Sec:SR CAO-AZ DPPS Date: . .2023
Time: Max. Marks:

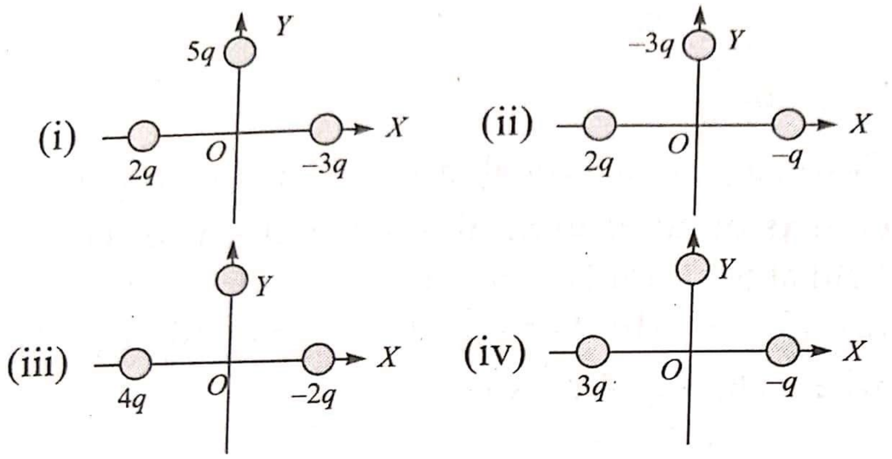
Name of the Student: ___________________ **H.T. NO:** | | | | | | | |

PHYSICS

1. Two copper balls,each weighing 10 g are kept in air 10cm apart.If one electron from every 10^6 atoms is transferred from one ball to the other, the coulomb force between them is (atomic weight of copper is 63.5)

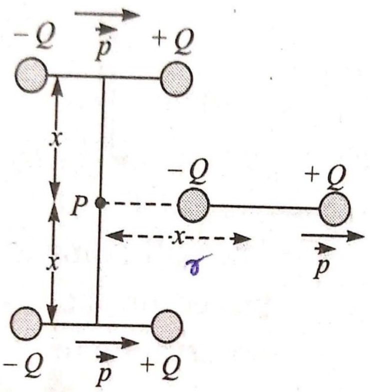
1) $2.0\times10^{10}\,N$ 2) $2.0\times10^{4}\,N$ 3) $2.0\times10^{8}\,N$ 4) $2.0\times10^{6}\,N$

2. In the following four situations charged particles are at equal distance from the origin.Arrange them as per the magnitude of the net electric field at origin greatest first



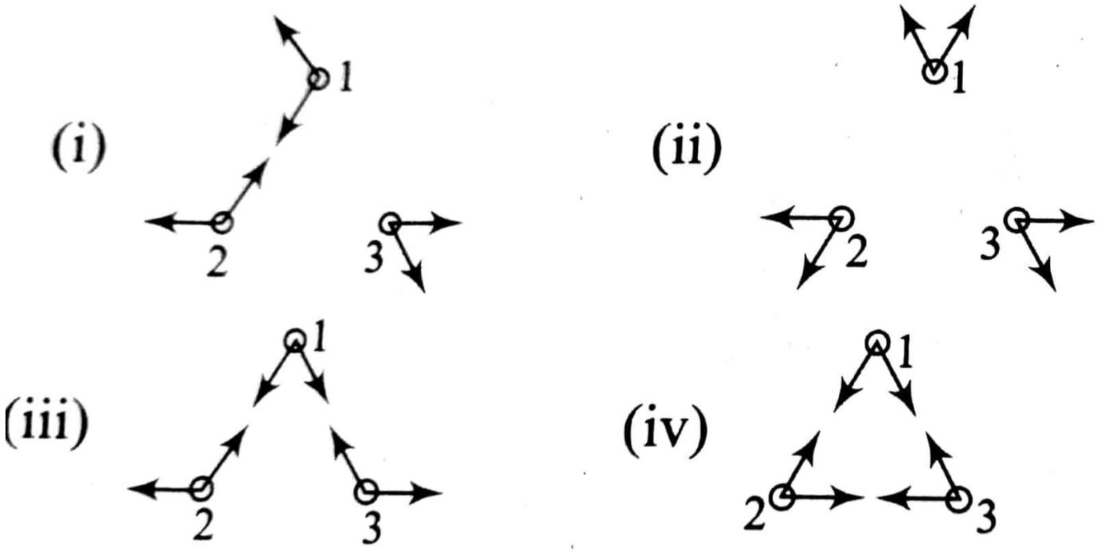
1)(i)>(ii)>(iii)>(iv) 2)(ii)>(i)>(iii)>(iv) 3)(i)>(iii)>(ii)>(iv) 4)(iv)>(iii)>(ii)>(i)

3. Three identical dipoles are arranged as shown below, what will be the net electric filed at P($k=\dfrac{1}{4\pi\varepsilon_0}$)?



