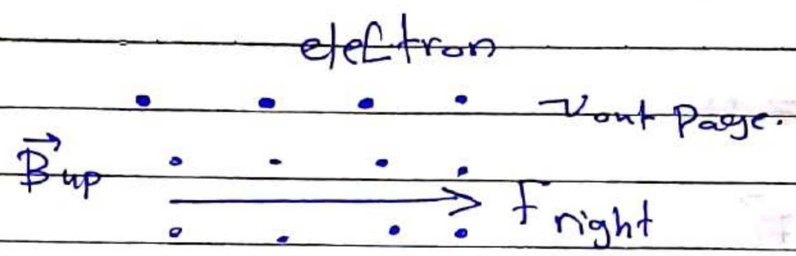
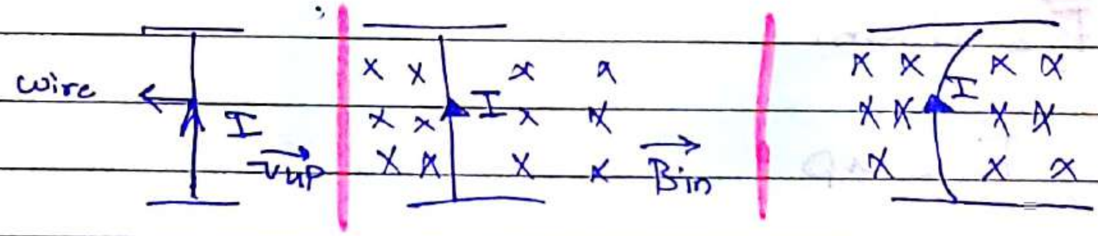
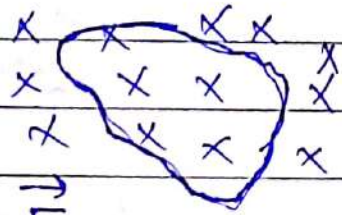


(2) magnetic force on a current carrying



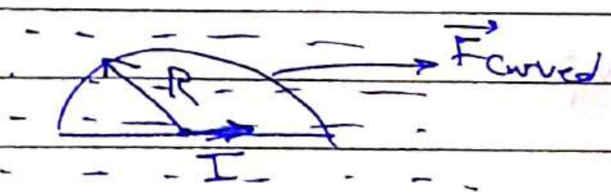
$\vec{F_L} = q(\vec{v} \times B)\ nAL \Rightarrow \vec{F_L} = I(\vec{L} \times \vec{B})$

$|\vec{F_L}| = ILB \sin\theta_{L,B}.$



$\vec{F}_{\text{closed loop}} = \text{zero}$

Ex.



$\vec{L} = L_1$

$L = 2R$

$F_{\text{closed loop}} = \text{Zero}$

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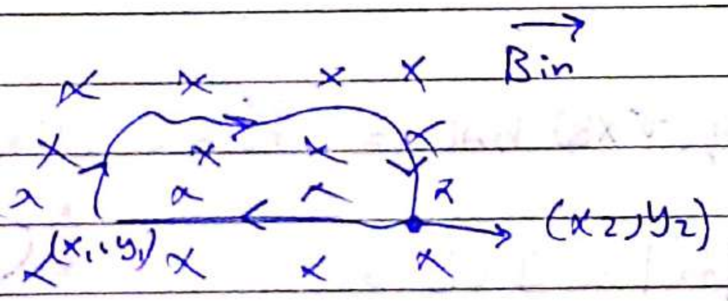
$\vec{F}_L + \vec{F}_c = 0$

$\vec{F}_c = -\vec{F}_L$

$|F_c| = |\vec{F}_L| = ILB = 2IRB$

$\vec{F}_L =$ down.

$\vec{F}_c =$ up

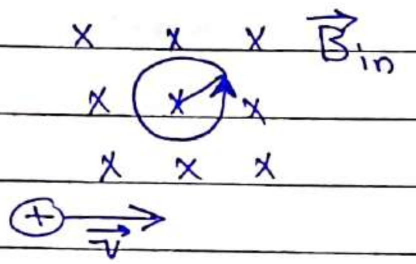


$L = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$F = ILB$
down

$\vec{F}_{wire} =$ up.

motion of a Charged particle in a uniform magnetic field. $[\vec{v} \perp \vec{B}]$



$$F_M = qvB = \frac{mv^2}{r}$$

$$r = \frac{mv}{qB}$$ r: radius of the Path.

