

[CHAPTER 3: CURRENT ELECTRICITY]

Resistivity of Various Materials

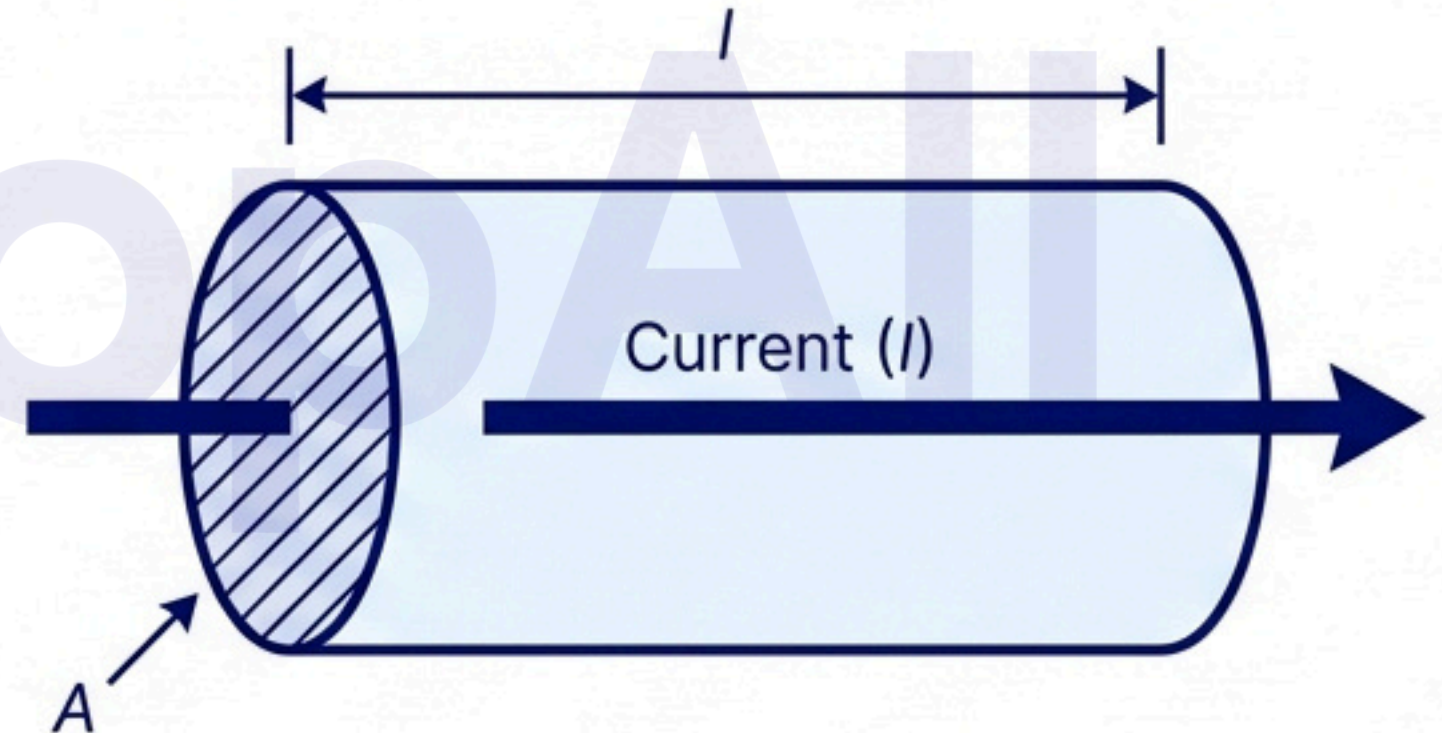
A comparative analysis of Conductors, Semiconductors,
and Insulators for NEET/JEE.