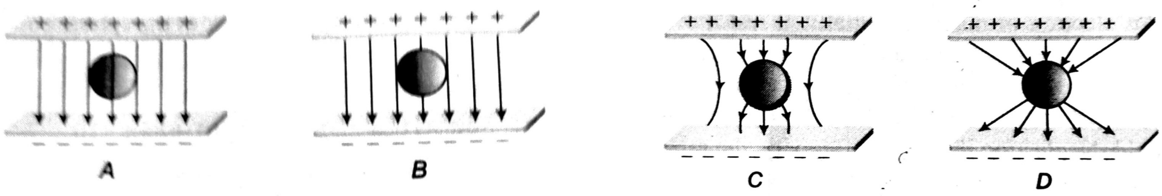
1) $\dfrac{k.p}{x^3}$ 2) $\dfrac{2kp}{x^3}$ 3)zero 4) $\dfrac{\sqrt{2}kp}{x^3}$

4. Which of the following four figures correctly show the forces that three charged particles exert on each other?



1)all of the above 2)none of the above 3)ii,iii 4)ii,iii and iv

5. An uncharged sphere of metal is placed in between two charged plates as shown.The lines of force look like

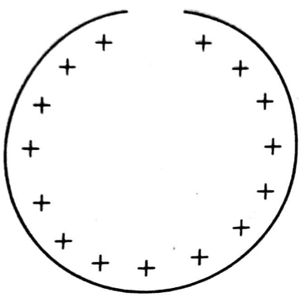


1)A 2)B 3)C 4)D

6. A point charge of $100\mu C$ is placed at $3\hat{i}+4\hat{j}$ m. Find the electric field intensity due to this charge at a point located at $9\hat{i}+12\hat{j}$ m.

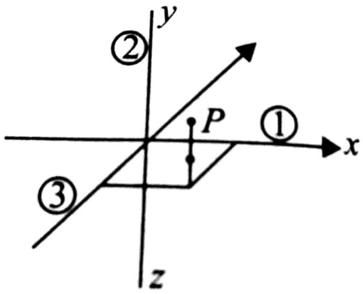
1) $8000\ Vm^{-1}$ 2) $9000\ Vm^{-1}$ 3) $2250\ Vm^{-1}$ 4) $4500\ Vm^{-1}$

7. A ring of charge with radius 0.5 m has $0.002\,\pi m$ gap.If the ring carries a charge of +1 C,the electric field at the centre is



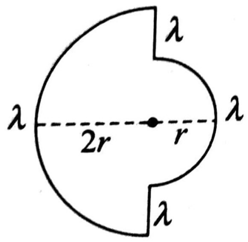
1) $7.5\times10^{7}\ NC^{-1}$ 2) $7.2\times10^{7}\ NC^{-1}$ 3) $6.2\times10^{7}\ NC^{-1}$ 4) $6.5\times10^{7}\ NC^{-1}$

8. Find the electric field vector at P (a,a,a) due to three infinetly long lines of charges along the x-,y- and z-axes,respectively.The charge density,i.e., charge per unit length of each wire is λ



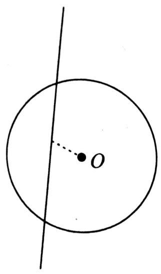
1) $\frac{\lambda}{3\pi\varepsilon_0 a}(\hat{i}+\hat{j}+\hat{k})$ 2) $\frac{\lambda}{2\pi\varepsilon_0 a}(\hat{i}+\hat{j}+\hat{k})$ 3) $\frac{\lambda}{2\sqrt{2}\pi\varepsilon_0 a}(\hat{i}+\hat{j}+\hat{k})$ 4) $\frac{\sqrt{2}\lambda}{\pi\varepsilon_0 a}(\hat{i}+\hat{j}+\hat{k})$

9. Two semicircular rings lying in the same place of uniform linear charge density λ have radii r and 2r.They are joined using two straight uniformly charged wires of linear charge density λ and length r as shown in the figure.The magnitude of electric field at common centre of semi circular rings is



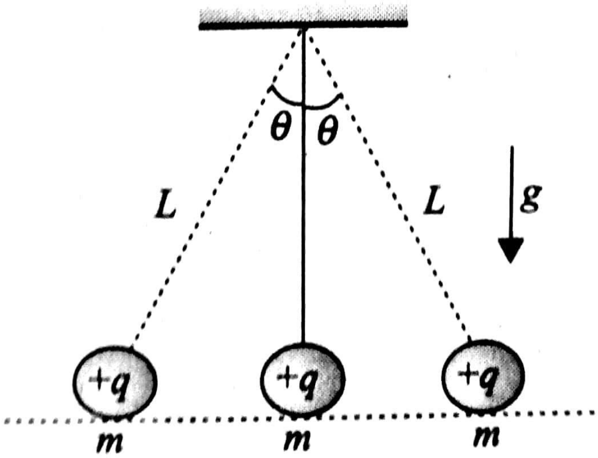
1) $\frac{1}{4\pi\varepsilon_0}\frac{3\lambda}{2r}$ 2) $\frac{1}{4\pi\varepsilon_0}\frac{\lambda}{2r}$ 3) $\frac{1}{4\pi\varepsilon_0}\frac{2\lambda}{r}$ 4) $\frac{1}{4\pi\varepsilon_0}\frac{\lambda}{r}$

10. A uniformly charged and infinitely long line having a linear charge density λ is placed at a normal distance y from a point O.Consider a sphere of radius R with O as the center and R>y.Electric flux through the surface of the sphere is



1)zero 2) $\frac{2\lambda R}{\varepsilon_0}$ 3) $\frac{2\lambda\sqrt{R^2-y^2}}{\varepsilon_0}$ 4) $\frac{\lambda\sqrt{R^2+y^2}}{\varepsilon_0}$

11. Three identical point charges, each of mass m and charge q, hang from three strings as shown in figure.The value of q in terms of m,L, and q is



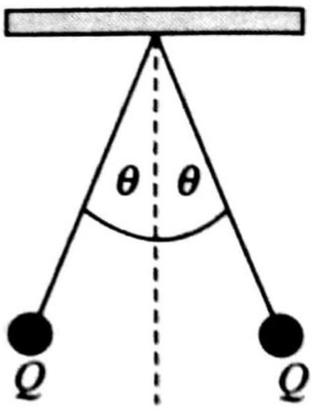
1) $q = \sqrt{(16/5)\pi\varepsilon_0 mgL^2 \sin^2\theta \tan\theta}$