Angular speed :

$$\omega = \frac{v}{r}$$

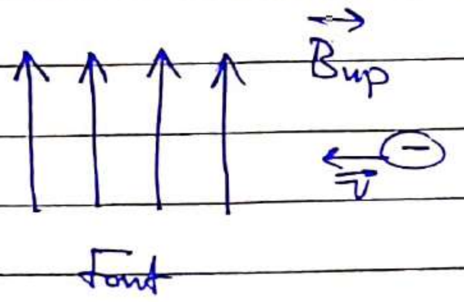
The period of motion: T / $v = \frac{d}{t}$

$$T = \frac{2\pi r}{v}$$

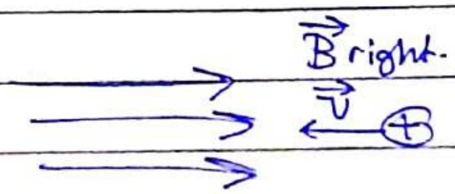
$$r = \frac{mv}{qB} \Rightarrow T = 2\pi \frac{m}{qB}$$

$\frac{2}{895}$ deflection انحراف

(b)

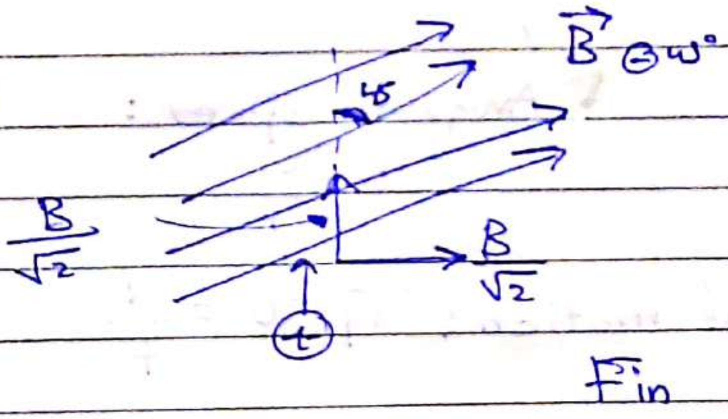


(c)

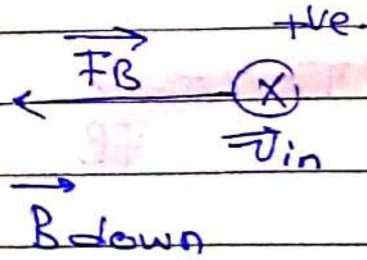


No defection.

(d)



$\frac{3}{895}$



(6) $m_p = 1.67 * 10^{-27}$ Kg

$+e = 1.6 * 10^{-19}$ C

$v = 4 * 10^{6}$ m/s , $B = 1.7$ T , $F = 8.2 * 10^{-13}$ N

$F = qvB \sin\theta$

$$\sin\theta = \frac{F}{qvB} = \frac{8.2 * 10^{-13}}{1.6 * 10^{-19} * 4 * 10^{6} * 1.7}$$

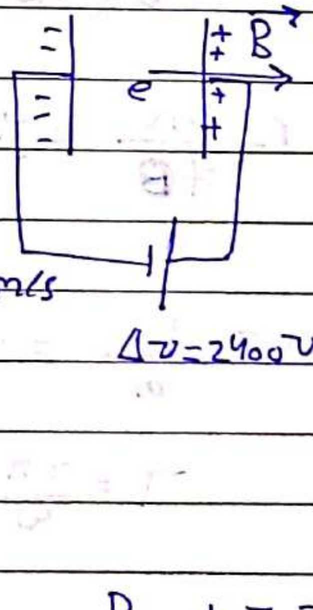
$\theta = 48.9°$

(7) $m_e = 9.11 * 10^{-31}$ Kg

$-e = -1.6 * 10^{-19}$ C

$\Delta K + \Delta U = 0$

$\frac{1}{2} m v_f^2 = -q \Delta V$



$$v_f = \sqrt{\frac{-2q\Delta V}{m_e}} = \sqrt{\frac{2 * 1.6 * 10^{-19} * 2400}{9.11 * 10^{-31}}} \text{ m/s}$$

$\Delta V = 2400$ V

$F_{min} = zero$; $\theta = 0 , \pi$

$F_{max} = qvB$; $\theta = \frac{\pi}{2} , \frac{3\pi}{2}$, $B = 1.7$ T

8) Proton.

