ASSIGNMENT 2

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Course Name : Physics

Course Code : PHY 2105

Sec : B

Ans: to the ques: no: 1

(a) Given that.

$r = 4.0 \times 10^{-15} m$

We know
Charge of proton $= 1.6 \times 10^{-19} C$

∴ Magnitude of the repulsive electrostatic of the gravitational force between those same proton is

$$F = \frac{K q_1 q_2}{r^2} = \frac{9 \times 10^9 \times (1.6 \times 10^{-19}) \times (1.6 \times 10^{-19})}{(4 \times 10^{-15})^2}$$

$F = 14.4 N$

Ans.

(b) Gravitional force between two proton.

$G = 6.67 \times 10^{-11} Nm^2/kg^2$

mass of proton $m = 1.67 \times 10^{-27} kg$

$$F_G = G \frac{m_1 m_2}{r^2} = \frac{6.67 \times 10^{-11} \times (1.67 \times 10^{-27}) \times (1.67 \times 10^{-27})}{(4 \times 10^{-15})^2}$$

$F_G = 1.62 \times 10^{-35} N$

∴ Gravitional force $F_G = 1.62 \times 10^{-35} N$

Ans: to the qus: no: 2

a) The magnitude of the charge transferred during touching is given below,

For 1 : $\frac{+6e+4e}{2}$
$= +e$
$\therefore +6e-(+e) = 5e$

For 2 : $\frac{-12e+(+14e)}{2}$
$= +e$
$+14-(+e) = +13e$

For 3 : $\frac{0+(+2e)}{2e}$
$= +e$
$\therefore +2e-(+e) = +e$

$\therefore$ rank $3 > 1 > 2$ Ans:

b) Charge left on the positive charge sphere.

For 1 $\frac{+6e-4e}{2}$
$\Rightarrow +e$

For 2 $\frac{-12+14e}{2}$
$= +e$

For 3 $\frac{0+(+2e)}{2}$
$= +e$

$\therefore$ We can see that same positive charge $(+e)$ left on all sphere.

Ans: to the qus no: 3

Give We know that,

$$F = \frac{Kq_1q_2}{r^2}$$

$$r = \sqrt{\frac{Kq_1q_2}{F}}$$

$$r = \sqrt{\frac{9\times10^9 \times (26\times10^{-6})\times(47\times10^{-6})}{5.70}}$$

$r = 1.389$ m

Ans:

Here
$q_1 = 26.0\ \mu C = 26\times10^{-6} C$
$q_2 = 47\ \mu C = 47\times10^{-6} C$
$F = 5.70$ N
$r = ?$

Ans: to the qua: no: 4

Given that,

$r = 3.2\times10^{-3} m$

$a_1 = 7.0 m/s^2$ $a_2 = 9.0 m/s^2$

$m_1 = 6.3\times10^{-7} Kg$

(a) $m_2 = ?$

We know that,

$$F = ma$$

$$\therefore F_1 = F_2$$

$$\Rightarrow m_1 a_1 = m_2 a_2$$

$$\Rightarrow m_2 = \frac{6.3\times10^{-7} Kg \times 7.0 m/s^2}{9.0 m/s^2}$$

$$\Rightarrow m_2 = 4.9\times10^{-7} Kg$$

Ans.

(b) Magnitude of the charge particle is $q_1 = q_2 = q$

We know that

$$F = \frac{K q_1 q_2}{r^2} = \frac{K q^2}{r^2}$$

$$\Rightarrow q = \sqrt{\frac{F r^2}{K}}$$

For the first particle

$$q_1 = \sqrt{\frac{F r^2}{K}} = \sqrt{\frac{m_1 a_1 r^2}{K}}$$

$$= \sqrt{\frac{6.3\times10^{-7}\times7\times(3.2\times10^{-3})^2}{9\times10^9}}$$

$$= 7.08\times10^{-11} C$$

Ans:

For the second particle

$$q_1 = \sqrt{\frac{F_2 r^2}{K}} = \sqrt{\frac{m_2 a_2 r^2}{K}}$$

$$= \sqrt{\frac{4.9\times10^{-7}\times9\times(3.2\times10^{-3})^2}{9\times10^9}}$$

$$= 7.08\times10^{-11} Kg$$

Ans:

Ans to the qus: no:- 5

Given that,

$I = 2.5 \times 10^{4}$ A

$t = 20 \mu s = 20 \times 10^{-6}$ s

We know that

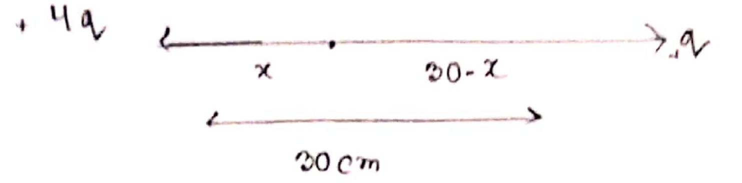
Charge, $q = It$

$= 2.5 \times 10^{4} A \times 20 \times 10^{-6} s$

$= 0.5$ C

Ans:

Ans: to the qus: no: 6



Given that, Two point charge +4q and +q are placed 30cm / 30×10^{-2} Apart.