2) $q = \sqrt{(16/15)\pi\varepsilon_0 mgL^2 \sin^2\theta \tan\theta}$

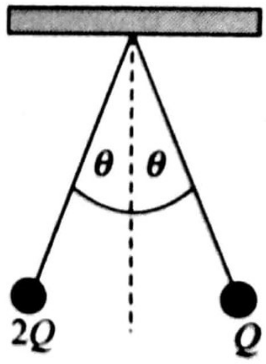
3) $q = \sqrt{(15/16)\pi\varepsilon_0 mgL^2 \sin^2\theta \tan\theta}$

4)none of these

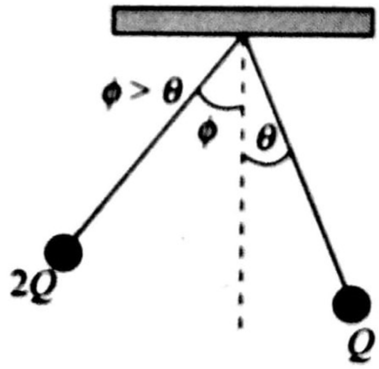
12. Two pith balls each with mass m are suspended from insulating threads. When the pith balls are given equal positive charge Q, they hang in equilibrium as shown. We now increase the charge on the left pith ball from Q to 2Q while leaving its mass essentially unchanged. Which of the following diagrams best represents the new equilibrium configuration?



(1)



(2)



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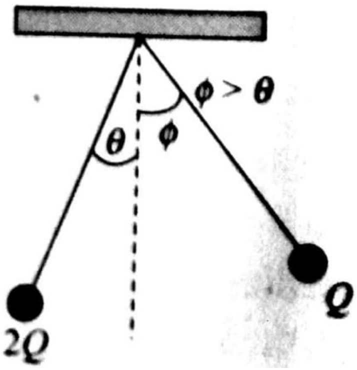
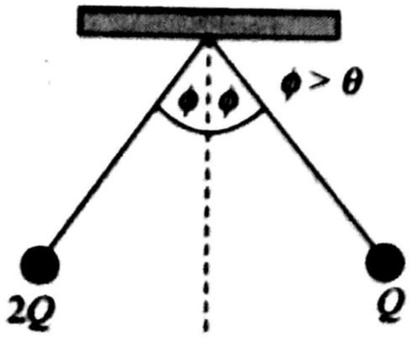
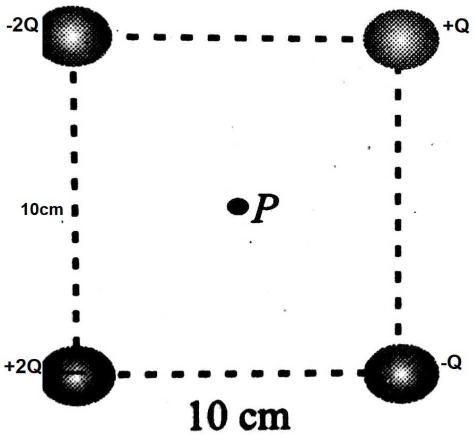


(4)



13. Four electrical charges are arranged on the corners of a 10 cm square as shown. What would be the direction of the resulting electric field at the center point P?



1) $\rightarrow$ right ward 2) $\uparrow$ upward 3) $\leftarrow$ left ward 4) $\downarrow$ down ward

14. If electron in ground state of H-atom is assumed in rest then find dipole moment of electron-proton system of H-atom in Debye.(Orbit radius of H-atom in ground state is $0.53\,A^0$.$1A^0 = 10^{-10}\,m$.)

1)15.44 Debye 2)25.44 Debye 3)35.44 Debye 4)45.44 Debye

15. At what angle θ a point p must be located from dipole axis so that the electric field intensity at the point is perpendicular to the dipole axis?

1) 50^0 *to* 51^0 2) 45^0 *to* 46^0 3) 52^0 *to* 53^0 4) 53^0 *to* 54^0

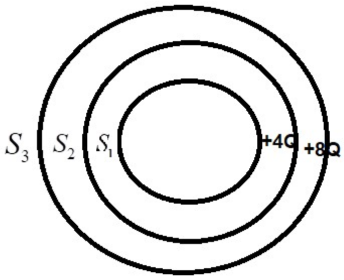
16. A copper ball 1 cm in diameter is immersed in oil with a density $800\,kg\,m^{-3}$. What is the charge of the ball if in a homogeneous electric field it is suspended in oil? The electric field is directed vertically upwards and its intensity $E = 36000\,V\,cm^{-1}$. The density of copper is $8600\ kgm^{-3}$

1) $1.10\times10^{-7}C$ 2) $1.10\times10^{-8}C$ 3) $1.11\times10^{-7}C$ 4) $1.11\times10^{-8}C$

17. An electric dipole is situated in an electric field to uniform intensity whose dipole moment $\overline{P}$ and moment of inertia I.If the dipole is displaced than angular frequency is

1) $\sqrt{\frac{PE}{I}}$ 2) $\left(\frac{PE}{I}\right)^{3/2}$ 3) $\left(\frac{I}{PE}\right)^{1/2}$ 4) $\sqrt{\frac{P}{IE}}$

18. S_1, S_2, S_3 are three concentric spherical shell's, as shown in figure. S_1 *and* S_2 have change 4Q and 8Q respectively where as S_3 is uncharged. Find the ratio of flux passing through S_1 to that through S_3



1)1:2 2)1:3 3)2:1 4)1:1

19. An electric field given by $E = 4\hat{i} - 3(y^2+2)\hat{j}$ passes through a Gauessian cube of side 1m placed with one corner at origin such that its sides represent x,y and z-axes the net charge enclosed with in the cube is

