	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	**Department: SCIENCE 2026 – 27** **SUBJECT: PHYSICS**	**Date of submission: 17-04-2026**
Worksheet No: 1	**CHAPTER: 1; ELECTRIC CHARGES AND FIELDS**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.**

MCQs (Choose the correct statement)

1.If a charged hollow sphere and a solid sphere of aluminium and copper of equal radii are in electrostatic equilibrium, then which of the following statements is true? CBSE 2026

(a) Both the spheres are having equal charges.

(b) The hollow sphere will have more charge than the solid sphere at its surface.

(c) The aluminium sphere will have more charge on its surface than the copper sphere.

(d) If the hollow sphere is also made up of aluminium, then it will have more charge.

2. Electric flux emanating through a surface element $d\vec{A} = 10\,\hat{\imath}$ placed in an electric field, $\vec{E} = 2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}$

(a) 10 units CBSE 2026

(b) 20 units

(c) 4 units

(d) 16 units

3. The electric field at a point in a region is given by E = $\alpha \frac{r}{|\vec{r}|^3}$, where α is a constant and r is the distance of the point from origin. The magnitude of potential of the point is CBSE 2025

(a) $\frac{\alpha}{r}$ (b) $\frac{\alpha r^2}{2}$ (c) $\frac{\alpha}{2r^2}$ (d) $-\frac{\alpha}{r}$

4. Two charge particles P and Q having the same charge but different masses m_P and m_Q, starts from rest and travel equal distances in a uniform electric field E in the time t_P and t_Q respectively. Neglecting the effect of gravity, the ratio (t_P / t_Q) is: CBSE 2024

(a) m_P / m_Q (b) m_Q / m_P (c) $\sqrt{m_P / mQ}$ (d) $\sqrt{m_Q / mP}$

5. A point charge situated at a distance 'r' from a short electric dipole on its axis, experiences a force $\vec{F}$. If the distance of the charge is '2r', the force on charge will be: CBSE 2023

(a) $\vec{F}$ /16 (b) $\vec{F}$ /8 (c) $\vec{F}$ /4 (d) $\vec{F}$ /2

6. The magnitude of the electric field due to a point charged object at a point distance of 4.0 m is 9 N/C. from the same charged object the electric field of magnitude, 16 N/C will be at a distance of CBSE 2023

(a) 1 m (b) $2m$ (c) $3m$ (d) $6m$

7. A point P lies at a distance x from the mid-point of an electric dipole on its axis. The electric field at a point P is proportional to CBSE 2023

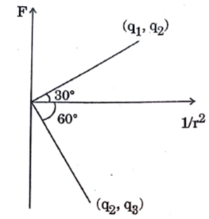
(a) $1/x^2$ (b) $1/x^3$ (c) $1/x^4$ (d) $1/x^{1/2}$

8. Two charges q_1 and q_2 are placed at the centres of two spherical conducting shells of radius r_1 and r_2 respectively. The shells are arranged such that their centres are d [> $(r_1 + r_2)$] distance apart. The force on q_2 due to q_1. CBSE 2023

(a) $\frac{1}{4\pi\epsilon_o}\frac{q_1q_2}{d^2}$ (b) $\frac{1}{4\pi\epsilon_o}\frac{q_1q_2}{(d-r_1)^2}$ (c) zero (d) $\frac{1}{4\pi\epsilon_o}\frac{q_1q_2}{[d-(r_1+r_2)]^2}$

9. Coulomb force F versus $(1/r^2)$ graphs for two pairs of point charges (q_1 and q_2) and (q_2 and q_3) are shown in the figure. The ratio of charges (q_1/q_3) is: CBSE 2024

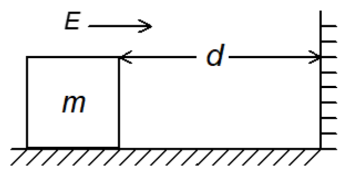
(a) *3* (b) 1/*3* (c) $\sqrt{3}$ (d) $1/\sqrt{3}$



10. A charge Q is placed at each of the two opposite corners of a square. A charge q is placed at each of the other two corners. If the resultant electric force on Q is zero, then Q is equal to

