

Charging by Induction

Charging an object without touching it



Step 1: Starting Neutral

A metallic conductor contains an enormous number of free electrons. In its normal state, the negative charges (electrons) exactly balance the positive charges (protons).

Net Charge: Zero

Status: Equilibrium



Key insight: Neutral does not mean “empty of charge.” It means “perfectly balanced.”



Step 2: Bring a Charged Body Nearby

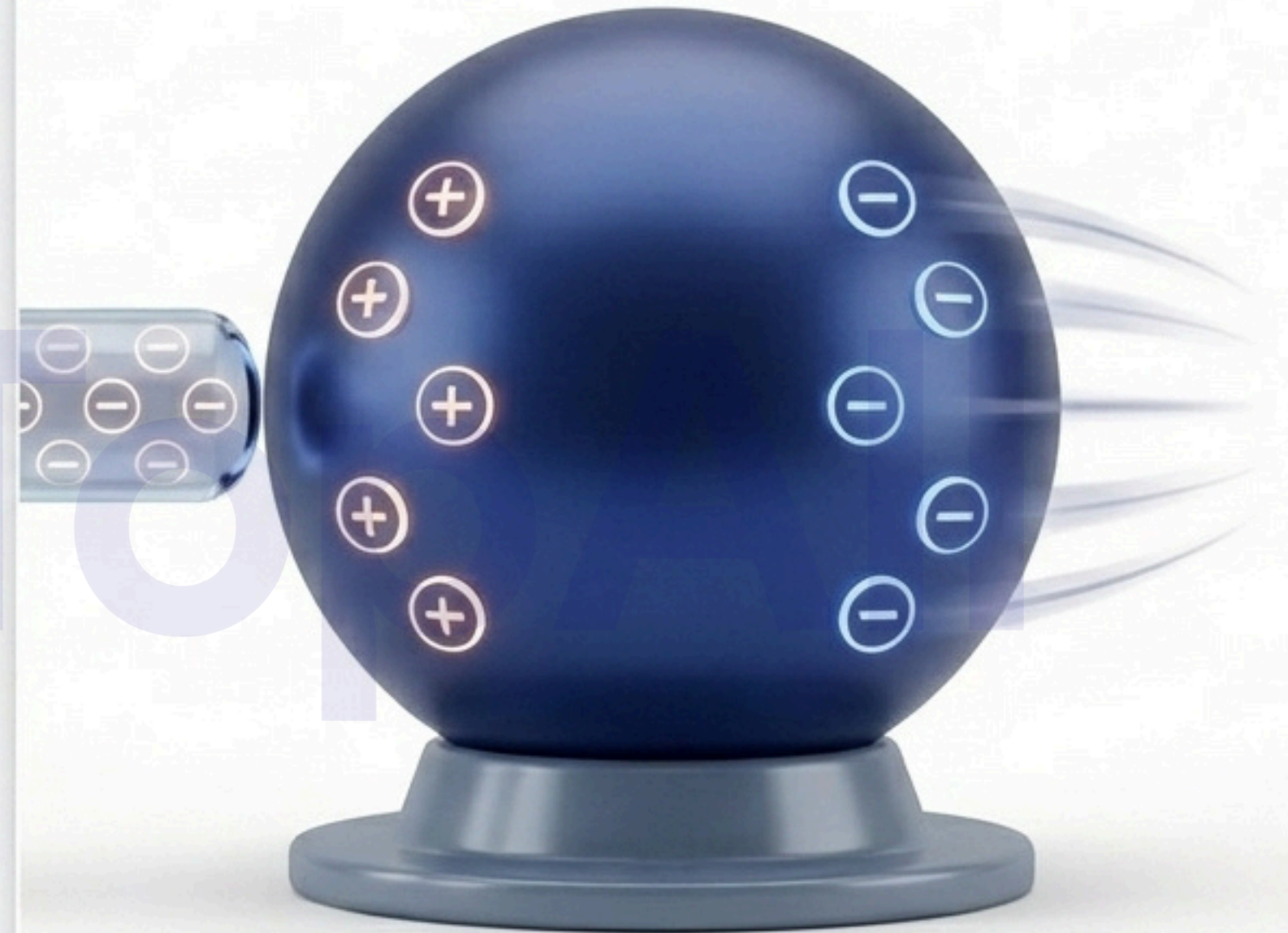
When a heavily charged object is brought close to the sphere, it exerts an electrostatic force. Free electrons inside the metal shift instantly.

Polarization

The separation of centers of positive and negative charge. The sphere has two poles, but the net charge is still zero!



Exam Trap: Do NOT let the rod touch the sphere! Direct contact is conduction, which transfers charge directly.





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$$E=mc^2$$



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Step 3: Earthing / Grounding

We connect the far side of the sphere to the Earth using a conducting wire. The Earth acts as an infinite sink.

The repelled electrons seize this path to escape the repulsive force of the rod.



Crucial Order: The inducing rod **MUST** remain in place to hold the positive charges captive while grounding happens.



Step 4: Final Charged State

First, disconnect the grounding wire. Second, remove the inducing rod. The sphere is now permanently charged with the opposite sign of the inducing body.

Final Charge: Positive

Net Charge: $+Q$



The inducing body loses NO charge during this entire process. It merely acts as an influencer.

1. Isolate



2. Remove Catalyst



Key Takeaways & Check Your Understanding

1. Polarize

Bring near, separate charges



2. Ground

Drain repelled charges



3. Isolate

Cut ground, remove rod

Q1: A positive rod induces a charge on a neutral sphere. Which particles move into the ground during Earthing?

Answer Box

None! Protons do not move. Electrons flow UP from the earth to neutralize the repelled positive end.

Q2: What happens if you remove the inducing rod before cutting the ground wire?

Answer Box

The sphere returns to neutral. The "captive" charges escape into the ground.

Next Module: 1.4.1 Basic Properties of Charge →



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