Date:

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Assignment → 03

Chapter # 21

P1.

(a) A proton & neutron.

Data:-

$q_p = 1.6 \times 10^{-19} C$

$q_n = 0 \; C$

$F_E = ??$

$$F_E = \frac{k q_1 q_2}{r^2} = \frac{k (1.6 \times 10^{-19})(0)}{r^2}$$

$$\boxed{F_E = 0 \; N}$$

Data

$m_p = 1.67 \times 10^{-27} kg$

$m_n = 1.6 \times 10^{-27} kg$

$F_G = ??$

$$F_G = \frac{G m_p m_n}{r^2}$$

$$F_G = \frac{6.67 \times 10^{-11} \times (1.67 \times 10^{-27})^2}{(10^{-10})^2}$$

$$\boxed{F_G = 1.86 \times 10^{-44} N}$$

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(B) Two protons.

Data:-

$q_p = 1.6 \times 10^{-19} C$

$r = 1 \times 10^{-10} m$

$F_E = ??$

$$F_E = \frac{kq^2}{r^2} = \frac{(9 \times 10^9) \times (1.67 \times 10^{-19})^2}{(1 \times 10^{-10})^2}$$

$$\boxed{F_E = 2.3 \times 10^{-8} N}$$

Data:-

$m_p = 1.67 \times 10^{-27} kg$

$r = 1 \times 10^{-10} m$

$F_G = ??$

$$F_G = \frac{Gm^2}{r^2} = \frac{6.7 \times 10^{-11} \times (1.67 \times 10^{-27})^2}{(1 \times 10^{-10})^2}$$

$$\boxed{F_G = 1.86 \times 10^{-44} N}$$

Hence, the electric force between two proton in nucleus is much stronger then gravitational force.

(C) An electron

(C) An electron & proton.

Data:-

$q_1 = 1.6 \times 10^{-19}$ C

$q_2 = 1.6 \times 10^{-19}$ C

$r = 0.53 \times 10^{-10}$ m

$$F_E = \frac{k q^2}{r^2} = \frac{(9 \times 10^9)(1.6 \times 10^{-19})^2}{(0.53 \times 10^{-10})^2}$$

$$\boxed{F_E = 8.22 \times 10^{-8} N}$$

Data:-

$m_1 = 9.1 \times 10^{-31}$ kg

$m_2 = 1.6 \times 10^{-27}$ kg

$$F_G = \frac{(6.67 \times 10^{-11})(9.1 \times 10^{-31})(1.6 \times 10^{-27})}{(0.53 \times 10^{-10})^2}$$

$$\boxed{F_G = 3.6 \times 10^{-47} N}$$

$\therefore (F_E > F_G)$

(Comparing part b)

Result shows that in both cases electric feild is much stronger then gravitational feild.

Date:

(D)

$m_1 = m_2 = 50kg$

$q_1 = q_2 = 10^{-9} C$

$r = 1.2 \times 10^{7} m$

$$F_E = \frac{kq^2}{r^2} = \frac{(9 \times 10^9)(10^{-9})^2}{(1.2 \times 10^7)^2}$$

$$\boxed{F_E = 6.25 \times 10^{-23} N}$$

$$F_G = \frac{G m^2}{r^2} = \frac{(6.67 \times 10^{-11})(50)^2}{(1.2 \times 10^7)^2}$$

$$\boxed{F_G = 1.16 \times 10^{-21} N.}$$

(e) Earth & Moon.

$q_1 = 3C$

$q_2 = -2C$

$r = 3.8 \times 10^{8} m$

$$F_e = \frac{(9 \times 10^9)(3)(-2)}{(3.8 \times 10^8)^2}$$

$$\boxed{F_e = 3.74 \times 10^{7} N}$$

Date:

Earth mass = 6×10^{24}

moon mass = 7.3×10^{22}.

$$F_G = \frac{G m_1 m_2}{r^2}$$

$$F_G = \frac{(6.67 \times 10^{-11})(6 \times 10^{24})(7.3 \times 10^{22})}{(3.8 \times 10^{8})^2}$$

$$\boxed{F_G = 2.02 \times 10^{20} N}$$

$\therefore$ $(F_G > F_E)$ at astronomical level because of Greater masses.

