JEE 2022

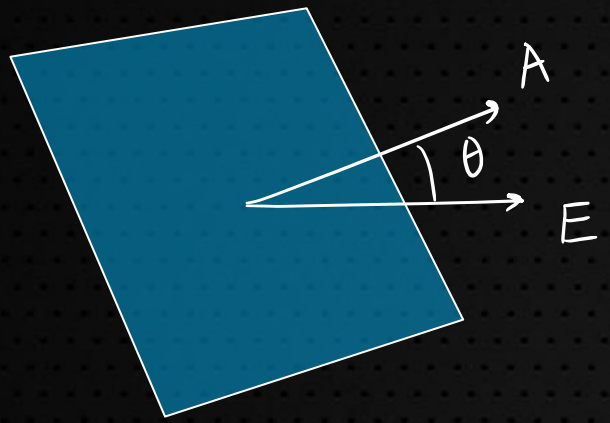
GAUSS'S LAW

CLEAR YOUR DOUBTS

MOHIT SIR-IIT KGP

ELECTRIC FLUX

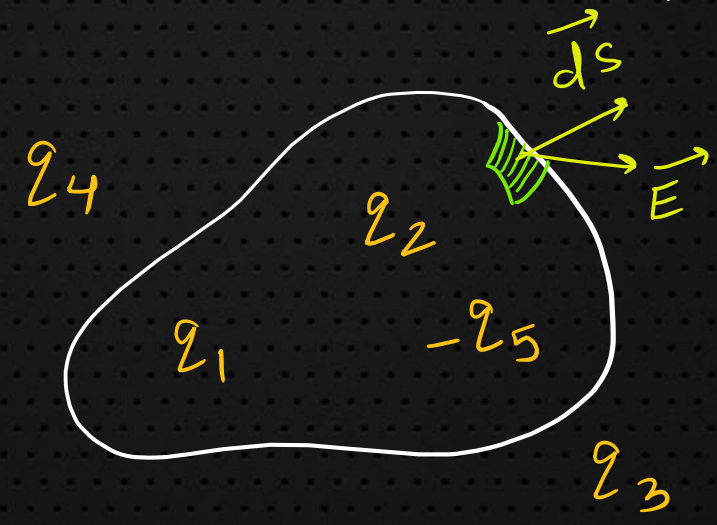
No of electric field lines crossing an area.



$$\phi = \vec{E} \cdot \vec{A} = EA\cos\theta$$

GAUSS'S LAW

Total flux linked with closed surface is $\frac{1}{\varepsilon_0}$ times the charge enclosed

