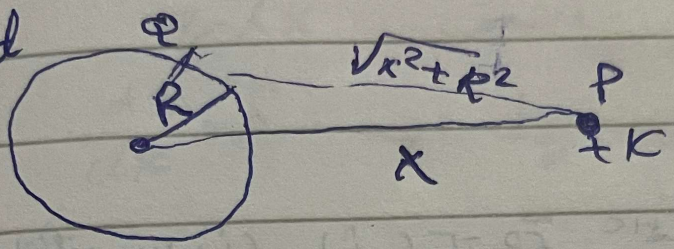
/ / التاريخ ——— اليوم ——— موضوع الدرس

# Ex 2: charged Ring




Increasecharged density

$\lambda = \frac{Q}{2\pi R}$

$E = \int ke \frac{dq}{r^2}$

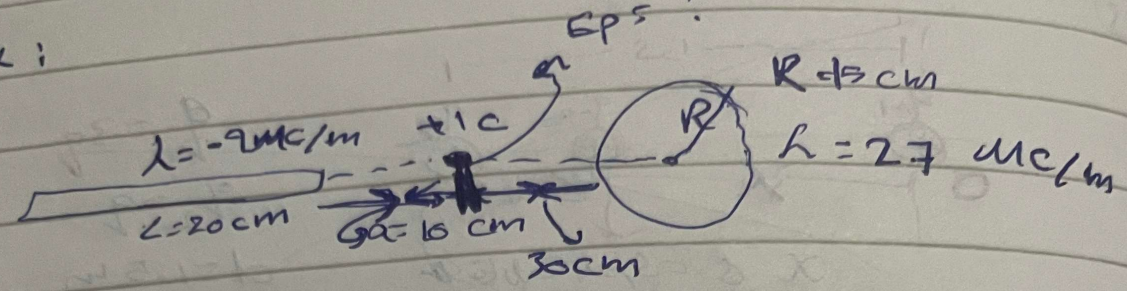
$\vec{E} = ke \int \frac{dq}{(x^2+R^2)} \hat{r}$

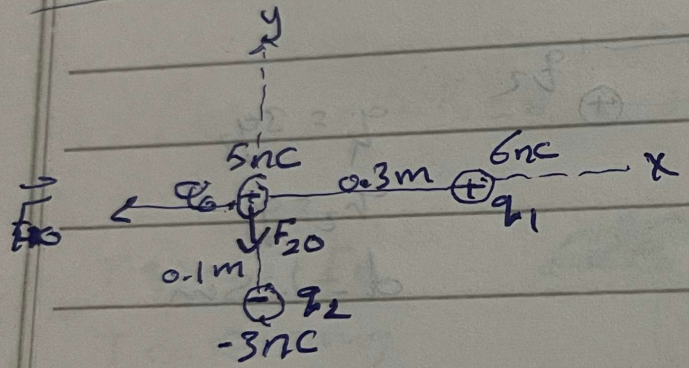
x is the distance on the axis of the ring force

$E_{Ring} = \frac{Re\ Q\ x}{(x^2+R^2)^{\frac{3}{2}}}$ ثبت

موضوع الدرس ____ اليوم ____ التاريخ / /

Ex :



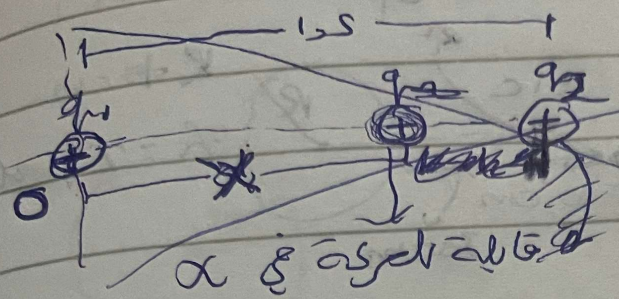

$$F_{1\to 0} = 9\times10^{9} \times \frac{6\times10^{-9} \times 5\times10^{-9}}{(0,3)^2} = 3(-\hat{i})\ \mu N$$

$$F_{2\to 0} = 9\times10^{9}\ \frac{3\times10^{-9} \times 5\times10^{-9}}{(0,1)^2} = 13.5(-\hat{j})\ \mu N$$