1) $-4\varepsilon_0$ 2) $5\varepsilon_0$ 3) $-3\varepsilon_0$ 4) $2\varepsilon_0$

20. The short dipoles ,each of dipole moment P, are placed at origin.The dipole moment of one dipole is along x-axis , while that of other is along y-axis.The electric field at a point (a,0) is given by

1) $\frac{1}{4\pi\varepsilon r}\frac{P}{a^3}$ 2) $\frac{1}{4\pi\varepsilon r}\frac{\sqrt{5}P}{a^3}$ 3) $\frac{1}{4\pi\varepsilon r}\frac{2P}{a^3}$ 4)zero

21. An electric dipole is placed at the origin and is directed along the x-axis at a point 'P' far away from the dipole.The electric field is parallel to Y-axis makes an angle θ with the x-axis then $\tan(\theta) =$

1) $\tan(\theta) = \sqrt{3}$ 2) $\tan(\theta) = 2$ 3) $\tan(\theta) = \frac{1}{\sqrt{2}}$ 4) $\tan(\theta) = \sqrt{2}$

22. Two concentric conducting spheres of radii 'R' and '2R' carrying change 'Q' and d-2Q. respectively.If the charge on inner sphere is doubled the potential difference between the two spheres will

1)becomes two times 2)becomes four times 3)be halved 4)remains the same

23. An electric dipole consisting of two opposite charges of magnitude $4\times10^{-6}C$ each separated by a distance 6 cm is placed in an electric field of magnitude $3\times10^5\ N/C$ along the direction making 90^0 with field torque acting on the dipole is

1) $7.2\times10^{-3}\ Nm$ 2) $7.2\times10^{-4}\ Nm$ 3) 7.2 Nm 4) $720\times10^{-4}\ Nm$

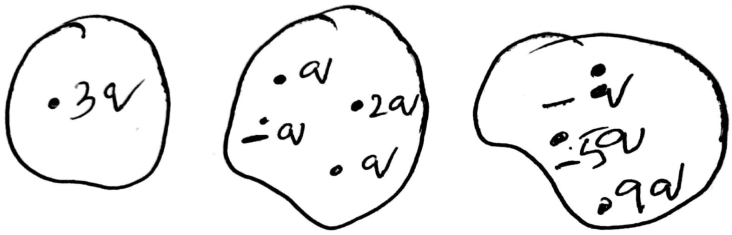
24. The volume charge density of a sphere of diameter 14 m is $3\mu c\ cm^{-3}$ the number of lines of force per unit surface area coming out from the surface of the sphere is

1) $7.9\times10^{10}\ N/C$ 2) $79\times10^{10}\ N/C$ 3) $79\times10^{12}\ N/C$ 4) $79\times10^{14}\ N/C$

25. A solid sphere of radius R has a charge Q distributed in its volume with a charge density $\rho(r) = Kr^3$ where 'k' and 'a' are constant and 'r' is the distance from its centre. If the electric field at r=R/2 is $\frac{1}{8}$ times that at r=R, find the value of 'a'=

1)1 2)2 3)4 4)16

26. Three closed surfaces and corresponding charge distributions are shown below.

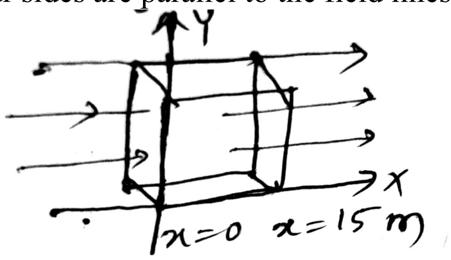


1) $Q_1 < Q_2 < Q_3$ 2) $Q_1 > Q_2 > Q_3$ 3) $Q_1 = Q_2 = Q_3$ 4) $Q_1 > Q_2 < Q_3$

27. Two charges $+1.6\times10^{-19}C$ and $-1.6\times10^{-19}C$ placed 0.12 nm apart from an electric dipole in a uniform electric field of $2\times10^5\ v/m$.The work done to rotate the electric dipole from the equilibrium position by 180^0 is _________

1) $6.14\times10^{-24}J$ 2) $7.68\times10^{-24}J$ 3) $61.4\times10^{-24}J$ 4) $76.8\times10^{-24}J$

28. In a certain region of space the electric field always pointing in x-direction but its magnitude decreases from E=460 N/C at x=0 to $E = 310\,N/C$ at x=15m. If a cubic box of side length l=15 cm is oriented such that is four sides are parallel to the field lines, then charge enclosed by the box is

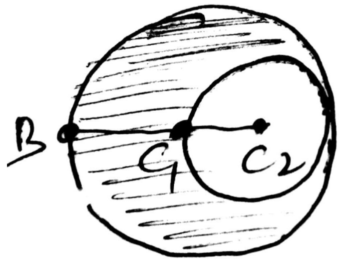


1) $2.9\times10^{-7}C$ 2) $-2.9\times10^{-7}C$ 3) $2.9\times10^{7}C$ 4) $-2.9\times10^{7}C$

29. Consider if the electric flux entering and leaving an enclosed surface respectively are ϕ_1 and ϕ_2 the electric charge inside the surface will be

1) $\varepsilon_0(\phi_1+\phi_2)$ 2) $\dfrac{(\phi_1-\phi_2)}{\varepsilon_0}$ 3) $\dfrac{(\phi_2-\phi_1)}{\varepsilon_0}$ 4) $\dfrac{(\phi_1+\phi_2)}{\varepsilon_0}$

30. A positively charged sphere of radius r_0 carries a volume charge density (ρ)A sphere cavity of radius $\dfrac{r_0}{2}$ is then scooped out an left empty C_1 is the centre of the sphere and C_2 that of the cavity.What is the direction and magnitude of the electric field at point 'B'?