Let this point b at a distance x from 4q. then its distance from q = 30 − x.

$$E_1 = E_2$$

$$\Rightarrow \frac{1}{4\pi\varepsilon_0}\frac{4q}{x^2} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(30-x)^2}$$

$$\Rightarrow \frac{4}{x^2} = \frac{1}{(30-x)^2}$$

$$\Rightarrow 2(30-x) = x$$

$$\Rightarrow x = 20\,cm$$

$$\Rightarrow x = 20\times10^{-2}\,m$$

∴ at 20×10^{-2} m electric field will be zero

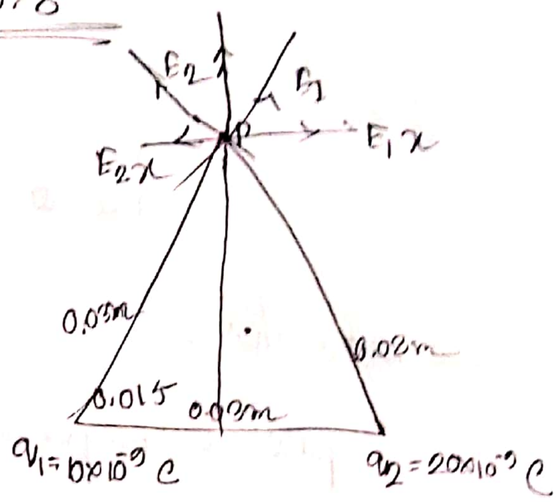
Ans: to the qus. no: 7

Since the dipole is placed in a uniform electric field. So it experiences zero external force. Also dipole is placed to parallel to electric field. Angle Between p and E is $\theta = 0^\circ$

$$\tau = PE\sin\theta = PE\sin(0^\circ) = 0$$

∴ Torque is 0

Ans: to the ques: no: 8



Given that,

$q_1 = 10\times10^{-9}$ C

$q_2 = 20\times10^{-9}$ C

$r = 0.03$ m

We know that,

$x = \sqrt{(0.03)^2 - (0.015)^2}$

$x = 0.026$

$\sin\theta = \frac{0.026}{0.03}$

$\theta = 60^\circ$

$E_1 = \frac{9\times10^9 \times 10\times10^{-9}}{(0.03)^2} = 100000$

$E_1x = E_1\cos\theta$
$= 100000 \cos 60^\circ$
$= 5\times10^4$

$E_1y = E_1\sin\theta$
$= 100000 \times \sin 60^\circ$
$= 86602.54038$

Now,

$E_2 = \frac{9\times10^9 \times 20\times10^{-9}}{(0.03)^2}$
$= 2\times10^5$

$E_2x = \cancel{E_2\cos\theta}$
$= 2\times10^5 \times \cos(60^\circ)$
$= 1\times10^5$

$E_2y = E_2\sin\theta$
$= 2\times10^5 \sin 60^\circ$
$= 173205.0808$

$E_{xnet} = E_{2x} - E_{1x} = 50000$ N/C

$E_{ynet} = E_{2y} + E_{1y} = 103907.6212$ N/C

$E_{net} = \sqrt{(E_{xnet})^2 + (E_{ynet})^2} = 115311.7242$ N/C

Ans: third corner $E = 115311.7242$ N/C

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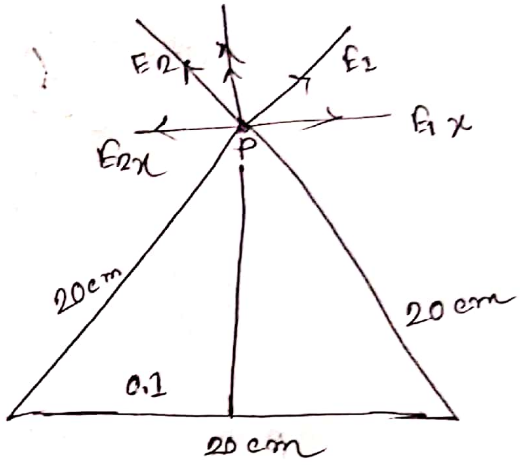
Ans: to the ques: no:- 9



Given that,

Equal charges

$q_1 = q_2 = 10\times10^{-5}C$

Here x component E_1 and E_2 will be cancel because the value of the charge is equal.