$$E_{net} = \sqrt{3^2 + 13,5^2}$$

$$\vec{E}_{net} = -3\hat{i} - 13.5\,\hat{j}$$

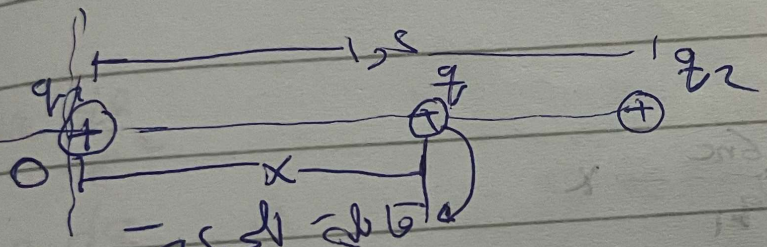
موضوع الدرس ____ اليوم ____ التاريخ




$q_1 = 3q$

$q_2 = q$

$d = 1,5\ m$




$q_1 = 3q$

$q_2 = q$

$d = 1,5\ m$

$|F_1| = |F_2|$

$$k_e \frac{q_1 q}{x^2} = k_e \frac{q_2 q}{(d-x)^2}$$

$$3(1,5-x)^2 = x^2$$

$$2x^2 - 9x + 6,75$$

$a = 2$

$b = -9$

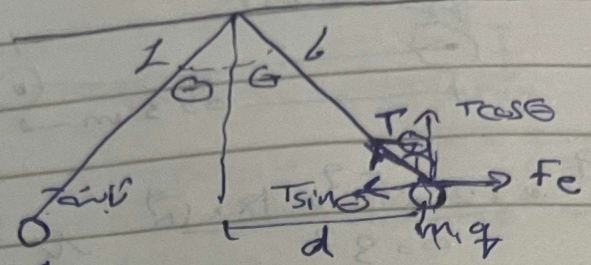
$c = 6,75$

$x_1 = 3,54\ m$ (مرفوض)

$x_2 = 0,95\ m$

موضوع الدرس ____ اليوم ____ التاريخ / /

also
suspended
$m = 0,2g$
$q = 7.2nc$
$\theta = 5°$ virtecal
how long the string?




$\rightarrow \Sigma \vec{F} = 0 \rightarrow \Sigma F_x = 0 \;,\; \Sigma F_y = 0$

$T\sin\theta = Fe$

$T\cos\theta = mg$

$\div$ اقسم على بعض

$\tan\theta = \frac{Fe}{mg}$

$Fe = mg\tan\theta$

$Fe = ke\frac{q_1 q_2}{r^2}$

$\theta, L, d$ عدد

$\sin\theta = \frac{d}{L}$

$d = L\sin\theta$

$r = 2d$

$= 2L\sin\theta$

$= \frac{keq^2}{4L\sin^2\theta} = mg\tan\theta$

1:1

$m = 0,2\,mg = 0,2 \times 10^{-6}\,kg$

$m = 0,2\,dg = 0,2 \times 10^{-9}\,kg$

$L = \sqrt{\frac{ke\,q^2}{4\,mg\tan\theta\sin^2\theta}}$

أتأكد انو الآلة الحاسبة degree

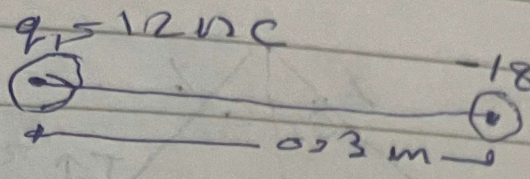
Sigma

التاريخ / /

اليوم

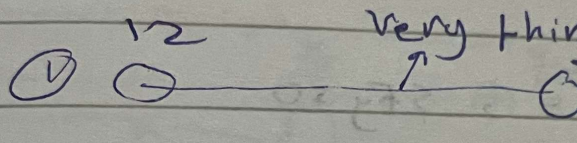
موضوع الدرس

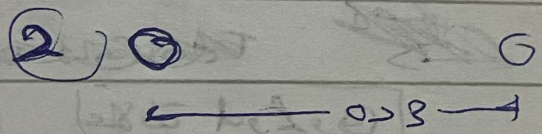
(a)




$$F = 9\times10^{9} \frac{12\times10^{-9} \times 18\times10^{-9}}{0.3^2} \text{ N (Attractive)}$$

(b)




what is the force between them?

$$q_i^T = q_f^{Total}$$

$$q_1 + q_2 = q_{1f} + q_{2f}$$

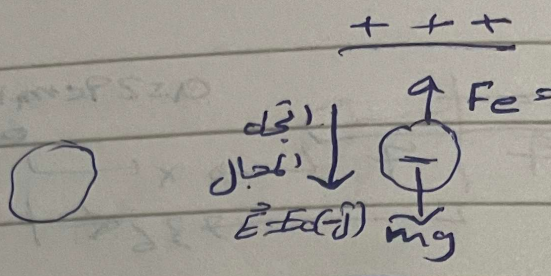
$$= 2q_f$$

$$q_f = \frac{q_1 + q_2}{2} = \frac{12 - 18}{2} = -3 \text{ nC}$$

$$F_e = \frac{9\times10^{9}(3\times10^{-9})(3\times10^{-9})}{0.3^2} \quad \text{(Repulsive)}$$

موضوع الدرس _____ اليوم _____ التاريخ / /

(24)