$\vec{v} = 2\hat{i} - 4\hat{j} + \hat{k}$ m/s

$\vec{B} = \hat{i} + 2\hat{j} - \hat{k}$ (T)

$\vec{F} = q\vec{v} \times \vec{B}$

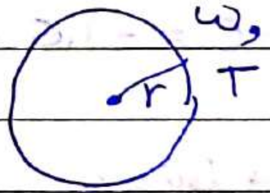
$$= q \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -4 & 1 \\ 1 & 2 & -1 \end{vmatrix} = q\left[(2)\hat{i} - (-3\hat{j} + 8\hat{k}\right]$$

$$F = q\sqrt{4+9+64} = 1.6 * 10^{-19}\sqrt{77}\ N.$$

(13)
895

$B = 2\,mT$

$v = 1.5 * 10^{7}$ m/s.



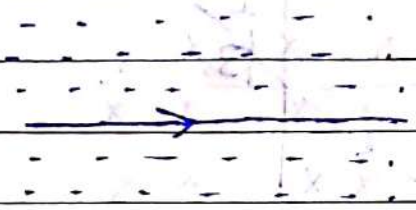
$$r = \frac{mv}{qB} = \frac{9.11*10^{-31} * 1.5*10^{7}}{1.6*10^{-19} * 2*10^{-3}} = 0{,}0427\,m$$

$= 42{,}7$ mm.

$$\omega = \frac{qB}{m} = \frac{1.6*10^{-19} * 2*10^{-3}}{9.11 * 10^{-31}} = 0{,}35 * 10^{9}\ s^{-1}\ (HZ)$$

$$T = \frac{2\pi}{\omega} = \frac{2\pi m}{qB} = 18*10^{-9}\ sec.$$

$\frac{32}{897}$



$I = 3A$

$B = 0{,}280\ T$

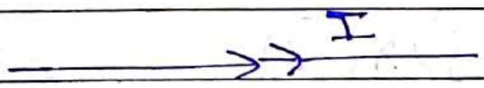
$L = 14\ cm.$

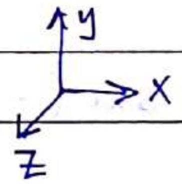
$$\vec{F} = I \vec{L} \times \vec{B}$$

$$F = ILB\sin\theta = 3 * 0.14 * 0.28$$

$\vec{F}$: down.

$\frac{35}{897}$ $I = 2.4A$; $L = 0{,}75$





$\vec{B} = 1{,}6\,\hat{k}\ (T)$

$I = 0{,}75\,\hat{i}$

$$\vec{F} = I \vec{L} \times \vec{B}$$

$$= 2.4\left[0{,}75\,\hat{i} \times 1{,}6\,\hat{k}\right] = 2.4 * 0.75 * 1.6\,(-\hat{j})$$

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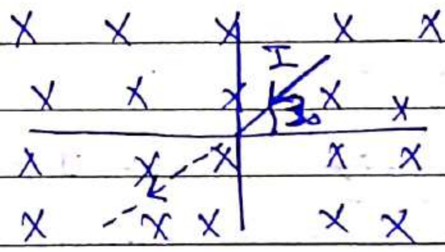