$r = 20\,cm = 0.2m$

a) $E_1 = E_2 = \frac{9\times10^9 \times 10\times10^{-5}}{(0.2)^2}$

$= 2.25\times10^7\ N/C$

Here, $\sin\theta = \frac{0.1}{0.2}$; $\theta = 30°$

$E_1y = E_1\sin\theta = 2.5\times10^7 \times \sin 30° = 1.25\times10^7\ N/C$

$E_2y = E_2\sin\theta = 2.5\times10^7 \times \sin 30° = 1.25\times10^7\ N/C$

$E_{net} = E_1y + E_2y = (1.25\times10^7 + 1.25\times10^7)\ N/C$

$= 2.5\times10^7\ N/C$

∴ Magnitude of the field at p is $2.5\times10^7\ N/C$

(b) The direction of the field is positive y-axis.
Because we have only y-component.

and also

(c) Because of equal charge, x-component cancel because
and they are opposite direction.

From (a) we can find that Y component is

$E_{ynet} = 2.5 \times 10^{7}$ N/C

(d) Direction of the net field is positive y-axis
Because we have only Y-component

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Ans: to the qus: no:-10

Given that,

electric flux $= -6\times10^{3}\ Nm^2/C$

Radius of the Gaussian surface is $r = 10cm = 10\times10^{-2}cm$

(i) Electric flux out through a surface depends on the net charge enclosed inside a body. it doesn't not depend on the size of the body. If the radius of the surface is doubled the the flux passing through the surface remains the same

$-6\times10^{3}\ Nm^2/C$

(ii) We know that

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

$$q = \varepsilon_0 \phi$$

$$= \left(8.854\times10^{-12}\ \frac{C}{Nm^2}\right)\times -6\times10^{3}\ \frac{Nm^2}{C}$$

$$= -5.3124\times10^{-8}\ C$$

$\therefore$ The value of the charge is $-5.3124\times10^{-8}C$

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Ans: to the ques no:- 11

Given that.

$\vec{E} = 4\hat{i} - 5\hat{j}$

Now,

ϕ_R = Right face = $\int \vec{E} \cdot d\vec{A}$

$= \int (4\hat{i} - 5\hat{j})\, dA\,(\hat{i})$

$= 4\int dA$

$= 4A$

ϕ_L = Left face = $\int \vec{E} \cdot d\vec{A}$

$= \int (4\hat{i} - 5\hat{j})\, dA\,(-\hat{i})$

$= -4A$

ϕ_T = Top face = $\int (4\hat{i} - 5\hat{j})\, dA\,(\hat{j}) = \int -5\, dA = -5A$

ϕ_B = Bottom face = $\int \vec{E} \cdot d\vec{A} = \int (4\hat{i} - 5\hat{j})\, dA\,(-\hat{j}) = \int 5\, dA = 5A$

ϕ_F = Front face = $\int \vec{E} \cdot d\vec{A} = \int (4\hat{i} - 5\hat{j})\, dA \cdot (\hat{k}) = 0$

ϕ_b = Back face = $\int \vec{E} \cdot d\vec{A} = \int (4\hat{i} - 5\hat{j})\, dA \cdot (-\hat{k}) = 0$

$\phi = \phi_L + \phi_R + \phi_R + \phi_B + \phi_b + \phi_F = (4 - 4 + 5 - 5 + 0 + 0)\, A$

$= 0$

$\therefore q_{enc} = \phi \times \varepsilon_0$

$= 0 \times \varepsilon_0$

$= 0$

Ans

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Ans: to the qus:-no:-12

Given that,

a) $\vec{E} = 2i$ N/C

b) $\vec{E} = 3\hat{k}$ N/C

and the surface area vector $\vec{A} = (4i+5j)m^2$

∴ The flux of a uniform electric field through the are if the field is,

a) - $\vec{E} = 2i$ N/C

Flux = $2i\,(4i+5j) = 8$ N.m^2

for b) $\vec{E} = 3\hat{k}$ N/C

flux = $3\hat{k}\,(4\hat{i}+5\hat{j})m^2 = 0$

Ans:-

Ans: to the ques: no:- 12

Given that.

$E = 3.0\ m\ N/C = 3.0 \times 10^{-3} N/C$

$r = 11\ cm = 11 \times 10^{-2} m$

Now the magnitude. of the electric. flux throught the celling is;

$\phi = \oint \vec{E} \cdot d\vec{A}$

$= \oint E\, dA \cos\theta$

$= \oint E\, dA \cos 0^\circ$ [dA vector and the angle. between electric field is 0°]

$= E \int dA$

$= E \pi r^2$

$= 3.0 \times 10^{-3} \times 3.1416 \times (11 \times 10^{-2})^2$

$= 1.1403 \times 10^{-4} \frac{N.m^2}{C}$

Ans:

Ans to the ques: no:- 14

We know that,

proton charge is, $q = +1.6\times10^{-19}C$

and the cube has six faces

$$\therefore \Phi = \frac{q}{6\varepsilon_0} = \frac{1.6\times10^{-19}C}{6(8.85\times10^{-12}C^2/N.m^2)} = 3.01\times10^{-9}\ N.m^2/C$$

$\therefore$ The magnitude of the electric flux is $3.01\times10^{-9} N.m^2/C$

---- THE END ----