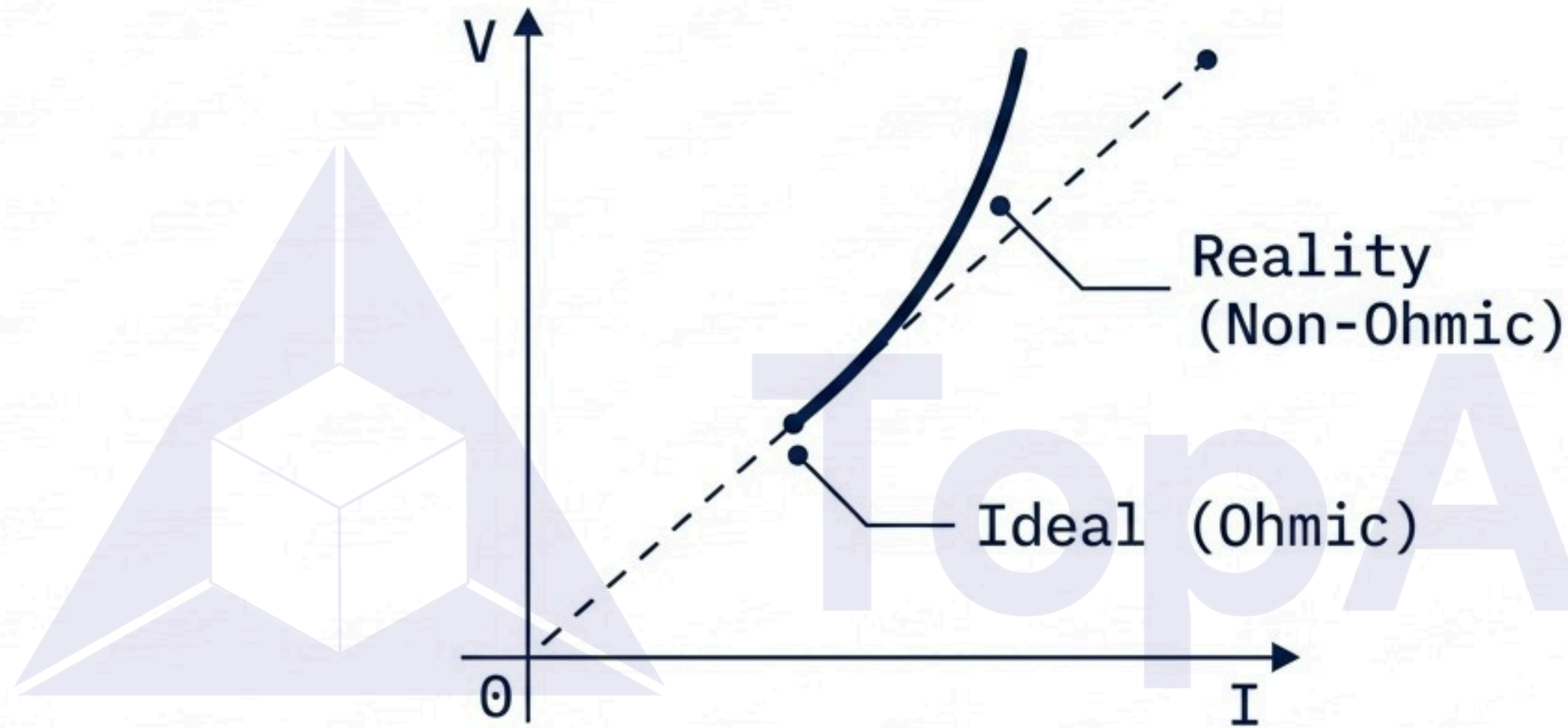




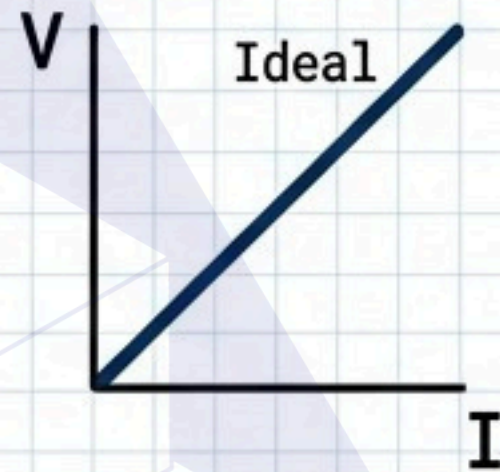
# When Ohm's Law Fails: The Limitations of $V = RI$

## OHMIC BEHAVIOR

Mathematical Condition

$$V \propto I$$

V-I Graph Profile



Resistance (R)

Strictly constant.  