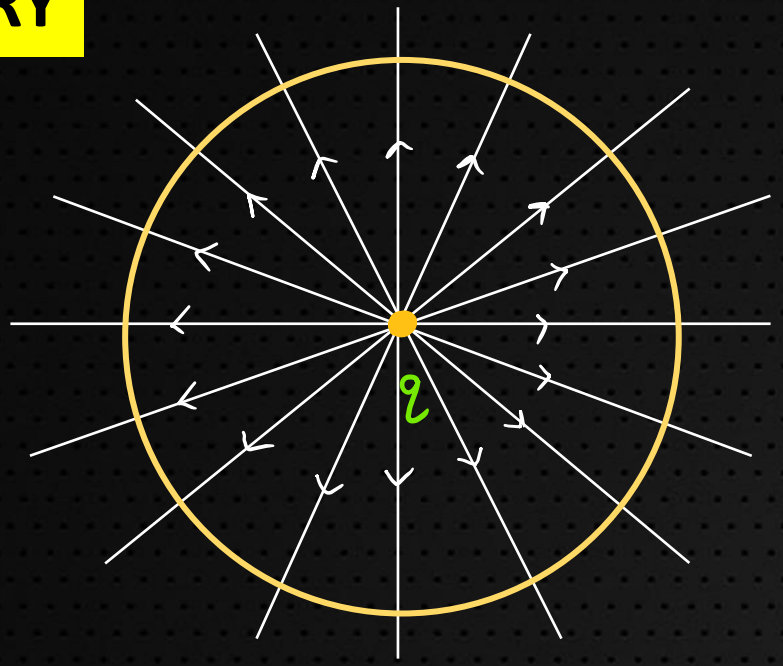


$$\oint \vec{E} \cdot \vec{ds} = \frac{q_{en}}{\varepsilon_0}$$

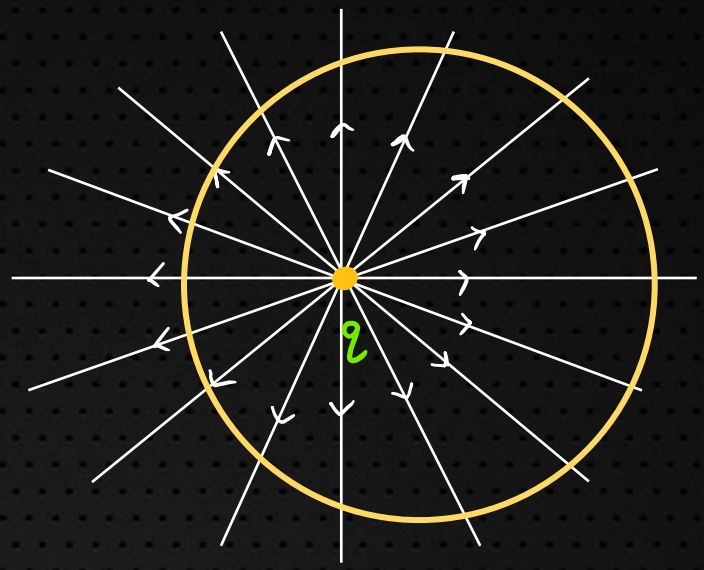
due to all charges

charge enclosed $(q_1 + q_2 - q_5)$

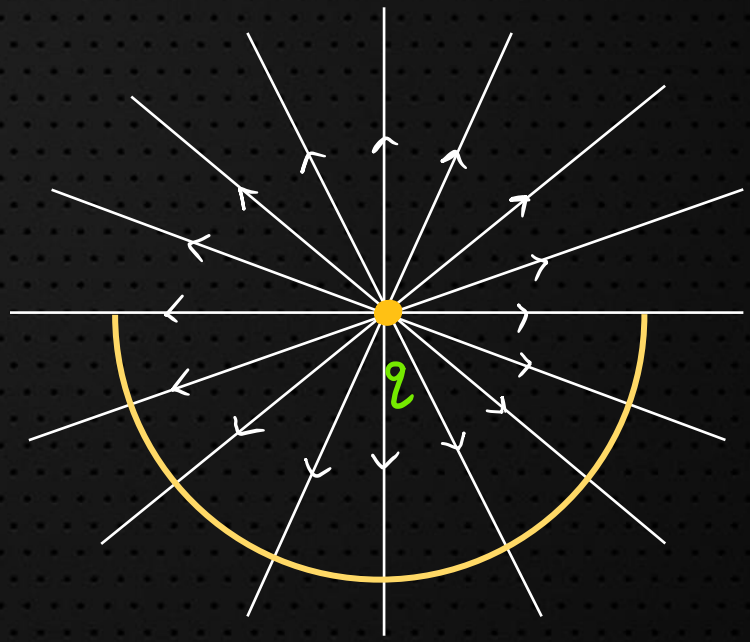
SYMMETRY



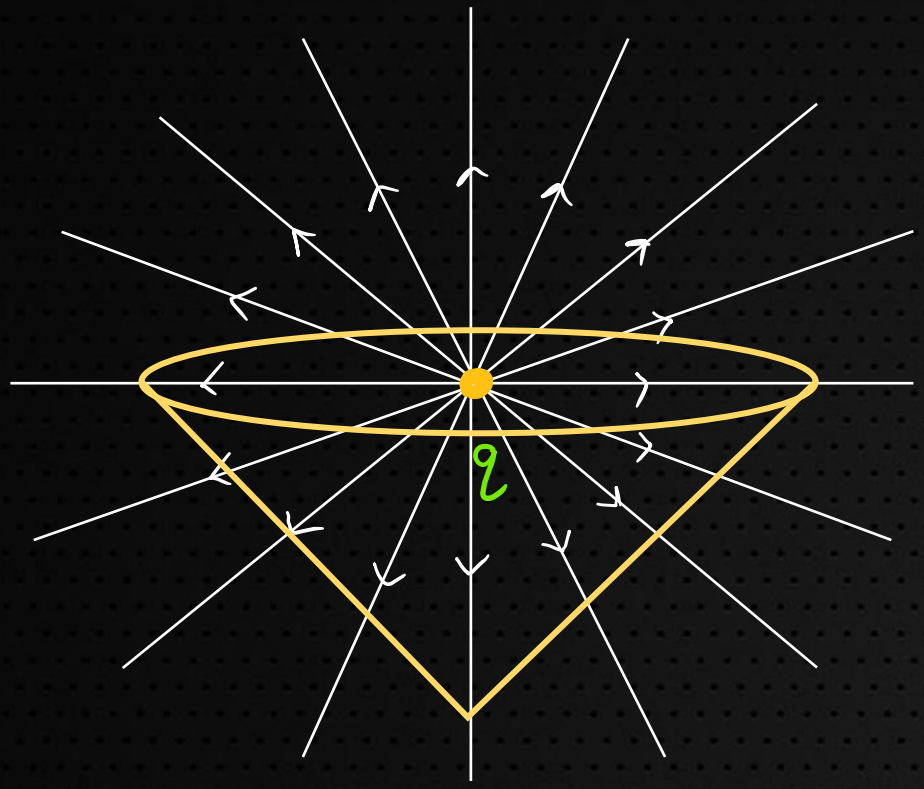
$\Phi = \frac{q}{\varepsilon_0}$



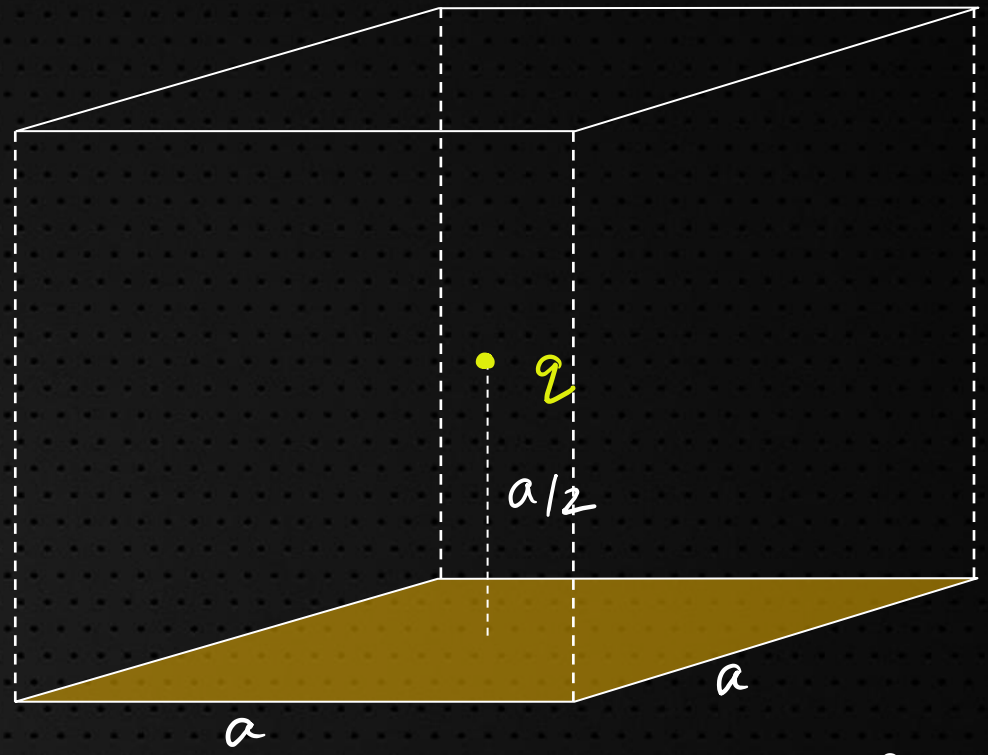
$\Phi = q/\varepsilon_0$



$\Phi = \frac{q}{2\varepsilon_0}$



$$\Phi = \frac{q}{2\varepsilon_0}$$