(a) $\frac{2\sqrt{2}}{q}$ (b) $\frac{-q}{2\sqrt{2}}$ (c) $-2\sqrt{2}q$ (d) $2\sqrt{2}q$

11. A block of mass m carrying a positive charge q is placed on a smooth horizontal table, which ends in a vertical wall situated at a distance d from block. An electric field E is switched on towards right. Assuming elastic collisions, find the time period of resultant oscillation



(a) $\sqrt{\frac{2qEd}{m}}$ (b) $\sqrt{\frac{8\ md}{qE}}$ (c) $\sqrt{\frac{2\ md}{qE}}$ (d) $\sqrt{\frac{md}{qE}}$

12. An electric dipole is placed in an electric field generated by a point charge. Then

(a) the net electric force on the dipole must be zero

(b) the net electric force on the dipole may be zero

(c) the torque on the dipole due to the field may be zero

(d) the torque on the dipole due to the field must be zero

Assertion-Reason type questions;

Directions: *Choose any one of the following four responses.*

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) Assertion is correct, Reason is incorrect

(d) Both Assertion and Reason are correct.

13. **Assertion**: Total energy of an electron in a hydrogen atom is negative.
Reason: The centripetal force is provided by electrostatic force. CBSE 2026

14. **Assertion:** Electric lines of force never cross each other.
Reason: Electric field at a point superimpose to give one resultant electric field.

15. **Assertion:** The Coulomb force is the dominating force in the universe.
Reason: The Coulomb force is weaker than the gravitational force.

16. **Assertion:** When bodies are charged through friction, there is a transfer of electric charge from one body to another, but no creation or destruction of charge.
Reason: This follows from conservation of electric charges.

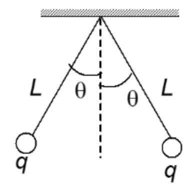
Descriptive type questions (2/3 marks)

17. How many electrons must be removed from a piece of metal so as to leave it with a positive charge of 3.2×10^{-17} coulomb?

18. A copper penny has a mass of 32 g. Being electrically neutral, it contains equal amounts of positive and negative charges. What is the magnitude of these charges in μC. A copper atom has a positive nuclear charge of 3×10^{-26} C. Atomic weight of copper is 64g/mole and Avogadro's number is 6×10^{-26} atoms/mole.

19. The electron and the proton in a hydrogen atom are 0.53×10^{-11} m apart. Compare the electrostatic and the gravitational forces between them in power of 10^{-41}.

20. Two identical small charged spheres, each having a mass of 3.0 × 10–2 kg, hang in equilibrium as shown below. If the length of each string is $\sqrt{\frac{3}{2}}$m and the angle θ = 45°, find the magnitude of the charge on each sphere in nC. (g = 10 m/s^2)



21. An electron (q = – e) is placed near a charged body experiences a force in the positive y direction of magnitude 3.60×10^{-8} N.

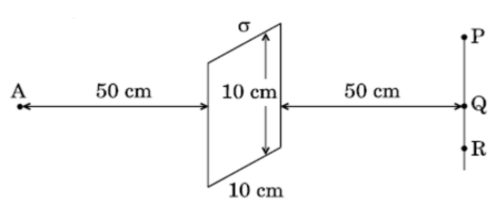
(a) The electric field at that location is n x 10^{-9}, find n.

(b) What would be the force exerted by the same charged body on an alpha particle (q = +2e) placed at the location initially occupied by the electron?

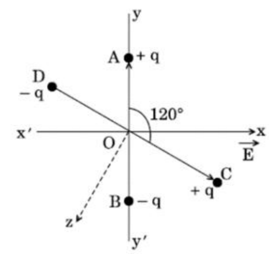
22. Use Gauss's law to show that due to a uniformly charged spherical shell of radius R, the electric field at any point situated outside the shell at a distance r from its centre is equal to the electric field at the same point, when the entire charge on the shell were concentrated at its centre. Also plot the graph showing the variation of electric field with r, for r ≤ R and r ≥R.

(b) Two-point charges of + 1 μC and + 4 μ C are kept 30 cm apart. How far from the + 1 μ C charge on the line joining the two charges, will the net electric field be zero?