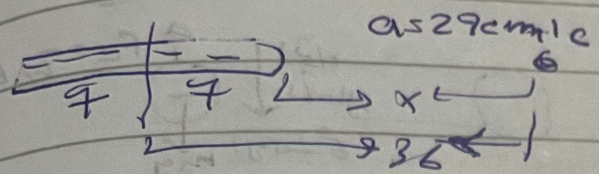

$m = 3.8g$

$q = -18\mu C$

معمور
مغمورة
suspending and motion less and Immersed
(متزنة)

$\Sigma F = 0$ $\quad q_0 E_0 = mg$

$$E_0 = \frac{mg}{q_0} = \frac{3.8(10)}{18+10^{-6}} = 2.11 KN/C \ , \ (-\hat{j})$$




$E_{rod} = \frac{KQ2L}{a(a+L)}$ ; $L = 7$

$L = 14\,cm$

$Q = -22\,\mu C$

$E_{rod} = \frac{9\times10^{9} \times 22\times10^{-6}}{0,29(0,29+0,14)}$ N/C , $(-\hat{i})$ Inwards)

(c) Find the force between the rod and charge $Q = -10\,\mu C$ located at point P

$F = QE$

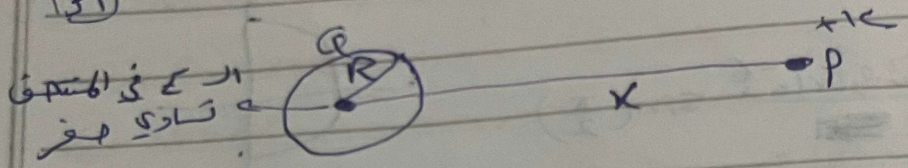
$= 10\times10^{-6}$ ← Repulsive

$\omega_0 = \infty$

$\int$

موضوع الدرس ____ اليوم ____ التاريخ / /

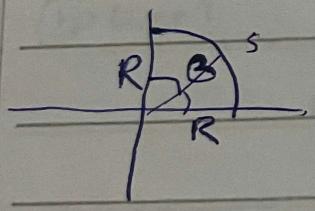
39




$E_{Ring} = \frac{k_e Q x}{(x^2+R^2)^{\frac{3}{2}}}$ $\quad R=16cm\ ,\ Q=75\mu C$

$E_{\substack{x=15cm}} = \frac{9\times10^9 \cdot 75\times10^{-6} \cdot 0.1}{[0.15^2+0.1^2]^{\frac{3}{2}}}$ outward

45 charged sector (Arc) قطاع دائري



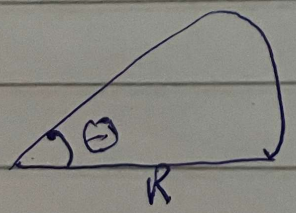

$S = R\theta^r$

$360 = 2\pi$ $\quad 30 = \frac{\pi}{6}$

$180 = \pi$ $\quad 45 = \frac{\pi}{4}$

$90 = \frac{\pi}{2}$

$\theta$ : suspended angle of the charged Arc




$\lambda = \frac{q}{R\theta}$

اذا + مقبول من المركز

اذا - مبتعد عن المركز

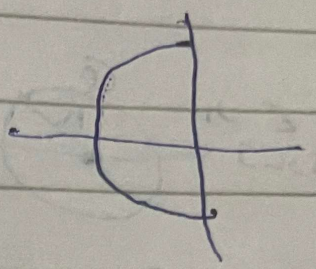
$E_o^{Arc} = \frac{2k_e\lambda}{R}\sin\left(\frac{\theta}{2}\right) = \frac{2k_e q}{R^2\theta^r}\sin\left(\frac{\theta}{2}\right)$

bent: حني / semi-circle: نصف دائرة

Sigma

التاريخ / / اليوم موضوع الدرس

$q = -7,5 \ \mu C$



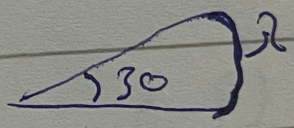
$L = 45 \ cm$

$$E_0^{Arc} = \frac{2 \times 9 \times 10^9 \times 7,5 \times 10^{-6}}{\left(\frac{0,45}{\pi}\right) 2\pi} \sin\left(\frac{\pi}{2}\right)$$

$$s = \ell = R\theta^{rad}$$

$$R = \frac{0,45}{\pi}$$

Ex 6




$\lambda = -27 \ nC/m$

$R = 10 cm$

$$E_0^{Arc} = \frac{2 \times 9 \times 10^9 \times 27 \times 10^{-9}}{0,1} \times \sin(15)$$

