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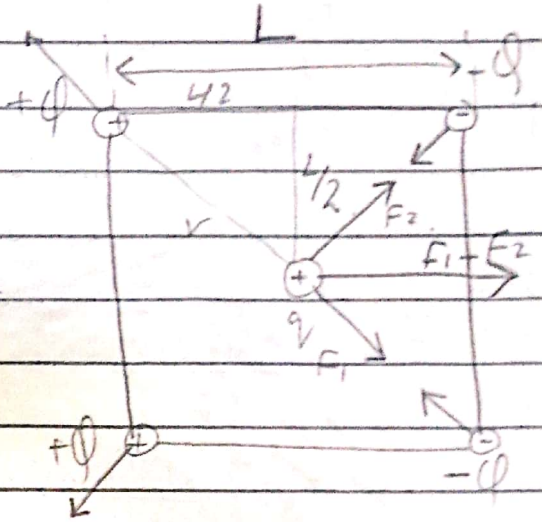
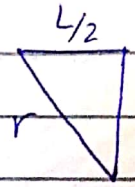
BSSE23058
Section A

Assignment #3
Applied Physics.

Q1



The distance between the points $\pm Q$ and $+q$.



$$r^2 = \left(\frac{L}{2}\right)^2 + \left(\frac{L}{2}\right)^2$$

$$r = \sqrt{\frac{L^2}{4} + \frac{L^2}{4}}$$

$$r = \sqrt{\frac{2L^2}{4}}$$

$$r = \frac{L}{\sqrt{2}}$$

$$F_2 = \frac{k(+Q)(+q)}{\left(\frac{L}{\sqrt{2}}\right)^2}$$

$$= \frac{kQq}{\frac{L}{2}}$$

$$= \frac{2kQq}{L}$$

$-F_2 = +F_1$

$$F_1 = -\frac{2kQq}{L}$$

$$F_{net} = F_1 + F_2$$

$$= -\frac{2kQq}{L} + \frac{2kQq}{L}$$

$$= 0$$

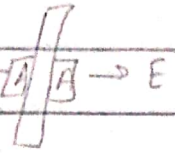
Q2

Electric field. $E = \frac{\sigma}{\varepsilon_0}$?

The charge enclosed by the cylinder is $\sigma A \Rightarrow Q = \sigma A \mid \sigma = \frac{q}{A}$
but in this case the charges are distributed.

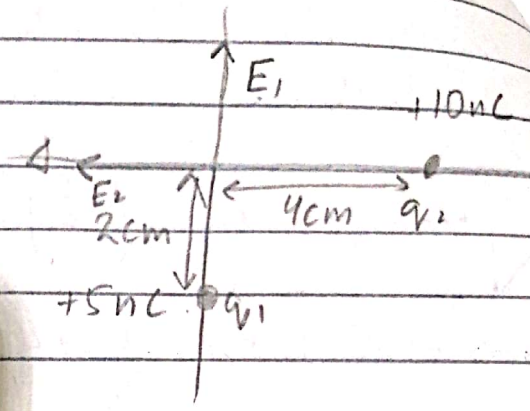
so $\sigma = \frac{Q}{2A}$

$$E = \frac{\sigma}{\varepsilon_0}$$



$$E = \frac{Q}{2A\varepsilon_0}$$

Q3



$$E_1 = \frac{kq_1}{r_1^2}$$

$$= \frac{8.99\times10^9 \times +5\times10^{-9}}{\left(\frac{2}{100}\right)^2}$$

$$= 1.12\times10^5$$

$$E_2 = \frac{kq_2}{r_2^2}$$

$$= \frac{8.99\times10^9 \times +10\times10^{-9}}{\left(\frac{4}{100}\right)^2}$$

$$= 5.62\times10^4$$

$$|E| = \sqrt{(E_1)^2 + (E_2)^2}$$

$$= \sqrt{(1.12\times10^5)^2 + (5.62\times10^4)^2}$$

$$= 1.25\times10^5$$

$$\tan\theta = \frac{E_2}{E_1}$$

$$\theta = \tan^{-1}\left(\frac{5.62\times10^4}{1.12\times10^5}\right)$$

$$\theta = 26.6$$

Q4

a. $r < a$

If r is less than a than E=0 because no charge enclosed in this region.

b. $a < r < b$

If r is between a & b than $E = \frac{kQ_1}{r^2}$

c. $b < r < c$

If r is between b & c shell has a ...

d. $r >$ ...

c. $b < r < c$

If r is between b & c then $E = \frac{kQ}{r^2}$ because outer shell has a negative charge.

d. $r > c$

$E = 0$

Q5

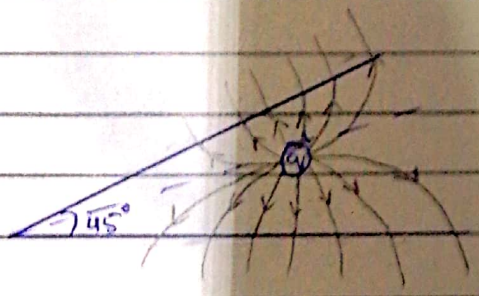
$Q = 8 \times 10^{9} C$.