1) $\dfrac{17\rho r_0}{54\varepsilon_0}\,left$ 2) $\dfrac{\rho r_0}{6\varepsilon_0}\,left$ 3) $\dfrac{17\rho r_0}{54\varepsilon_0}\,Right$ 4) $\dfrac{\rho r_0}{6\varepsilon_0}\,Right$

KEY

PHYSICS										
1-10	3	3	3	3	3	2	2	2	4	3
11-20	1	4	2	2	4	4	1	2	3	2
21-30	4	4	4	2	2	3	2	2	1	1

HINTS

1. **Number of atoms in given mass**= $\frac{10}{63.5}\times 6.02\times 10^{23}=9.48\times 10^{22}$

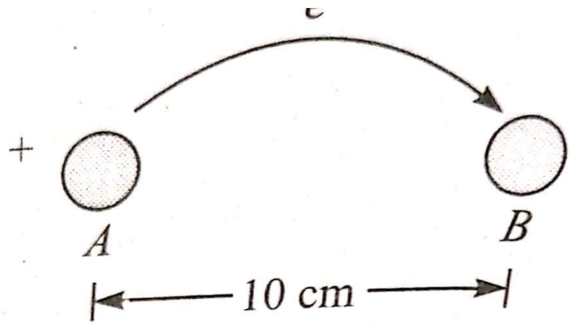
   Transfer of electron between balls $=\frac{9.48\times 10^{22}}{10^{6}}=9.48\times 10^{16}$

   Hence magnitude of charge gained by each ball.

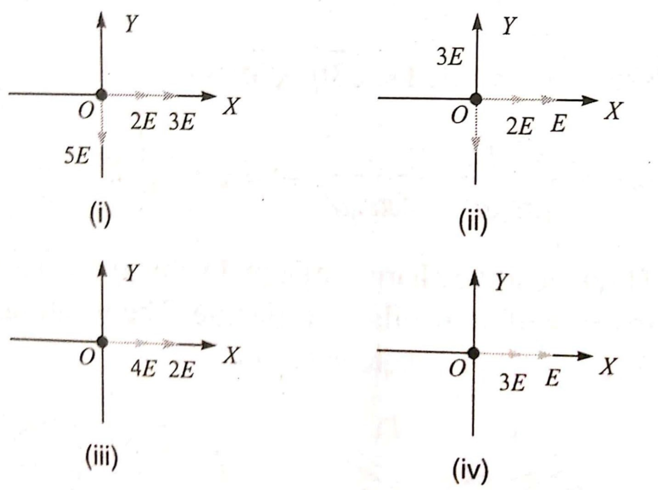
   $Q=9.48\times 10^{16}\times 1.6\times 10^{-19}=0.015C$

   Force of attraction between the balls

   $F=9\times 10^{9}\times \frac{(0.015)^2}{(0.1)^2}=2\times 10^{8}N.$



2. **If electric field due to charge** $|q|$ at origin is E then electric field due to charges $|2q|,|3q|,|4q|,|5q|$ are respectively 2E.3E,4E and 5E



$E_{(i)} = \sqrt{(5E)^2 + (5E)^2} = 5\sqrt{2}E$

$E_{(ii)} = \sqrt{(3E)^2 + (3E)^2} = 3\sqrt{2}E$

$E_{(iii)} = 4E + 2E = 6E \ \ and \ \ E_{(iv)} = 3E + E = 4E$

$\Rightarrow E_{(i)} > E_{(iii)} > E_{(ii)} > E_{(iv)}$

3. **point P lies at equatorial positions of dipole 1 and 2 and axial position of dipole 3.**
Hence field at P
Due to dipoles 1

$E_1 = \frac{k.p}{x^3}(towards\ left)$

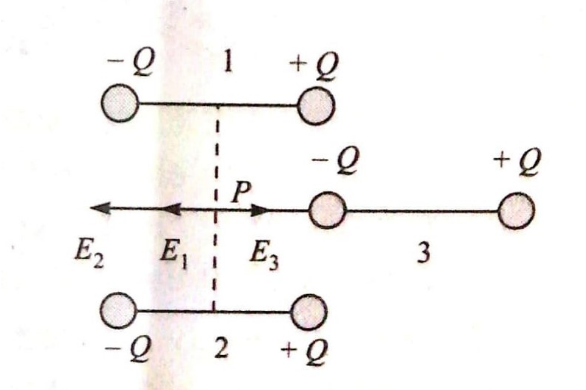
Due to dipole 2

$E_2 = \frac{k.p}{x^2}(towards\ left)$

Due to dipole 3

$E_3 = \frac{k.(2p)}{x^2}(towards\ right)$

So net field at P will be zero



4. **(i) is incorrect because '1' and '2' are repelled by '3' .So '1' and '2' have charge of same nature. Hence they should repel each other. For this reason,**
(ii) is correct.
(iii) is correct if charge on '2' and '3' is of same nature and on '1' opposite of them.
(iv)All attraction is not possible.