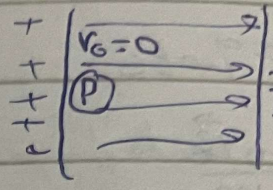
موضوع الدرس ____ اليوم ____ التاريخ / /

(51) proton $m_p = 1,67 \times 10^{-27}$ Kg , $+e = 1,6 \times 10^{-19}$ C

start from rest

$E_0 = 640$ N/C

$\vec{E} = E_0 \hat{i}$




تسارع عندما يكون الجال

(a) the acceleration

$F_e = ma = q_0 E_0$

$a = \frac{q_0 E_0}{m}$

$= \frac{1,6 \times 10^{-19} \times 640}{1,67 \times 10^{-27}} = 613 \times 10^8$ m/s$^2$

(b) time? $v_f = v_i + at$

$1,2 \times 10^6 = 0 + 613 \times 10^8 t \longrightarrow t = 1,95 \times 10^{-5}$ sec

$= 19,5$ μs

(c) $\Delta x$? $\Delta x = v_0 t + \frac{1}{2} a t^2$

$= 0 + \frac{1}{2}(613 \times 10^8)(19,5 \times 10^{-6})^2$

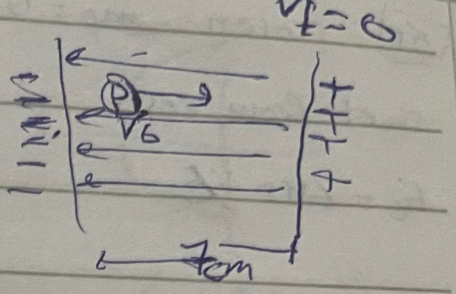
التاريخ / /

اليوم

موضوع الدرس

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$\vec{E} = -6\times10^{5}$ ; $\frac{N}{C}$ ← الاتجاه




$F_e = ma = q_0 E_0$

$\vec{a} = \frac{q_0 \vec{E_0}}{m}$

$\vec{a} = \frac{-1,6\times10^{-19} \times 6\times10^{5}}{1,67\times10^{-27}}$ ? $\quad \vec{a} = -5,75\times10^{13}$ $m/s^2$ ?

$a = 5,75\times10^{13}$ $m/s^2$

deccelartion

~~$V_f^2 = V_0^2 + 2a\Delta x$~~

$V_f^2 = V_0^2 + 2a\Delta x$

$0 = V_0^2 - 2\times5,75\times10^{13}\times7\times10^{-2}$

$V_0 = -\sqrt{\quad}$

(c) the time interval

$t = -\frac{V_0}{a}$

موضوع الدرس ____ اليوم ____ التاريخ / /

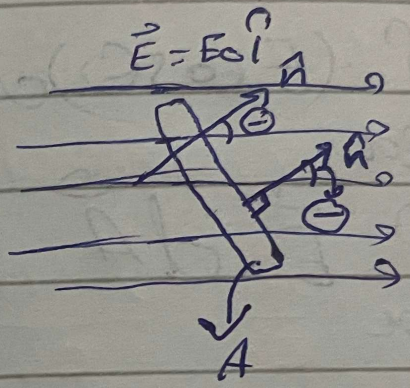
# CH 24 - Gauss's law -

## • The electric flux: التدفق الكهربائي

we define the electric flux; $\Phi_E$ as

$$\Phi_E = E_0 A \cos\theta_{\hat{A}E}$$

$$= \vec{E} \cdot \vec{A} \qquad \vec{A} = A\hat{n}$$




Flux: scaler quanitity

$\hat{A} = \hat{i} - \hat{i}$

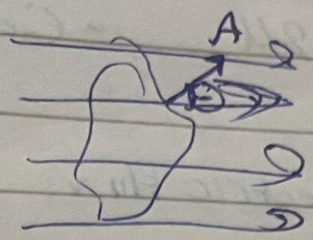
$\hat{n} = \hat{j} - \hat{j}$

$\hat{n} = \hat{k} - \hat{k}$

التاريخ / / اليوم موضوع الدرس

$\Phi_E = \vec{E} \cdot \vec{A}$

$\Phi_E = EA\cos\theta_{AE}$

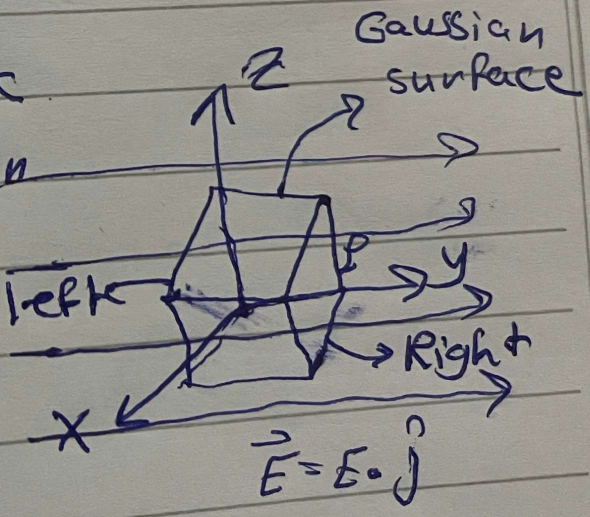



$\Phi_E = \int_{A_{area}} (E\cos\theta)\, dA$

$\Phi_E = \int_{A_{area}} \vec{E} \cdot d\vec{A}$

→ cubic shape immersed in a uniform $\vec{E}$-field.