P2:

a- Electrical force.

b- Gravitaional force.

c- Gravitational force.

d- Gravitational force.

Date:

P3:

$q_1 = 1 \times 10^{-6} C$

$q_2 = -3 \times 10^{-6} C$

$L = 10 cm = 0.1 m$

& x, y cordinates of q_3 = ?

Sol

let x be distance of q_3 where $E = 0$

i.e Net $E = 0$

$E_1 = E_2$

$$\frac{kq_1}{x^2} = \frac{kq_2}{(L+x)^2}$$

$$\frac{q_1}{q_2} = \frac{(L+x)^2}{x^2}$$

$$\sqrt{3} = \frac{L+x}{x}$$

$x\sqrt{3} = 0.1 + x$

$x(\sqrt{3}-1) = 0.1$

$$x = \frac{0.1}{(\sqrt{3}-1)}$$

$$\boxed{\begin{array}{c} x = 0.14\,m \\ \text{or} \\ x = 14\,cm \end{array}}$$

The x & y cordinates of q_3 is 14 cm & 0 cm

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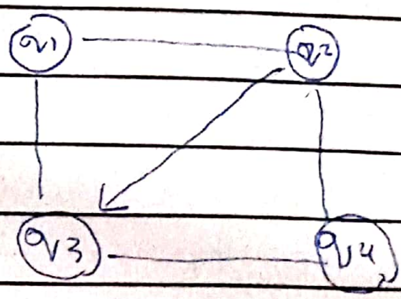
P4 :-

$q_1 = q_2 = 100 \times 10^{-9} C$

$q_3 = q_4 = 200 \times 10^{-9} C$



$F_{3x} = ?$ $F_{3y} =$ 0.05m

Solution:-

$F_{3x} = F_{34} + F_{23} \cos 45$

$$F_{3x} = \frac{(9\times10^9)(200\times10^{-9})^2}{(0.05)^2} + \frac{(9\times10^9)(100\times10^{-9})(200\times10^{-9})}{(\sqrt{2}\times0.05)^2}$$

$= 0.144 + 0.026$

$$\boxed{F_{3x} = 0.17N}$$

$F_{3y} = -F_{13} + F_{23} \sin 45$

$$= \frac{(9\times10^9)(100\times10^{-9})(200\times10^{-9})}{(0.05)^2} (0.036) \sin 45$$

$= -0.072 + 0.026$

$$\boxed{F_{3y} = -0.046 N}$$

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Date:

PS.

Data:-

$q_1 = 7\mu c$

Req:-

Force on $7\mu c$ = ??

Solution:-

· The force exerted on the 7.0 - μc charge by the 2.00 μc

$$\vec{F_1} = k_e \frac{q_1 q_2}{r^2} \hat{r}$$

$$= \frac{(8.99 \times 10^9)(7.00)(10^{-6})(2 \times 10^{-6})}{(0.500)^2} \times (\cos 60° \hat{i} + \sin 60° \hat{j})$$

$$\vec{F_1} = (0.252\hat{i} + 0.436\hat{j})\ N.$$

→ Similarly, the force on the $7\mu c$ charge by the $-4 - \mu c$

$$\vec{F_2} = k_e \frac{q_1 q_2}{r^2}$$

$$= \frac{(8.99 \times 10^9)(7 \times 10^{-6})(-4 \times 10^{-6})}{(0.500)^2} \times (\cos 60° \hat{i} - \sin 60° \hat{j})$$

$$\vec{F_2} = (0.503\hat{i} - 0.872\hat{j}).$$

$$\vec{F} = \vec{F_1} + \vec{F_2}$$

$$\boxed{F = (0.755\hat{i} - 0.436\hat{j})}\ N.$$

Date:

P6

$q_1 = -9 \times 10^{-6} C$

$q_2 = 4 \times 10^{-6} C$

$r = 1 m$

let x be point where field is zero

Sol:-

$E = 0$

$E_1 + (-E_2) = 0$

$E_1 = E_2$

$$\frac{kq_1}{d^2} = \frac{kq_2}{(d+r)^2}$$

$$\frac{q_1}{q_2} = \frac{(r+d)^2}{d^2}$$

$2d = 3(1+d$

$2d = 3+3d$

$\boxed{d = -3 m}$

So, $x = r+d = -3 = -2m$

$\therefore$ Since distance can't be negative.