$\vec{B} = -2\hat{k}$ mT | $L = 2$ m

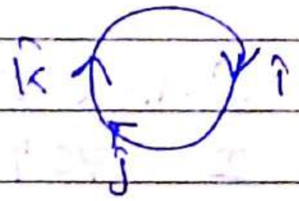
$I = 3A$ | $\vec{F} = ?!$

$$\vec{L} = L(-\cos(30)\,\hat{i} - \sin(30)\,\hat{j}]$$

$$= 2\left(-\frac{\sqrt{3}}{2}\hat{i} - \frac{1}{2}\hat{j}\right) = -\sqrt{3}\,\hat{i} - \hat{j}$$

$$\vec{F} = I\vec{L} \times \vec{B}$$

$$= 3*2(-\sqrt{3}\,\hat{i} - \hat{j}) \times (-\hat{k})$$



$$F = 6\sqrt{3+1} = 12N$$

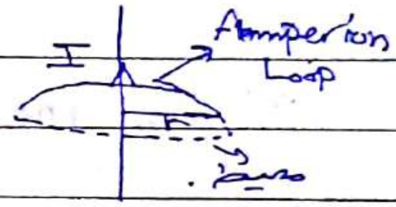
CH.30 Sources of magnetic field

(1) Amper's Law

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

مسار مغلق $\oint \vec{B}\cdot d\vec{s} = \mu_0 I_{in}$

$\mu_0 = 4\pi * 10^{-7} \frac{T.m}{A}$

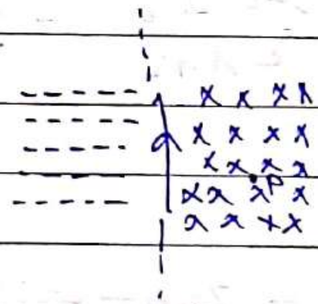


Free space Permeabi lity

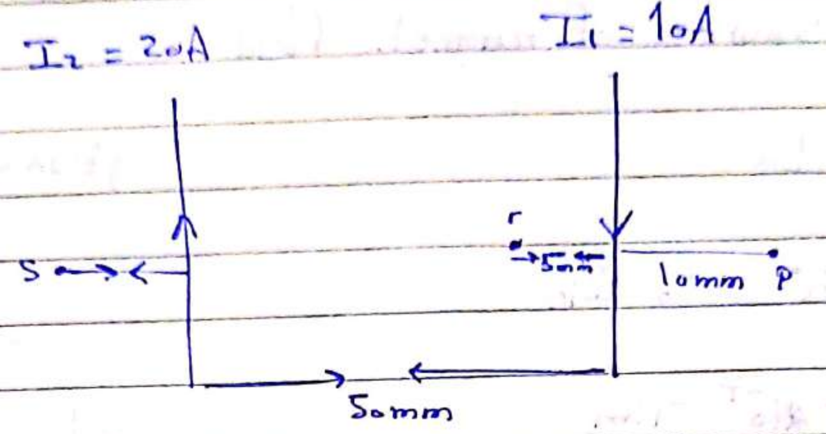
$\int B\,ds = \mu_0 I_{in}$

$B(2\pi r) = \mu_0 I$

$B = \frac{\mu_0 I}{2\pi r}$



Subject Date No



$$B = \frac{\mu_0 I}{2\pi r}$$

Find the magnetic field at the Point P

$$B_1 = \frac{\mu_0 I_1}{2\pi r_1} = \frac{4\pi * 10^{-7} * 10}{2\pi * (10 * 10^{-3})} = 2 * 10^{-4}\ T = 200\ \mu T \odot$$

$$B_2 = \frac{\mu_0 I_2}{2\pi r_2} = \frac{4\pi * 10^{-7} * 20}{2\pi * 60 * 10^{-3}} = \frac{2}{3} * 10^{-4}$$

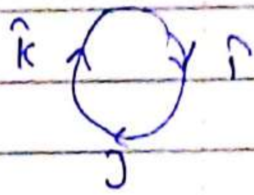
$$= \frac{200}{3}\ \mu T \otimes$$

$$B_p = 200 - \frac{200}{3} = \frac{400}{3}\ \mu T \odot$$

Proton

$\vec{V} = 5\times10^{6}\,(-\hat{i})$

$F = qvB \quad = 1.6\times10^{-19}\times5\times10^{6}\times\frac{400}{3}\times10^{-6}$



$\vec{F} = q\vec{v}\times\vec{B}$

$-\hat{i}\times\hat{j}$

$\vec{B_r} = ?$

$B_1 = \frac{\mu_0 I_1}{2\pi r_1} = \frac{4\pi\times10^{-7}\times10}{2\pi\times5\times10^{-3}} = 400\ \mu T\ (\times)$