Independent of V or I.

Material Examples

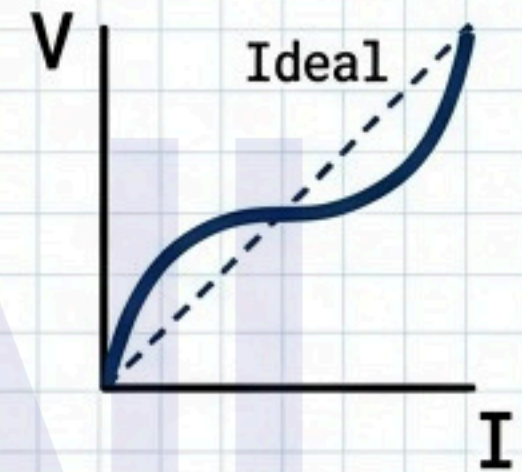
Copper wire at a constant temperature.

## NON-OHMIC BEHAVIOR

Mathematical Condition

$$V \approx I$$

V-I Graph Profile



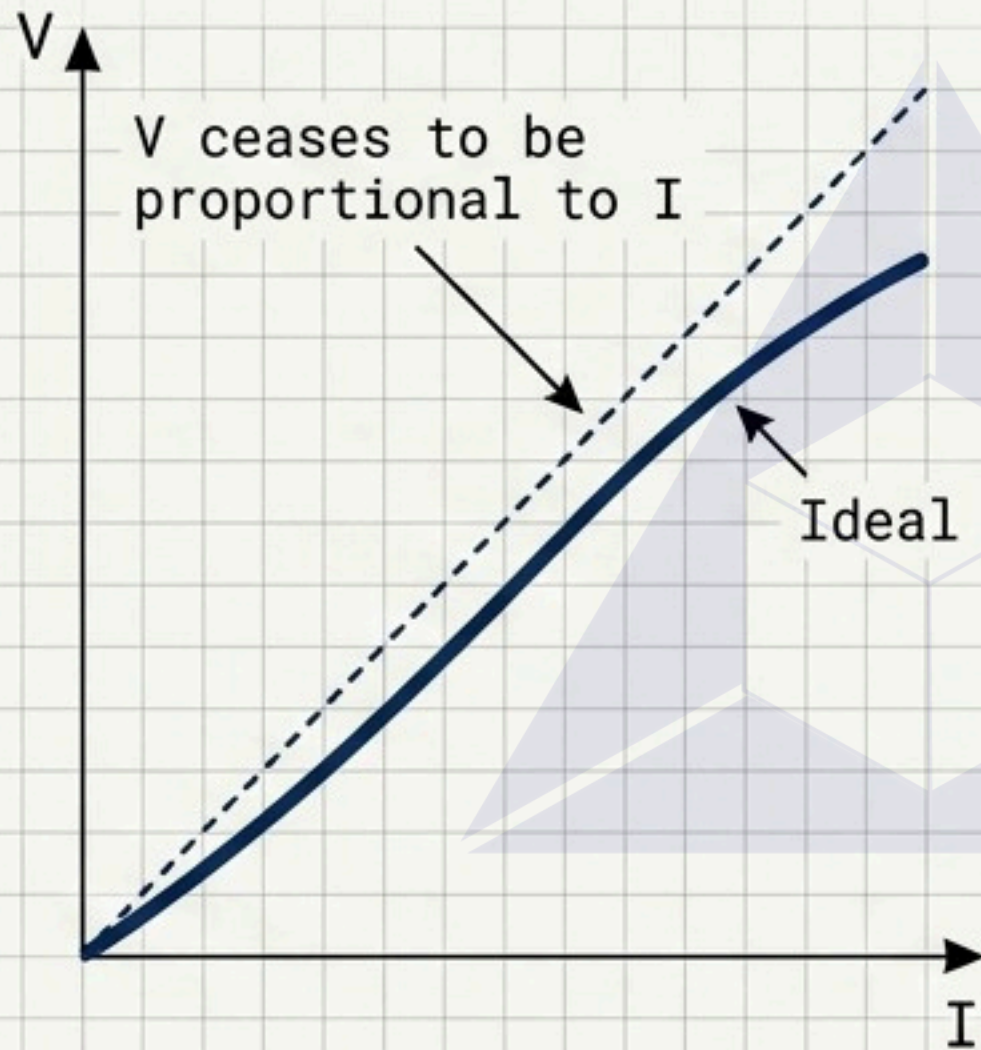
Resistance (R)