Date:

P7.

Data

photon = 1.602×10^{-19}

electron = -1.602×10^{-19}

$k = 9 \times 10^{9}$

$FE = 1$

Required

$r = ??$

Solution:-

$$FE = \frac{k q_1 q_2}{r^2}$$

$$r = \sqrt{\frac{k q_1 q_2}{FE}}$$

$$r = \sqrt{\frac{9 \times 10^{9} \times (1.602 \times 10^{-19})^2}{1}}$$

$$\boxed{r = 1.517 \times 10^{-14} \text{ m.}}$$ Ans.

P8.

Date: ____

Data:-

$q_1 = q_2 = 20.0 mC$

$r = 1.50 m$

$k = 9 \times 10^9$

Required:-

$F_{12} = ??$

$|F_y| = ??$

Solution:-

$$F_{12} = \frac{k q_1 q_2}{r^2}$$

$$F_{12} = \frac{(9 \times 10^9)(20.0 \times 10^{-6})^2}{(1.05)^2}$$

$$\boxed{F_{12} = 1.60 N \text{ Ans}}$$

$$|F_y| = 2\left(k\frac{q^2}{r^2}\right)\cos 30^\circ = 2(8.99 \times 10^9)\frac{(20.0 \times 10^{-6})^2}{(1.50)^2} \times \cos 30$$

$$\boxed{|F_y| = 2.77 N \text{ Ans}}$$

Date:

P9 :-

(a) As, particle 1 & 2 have same charges, so equiliber-ium position at 0, maximum force will be

$\boxed{x_{min} = 0}$

(b) $F_{3x} = F_{31}\cos\theta + F_{32}\cos\theta$

$$F_{3x} = \frac{kq_1q_3}{r^2}\cos\theta + \frac{kq_2q_3}{r^2}\cos\theta$$

but $q_1 = q_2 = q$ so:

$$F_{3x} = \frac{2kqq_3\cos\theta}{x^2+d^2}$$

From graph

$$\cos\theta = \frac{x}{r^2} = \frac{x}{\sqrt{x^2+d^2}}$$

$$F_{3x} = \frac{2kqq_3x}{(x^2+d^2)^{3/2}}$$

For max-pos set $F_{3x} = 0$ and take derivative.

$$d/dx\, F_{3x} = \frac{d}{dx}\left[\frac{2kqq_3x}{(x^2+d^2)^{3/2}}\right] = 0$$

$$\rightarrow (x^2+d^2)^{3/2} - 3x^2\sqrt{x^2+d^2} = 0$$

We cancel all constants as they have not effect on derivative.

→ $x^2 + d^2 = 3x^2$

$$d^2 = 3x^2 - x^2$$

$$d^2 = 2x^2$$

$$x = \frac{d}{\sqrt{2}}$$

→ Substituting values

$$x = 17/\sqrt{2}$$

$$\boxed{x = 12.02\,cm}$$

↳ Hence, electrostatic force will be minimum at $x = 0$ & maximum at $x = 12.02$ cm.

Date:

P10

Data:-

$k = 9 \times 10^{9}$

$G = 6.67 \times 10^{-11}$

$q_1 = 1.602 \times 10^{-19}$

$q_2 = -1.602 \times 10^{-19}$

$m_1 = 9.109 \times 10^{-31}$

$m_2 = 1.672 \times 10^{-27}$

Req

$\frac{F_E}{F_G} = ??$

Solution:-

$$\frac{F_E}{F_G} = \frac{k q_1 q_2}{G m_1 m_2}$$

$$\frac{F_E}{F_G} = \frac{(9 \times 10^{9})(1.602 \times 10^{-19})^2}{(6.67 \times 10^{-11})(9.109 \times 10^{-31})(1.672 \times 10^{-27})}$$