What is the total electric flux through the Gaussian surface (cubic shape)




$\Phi_{right} = \vec{E} \cdot \vec{A}$

$= E_0 A\cos 0$

$= E_0 L^2$

$\Phi_{left} = \vec{E} \cdot \vec{A}$

$= E_0 A\cos(\pi)$

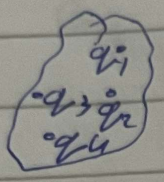
$= -\vec{E} A$

$\Phi_T = \text{zero}$

موضوع الدرس _____ اليوم _____ التاريخ / /

for a Non-charge Gaussian surface immersed totaly in an $\vec{E}$-field, then the total electrical flux is zero

$$\Phi_E = \frac{\sum q_{in}}{\epsilon_0} \rightarrow \vec{0}, \perp \rightarrow \text{لا}$$

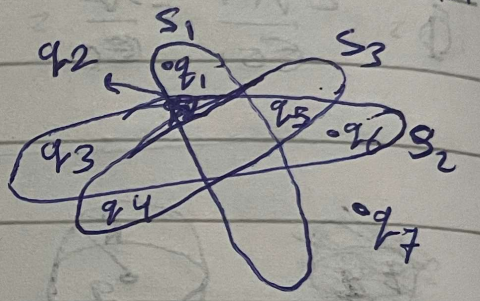



EX: Find the electric flux through each Gaussian surface

$q_1 = 5nc$, $q_2 = -10nc$, $q_3 = 15nc$

$q_4 = -7nc$, $q_5 = -12nc$, $q_6 = 10nc$

$q_7 = 8nc$



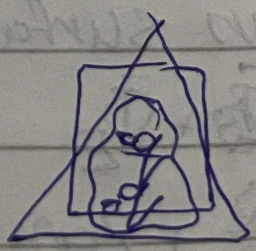

$$\Phi = \frac{\sum q_{in}}{\epsilon_0}$$

$$\Phi_3 = \frac{q_4 + q_5}{\epsilon_0} = \frac{-7-12}{8,85} \frac{KN \cdot m^2}{C}$$

$$\Phi_1 = \frac{q_1 + q_2}{\epsilon_0} = \frac{5-10}{8,85 \times 10^{-12}} \times 10^{-9} = \frac{-5}{8,85} \times 10^2 \frac{N \cdot m^2}{C}$$

$$\Phi_2 = \frac{q_2 + q_3 + q_5 + q}{\epsilon_0} = \frac{-10+15-12+10}{8,85 \times 10^{-12}} \times 10^{-9} = \frac{3}{8,85} \frac{KN \cdot m^2}{C}$$

* The electric flux does not depend on Geometry

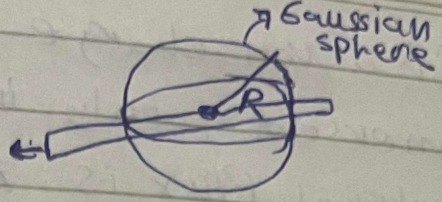


التاريخ اليوم موضوع الدرس

Ex, R = 10cm

$\lambda = -27 \frac{nc}{m}$

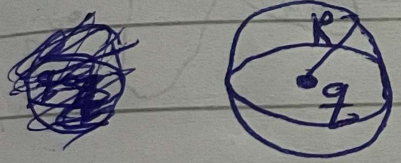
linear charge density



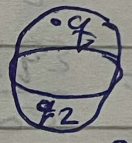

$\lambda = \frac{q}{L}$ , $q = \lambda L$

find the flux throughout the sphere

$\Phi = \frac{\Sigma q_{in}}{\epsilon_0} = \frac{\lambda L}{\epsilon_0} = \frac{\lambda (2R)}{\epsilon_0}$




$\Phi = \frac{q}{\epsilon_0}$



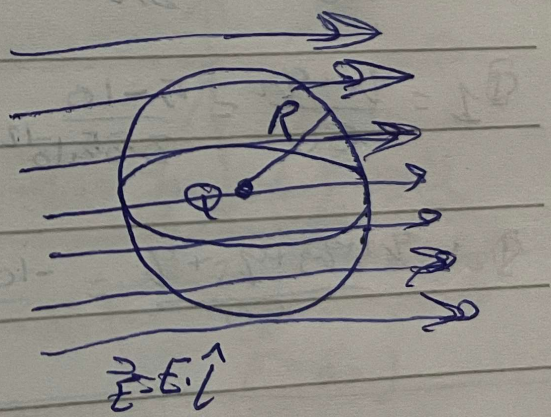

$\Phi = \frac{q_1 + q_2}{\epsilon_0}$

Ex 0

$\Phi = 15 \frac{Nc}{}$

$E_0 = 500$ N/C

R = 20 cm



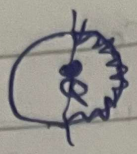

① what is the total flux through the Gaussian surface?