$\phi = \frac{Q}{\varepsilon_0}$

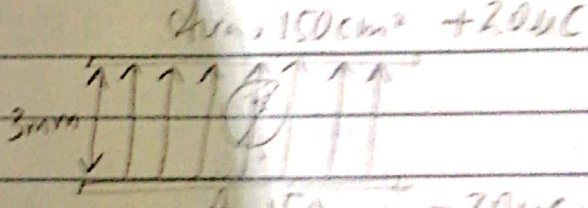
$= \frac{8 \times 10^{9}}{8.85 \times 10^{-12}}$

$= 9.0 \times 10^{20} \ Nm^2/C.$

Q6



Q7



$\sigma = \frac{q}{A}$

$= \frac{20 \times 10^{-6}}{\frac{150}{(100)^2}}$

$= 1.33 \times 10^{-3}$

Area of circle $= \pi r^2$

$= \frac{22}{7} \times \left(\frac{3}{100}\right)^2$

$= 2.83 \times 10^{-3}$

$E = \frac{\sigma}{\varepsilon_0} = \frac{1.33 \times 10^{-3}}{8.85 \times 10^{-12}}$

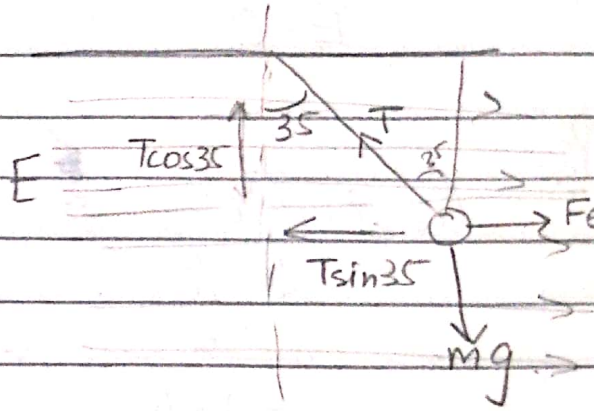
$= 1.5 \times 10^{8} \ N/C$

$\Phi = EA\cos\theta$

$= 1.5\times10^{8} \times 2.83\times10^{-3} \times \cos(5)$.

$= 4.2\times10^{5}\ Nm^2/C$

Q8



y component

$T\cos 35 = mg$

$T = \frac{3.0105\times9.81}{\cos 35}$

$T = 36.1\ N$

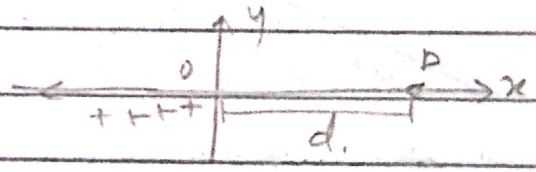
$T\sin 35 = F_e$

$36.1\sin 35 = qE$

$\frac{36.1\sin 35}{4.0107} = E$

$5.16\ N/C = E$

Q9



a. $E = \frac{kq}{r^2}$ linear charges $dq = \lambda dL$

$= -k$

$dE = \frac{k\,dQ}{r^2}$

$dE = \frac{k\lambda dx}{d^2}$

$E = \frac{1}{2\pi\varepsilon_0}\frac{\lambda}{d}$.

b. $F = qE$

$= q \times \frac{1}{2\pi\varepsilon_0} \frac{\lambda}{d}$

$= \frac{q\lambda}{2\pi\varepsilon_0 d}$

c. $F = \frac{kq_1q_2}{r^2}$

$= \frac{kq_1q_2}{d^2}$

Q10

$\phi = \frac{q}{\varepsilon_0}$

	Charges in each cross-sectional surface.			
S_1	$-2q$	$+q$	$-2q$	$+3q$
S_2	$-2q$			
S_3	$+q$			
S_4	$-2q$	$-2q$		
S_5	$-2q$			
S_6	$+3q$			

S_1 $\phi = \frac{-2q+q-2q+3q}{\varepsilon_0}$

$\phi = 0$

S_2 $\phi = \frac{-2q}{\varepsilon_0}$

S_3 $\phi = \frac{+q}{\varepsilon_0}$

S_4 $\phi = \frac{-2q-2q}{\varepsilon_0}$

$= \frac{-4q}{\varepsilon_0}$

S_5 $\phi = \frac{-2q}{\varepsilon_0}$

S_6 $\phi = \frac{+3q}{\varepsilon_0}$