Conductors, insulators, free charges and bound charges inside a conductor,

CLASS-XII

SUBJECT : PHYSICS
CHAPTER NUMBER: 02
CHAPTER NAME : ELECTROSTATIC POTENTIAL AND CAPACITANCE

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LEARNING OUTCOME

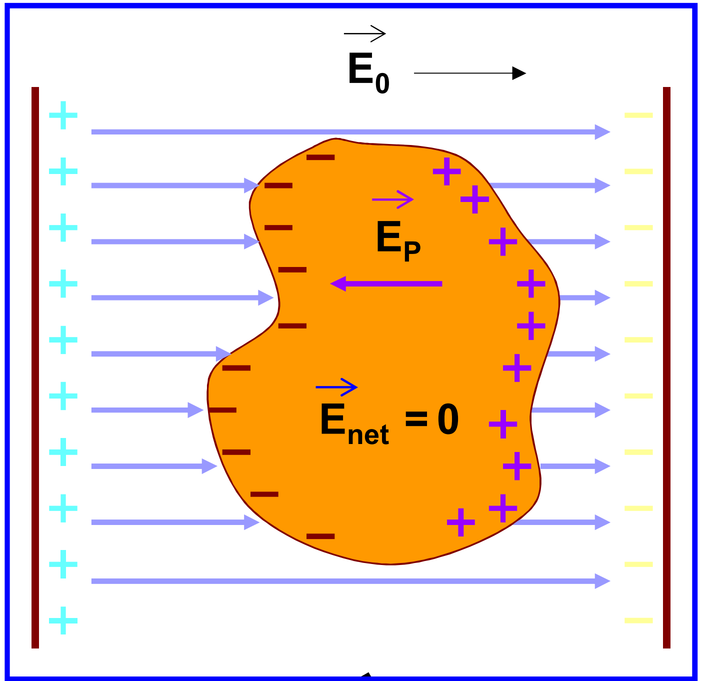
- Identify that the net electric field intensity in the interior of a conductor is zero .
- To understand that electric field just outside the charged conductor is perpendicular to the surface of the conductor.
- To understand that electric potential is constant inside the conductor.
- To explain that charge always resides on the surface of a conductor.
- To understand that during a thunderstorm accompanied by lightning, it is safest to sit inside a car.
- To understand why Sensitive components of electronic devices are protected or shielded from external electric disturbances.

REVIEW

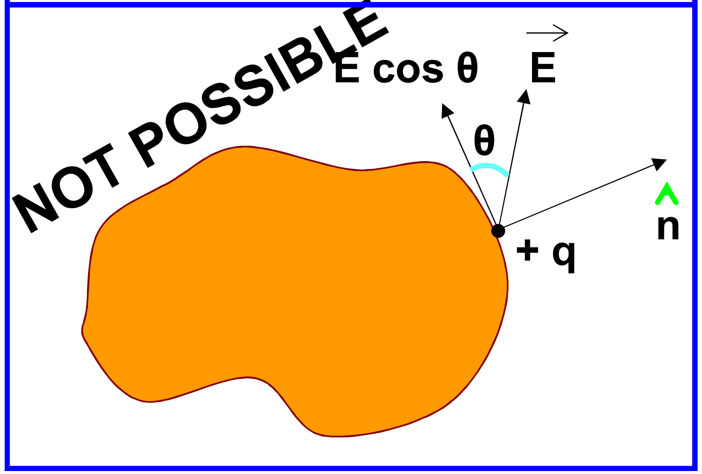
- How do assemble a number of charges by bringing it from infinity?
- How electric appliances are based on electric potential energy?
- What happens to your car's headlights before they are turned on?

Behavior of Conductors in the Electrostatic Field:

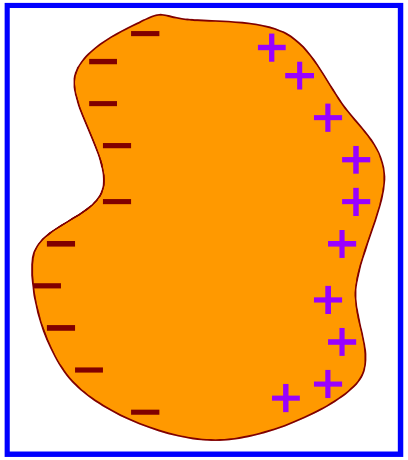
1. Net electric field intensity in the interior of a conductor is zero.



