

Resistance, Resistivity, Conductance & Conductivity

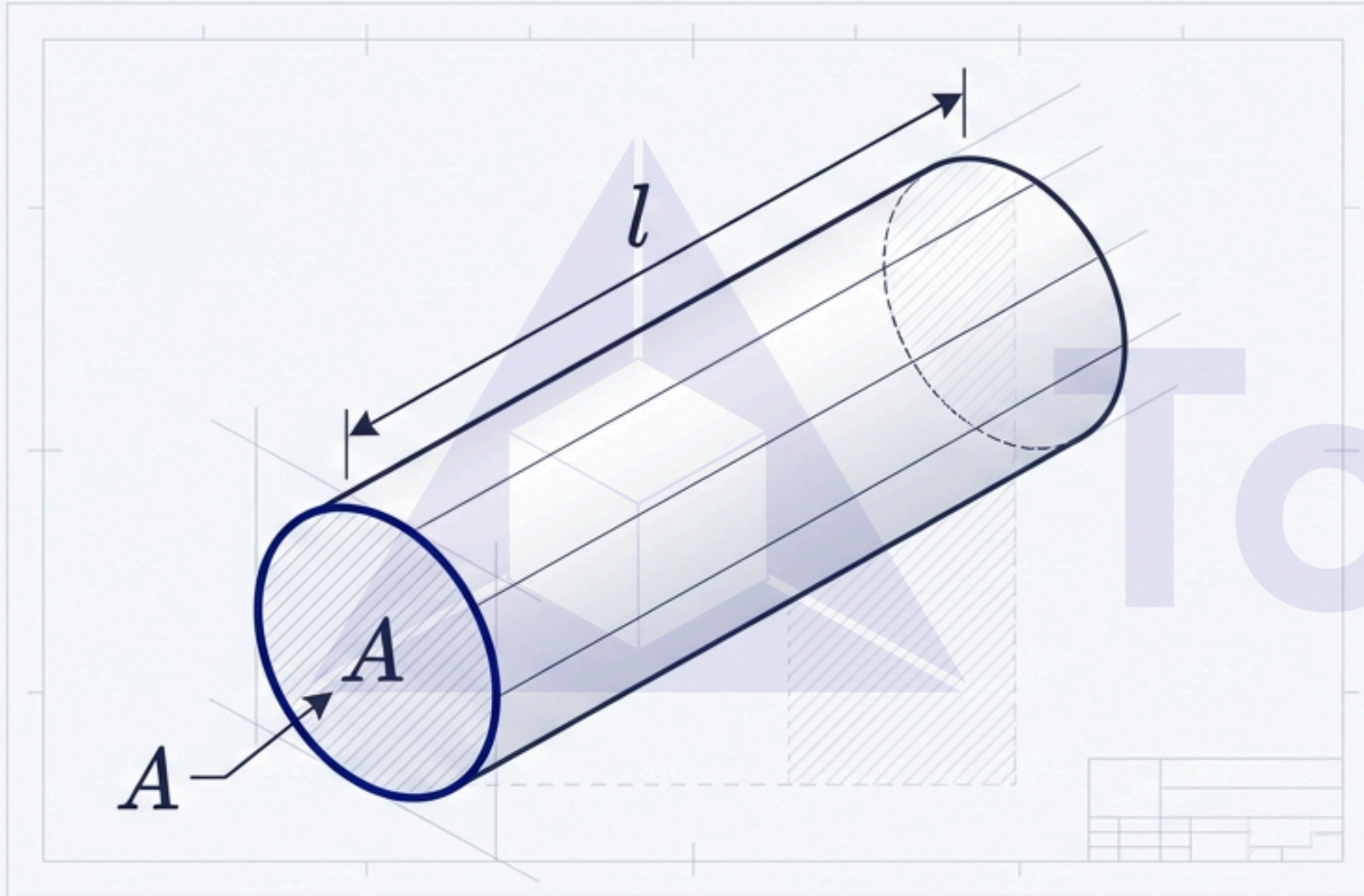
R

ρ

G

κ

Physical Geometry dictates Resistance



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

↑ Length (l) ↑ → Resistance (R) ↑

↑ Area (A) ↑ → Resistance (R) ↓

SI Unit of Resistance: Ohm (Ω) = $\text{kg} \cdot \text{m}^2 / (\text{S}^3 \cdot \text{A}^2)$ in base units.



You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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Key Highlights

- » Free Study Material, Videos & Infographics
- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter



Resistivity: The Material Essence

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

✓ Key Takeaways

- A material-specific constant of proportionality.
- Physically represents the resistance of a substance exactly 1 m long with a 1 m² cross-sectional area.
- Depends entirely on the nature of the material, not its shape.

NOMENCLATURE & UNITS

IUPAC Recommendation: Use “Resistivity” over “specific resistance”.

SI Unit: ohm metre (Ωm)

Common submultiple: ohm centimetre (Ωcm)

Conductance & Conductivity

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Conductance (G)

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$$G = \frac{1}{R}$$

Definition: The precise inverse of resistance.

Unit: Siemens (S), equal to Ω^{-1} (mho).

Conductivity (κ)

24–28px semi-bold

$$\kappa = \frac{1}{\rho}$$

Definition: The inverse of resistivity. IUPAC recommends 'conductivity' over 'specific conductance'.

Unit: S m^{-1} or S cm^{-1} .

$$G = \kappa \frac{A}{l}$$

Critical Unit Conversions

RESISTIVITY CONVERSION

$$1 \, \Omega m = 100 \, \Omega cm$$

$$1 \, \Omega cm = 0.01 \, \Omega m$$

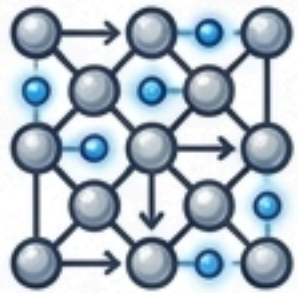
CONDUCTIVITY CONVERSION

$$1 \, S cm^{-1} = 100 \, S m^{-1}$$

⚠ JEE TRAP

Mixing up **cm** and **m** in conductivity (**k**) calculations. Always check if your cell constant (l/A) uses the exact same base unit as your conductivity data before calculating.

Charge Transport: Electronic vs Ionic



Metallic (Electronic) Conductance

- Charge Carriers: Electrons.
- Dependencies: Nature/structure of metal, number of valence electrons.
- Temperature Effect: Conductivity **DECREASES** as temperature increases (due to increased vibration of metal kernels).



Electrolytic (Ionic) Conductance

- Charge Carriers: Ions.
- Dependencies: Nature of electrolyte, ion size/solvation, solvent viscosity, concentration.
- Temperature Effect: Conductivity **INCREASES** with temperature (due to increased dissociation and kinetic mobility of ions).

Master Dashboard: Conductance Variables

R

Resistance

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

SI Unit: Ω

ρ

Resistivity

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

SI Unit: Ωm

G

Conductance

$$G = \frac{1}{R}$$

SI Unit: S

κ

Conductivity

$$\kappa = \frac{1}{\rho} = G \frac{l}{A}$$

SI Unit: S m^{-1}



You've Learned the Theory.

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