23. (a) A uniformly charged large plane sheet has charge density, $\sigma = \frac{1}{18\pi}$ x 10^{-15} C/m^2. find the electric field at point A which is at 50 cm from the sheet. Consider a straight line with three points P, Q and R, placed 50 cm from the charged sheet on the right side as shown in the figure, at which of these points, does the magnitude of the electric field due to the sheet remains the same as that at point A and why?

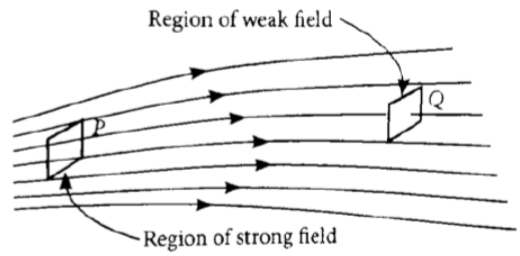


24. Two small identical electric dipoles AB and CD, each of dipole moment $\vec{P}$ are kept at an angle of 120° to each other in an external electric field $\vec{E}$ pointing along the x-axis as shown in the figure. Find the
(a) dipole moment of the arrangement, and
(b) magnitude and direction of the net torque acting on it.



25. (a) Derive an expression for the electric field at any point on the axial line of an electric dipole.
(b) Two identical point charges, q each, are kept 2m apart in air. A third point charge Q of unknown magnitude and sign is placed on the line joining the charges such that the system remains in equilibrium. Find the position and nature of Q.

Case Study Question:
26. Electric field strength is proportional to the density of lines of force i.e., electric field strength at a point is proportional to the number of lines of force cutting a unit area element placed normal to the field at that point. As illustrated in given figure, the electric field at P is stronger than at Q.



(i) Electric lines of force about a positive point charge are
(a) radially outwards (b) circular clockwise
(c) radially inwards (d) parallel straight lines

(ii) Which of the following is false for electric lines of force?
(a) They always start from positive charge and terminate on negative charges.
(b) They are always perpendicular to the surface of a charged conductor.
(c) They always form closed loops.
(d) They are parallel and equally spaced in a region of uniform electric field.

(iii) Which one of the following patterns of electric line of force is not possible in field due to stationary charges?

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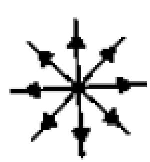
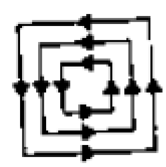
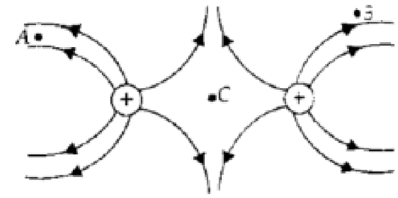
(b) 
(c) 
(d) 

(iv) Electric field lines are curved
(a) in the field of a single positive or negative charge
(b) in the field of two equal and opposite charges.
(c) in the field of two like charges.
(d) both (b) and (c)

(v) The figure below shows the electric field lines due to two positive charges. The magnitudes E_A, E_B and E_C of the electric fields at point A, B and C respectively are related as



(a) $E_A>E_B>E_C$ (b) $E_B>E_A>E_C$ (c) $E_A=E_B>E_C$ (d) $E_A>E_B=E_C$

27. Smallest charge that can exist in nature is the charge of an electron. During friction it is only the transfer of electron which makes the body charged. Hence net charge on any-body is an integral multiple of charge of an electron (1.6×10^{-19} C) i.e., q=±ne, where r= 1, 2, 3, 4 …. Hence, no-body can have a charge represented as 1.8e, 2.7e, 2e/5, etc. Recently, it has been discovered that elementary particles such as protons or neutrons are elemental units called quarks.

(i) Which of the following properties is not satisfied by an electric charge?
(a) Total charge conservation. (b) Quantization of charge.
(c) Two types of charge. (d) Circular line of force.