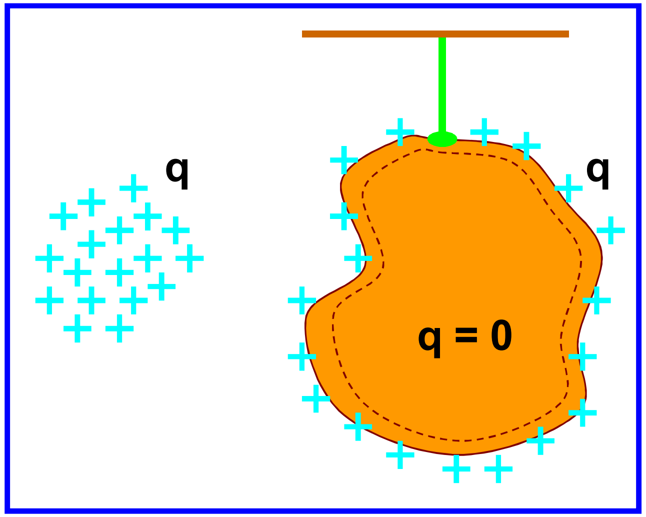
2. Electric field just outside the charged conductor is perpendicular to the surface of the conductor.



3. Net charge in the interior of a conductor is zero.



4. Charge always resides on the surface of a conductor.



5. Electric potential is constant for the entire conductor.

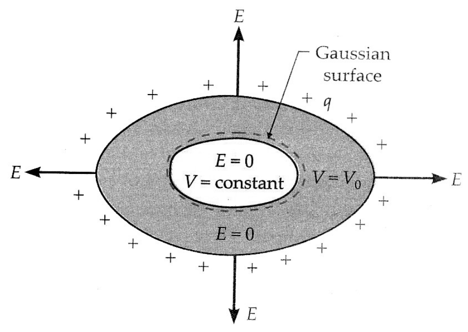
6. The electric field at any point close to the charged conductor is σ / ε_0

ELECTROSTATICS OF A CONDUCTOR

Electrostatic Shielding:-

Definition:- The phenomenon of making a region free from any electric field is called electrostatic shielding. it is based on the fact that the electric field varnishes inside the charity of a hollow conductor.

Proof:-



For the Gaussian Surface inside the conductor

$$\oint \vec{E}.\overrightarrow{ds} = \frac{q_{in}}{\varepsilon_0}$$

We know, E = 0 (inside the conductor)

Therefore $q_{in} = 0$

Furthermore, if we consider the surface of the cavity as a Gaussian surface

By Gauss Theorem,

$$\oint \vec{E}.\overrightarrow{ds} = \frac{q_{in}}{\varepsilon_0} = \frac{0}{\varepsilon_0}$$

E = 0 (inside the cavity)

Applications of Electrostatic Shielding:-

- In a thunderstorm accompanied by lightning, it is safest to sit inside a car, rather than near a tree or on the open ground. The metallic body of the car becomes an electrostatic shielding from lightning.
- Sensitive components of electronic devices are protected or shielded from external electric disturbances by placing metal shields around them.
- In a coaxial cable, the outer conductor connected to the ground provides an electrical shield to the signals carried by the central conductor.

HOME ASSIGNMENT

1. If a conductor has a potential $V \neq 0$ and there are no charges anywhere else outside, then
(a) there must be charges on the surface or inside itself.
(b) there cannot be any charge in the body of the conductor.
(c) there must be charges only on the surface.
(d) there must be charges inside the surface

2. Can there be a potential difference between two adjacent conductors carrying the same charge?

3. Two charged conducting spheres of radii *a* and *b* are connected to each other by a wire. What is the ratio of electric fields at the surfaces of the two spheres? Use the result obtained to explain why charge density on the sharp and pointed ends of a conductor is higher than on its flatter portions

THANKING YOU

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