$B_2 = \frac{\mu_0 I_2}{2\pi r_2} = \frac{4\pi\times10^{-7}\times20}{2\pi\times(45\times10^{-3})} = \frac{4000}{45}\ \mu T\ (\times)$

$B_R = B_1 + B_2$

$= 400 + \frac{4000}{45}\ \mu T\ (\times)$

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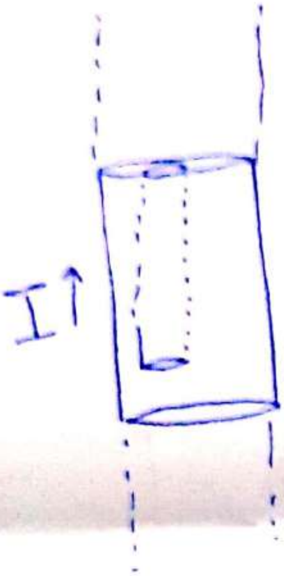
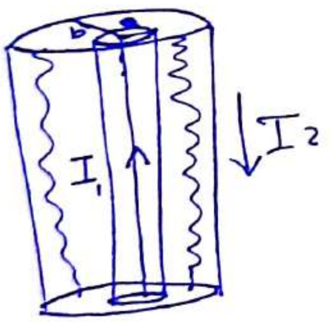


$$J = \frac{I}{\pi R^2} = \frac{I_{in}}{\pi r^2}$$

$$I_{in} = \frac{r^2}{R^2} I$$

$$\int B \, ds = \mu_0 I_{in}$$

Ex:



$I_1 = 5A$, $I_2 = 10\ A$

$a = 3mm$, $b = 6mm$.

* Find the magnetie field?

a) $r = 1,5\ mm$

$$B = \frac{\mu_0 I}{2\pi r} = \frac{4\pi \times 10^{-7} \times 5}{2\pi \times 1,5 \times 10^{-3}} \otimes T$$

b) $r = 10\ mm$

$$B = \frac{\mu_0}{2\pi r} (I_2 - I_1) = \frac{4\pi \times 10^{-7}}{2\pi \times 10 \times 10^{-3}} (10 - 5) = 1 \times 10^{-4} \otimes T$$

c) $r = 4\,mm$

$$J = \frac{I_2}{\pi(b^2 - a^2)} = \frac{I_{in}}{\pi(r^2 - a^2)}$$

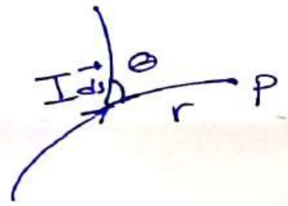
$$I_{in} = \frac{r^2 - a^2}{b^2 - a^2} I_2$$

$$B = \frac{\mu_o (I_{in} - I_1)}{2\pi r}$$

$$I_{in} = \frac{16 - 9}{36 - 9} \cdot 10 = \frac{70}{27} \ ; \quad I_1 = 5$$

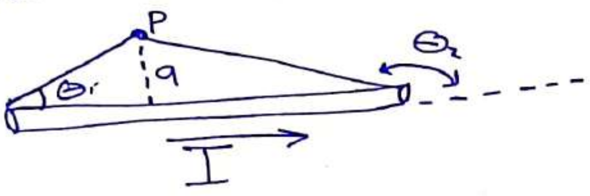
$$B\Big|_{r = 4m} = \frac{4\pi \times 10^{-7} \left(5 - \frac{70}{27}\right)}{2\pi \times \cdot \times 10^{-3}}$$

2) Biot - Savart Law



$$B = \frac{\mu_o}{4\pi} \int \frac{\vec{ds} \times \hat{r}}{r^2}$$

magnetic field of a finite wire?