Defining Resistivity (ρ)

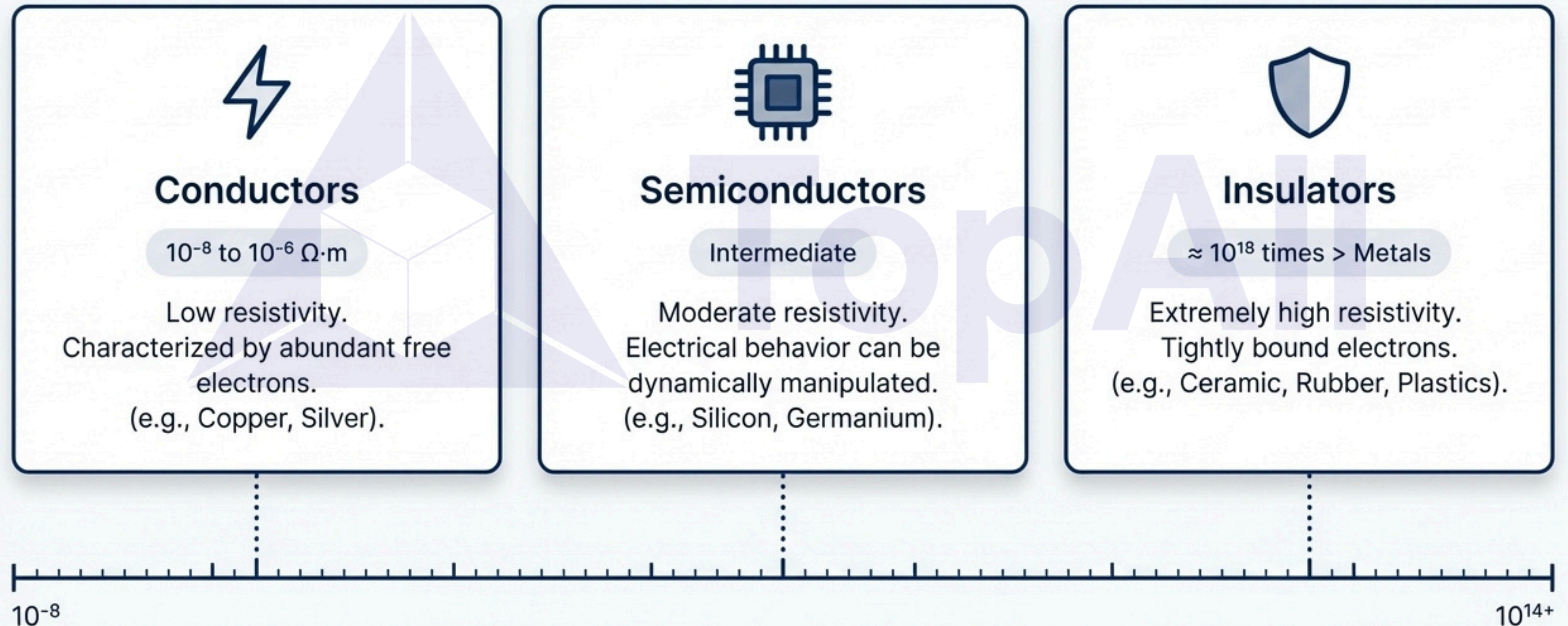
Resistivity is an intrinsic property of a material that quantifies how strongly it resists the flow of electric current. Unlike resistance, it does not depend on the physical dimensions of the object.

$$\rho = R \cdot \frac{A}{l}$$

SI Unit: Ohm-meter ($\Omega \cdot \text{m}$)