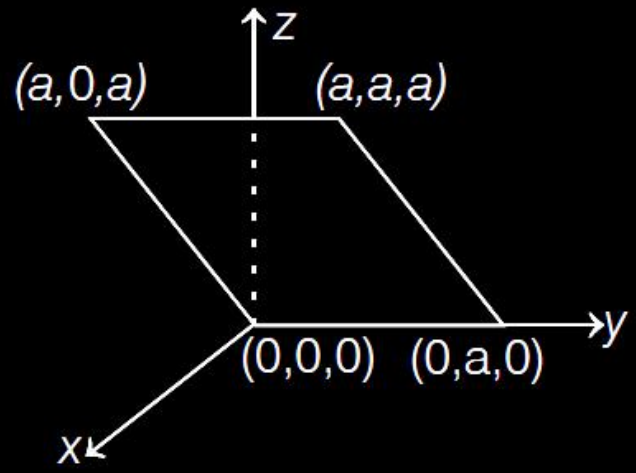


$$\Phi = \frac{1}{6} \times \frac{q}{\varepsilon_0}$$

Q1. The electric field in a region is given by $\vec{E} = \frac{E_0 x}{L}\hat{i}$.

Find the charge contained inside a cubical volume bounded by the surfaces $x = 0, x = a, y = 0, y = a, z = 0$ and $z = a$. (Take $E_0 = 5 \times 10^3$ N/C, $L = 2$cm and a = 1cm)

Q2. Consider an electric field $\mathbf{E} = E_0\,\hat{\mathbf{x}}$, where E_0 is a constant. The flux through the shaded area (as shown in the figure) due to this field is **(2011)**