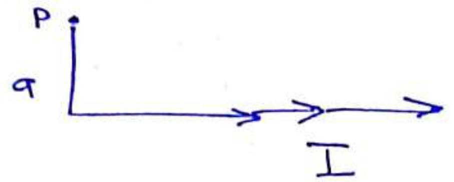
$$B = \frac{\mu_o I}{4\pi a} (\cos\theta_1 - \cos\theta_2)$$

$$\underset{\text{infint}}{B} = \frac{\mu_0 I}{2\pi a} \quad ✓$$

$$\underset{\text{infinit}}{B} = \frac{\mu_0 I}{4\pi a}\left(1 - (-1)\right)$$

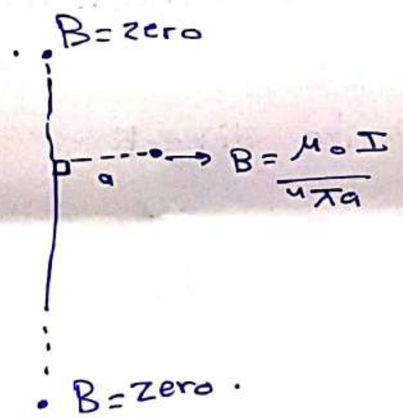
$$= \frac{\mu_0 I}{2\pi a}$$

semi-infinite wire.



$$B = \frac{\mu_0 I}{4\pi a}\left(0 - (-1)\right) = \frac{\mu_0 I}{4\pi a}$$

#



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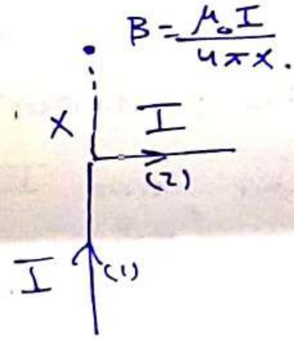
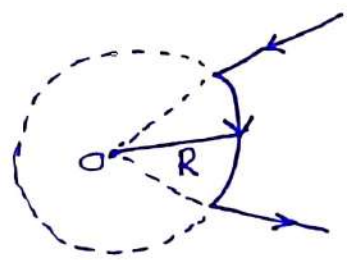


(3) Magnetic field due to Curved wire



$$B = \frac{\mu_0 I}{4\pi R}\theta$$

θ = radian. ; $\theta = 30 \longrightarrow \frac{\pi}{6}$
$= 90 \longrightarrow \frac{\pi}{2}$

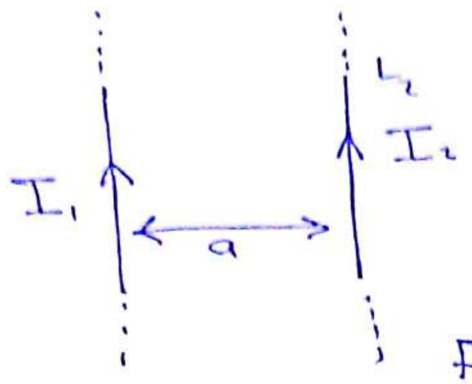
For full circle $\theta = 2\pi$

$$\underset{\text{circle}}{B} = \frac{\mu_0 I}{2R}$$

N: number of turns.

$$B = \frac{\mu_0 I N}{4\pi R}\theta \quad \text{ⓧ}$$

The magnetic force between two Parallel conductors.



$$F_{L_2} = I\vec{L_2} \times \vec{B_1}$$

$$B_1 = \frac{\mu_0 I_1}{2\pi a}$$

$$F_{L_2} = I_2 L_2 \frac{\mu_0 I_1}{2\pi a}$$

$$F_L = \frac{\mu_0 I_1 I_2 L}{2\pi a}$$

force Per unite length

$$\frac{F_L}{L} = \frac{\mu_0 I_1 I_2}{2\pi a}$$

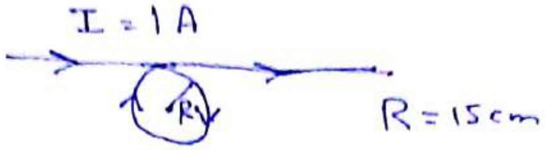
(1) if I_1 and I_2 in the same direction.

→ force : attractive.

(2) if I_1 and I_2 in opposite direction.

→ Force : repulsive.