Variable / Dynamic.  
Changes at different points.

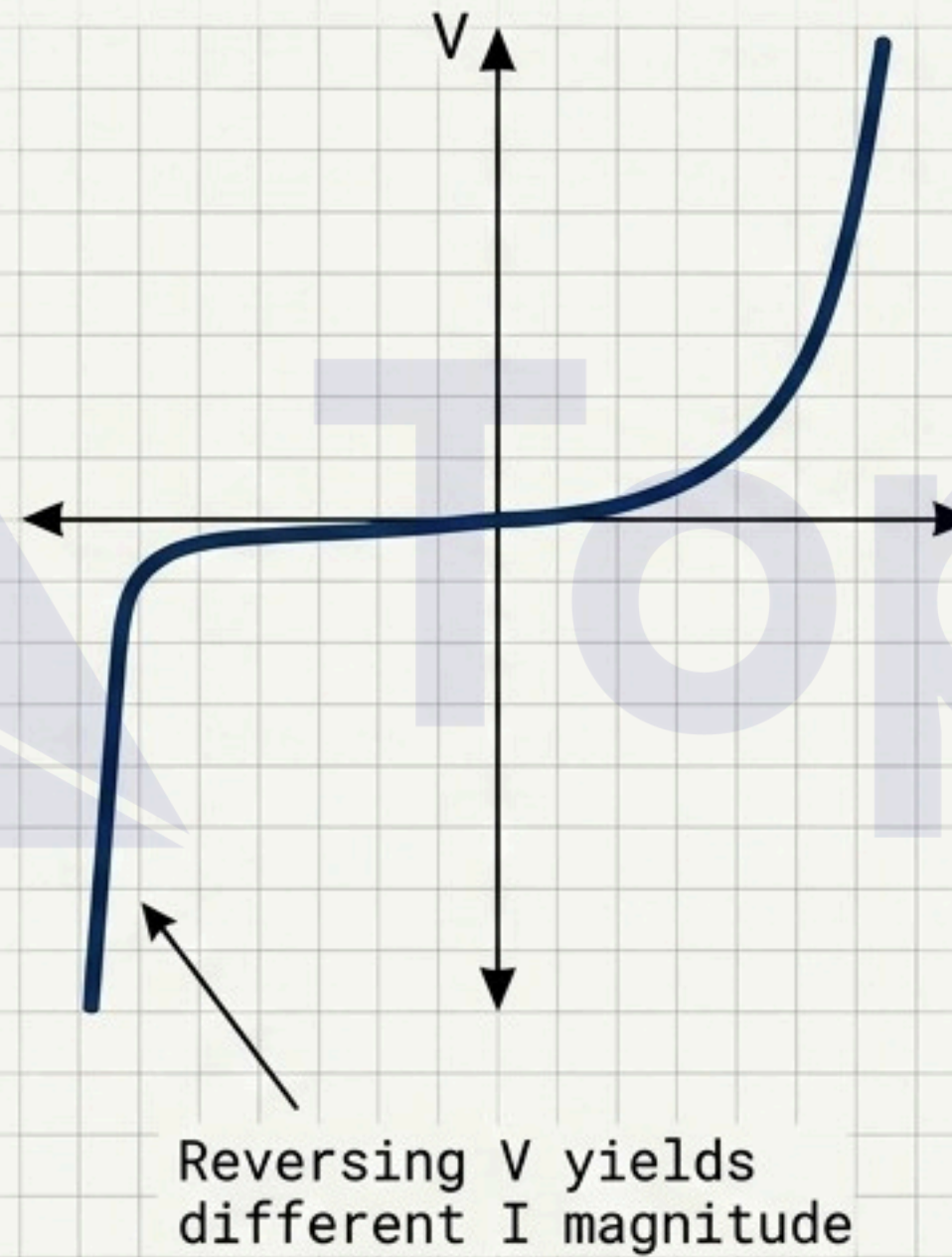
Material Examples

Diodes, GaAs, Semiconductors.