(ii) Which one of the following charges is possible?
(a) 5.8×10^{-18} C (b) 3.2×10^{-18} C
(c) 4.5×10^{-19} C (d) 8.6×10^{-19} C

(iii) If a charge on a body is 1 nC, then how many electrons are present on the body?
(a) 6.25×10^{27} (b) 1.6×10^{19} (c) $6.25 \text{ X } 10^{28}$ (d) $6.25 \text{ X } 10^{9}$

(iv) If a body gives out 10^9 electrons every second, how much time is required to get a total charge of 1 from it?
(a) 190.19 years (b) 150.12 years (c) 198.19 years (d) 188.21 years

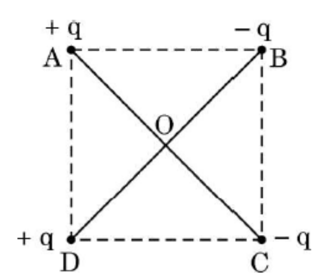
(v) A polythene piece rubbed with wool is found to have a negative charge of 3.2×10^{-7}C. Calculate the number of electrons transferred.
(a) 2×10^{12} (b) 3×10^{12} (c) 2×10^{14} (d) 3×10^{14}

Long answer type questions: (5 marks)

28. (i) Derive an expression for the electric field at a point on the equatorial plane of an electric dipole consisting of charges q and q separated by a distance 2a.

(ii) The distance of a far-off point on the equatorial plane of an electric dipole is halved. How will the electric field be affected for the dipole?

(iii) Two identical electric dipoles are placed along the diagonals of a square ABCD of side $\sqrt{2}$ m as shown in the figure. Obtain the magnitude and direction of the net electric field at the centre (O) of the square. CBSE 2024



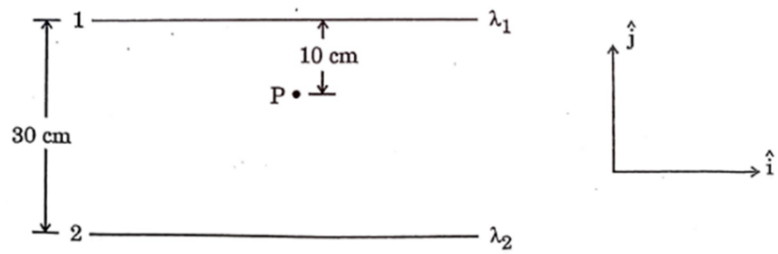
29. (i) Use Gauss' law to obtain an expression for the electric field due to an infinitely long thin straight wire with uniform linear charge density λ.

(ii) An infinitely long positively charged straight wire has a linear charge density λ. An electron is revolving in a circle with a constant speed v such that the wire passes through the center, and is perpendicular to the plane, of the circle. Find the kinetic energy of the electron in terms of magnitudes of its charge and linear density λ on the wire.

(iii) Draw a graph of kinetic energy as a function of linear charge density λ. CBSE 2025

30. (i) State Gauss's Law in electrostatics. Apply this to obtain the electric field at appoint near a uniformly charged infinite sheet. CBSE 2023

(ii) Two long straight wires 1 and 2 are kept as shown in the figure. The linear charge density of the two wires are λ_1 = 10 μ C/m and λ_2 = - 20 μC/m. Find the net force F experienced by an electron held at point P.



Answers;

MCQs: -1. a, 2.b, 3.d, 4.c, 5.c, 6.c, 7.b, 8.c, 9.b, 10.c, 11.b, 12.c,

13. B

14. A

15. D

16. A

17. From 'Quantization of charge' we know, $Q = ne$

$$\therefore n = \frac{Q}{e} = \frac{3.2\times10^{-17}C}{1.6\times10^{-19}C} = \mathbf{200}$$

18. 1 mole i.e., 64 g of copper has 6×10^{23} atoms. Therefore, the number of atoms in copper penny of 32 g is

$$\frac{6\times10^{23}}{64}\times 32\times10^{-3} = 3\times10^{20}$$

One atom of copper has each positive and negative charge of 3×10^{-26} C. So each charge on the penny is

$(3 \times 10^{20}) \times (3 \times 10^{-26})$ = **9μC.**

19. The magnitude of the electrostatic force is

$$F_E = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2}$$

$$= \frac{(9\times10^9\ N-m^2/C^2)\times(1.6\times10^{-19}C)^2}{(5.3\times10^{-11}m)^2}$$