$\Phi = \Phi_{\text{inside}} + \Phi_E$

$= \frac{Q}{\epsilon_0} + \text{zero}$

Sigma

(b) What is the electric flux through the Right hemisphere?
نصف كرة



$\Phi_T = \frac{Q}{\epsilon_0}$

$\Phi_{Q_{Right}} = \frac{Q}{2\epsilon_0}$

left طالب لو طلب

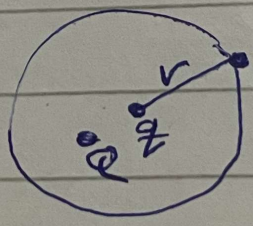
$\Phi_{E_{Right}} = EA\cos\theta = E_0\left(\frac{4\pi R^2}{2}\right)(+1)$

$\Phi_T = \Phi_Q + \Phi_E = \frac{15\times10^{-6}}{2\times8{,}85\times10^{-12}} + \frac{500(4\pi)(0{,}2)^2}{2}$

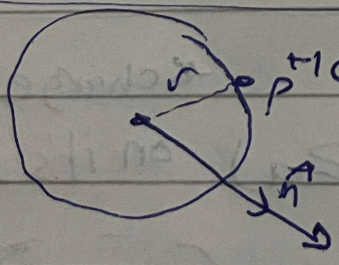
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Ex: How to obtaine the electric field using Gauss's law?

(1) the $\vec{E}$-field of point charge




$\Phi = \frac{q + (-Q)}{\epsilon_0}$

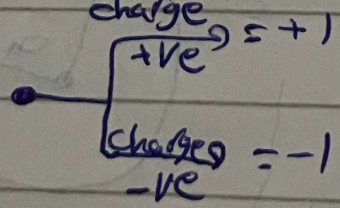



$\Phi = \oint \vec{E}\,dA = \frac{q_{in}}{\epsilon_0} = \frac{q}{\epsilon_0}$

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

$E = \frac{q}{4\pi\epsilon_0 r^2}$

$= \frac{kq}{r^2}$



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spherical symmetry

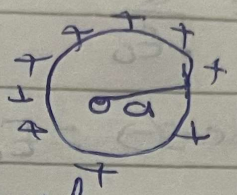
① The conducting sphere

Emeralic, copper, Almcuium ---}

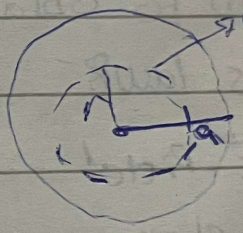
a: Radius

Q: charge

Find the electric field.




ⓐ Inside the sphere (r<a)




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

$E(4\pi r^2) = 0$

$E_{in} = 0 \rightarrow r < a$

ⓑ outside the sphere ($r \geq a$) on it's surface

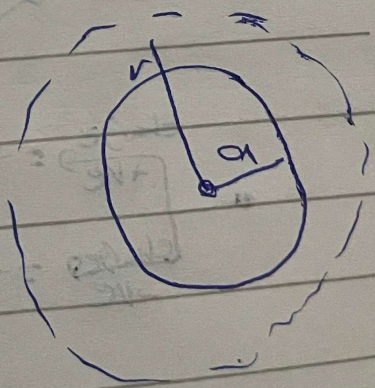
charge distribut

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

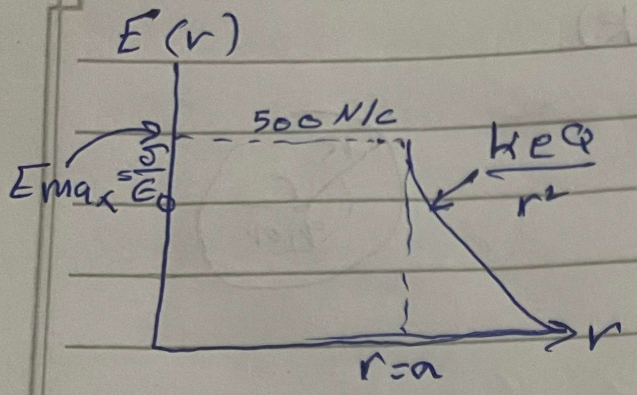
$E = \frac{k_e Q}{r^2} \rightarrow r \geq a$