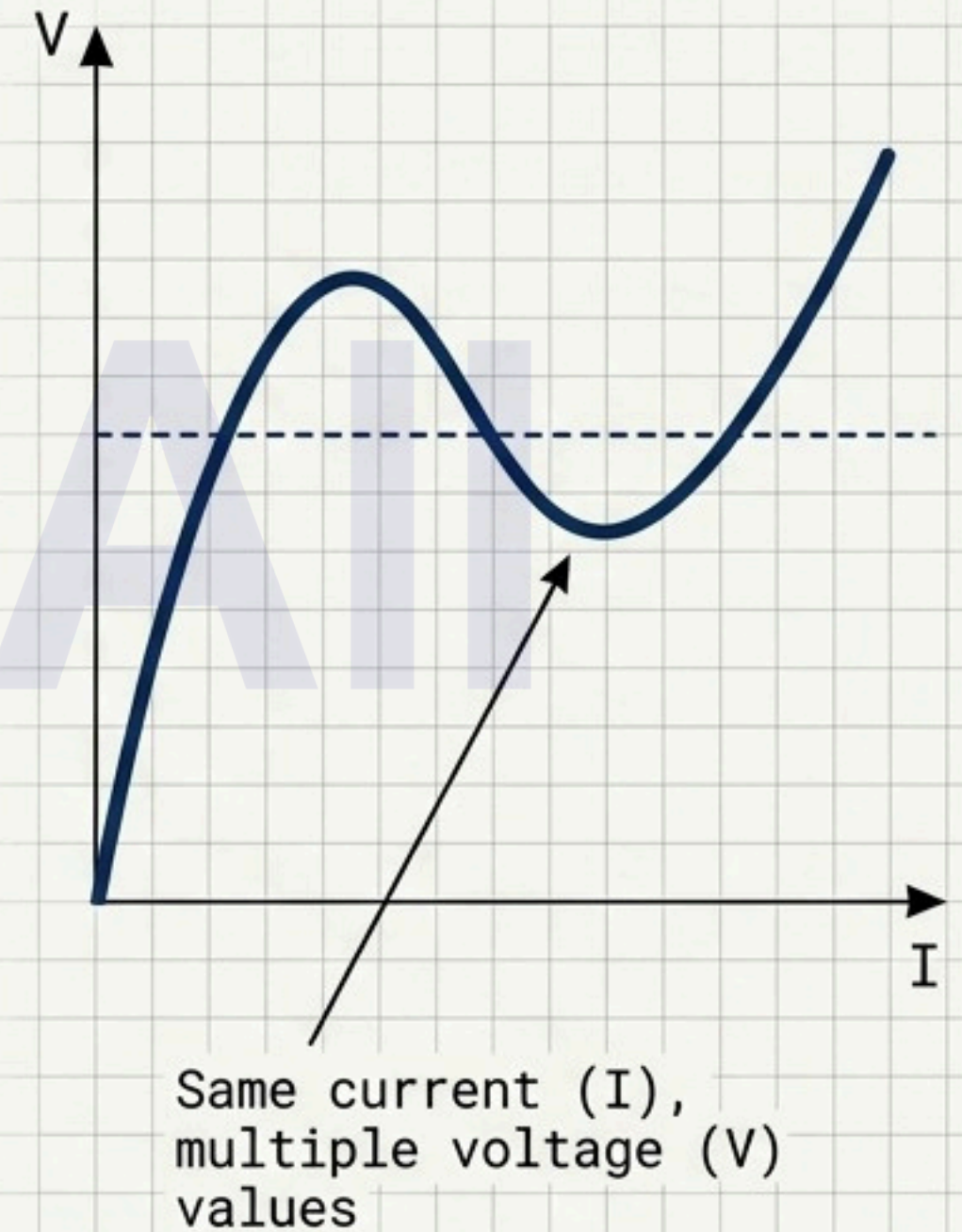
## Loss of Linearity



## Sign-Dependent



## Non-Unique





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

$$E=mc^2$$



Turn theory into marks with **unlimited MCQs, smart analysis, and focused revision.**

