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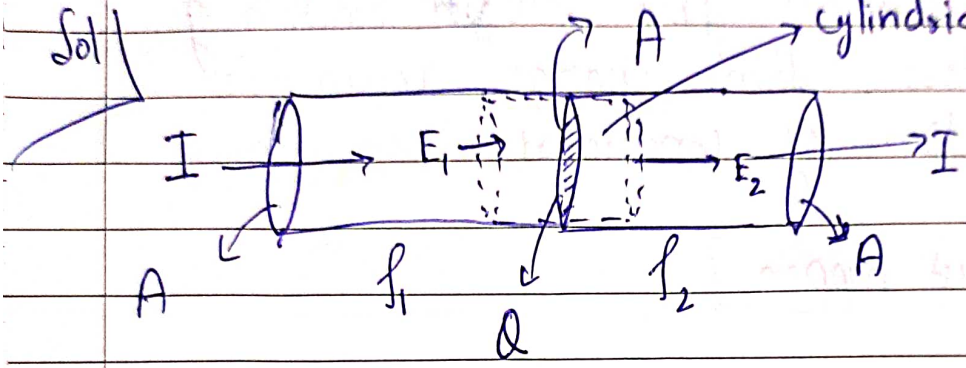
2021055

Date No.

Q] Two cylindrical conductors with equal cross-section and different resistivities ρ_1 and ρ_2 are put end to end. Find the charge at the ~~bond~~ boundry of conductors if a current I ~~follow~~ flows from conductor 1 to conductor 2.

Sol]



$$E = \rho \times J = \rho \frac{I}{A}$$

$$E_1 = \rho_1 \frac{I}{A} \quad \text{and} \quad E_2 = \rho_2 \frac{I}{A} \quad \text{---} \quad (1)$$

Consider cylindrical gaussian surface denoted by dotted cylinder

$$\Rightarrow \oint E \cdot dA = \frac{Q}{\epsilon_0}$$

$$\Rightarrow -E_1 A + E_2 A = \frac{Q}{\epsilon_0}$$

$$\Rightarrow (\rho_2 - \rho_1) I = \frac{Q}{\epsilon_0} \quad \text{(using (1))}$$

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$\Rightarrow$ ~~$Q = (E_2 - E_1) A \epsilon_0$~~

$$\boxed{Q = (\ell_2 - \ell_1) I \epsilon_0}$$

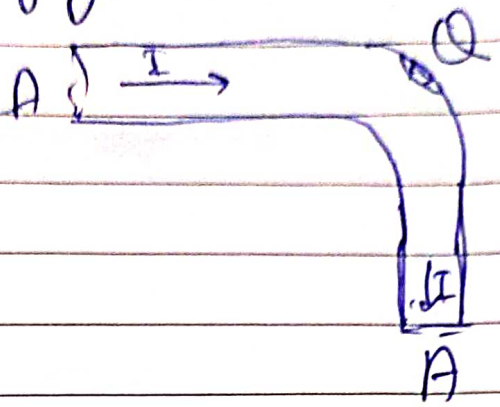
∴ When current flow ~~between~~ through junction of two conductors, some charge accumulate at the junction of conductors.

Why it must happen?

When current is flowing through one conductor the electric field is same, but when there are two conductors, there must be different electric fields to maintain steady flow of ~~current~~ current through their junction. As the conductor change, the resistivity also change, so charge flowing in that electric current should get some extra push or pull to maintain steady current, and this charge accumulated at the junction of ~~that conductors~~ these conductors is helpful and responsible in providing that extra push or pull

Beyond that:

Bending of wire.



When we bend a wire, certain charge (Q) is accumulated at the edge of the wire. This charge Q, after reaching to steady state help in ~~direct~~ directing upcoming charges towards bend.

In this case, since ρ (resistivity) is same, but charge density is different because of difference in area of wire at bend and area of straight wire, ~~So accumulated~~