$= 8.2 \times 10^{-8}$ N

The magnitude of the gravitational force is

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

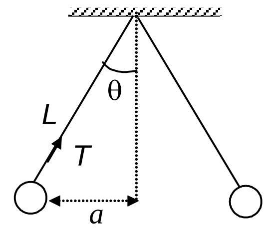
$$= \frac{(6.67\times10^{-11}\text{N}-\text{m}^2/\text{kg}^2)(9.11\times10^{-31}\text{kg})(1.67\times10^{-27}\text{kg})}{(5.3\times10^{-11}\text{m})^2}$$

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

The ratio of the forces

$\frac{F_G}{F_E}$ = **44**

20.



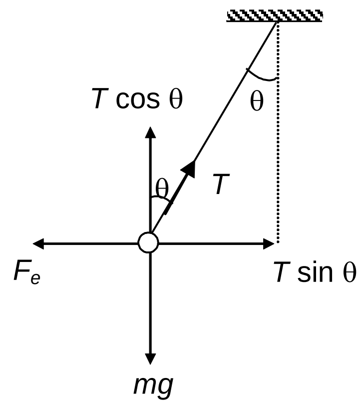
From the right angled triangle, we have $\sin\theta = \frac{a}{L}$

or, $a = L \sin\theta$ = (15 m) sin 5° = 0.013 m

Hence, the separation of the spheres is

$2a$ = 0.026 m

F.B.D. of one of the spheres:-



Since the sphere is in equilibrium, the resultants of the forces in the horizontal and vertical directions must separately add up to zero. thus

$T \sin\theta - F_e = 0$

$\Rightarrow$ $T \sin\theta = F_e$ ... (i)

and $T \cos\theta - mg = 0$

$\Rightarrow$ $T \cos\theta = mg$ ... (ii)

Dividing equation (i) by equation (ii) , we get

$\tan\theta = \frac{F_e}{mg}$ or, $F_e = mg \tan\theta$

$= (3 \times 10^{-2}\text{ kg}) \times (10\text{ m/s}^2)(\tan 45°)$

= 0.3 N

Let q be charge on each sphere.

According to Coulomb's law

$$F_e = \left(\frac{1}{4\pi\varepsilon_0}\right)\frac{|q||q|}{r^2}$$

$\therefore$ q = **15 μC**

21. Using equation (7), we have

$$E_y = \frac{|F_y|}{|q_0|} = \frac{3.60\times10^{-8}\text{N}}{1.60\times10^{-19}\text{C}}$$ = **225**

The electric field is in the negative y direction.

(b) The force on the alpha particle is given by

$F_y = q_0 E_y = 2(+1.60 \times 10^{-19}\text{ C})(2.25 \times 10^{11}\text{ N/C})$ = **72**

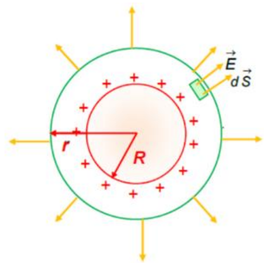
The force is in the negative *y* direction, the same direction as the electric field.

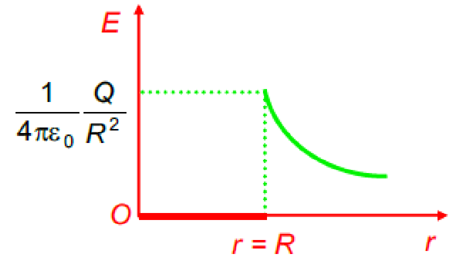
22. (a) point is outside,

$\phi_E = \oint \vec{E}.\mathrm{d}\vec{A} = \frac{q}{\epsilon_\circ}$,

$E.\oint \mathrm{dA} = \frac{q}{\epsilon_\circ}$, $\quad$ $E.(4\pi r^2) = \frac{q}{\epsilon_\circ}$

$E = \frac{1}{4\pi\epsilon_\circ}\frac{q}{r^2}$ $\quad$ $E \propto \frac{1}{r^2}$