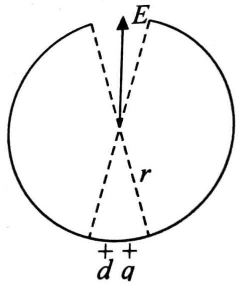
5. **Electric lines force never intersect the conductor.They are perpendicular and slightly curved near the surface of conductor.**

6. $\vec{r} = (9-3)\hat{i} + (12-4)\hat{j} = 6\hat{i} + 8\hat{j}$

Or $r = \sqrt{6^2 + 8^2} = 10m$

$E = \frac{9 \times 10^9 \times 100 \times 10^{-6}}{10^2} = 9000\ V\ m^{-1}$

7. **Chrage on the element opposite to the gap is** $dq = \dfrac{Q}{2\pi r}(0.002\pi)$



$$= \frac{1}{2\pi(0.5)} \times \frac{2\pi}{1000} = 2\times10^{-3} C$$

$$E = \frac{9\times10^{9}\times2\times10^{-3}}{(0.5)^2} = 7.2\times10^{7}\ NC^{-1}$$

8. **Let us consider the electric field due to wire (3) only.**

$$\vec{E}_3 = E\hat{u}$$

$$\vec{E}_3 = \frac{\lambda}{2\pi\varepsilon_0(a^2+a^2)^{1/2}}(\hat{i}\cos45^0 + \hat{j}\cos45^0)$$

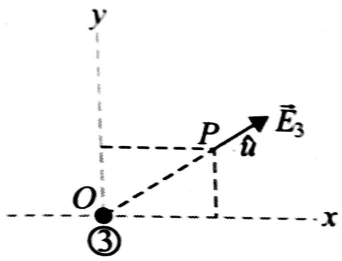
$$\vec{E}_3 = \frac{\lambda}{2\sqrt{2}\pi\varepsilon_0 a}\frac{1}{\sqrt{2}}(\hat{i}+\hat{j})$$

$$\vec{E}_3 = \frac{\lambda}{4\pi\varepsilon_0 a}(\hat{i}+\hat{j})$$

Similarly,electric field to wires (1) and (2)

$$\vec{E}_1 = \frac{\lambda}{4\pi\varepsilon_0 a}(\hat{j}+\hat{k}) \quad and \quad \vec{E}_2 = \frac{\lambda}{4\pi\varepsilon_0 a}(\hat{i}+\hat{k})$$

$$\vec{E}_{net} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 \qquad \vec{E}_{net} = \frac{\lambda}{2\pi\varepsilon_0 a}(\hat{i}+\hat{j}+\hat{k})$$

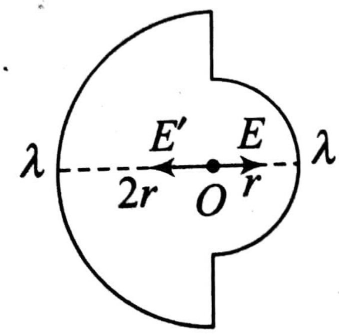


9. **The electric charge field due to both straight wires shall cancel at common centre O.The electric field duw to larger and smaller semi-circular rings at O be E and** E^1 respectively.

$$E = \frac{1}{4\pi\varepsilon_0}\frac{2\lambda}{2r}; E^1 = \frac{1}{4\pi\varepsilon_0}\frac{2\lambda}{R}$$

$\therefore$ Magnitude of electric field at O is

$$E - \frac{1}{4\pi\varepsilon_0}\left(\frac{2\lambda}{r} - \frac{\lambda}{r}\right) = \frac{1}{4\pi\varepsilon_0}\frac{\lambda}{r}$$



10. Electric flux $E - \frac{1}{4\pi\varepsilon_0}\left(\frac{2\lambda}{r} - \frac{\lambda}{r}\right) = \frac{1}{4\pi\varepsilon_0}\frac{\lambda}{r}$

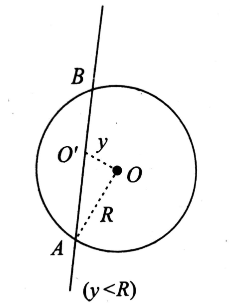
q_{in} is the charge enclosed by the Gaussian surface, which, in the present case, is the surface of the given sphere.As shown, length AB of line inside the sphere. In ΔOO^1A

$R^2 = Y^2 + (O^1A)^2$

$\therefore O^1A = \sqrt{R^2 - y^2}$

and $AB = 2\sqrt{R^2 - y^2}$

charge on length AB is $2\sqrt{R^2 - y^2} \times \lambda$ therefore electric flux is $\oint_s \vec{E}.\vec{d}s = \frac{2\lambda\sqrt{R^2 - y^2}}{\varepsilon_0}$



11. $F_e = F_2 + F_3 = \frac{kq^2}{(L\sin\theta)^2} + \frac{kq^2}{(2L\sin\theta)^2}$

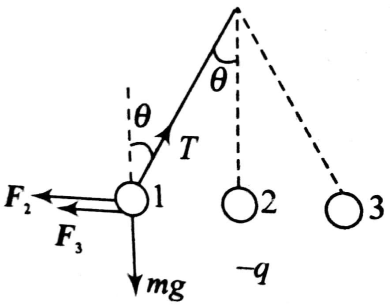
$F_e = \frac{5}{4}\frac{kq^2}{L^2\sin^2\theta}$ (i)

$T\sin\theta = Fe$ (ii)

$T\cos\theta = Mg$ (iii)

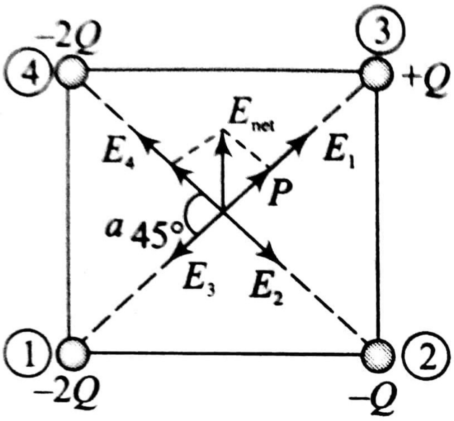
From (i),(ii) and (iii)

$q = \sqrt{\frac{16}{5}\pi\varepsilon_0 mgL^2\sin^2\theta\tan\theta}$



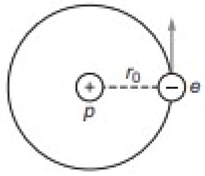
12. **Both angles will remain same at any time.It is because, force on the balls will be equal and opposite, although they have different charges.** $\phi > \theta$, becasues force has increased. Angles would have been differnet if masses were different.