$$\boxed{\frac{F_E}{F_G} = 4.399 \times 10^{40}}$$

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$x = 12.52$ cm

Q11

$m_p = 1.6 \times 10^{-27}$ kg , $r = 0.013$ m

$q_p = 1.6 \times 10^{-19}$ C , $V = 2.94 \times 10^{5}$ m/s

$$F_c = \frac{mv^2}{r}$$

$$F_E = \frac{k q_1 q_2}{r^2}$$

Compare ① & ②

$$q_s = \frac{mv^2 r}{k q_p} = \frac{(0.013)(1.6 \times 10^{-27})(294 \times 10^{3})^2}{(9 \times 10^{9})(1.6 \times 10^{-19})}$$

$$\boxed{q_s = 1.08 \times 10^{-19}\ C}$$

P12

$q_1 = -5\mu C$, $q_2 = -8\mu C$

$q_3 = 15\mu C$, $q_4 = -16\mu C$

$\theta = 37^\circ$ $d_4 = 0.3m$

$d_2 = 0.4m$

$$F_{21} = \frac{(9\times10^9)(8\times10^{-6})(5\times10^{-6})}{(0.3)^2}$$

$\boxed{F_{21} = 4N}$

$$F_{31} = \frac{(9\times10^9)(5\times10^{-6})(15\times10^{-6})}{(0.5)^2}$$

$\boxed{F_{31} = 2.7N}$

$F_{3,x} = 2.7\cos 37^\circ = 2.156$

$F_{3,y} = 2.7\sin 37^\circ = 1.625$

$$F_{41} = \frac{(9\times10^9)(5\times10^{-6})(16\times10^{-6})}{(0.4)^2}$$

$\boxed{F_{41} = 4.5N}$

$F_x = F_{41} + f_{3x} = 4.5 - 2.156$

$F_y = -F_{21} + f_{3y} = -4 + 1.625$

$F_x = 2.3\hat{i}N$

$F_y = -2.4\hat{j}N$

So, Net Electrostatic force in vector notation.

$\boxed{F_{NET} = (2.3\hat{i} - 2.4\hat{j})N}$

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P13

$q_1 = -2\mu c$

$q_2 = 5\mu c$

$q_3 = 3\mu c$

a)

$$F_{12} = -\frac{K q_1 q_2}{r^2}$$

$$= -\frac{(9\times10^{9})(5\times10^{-6})(2\times10^{-6})}{(0.02)^2}$$

$$\boxed{F_{12} = -225\,N}$$

$$F_{23} = -\frac{(9\times10^{9})(2\times10^{-6})(3\times10^{-6})}{(0.04)^2}$$

$$\boxed{F_{23} = -33.75}$$

$$\boxed{F_R = -255-(-33.75) = -191.25\,N}$$

b)

$$F = \frac{(9\times10^{9})(5\times10^{-6})(2\times10^{-6})}{(0.02)^2}$$

$$= 225\,N$$

$$= \frac{(9\times10^{9})(5\times10^{-6})(3\times10^{-6})}{(0.06)^2}$$

$$= 37.5\,N$$

$$\boxed{F_R = 225-37.5 = 187.5\,N}$$

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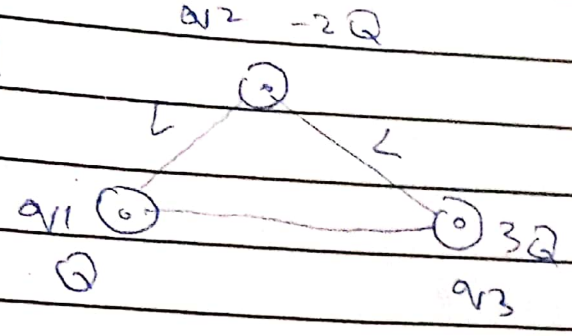
Date:

P14



$Q = 2\times10^{-6}$ C
$L = 0.03$ m

(a) F_R on (3Q)
F or -2Q to 3Q

$$F_{23} = \frac{(9\times10^{9})(4\times10^{-6})(6\times10^{-6})}{(0.03)^2}$$

$$\boxed{F_{23} = 240\,N}$$

For Q to 3Q ($\theta = 120°$

$$F_{13} = \frac{(9\times10^{9})(2\times10^{-6})(6\times10^{-6})}{(0.03)^2}$$

$$\boxed{F_{13} = 120\,N}$$

Component of

$F_{23x} = 240 \cos 120° = -120\,N$
$F_{23y} = 240 \sin 120° = 207.85\,N$
$F_x = F_{23x} + F_{13x} = -120 + 120 = 0\,N$

$F_y = F_{23y} = 207.85\,N$

$\boxed{F_R = 207.85\,N}$

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(b) From on $-2Q$

For Q to $-2Q$

$$F_{12} = \frac{(9\times10^{9})(4\times10^{-6})(2\times10^{-6})}{(0.03)^2}$$

$$\boxed{F_{12} = 80N}$$

For $3Q$ to $-2Q$

$$F_{32} = \frac{(9\times10^{9})(6\times10^{-6})(4\times10^{-6})}{(0.03)^2}$$

$$\boxed{F_{32} = 240N}$$

$F_{12x} = 80\cos 60^\circ = 40N$

$F_{12y} = 80 \sin 60^\circ = 69.25N$

or

$F_{32x} = 240 \cos 120^\circ = -120N$

$F_{32y} = 240 \sin 120^\circ = 207.85N$

$$\boxed{\begin{aligned} F_x &= 80N \\ F_y &= 277.13N \end{aligned}}$$

Date:

P 15 :

$E = 100\ N/C$

The magnitude of Fe is

$F_e = eE = 1.6 \times 10^{-19} \times 100$

$F_e = 1.6 \times 10^{-17}\ N$ (upward).

The Magnitude of F_G is

$F_g = mg = 9.11 \times 10^{-31} \times 9.8$

$F_g = 8.9 \times 10^{-30}\ N$ downward.

Now,

$$\frac{F_g}{F_e} = \frac{8.9 \times 10^{-30}}{1.6 \times 10^{-17}}$$

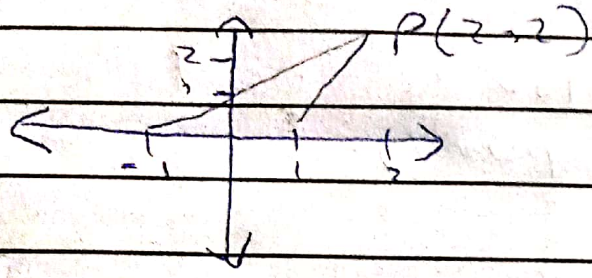
$$\boxed{\frac{F_g}{F_e} = 5.6 \times 10^{-13}}$$

Date:

P.16.

$Q_1 = 20\times10c$, $Q_2 = -10\times10^{-6}C$

$d = 1m$ & $x = y = 2m$



$\overrightarrow{Q_1P} = \sqrt{(2+1)^2+(2-0)^2}$

$= \sqrt{13} = 3.61m$

$\overrightarrow{Q_2P} = \sqrt{2^2+9^2}$

$= 2.24m$

$\tan\theta = 2/3$

$\boxed{\theta = 33.7^0}$

Feild due to Q_1 at P

$= \dfrac{9\times10^9\times20\times10}{(3.61)^2}$

$E = \boxed{1.3\times10^4}$ N/C.

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Date:

Feild strenght due to Q_2 at P

$$= \frac{9\times10^{9}\times(-10\times10^{-6})}{(2.24)^2}$$

$$= \boxed{1.79\times10^{4}\ N/C}$$

$\tan\theta = 2/1$

$\theta = 63.43^\circ$

$1.79\times10^{4}\cos 63.43 = 8.01\times10^{3}$

$1.79\times10^{4}\sin 63.43 = 1.6\times10^{4}$

Resultant feild of x component.

$\boxed{1.15\times10^{4} - 8.01\times10^{3} = 3.5\times10^{3}}$

Resultant feild at y component.

$\boxed{1.6\times10^{4} - 7.65\times10^{3} = 8.35\times10^{3}}$.

at P

$\sqrt{((3.5)\times10)^2+(8.35\times10^{3})}$

$= \boxed{9.05\times10^{3}\ \text{Ans}}$

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Q17.