At the surface,

$E_{MAX} = \frac{1}{4\pi\epsilon_\circ}\frac{q}{R^2}$

(b) let distance from 1 μC is 'r' then, from 4 μC is (30 - r)

$$E_1 = E_2$$

$$\frac{1}{4\pi\epsilon_\circ}\frac{q1}{r^2} = \frac{1}{4\pi\epsilon_\circ}\frac{q2}{(30-r)^2}$$

$$\frac{30-r}{r} = \sqrt{\frac{q1}{q2}} = \frac{2}{1}$$

$$30 - r = 2r$$

$$r = 10 \text{ cm}$$

23. Electric field due to a uniformly charged sheet

$$E = \frac{\sigma}{2\varepsilon_0}$$

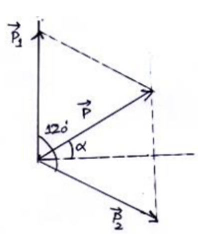
$$E = \frac{1 \times 10^{-15} \times 4\pi \times 9 \times 10^9}{18\pi \times 2} \quad \left(\because \frac{1}{\varepsilon_0} = 4\pi \times 9 \times 10^9\right)$$

$E = 10^{-6}$ N/C outwards.

Point is Q

As, for the finite plane sheet, electric field is uniform in the middle and the edges it will be curved.

24.



$$P = (p_1^2 + p_2^2 + 2\,p_1\,p_2\cos 120^0)^{1/2}$$
$$= (2p^2 - p^2)^{1/2}$$
$$= p$$

Making 60^0 angle with $\overrightarrow{p_1}$ and $\alpha = 30^0$ (angle with X axis)

[$p_1 = p_2 = p$]

$$\vec{\tau} = \vec{P} \times \vec{E}$$
$$\tau = PE\sin 30^0$$
$$= \frac{1}{2}\text{pE}$$

25. (a) $E_{-q} = \frac{1}{4\pi\epsilon_\circ}\frac{q}{(r+a)^2}$ and $E_{+q} = \frac{1}{4\pi\epsilon_\circ}\frac{q}{(r-a)^2}$

$\vec{E} = \vec{E}_{-q} + \vec{E}_{+q} = \frac{1}{4\pi\epsilon_\circ}\frac{q}{(r-a)^2} - \frac{1}{4\pi\epsilon_\circ}\frac{q}{(r+a)^2}$

$\vec{E} = \frac{1}{4\pi\epsilon_\circ}\left(\frac{q}{(r-a)^2} - \frac{q}{(r+a)^2}\right) = \frac{q}{4\pi\epsilon_\circ}\left(\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2}\right) = \frac{q}{4\pi\epsilon_\circ}\left(\frac{(r+a)^2-(r-a)^2}{(r^2-a^2)^2}\right)$

$\vec{E} = \frac{q}{4\pi\epsilon_\circ}\left(\frac{r^2+a^2+2ar-r^2-a^2+2ar}{(r^2-a^2)^2}\right)$ (a<<r, a^2 is neglected)

$= \frac{q}{4\pi\epsilon_\circ}\left(\frac{4ar}{(r^2)^2}\right) = \frac{1}{4\pi\epsilon_\circ}\left(\frac{q.2a.2r}{r^4}\right) = \frac{1}{4\pi\epsilon_\circ}\left(\frac{2\vec{P}}{r^3}\right)$ $\quad\quad \vec{E} = \frac{1}{4\pi\epsilon_\circ}\left(\frac{2\vec{P}}{r^3}\right)$

(b) $\overrightarrow{F_{CA}} + \overrightarrow{F_{CB}} = \vec{0}$ or $\left|\overrightarrow{F_{CA}}\right| = \left|\overrightarrow{F_{CB}}\right|$

$\therefore \quad \frac{1}{4\pi\epsilon_0}\frac{qQ}{x^2} = \frac{1}{4\pi\epsilon_0}\cdot\frac{qQ}{(2-x)^2}$