13. $E_1 = E_4 - 2E_2 = 2E_3$



Horizontal components will be canceled, net field will be upward.

14. **charge on electron =charge on proton** $1.6\times10^{-19} = e$
Orbit radius,
$r_0 = 0.53A^0 = 0.53\times10^{-10}m$
$p = e\times2d = e\times r_0$
$= 1.6\times10^{-19}\times0.53\times10^{-10}C-m$
$= 0.848\times10^{-29}C-m$
$= 0.848\times10^{-29}\times3\times10^{29}\ Debye = 2.544\ Debye$



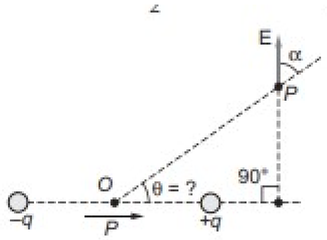
15. **As,** $\tan\alpha = \dfrac{\tan\theta}{2}$ and from geometry of the problem shown in figure $\alpha = 90^0 - \theta$

$\tan(90^0-\theta) = \dfrac{\tan\theta}{2}$ or $\cot\theta = \dfrac{\tan\theta}{2}$

or $\dfrac{1}{\tan\theta} = \dfrac{\tan\theta}{2}$

Or $\tan^2\theta = 2 \Rightarrow \tan\theta = \sqrt{2}$

$\theta = \tan^{-1}\sqrt{2} = 52^0\ to\,53^0$



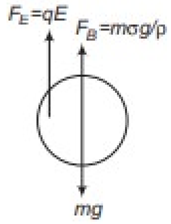
16. **Mass of copper ball m=$\frac{4}{3}\pi r^3\rho$**

The ball is immersed in oil and a uniform electric field passes through the oil upwards.Now the ball is acted on by three forces.

For the equilibrium of the copper ball

$$mg = F_E + F_B = qE + \frac{m}{\rho}\sigma g$$

$$q = \frac{mg}{E}\left(1-\frac{\sigma}{\rho}\right) = \frac{4}{3}\frac{\pi r^3 \rho g}{E}\left(1-\frac{\sigma}{\rho}\right) = \frac{4\pi(0.5\times10^{-2})^3(8600\times9.8)}{3\times36000\times100}(1-\frac{800}{8600}) = 1.11\times10^{-8}C$$



17. $$\Rightarrow \frac{d^2\theta}{dt^2} = -\omega^2\theta$$

$$\Rightarrow \frac{d^2\theta}{dt^2} = \frac{-PE}{I}\theta$$

$$\Rightarrow \omega^2 = \frac{PE}{I}\theta$$

$$\Rightarrow \omega = \sqrt{\frac{PE}{I}}$$

18. According to Gauss law $Q = \frac{q}{\varepsilon_v}$

Change on first surface is 4Q

Flux through $S_1 = \frac{4Q}{\varepsilon_0}$

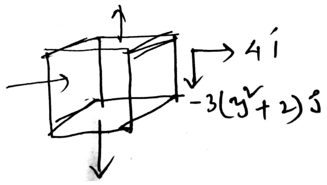
Total change enclosed in surface $S_3 = 4Q + 8Q = 12Q$

Flux through $S_3 = \frac{12Q}{\varepsilon_0}$

Ratio of S_1 & $S_3 \Rightarrow \frac{S_1}{S_3} = \frac{\frac{4Q}{\varepsilon_0}}{\frac{12Q}{\varepsilon_0}} = \frac{1}{3}$

$S_1 : S_3 = 1:3$

19. $\phi = \frac{q_{net}}{\varepsilon_0}$



$\phi = \oint \overline{E}.\overline{ds}$

x-direction $\phi_{in} = \phi_{ex}$ so net flux =0

y-direction $\phi_{in} = 3(0+2)\times 1 = 6\ unit$

net flux =6-9= $\frac{q_{net}}{\varepsilon_0}$

$q_{net} = -3\varepsilon_0$

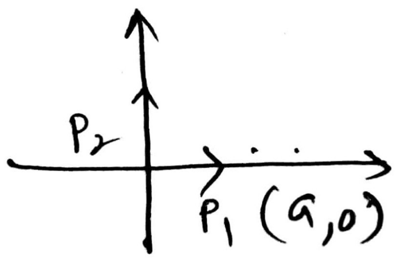
20. For P_1 the point (a,0) is lies in its axial position E due to P_1 is $E_a = \frac{1}{4\pi\varepsilon_0}\frac{2P}{a^3}$

For P_2 the point (0,0) is lies in its equatorial so E due to P_2 is $E_e = \frac{1}{4\pi\varepsilon_0}\frac{P}{a^3}$

'E' at (a,0)= $\sqrt{E_a^2 + E_e^2}$

$E = \frac{1}{4\pi\varepsilon_0}\frac{P}{a^3}\sqrt{2^2+1} \Rightarrow E = \frac{1}{4\pi\varepsilon_0}\frac{P}{a^3}\sqrt{5}$

$E = \frac{1}{4\pi\varepsilon_0}\frac{\sqrt{5}P}{a^3}$



21. The net field $\vec{E}$ makes an angle $(\theta+\alpha)$ with x-axis $\tan\alpha = \frac{E_T}{E_r} = \frac{\frac{k.p\sin\theta}{r^3}}{\frac{2k\cos\theta}{r^3}} = \frac{\tan\theta}{2}$