**Practice Now**

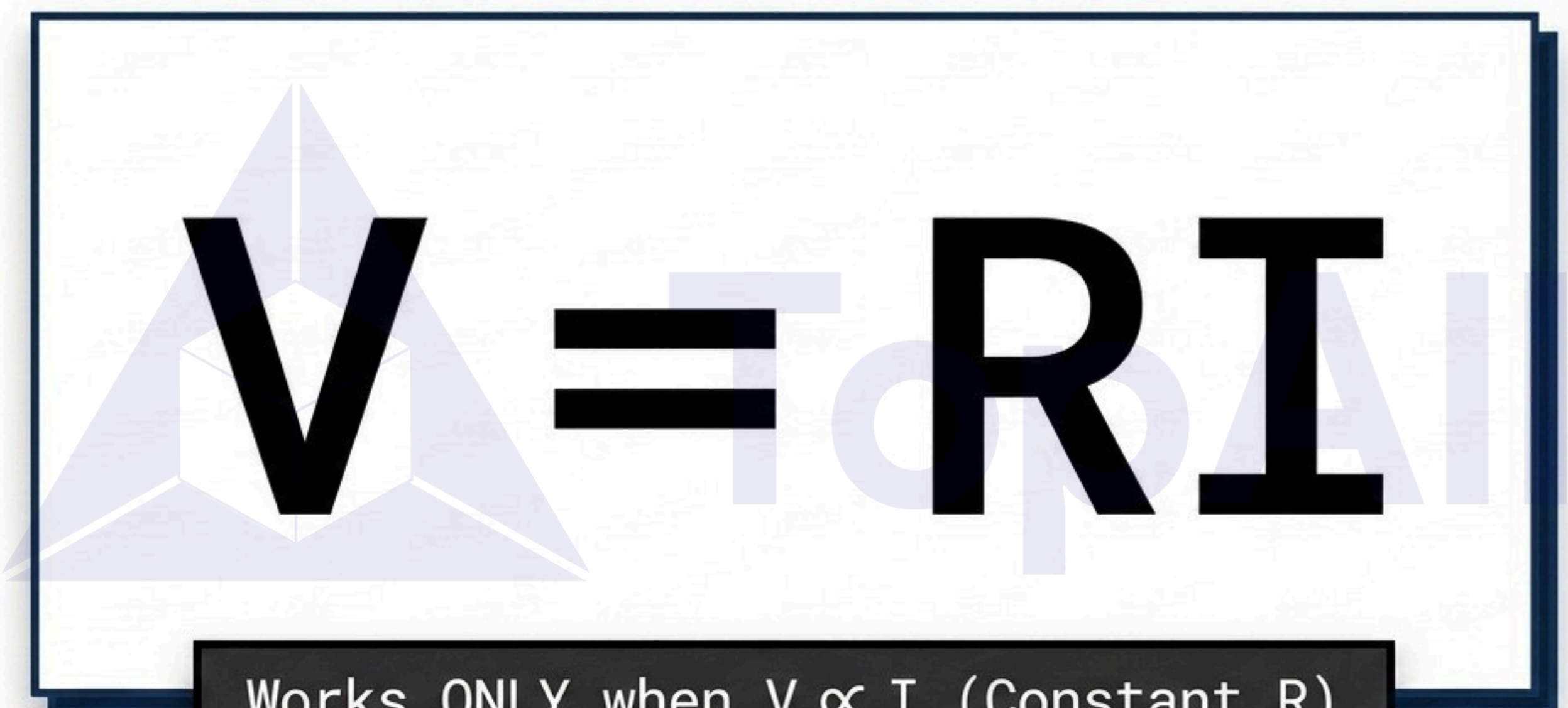


At [prep.topall.app](https://prep.topall.app)

## 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




$$V = IR$$

Works ONLY when  $V \propto I$  (Constant  $R$ )