$\Rightarrow \quad x = 2 - x$ or $x = 1m$

Again considering net force on charge q situated at point A, we have

$\overrightarrow{F_{AC}} + \overrightarrow{F_{AB}} = \vec{0}$

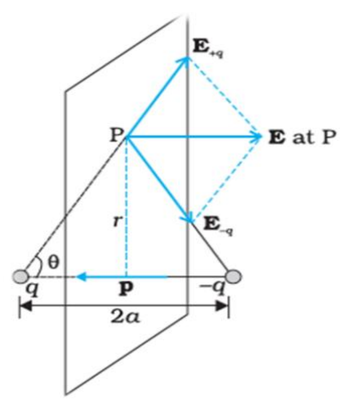
$\Rightarrow \quad \frac{1}{4\pi\epsilon_0}\cdot\frac{qQ}{(1)^2} + \frac{1}{4\pi\epsilon_0}\cdot\frac{q^2}{(2)^2} = 0$

$\Rightarrow \quad Q + \frac{q}{4} = 0$ or $Q = -\frac{q}{4}$

26. (i) (a) (ii) (c) (iii) (c) (iv)(d) (v) (a)

27. (i) (d) (ii) (b) (iii) (d) (iv)(c) (v) (a)

28. (i) As shown in the figure $\vec{E}$ is having two rectangular component, sine components are cancelling each other, we get net field in terms of cosine components,



$\vec{E}$ = 2Ecosθ

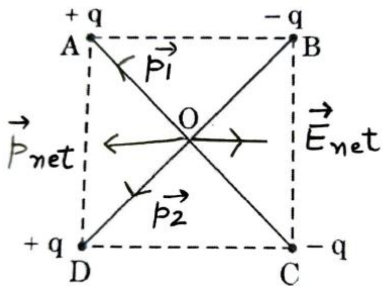
$\vec{E} = 2\frac{1}{4\pi\epsilon_\circ}\frac{q}{(\sqrt{r^2+a^2})^2} \times \frac{a}{\sqrt{r^2+a^2}}$

$\vec{E} = \frac{1}{4\pi\epsilon_\circ}\left(\frac{\vec{P}}{(r^2+a^2)^{3/2}}\right)$ (a<<r, a^2 is neglected)

$\vec{E} = \frac{1}{4\pi\epsilon_\circ}\left(\frac{\vec{P}}{r^3}\right)$

(ii) As, $\vec{E} = \frac{1}{4\pi\epsilon_\circ}\left(\frac{\vec{P}}{r^3}\right)$, increases 8 times.

(iii)



$p_1 = q \times 2\,Cm$ (along OA)

$p_2 = q \times 2\,Cm$ (along OD)

$p_{net} = \sqrt{p_1^2 + p_2^2}$

$= 2\sqrt{2}\,q\,Cm$

Electric field at centre O

$$E = \frac{kp_{net}}{(r^2 + a^2)^{3/2}}$$

at point O, r = 0 , a = 1 m

$$E = \frac{k \times 2\sqrt{2}q}{1^3} = 2\sqrt{2}kq = \frac{2\sqrt{2}q}{4\pi\in_o}$$

Along DC

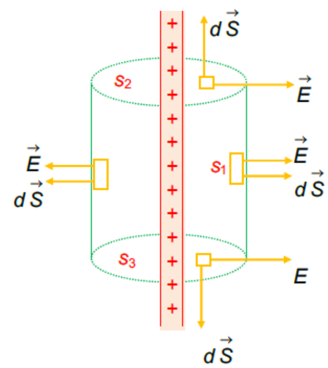
29. (i) Contribution of flux at flat surfaces (s_2 and s_3)

$= \vec{E}.\mathrm{d}\vec{A}$ = E dA cos90° = 0

Contribution of flux at curved surface(s_1)

$= \int \vec{E}.\mathrm{d}\vec{A} = \int \mathrm{E\,dA}\ \cos0° = \mathrm{E}\int \mathrm{dA} = \mathrm{E}(2\pi r L)$

Using Gauss's law,

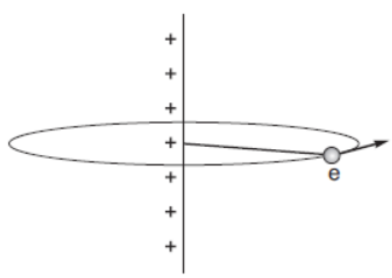


$\phi_E = \mathrm{E}(2\pi r\mathrm{L}) + 0 = \frac{total\ charge}{\epsilon_\circ} = \frac{\lambda L}{\epsilon_\circ}$

$\mathrm{E}2\pi r\mathrm{L} = \frac{\lambda L}{\epsilon_\circ}$, $\mathrm{E}2\pi r = \frac{\lambda}{\epsilon_\circ}$, $\mathrm{E} = \frac{1}{2\pi\epsilon_\circ}\frac{\lambda}{r}$.