$\sigma = \frac{Q}{4\pi a^2}$ surface charge density

$E = \frac{1}{4\pi\epsilon_0} \cdot \frac{\sigma 4\pi a^2}{r^2} = \frac{\sigma a^2}{\epsilon_0 r^2}$




ARAFAVK

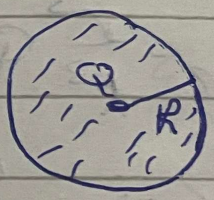



$\frac{\sigma}{\epsilon_0} = 500$

$\sigma = 500\epsilon = \frac{Q}{4\pi(0,1)^2}$

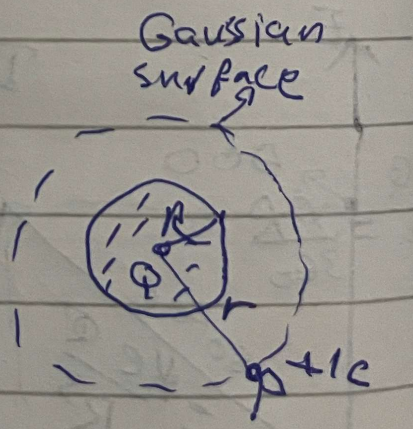
(2) Non-conducting sphere (insulating, insulator)

→ sphere of radius R and carrying a charge Q distributed through out it's volume




$$\rho = \frac{Q}{\frac{4}{3}\pi R^3}$$

(a) outside the sphere (r > R)




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

$E_{out} = \frac{kQ}{r^2}, \quad r \geq R$

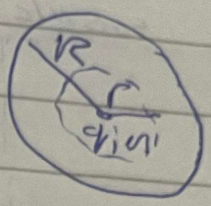
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(b) Inside ($r < R$)

$E_{out} = \frac{q_{in}}{\epsilon_0}$

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




$\rho = \frac{Q}{\frac{4}{3}\pi R^3} = \frac{q_{in}}{\frac{4}{3}\pi r^3}$

$\Rightarrow q_{in} = \frac{4\pi}{3} \rho r^3$

$\therefore q_{in} = \frac{r^3}{R^3} Q$

$E(4\pi r^2) = \frac{4\pi \rho r^3}{3\epsilon_0}$

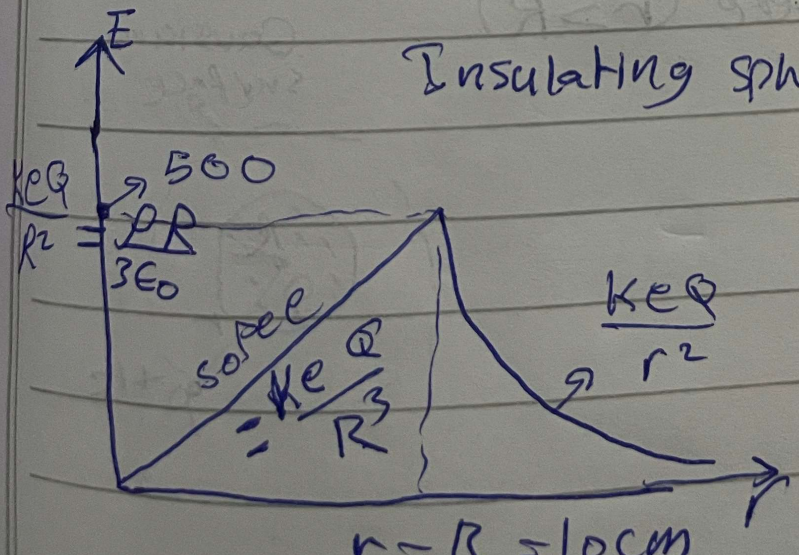
$E_{in} = \frac{\rho}{3\epsilon_0} r$

$E(4\pi r^2) = \frac{r^3}{R^3} \frac{Q}{\epsilon_0}$

$E = \frac{k_e Q}{R^3} r$

$y = x$

Insulating sphere




$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{500}{0,1} = \frac{k_e Q}{R^3} = \frac{\rho}{3\epsilon_0}$

③ sheet, plane, disk, wall
(large, infinite)

conducting (copper)