Ohm's law fundamentally asserts that  $R$  is independent of  $V$ .  
If  $R$  changes as voltage shifts, the material has broken the law.



# JEE TRAP ALERT

## The Misconception:

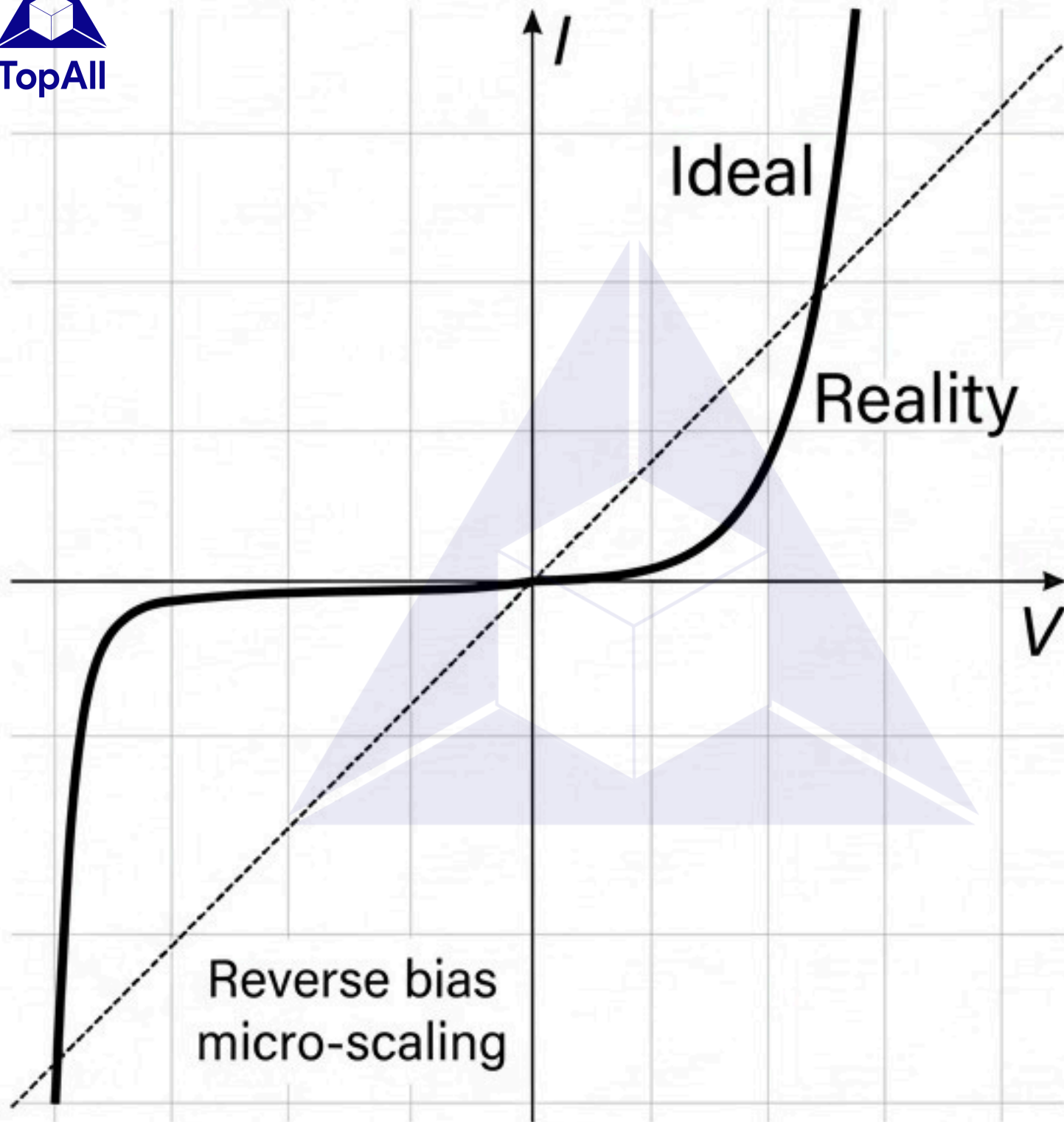
~~If a device is non-Ohmic and fails Ohm's Law, it has no resistance.~~