(ii)

$$E = \frac{\lambda}{2\pi\varepsilon_0 r} \quad \text{... (1)}$$

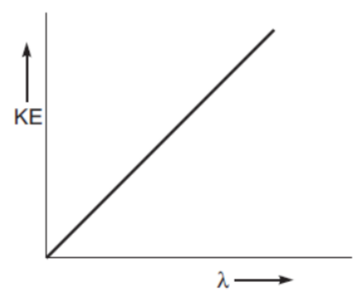


The revolving electron experience an electrostatic force and provides necessarily centripetal force.

$$eE = \frac{mv^2}{r} \quad \text{... (2)}$$

$$\frac{e.\lambda}{2\pi\varepsilon_0 r} = \frac{mv^2}{r}$$

$$\Rightarrow mv^2 = \frac{e\lambda}{2\pi\varepsilon_0}$$



Kinetic energy of the electron

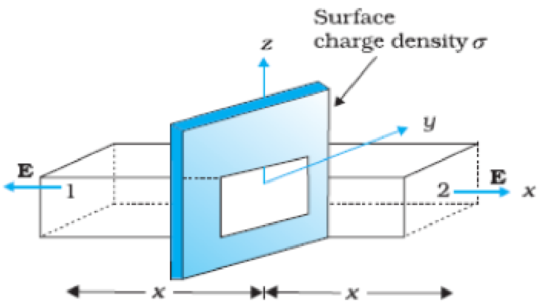
$$K = \frac{1}{2}mv^2 = \frac{e\lambda}{4\pi\varepsilon_0}$$

30.

The surface integral of electric field over a closed surface is $\frac{1}{\varepsilon_0}$ times the total charge enclosed by the surface.

$\oint \vec{E}.d\vec{S} = \frac{q}{\varepsilon_0}$

(Award ½ marks for writing the formula only.)



(Gaussian surface can be cylindrical also)
As seen from figure, only two faces 1 and 2 will contribute to the flux.
Flux $\vec{E}.d\vec{s}$ through both the surfaces is equal and add up.
The charge enclosed by surface is σA, where σ is surface charge density
According to Gauss's theorem

$2EA = \sigma A / \varepsilon_0$

$E = \sigma / 2\varepsilon_0$

$\vec{E} = \frac{\sigma}{2\varepsilon_0}\hat{n}$ where $\hat{n}$ is unit vector directed normally out of the plane

(ii) $\vec{E} = \dfrac{\lambda}{2\pi\varepsilon_0 r}\hat{r}$

According to question

$$E_1 \text{ (at point P)} = \frac{\lambda_1}{2\pi\varepsilon_0 r_1}$$

$$\vec{E} = \frac{10\times10^{-6}}{2\pi\varepsilon_0(10\times10^{-2})} \ (-\hat{j}) \ N/C$$

$$E_2 \text{ (at point P)} = \frac{\lambda_2}{2\pi\varepsilon_0 r_2}$$

$$\vec{E} = \frac{20\times10^{-6}}{2\pi\varepsilon_0(20\times10^{-2})} \ (-\hat{j}) \ N/C$$

$$E_{net} = \frac{10\times10^{-6}}{2\pi\varepsilon_0}\left(\frac{1}{0.1}+\frac{2}{0.2}\right) \ (-\hat{j}) \ N/C$$

$$= 3.6\times10^{6} \ (-\hat{j}) \ N/C$$

$$\vec{F}_{net} = q\times\vec{E}_{net}$$

$$\vec{F} = -1.6\times10^{-19}\times3.6\times10^{6} \ (-\hat{j}) \ N$$

$$= 5.76\times10^{-13} N \ (\hat{j})$$

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