$E = 10^3 N/C$

$d = 4cm = 0.04m$

$v_i = 0 m/s$

$v_f = ?$

$$E = \frac{F}{q}$$

$$E = \frac{ma}{q}$$

$$a = \frac{Eq}{m}$$

$$a = \frac{10^3 \times 1.6 \times 10^{-19}}{1.67 \times 10^{-27}}$$

$$\boxed{a = 1 \times 10^{11} m/s^2}$$

By using Equation of Motion.

$$v_f^2 = v_i^2 - 2as.$$

$$v_f = \sqrt{(10^5)^2 + 2(0.04)(10^{11})}$$

$$\boxed{V_F = 1.34 \times 10^5 m/s}$$

Date:

P18

Data:-

$E = 1 N/C$

$r = 1 m$

$$|q| = \frac{E r^2}{k}$$

$$= \frac{1 \cdot 1 m^2}{9 \times 10^9}$$

$$|q| = 1.11 \times 10^{-10} C.$$

P19.

(a) At feild at A.

$$E_1 = \frac{k q_i}{r_2} = \frac{KQ}{L^2/2} = \frac{2KQ}{L^2}$$

$$E_3 = E_4 = \frac{K4Q}{L^2}$$

$E_{Ax} = E_1 \cos 45 - E_2 \cos 45 + E_3 \cos 45 - E_4 \cos 45 -$

$E_{Ay} = E_1 \sin 45 + E_2 \sin 45 - E_3 \sin 45 - G \sin 45$

$$E_{Ay} = -\frac{4KQ}{L^2} \cdot \frac{1}{\sqrt{2}} = -\frac{4(9 \times 10^9)}{\sqrt{2}} \cdot \frac{Q}{L^2}$$

$$E = -2.54 \times 10^{10} \hat{j} \quad \text{Ans}$$

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P 19 PART B

$$E_1 = \frac{kQ}{\sqrt{5} \times L/2} = \frac{2kQ}{\sqrt{5}L} \qquad \left[\therefore r = \sqrt{5}\frac{L}{2}\right]$$

$$\boxed{E_3 = -\frac{4kQ}{\sqrt{5} \cdot L}}$$

$$E = E_1 + E_3 = \frac{-2kQ}{\sqrt{5}L}$$

$$= \frac{-2(9 \times 10^9)}{\sqrt{5}} \cdot Q/L$$

$$\boxed{E = -8.05 \times 10.9 \frac{Q}{L} \quad N/C}$$

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P20.

Data:-

$Q_1 = -2 \times 10^{-7} C$

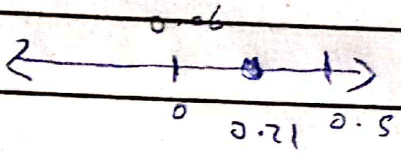
$x = 6cm = 0.06 m$

$Q_2 = 2 \times 10^{-7} C$

$x = 0.21 m$

$E_{net} = ?$

Sol:-



Mid way at these two particles.

$$\frac{(0.06 + 0.21)}{2} = \frac{0.27}{2} = 0.135 m$$

at $x = 0.135 m$

→ Ef due to particle 1

$$E_1 = \frac{9 \times 10^9 (-2 \times 10^{-7})}{(0.075)^2}$$

$$\boxed{E_1 = -3.2 \times 10^5 N/C}$$

→ Ef due to particle 2

$$E_2 = \frac{9 \times 10^9 (2 \times 10^{-7})}{(0.075)^2}$$

$$\boxed{E_2 = 3.2 \times 10^5 N/C}$$

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P 27

$q_1 = -5q$

$q_2 = +2q$

$-5q$ ―――――――― $2q$

Solution:-

$$\frac{\cancel{K}(-5q)}{r^2} = \frac{K(2q)}{(x-L)^2}$$

$$\frac{5}{2} = \frac{x^2}{x^2+L^2-2Lx} = 5(x^2+L^2-2Lx) = 2x^2$$

$\boxed{x = 2.72L}$ Ans.