## The Reality:

**The equation  $R = V/I$  is the universal definition of resistance.  
It applies to ALL conducting devices, Ohmic or not.**

### Lab Note:

For non-Ohmic devices,  $R$  simply changes at every point on the graph. You just calculate Dynamic Resistance ( $r = \Delta V / \Delta I$ ) instead of a single constant.



**Engineer's Diagnostic:** Which limitation of Ohm's law is exhibited here?

- ✓ **Sign-Dependent:** The relation between  $V$  and  $I$  depends on the sign of  $V$ . Reversing the polarity of voltage does not produce a reverse current of the same magnitude.

## Revision: The Empirical Reality

- ❖ Ohm's law is an empirical rule for specific materials (like metals at constant temperatures), NOT a fundamental law of nature.
- ❖ The 'failures' of Ohm's Law are not defects—they are features. Modern electronics (semiconductors, transistors, diodes) rely entirely on non-Ohmic behavior to manipulate current and process data.





# You've Learned the Theory.

## Now Let's Test It.

Reading notes gets you knowledge.

**Practicing MCQs gets you marks.**

**That's exactly what TopAll Pro is built for.**

**Try TopAll Pro Now**

### What TopAll Pro Does Differently

-  **Stuck? Snap it. Solve it. — Doubts AI**  
Photo → step-by-step solution in seconds, 24/7
-  **Your AI Coach finds your blind spots**  
Concept-level weakness detection — not just chapter-level
-  **4.5 Lakh+ questions. Never run out.**  
13× more content than any other prep app in India
-  **Build your own test in 60 seconds**  
Pick a chapter, set difficulty — AI does the rest instantly.
-  **AI Recommendation that helps you improve**  
AI Recommendation Analysis your Tests and tell you where you need to improve.



**Practice the moment you finish studying**  
Jump in while the concept is still fresh in your head

**4.5L+**  
MCQs

**1.5L+**  
Students

**AI Powered**  
In-Depth Analysis