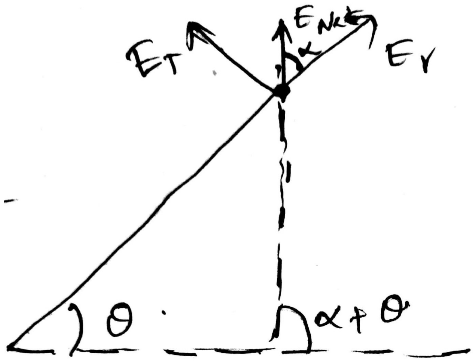
$\tan\alpha = \frac{\tan\theta}{2} \Rightarrow \alpha = \tan^{-1}\left(\frac{\tan\theta}{2}\right)$

$\theta + \tan^{-1}\left(\frac{\tan\theta}{2}\right) = 90^0$

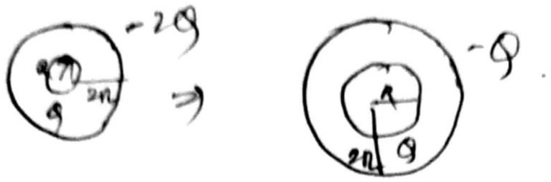
$\tan^{-1}\left(\frac{\tan\theta}{2}\right) = 90^0 - \theta$

$$\left(\frac{\tan\theta}{2}\right) = \tan(90^0 - \theta)$$

$$\tan\theta = \sqrt{2}$$



22.



potential of inner sphere $V_A = K\frac{Q}{R} + K\frac{(-2Q)}{2R} = 0$

Potential of outer sphere $V_B = \frac{KQ}{2R} + \frac{K(-2Q)}{2R} = \frac{KQ}{2R}$

$V_A - V_B = 0 - \frac{KQ}{2R}$

When change on the inner sphere doubled

$V_A = K\left(\frac{2Q}{R}\right) + \left(\frac{-2Q}{2R}\right)K$

$V_A = \left(\frac{KQ}{R}\right)$

$V_B = \frac{K(2Q)}{2R} + K\left(\frac{-2Q}{2R}\right) = 0$

$V_A - V_B = \frac{KQ}{R} - 0 = \frac{KQ}{R}$

Hence ΔV is remains same

23. $\Upsilon = PE\sin\theta\,(P = 2l \times q)$

24 $E = \dfrac{\rho r}{3\varepsilon_0}$

$\rho = 3\mu c / cm^{-3}$

$r = \dfrac{D}{2} = 7m$

$\varepsilon_0 = 8.85 \times 10^{-12}\ c^2 / NM^2$

25. $\rho = Kr^a\ \&\ r = \dfrac{R}{2} = \dfrac{1}{8}E$

$\dfrac{q_{enclose}}{4\pi\varepsilon_0\left(\dfrac{R}{2}\right)^2} = \dfrac{1}{8}\dfrac{Q}{4\pi\varepsilon_0 R^2}$

Q=32 q enclose

$q_{enclosed} = \int_0^{R/2} Kr^a 4\pi r^2 dr$

$q_{enclosed} = \left[\dfrac{4\pi K}{(a+3)}\dfrac{R}{2}(a+3)\right]$

$Q = \dfrac{4\pi K}{(a+3)} R(a+3)$

$\dfrac{Q}{q_{enclosed}} = 2^{a+3} \Rightarrow 2^{a+3} = 32 \Rightarrow a = 2$

26. $\phi = \dfrac{q}{\varepsilon_0}, \phi_1 = \dfrac{3q}{\varepsilon_0}, \phi_2 = \dfrac{4q - q}{\varepsilon_0} = \dfrac{3q}{\varepsilon_0}$

$\phi_3 = \dfrac{9q - 6}{\varepsilon_0} = 3q$

$\phi_1 = \phi_2 = \phi_3$

27. $W = PE(1 - \cos\theta)$

$W = 2l \times q \times E(1 - \cos\theta)$

28. $Q_{enclose} = (E_{right} - E_{left}) l^2 \varepsilon_0$

$\varepsilon_0 = 8.85 \times 10^{-12}\ c^2 / Nm^2$

$E_R = 310\ N/c\ \ E_L = 460\ N/c\ \&\ l = 15m$

29. $\phi = \dfrac{q}{\varepsilon_0}$

-q be the charge, due to which the flux ϕ,

Is entering the surface $\phi_1 = -\dfrac{q_1}{\varepsilon_0} \Rightarrow -q_1 = \phi_1\varepsilon_0$ & leaving the surface $\phi_2 = \dfrac{q_2}{\varepsilon_0} \Rightarrow q_2 = \phi_2\varepsilon_0$

Charge inside the surface q= $q_2 - q_1$

$q = \phi_2\varepsilon_0 - (-\phi, \varepsilon_0)$

$= \phi_2\varepsilon_0 + \phi_1\varepsilon_0$

q= $\varepsilon_0(\phi_1 + \phi_2)$

30. Electric field on surface of uniform change sphere.

$$\frac{Q}{4\pi\varepsilon_0 R^2} = \frac{\rho R}{3\varepsilon_0}$$

'E' at out side

$$E = \frac{Q}{4\pi\varepsilon_0 r^2} = \frac{\rho R^3}{3\varepsilon_0 r^2}$$

$$E_B = E_{wholesphere} - E_{cavity}$$

$$\frac{\rho r_0}{3\varepsilon_0} - \frac{\rho\left(\frac{r_0}{2}\right)^3}{3\varepsilon_0\left(\frac{3r_0}{2}\right)^2} = \frac{17\rho r_0}{54\varepsilon_0} left$$

THE END...

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