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

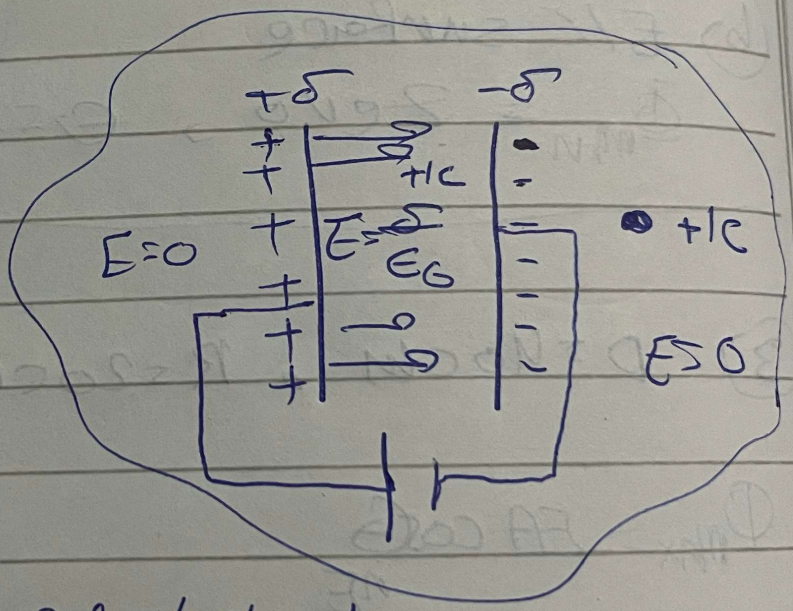
non-conducting (plus)

$E = \frac{\sigma}{2\epsilon_0}$

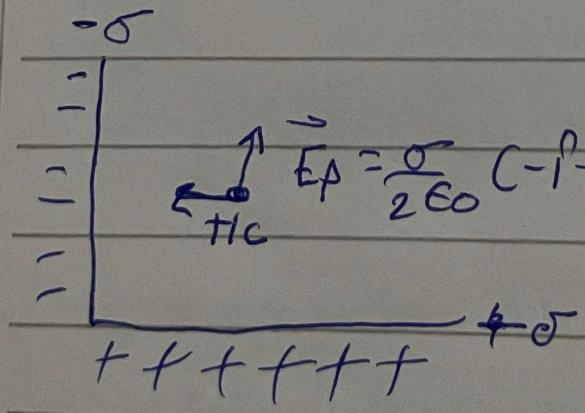
Ex: Find the electric field of the following non conducting sheets

$\Phi = 0$

$\Phi = EA$




non-conducting Infinit sheet




$\vec{E_A} = \frac{\sigma}{2\epsilon_0}(-\hat{i}+\hat{j})$

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2/740) $A = 3,20\ m^2$

$E = 6,20 \times 10^5\ N/C$

a) $\vec{E} \perp$ surface

$\Phi = EA\cos\theta_{A,E}$

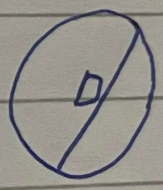
$\Phi_{max} = EA = 6,2 \times 10^5 * 3,2\ \frac{N.m^2}{C}$

b) $\vec{E} //$ surface

$\Phi_{min} =$ zero , $\theta = \frac{\pi}{2}$

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3) $D = 40\ cm$ , $R = 20\ cm$



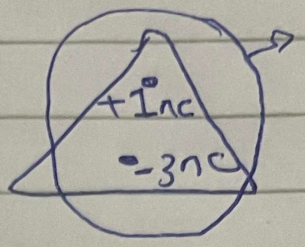
$\Phi_{max} = EA\cos\theta_{nE}$

$5,2 \times 10^5 = E(\pi R^2)$

$E = \frac{5,2 \times 10^5}{\pi (0,2)^2}\ N/C$

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(8)



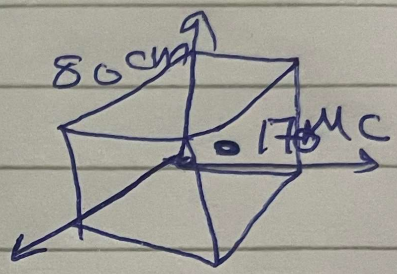

$$\Phi = \frac{q_{in}}{\varepsilon_0} = \frac{(1-3)\times 10^{-9}}{8{,}85\times 10^{-12}} \quad \frac{N\cdot m^2}{C}$$

(12) $$\Phi_T = \frac{170\times 10^{-6}}{8{,}85\times 10^{-12}}$$

$$= 19{,}2\times 10^{6} \quad \frac{N\cdot m^2}{C}$$

$$= 19{,}2 \ M \ \frac{N\cdot m^2}{C}$$

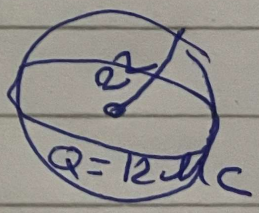
$$\Phi = \frac{\Phi_T}{6} = \frac{19{,}2}{6} \ M \ \frac{N\cdot m^2}{C}$$




edge : حرف

(14) (a) Spherical shell : قشرة كروية

$$\Phi_T = \frac{12\times 10^{-6}}{8{,}85\times 10^{-12}} \quad \frac{N\cdot m^2}{C}$$




(b) $$\Phi_{\text{hemi-sphere}} = \frac{\Phi_T}{2}$$

نصف كرة hemi-sphere