(a) $2E_0a^2$

(b) $\sqrt{2}E_0a^2$

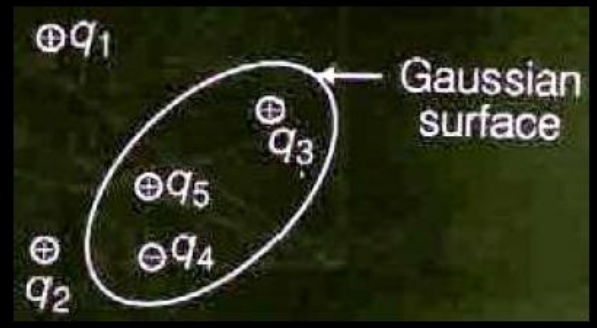
(c) E_0a^2

(d) $\dfrac{E_0a^2}{\sqrt{2}}$

Q3.

Consider a system of charges given in figure. For the Gaussian surface, Gauss' law states,

$$\int E.dA = \frac{q}{\varepsilon_0}$$



Which of the following statement is true?

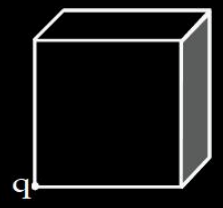
(a) E in the above equation will have a contribution of q_1 and q_2 and q will have a contribution from q_3, q_4 and q_5.