$\frac{7}{926}$



$$B_{wire} = \frac{\mu_0 I}{2\pi R} \quad \otimes$$

$$B_{circle} = \frac{\mu_0 I}{\cancel{4\pi}_{2} R} \cancel{2\pi} \quad \otimes$$

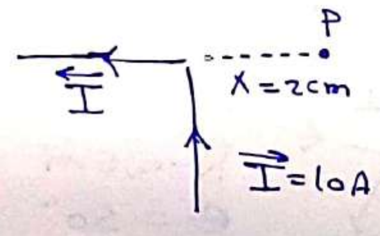
$$B_0 = B_{wire} + B_{circle}.$$

$$= \frac{\mu_0 I}{2R}\left(\frac{1}{\pi} + 1\right) = \frac{4\pi \times 10^{-7} \times 1}{2 \times 0{,}15} \left(\frac{1}{\pi} + 1\right) \quad \otimes$$

اذا المعطى
شحنة
وطلب سرعة

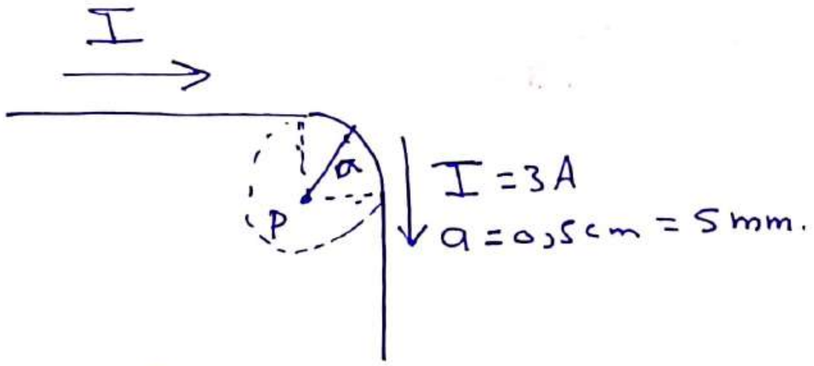
$$F = qvB$$

$\frac{10}{926}$



$$B_{\text{semi-infinit wire.}} = \frac{\mu_0 I}{4\pi x} = \frac{4\pi \times 10^{-7} \times 10}{4\pi \times 2 \times 10^{-2}} \; T$$

$\frac{11}{926}$

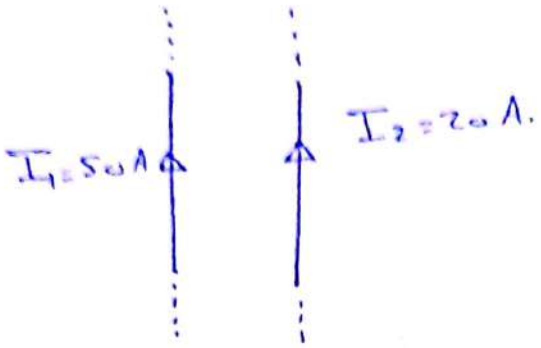


$$B_p = B_1 + B_{arc} + B_2$$

$$\frac{\mu_0 I}{4\pi a} + \frac{\mu_0 I}{4\pi a} \cdot \frac{\pi}{2} + \frac{\mu_0 I}{4\pi a}$$

$$\frac{\mu_0 I}{4\pi a}\left[2 + \frac{\pi}{2}\right]$$

Find the point between two wires at whi the magnetic field is zero?



$$B_1 - B_2 = 0$$

$$B_1 = B_2$$

$$\frac{\mu_0 I_1}{2\pi(10-\pi)} = \frac{\mu_0 I_2}{2\pi X}$$

$$\frac{50}{10-X} = \frac{20}{X}$$

$$5X = 20 - 2X$$

$$7X = 20$$

$$X = \frac{20}{7} \text{ cm.}$$

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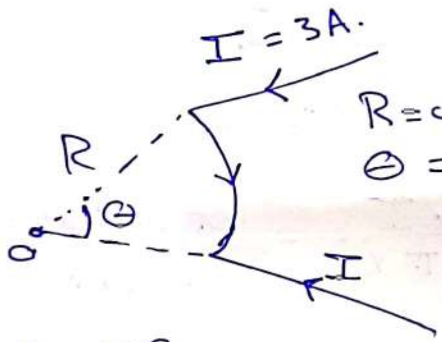

$R = 0.6\ m$

$\theta = 30°$

$$B_{arc} = \frac{\mu_0 I \theta}{4\pi R}$$