The Material Spectrum



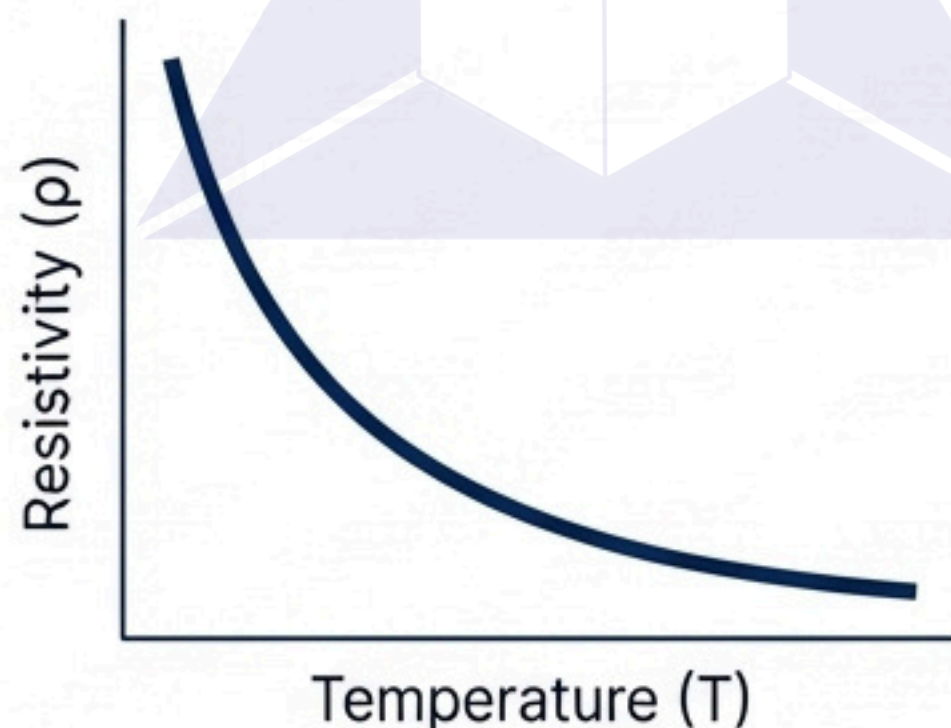
Why Semiconductors are Special

Unlike metals, the resistivity of semiconductors can be dynamically controlled.

Temperature Dependence

Heating decreases resistivity.

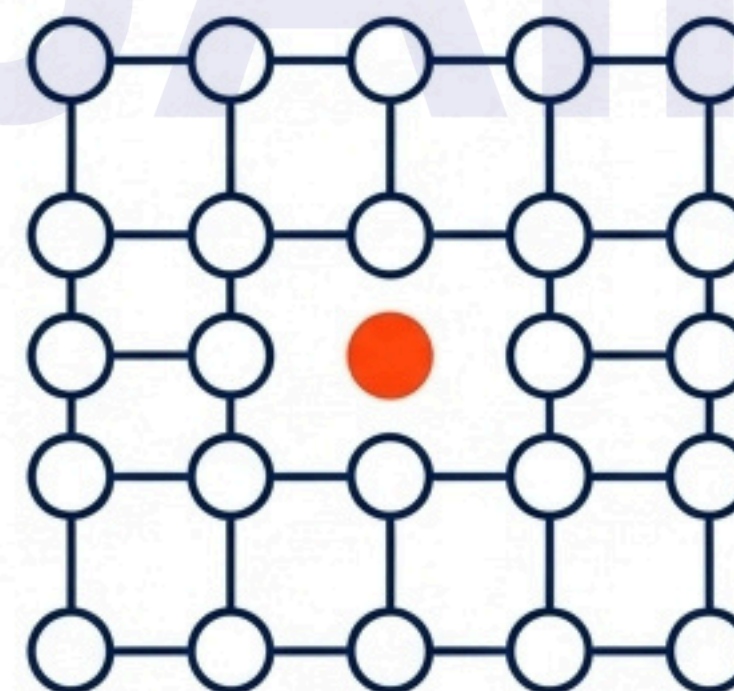
As temperature rises, the number of charge carriers (n) increases exponentially. This massive increase in n more than compensates for the decrease in relaxation time (τ), causing overall resistivity to fall.



Impurity Doping

Doping decreases resistivity.

Intentionally adding tiny amounts of specific impurities (doping) drastically reduces resistivity, forming the foundational mechanism behind all modern electronic devices.



[CHAPTER 3.7 SUMMARY]

Key Exam Takeaways

- ✓ **Resistivity** (ρ) is **intrinsic**: It is dependent entirely on the material's nature and temperature, never on its physical dimensions.
- ✓ **Massive magnitude span**: Insulators possess resistivities approximately 10^{18} times greater than typical metals.
- ✓ **Metal behavior**: For conductors, resistivity strictly increases with a rise in temperature.
- ✓ **Semiconductor behavior**: Uniquely, semiconductor resistivity decreases with a rise in temperature and with the introduction of impurities (doping).