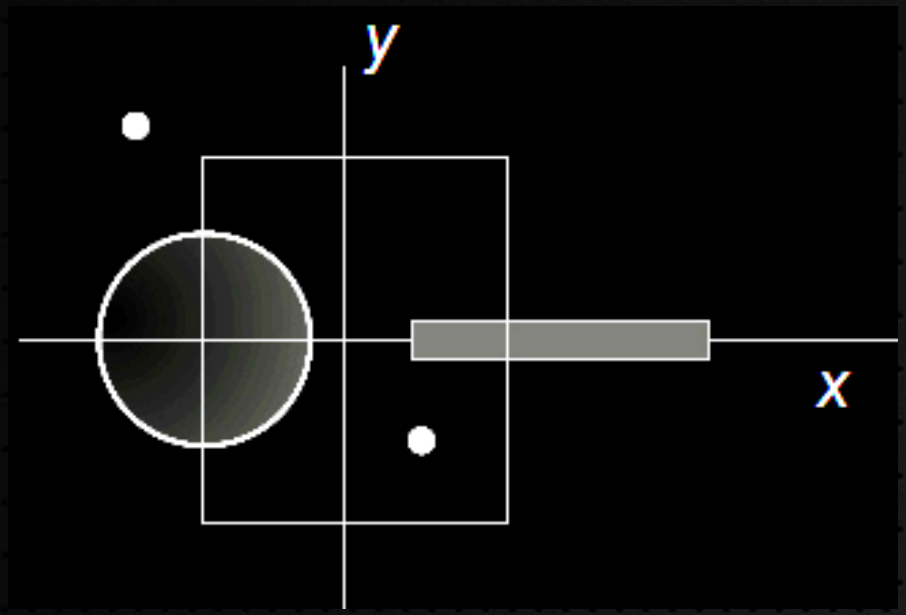
(b) E in the above equation will have a contribution from q_1, q_2, q_3, q_4 and q_5 and q will have a contribution from q_3, q_4 and q_5.

(c) E in the above equation will have a contribution from q_3, q_4 and q_5 and q will have a contribution from q_1, q_2, q_3, q_4 and q_5.

(d) Both E and q in the above equation will have contribution from q_3, q_4 and q_5 only.

Q4. The length of each side of a cubical closed surface is 1m. If charge q is situated on one of the vertices of the cube, then find the flux passing through shaded face of the cube.

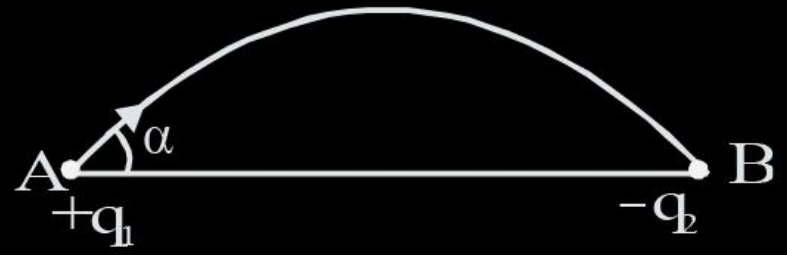




Q5. A disc of radius $\frac{a}{4}$ having a uniformly distributed charge 6C is placed in the x-y plane with its centre at $\left(\frac{-a}{2},0,0\right)$. A rod of length a carrying a uniformly distributed charge $8C$ is placed on the x-axis from $x=\frac{a}{4}$ to $x=\frac{5a}{4}$. Two point charges -7C and 3C are placed at $\left(\frac{a}{4},\frac{-a}{4},0\right)$ and $\left(\frac{-3a}{4},\frac{3a}{4},0\right)$, respectively. Consider a cubical surface formed by six surfaces $x=\pm\frac{a}{2}$, $y=\pm\frac{a}{2}$, $z=\pm\frac{a}{2}$. The electric flux through this cubical surface is **(2009)**

(a) $\frac{-2\,\text{C}}{\varepsilon_0}$ (b) $\frac{2\text{C}}{\varepsilon_0}$ (c) $\frac{10\text{C}}{\varepsilon_0}$ (d) $\frac{12\text{C}}{\varepsilon_0}$

Two charges + q_1 and $-q_2$ are placed at A and B respectively. A line of force emerges from q_1 at angle α with line AB. At what angle will it terminate at $-q_2$?



SOLID ANGLE CONCEPT

https://youtu.be/TqC9ONrBkw4

https://youtu.be/z_ZSxKkUrU0