Date:

P22

(a) Force of gravity on

Electron $= F = mg$ -(i)

(i.e. m of $\bar{e}$) grav

Force of Electric field

(q charge of $\bar{e}$)

$F_{elec} = +qE$ (ii)

Compare

$mg_e + qE$

or $E = \frac{mg}{q}$

$= \frac{9 \times 10^{-31} \times 9.8}{1.6 \times 10^{-19}}$

$\boxed{E = +5.51 \times 10^{-11}}$ N/C

Date:

(b) Similarly

$$E = \frac{mg}{q}$$

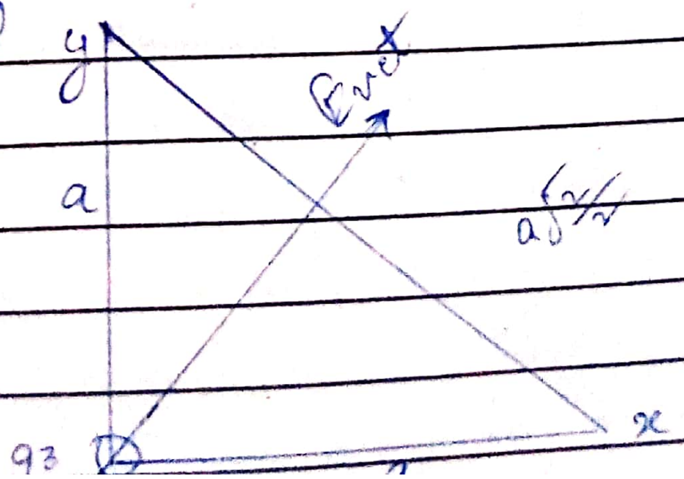
($\because$ m for Proton and q for Proton)

$$E = \frac{1.67 \times 10^{-27} \times 9.8}{1.6 \times 10^{-19}}$$

$$\boxed{E = 1.02 \times 10^{-7}\ N/C}$$ Ans

P 23

As, the net Electrical field at P due to q_1, q_2 is zero because they have same charge i.e (+e), say the only charge q_3 will produce a net electric field



applying Phythagrous Theorm

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

$$r^2 + \frac{a^2}{2} = a^2$$

$$r^2 = \frac{a^2}{1} - \frac{a^2}{2}$$

$$\frac{2a^2 - a^2}{2}$$

$$\boxed{r^2 \; \frac{2a^2}{2}}$$

Now, net Electric field

$$E = \frac{K|q_3|}{r^2}$$

$$= \frac{9 \times 10^9 \times 1.6 \times 10^{-19} \times 4}{(6.0 \times 10^{-6})^2}$$

$$\boxed{E_{net} = 160\ N/c}$$

(5) Angle $= 45^\circ$

Direction is Counter clock wise

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CH # 23

Date:

Gauss's Law

P24

Data:-

$r = 12\,cm = 0.12\,m$

$\theta = 30^\circ$

$E = 450\,N/c$

$\phi_E = ?$

Sol: Area of Circular Plate

$= \pi r^2$

$= \pi (0.12)^2$

$= 0.045$

As the Plate is Set along y-axis, So

$\phi_E = E \cdot S \sin\theta$

$= 450 \times 0.045 \sin(30^\circ)$

$$\boxed{\phi_E = 10.2\ Nm^2/c}$$

P25 Data:

$q_1 = 6 \times 10^{-6}\,c$

$q_2 = -8 \times 10^{-6}\,c$

$r = 5\,cm = 0.05\,m$

$\phi_{total} = ?$

Sol,

$\phi_{Total} = \dfrac{Q_{Enc}}{\varepsilon_0}$

$= \dfrac{q_1 + q_2}{\varepsilon_0}$

$= \dfrac{(6\times10^{-6} - 8\times10^{-6})}{8.85\times10^{-12}}$

$$\boxed{\phi_{total} = 2.26 \times 10^{5}\ Nm^2/c}$$

Scanned with CamScanner

Date:

P26

$Q = 10\,\mu C$

$q_1 = +3\,\mu C$

$q_2 = ?$

(a) $q^w = -q$

$q + q^w = 0$

$\boxed{q^w = -3.0 \times 10^{-6} C \quad \text{Ans}}$

(b) $Q = q^w + q_s$

$q_s = Q - q^w$

$= (10 \times 10^{-6} C) - (-3 \times 10^{-6} C)$

$\boxed{q_s = 13 \times 10^{-6} C}$

P27

DATA:

$q = 1.8\,mC$

$l = 0.55\,m$

$\varepsilon_0 = 8.85 \times 10^{-12}$

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

$= \frac{1.8 \times 10^{-3}}{8.85 \times 10^{-12}}$

$\boxed{\phi = 2.03 \times 10^{5}\, N\,m^2/C}$

Scanned with CamScanner

Date:

P (28)

$d = 1.2\,m$ or $r = 0.6\,m$

$\sigma = 8.1 \times 10^{-6}\,C/m^2$

a) $q = ?$

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

$q = \sigma . A$

$= \sigma . 4\pi r^2$

$= \sigma . 4 \times 3.14 \times (0.6)^2$

$= 8.1 \times 10^{-6} \times 3.14 \times 14.06$

$$\boxed{q = 3.66 \times 10^{-5}\,c}$$

(b) $$\phi = \frac{q}{\varepsilon_0}$$

$$= \frac{3.66 \times 10^{-5}}{8.85 \times 10^{-12}}$$

$$\boxed{\phi = 4.135 \times 10^{+6}\,Nm^2/c}$$

P (29)

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

$$E . A = \frac{q}{\varepsilon_0}$$

Area of cylender

$= 2\pi r h$

$$E = \frac{q}{\varepsilon_0 (2\pi r h)}$$

$$\Rightarrow \quad \sigma = \frac{q}{h}$$

$$E = \frac{\sigma h}{\varepsilon_0 (2\pi r h)}$$

$\sigma = E (2\pi r \varepsilon_0)$

$= 4.52 \times 10^4 (2 \times 3.14 \times 1.96 \times 8.85 \times 10^{-12})$

$$\boxed{\sigma = 5.0 \times 10^{-6}\,C/m}$$ Ans

PRODUCT OF

Date:

P (30)

DATA:

$q = 6 \times 10^{-6} C$

$L = 10 cm = 0.1 m$

$\phi_0 = ?$

(a) $\phi_{T_0} = \frac{1}{\varepsilon_0} \cdot Q$

$\therefore \phi_T = 6\phi$ side1 (symmetry).

$\phi_{T side1} = \frac{1}{\varepsilon_0} \cdot Q$

$\phi side1 = \frac{60 \times 10^{-6} C}{(8.85 \times 10^{-12})}$

(b) $\boxed{\text{Total flux} = 6.67 \times 10^{6}}$ $N m^2/C$

(c)

ϕ_{T_0} remains same no matter where the charge is as long it is inside the cub we solved for ϕ side by using symmetry this is because the charge is at the center moving it from center breaks the symmetry and ϕ side can easily be something different for each other.

(B) $\phi side = \frac{\phi_T}{6} = \frac{6.77 \times 10^{6}}{6}$

$\boxed{\phi \text{ side} = 1.13 \times 10^{6} N m^2/C}$

P31

$r = 0.08 m$

$\sigma = 0.1 \times 10^{-9} C/m^2$

$\therefore \sigma = \frac{Q}{A}$

So $Q = \sigma A$

Area of spherical conductor $= 4\pi r^2$

$= 4\pi (0.08)^2$

$= 0.0804 m^2$

then,

$Q = 0.1 \times 10^{-9} \times 0.0804$

$\boxed{Q = 8.04 \times 10^{-12} C}$

(a) At surface :-

$E = \frac{K \times Q}{r^2}$

$= \frac{(9 \times 10^9)(8.04 \times 10^{-12})}{(0.08)^2}$

$E = 11.3 N/C$

(b) $r = 0.1 m$

At $r = 0.1 m$

$E = \frac{9 \times 10^9 \times (8.04 \times 10^{-12})}{(0.1)^2}$

$\boxed{E = 7.236 N/C}$.