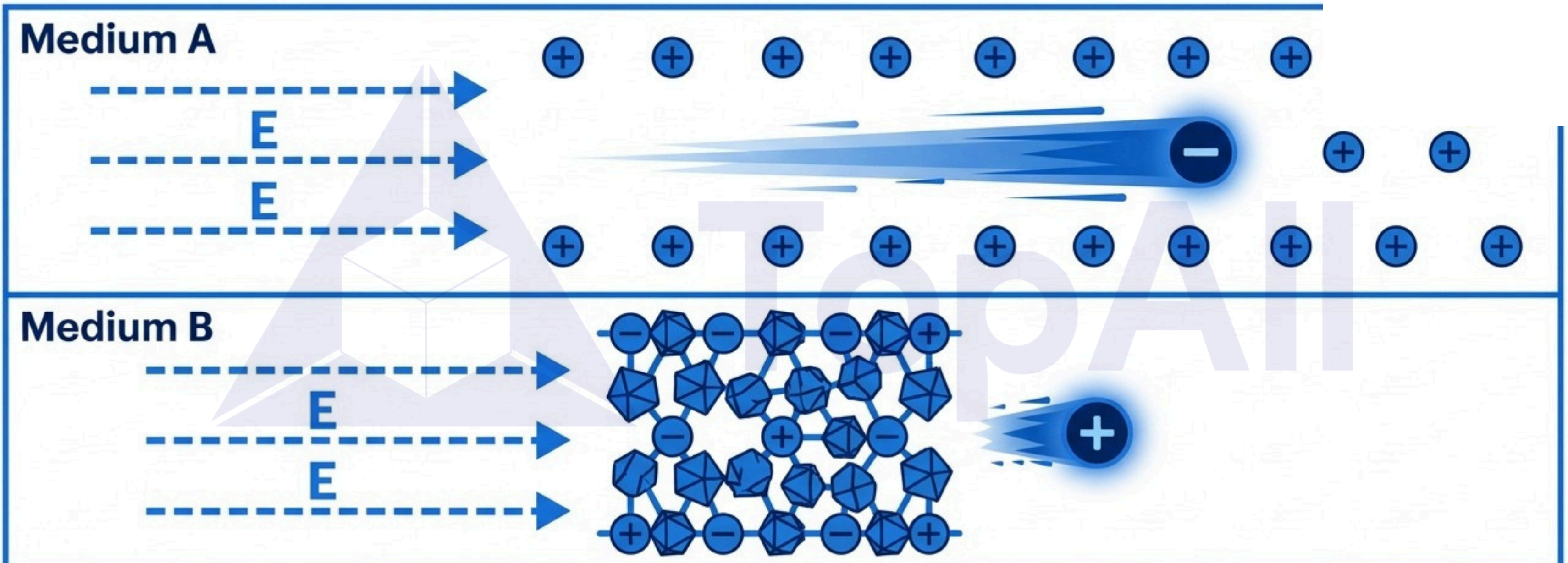


Mobility: Drift Speed per Electric Field



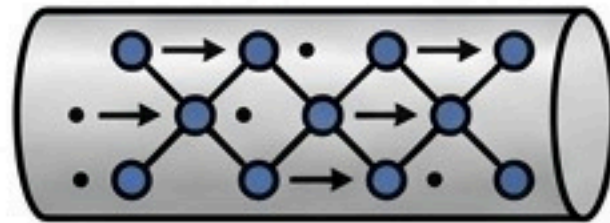
If the electric push (E) is identical, why do charges in different materials move at drastically different speeds? The answer lies in the material's **mobility**.

Defining the Carrier Response

What is Mobility (μ)?

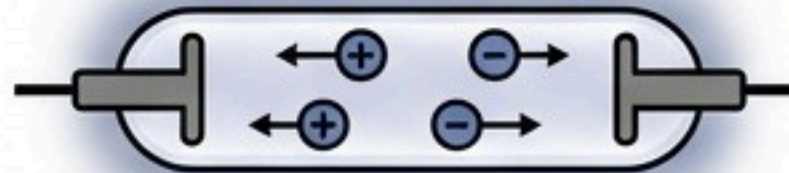
It is the responsiveness or agility of a charge carrier. It defines how easily a carrier can achieve a steady drift velocity when pushed by an external electric field.

Solid Metals



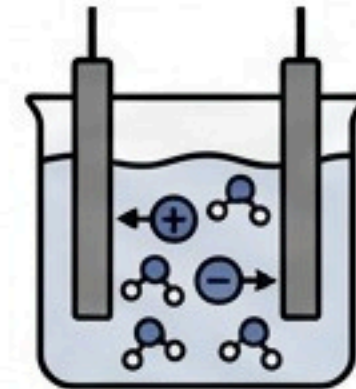
Carried by Free
Electrons

Ionized Gases



Carried by Electrons &
Positive Ions

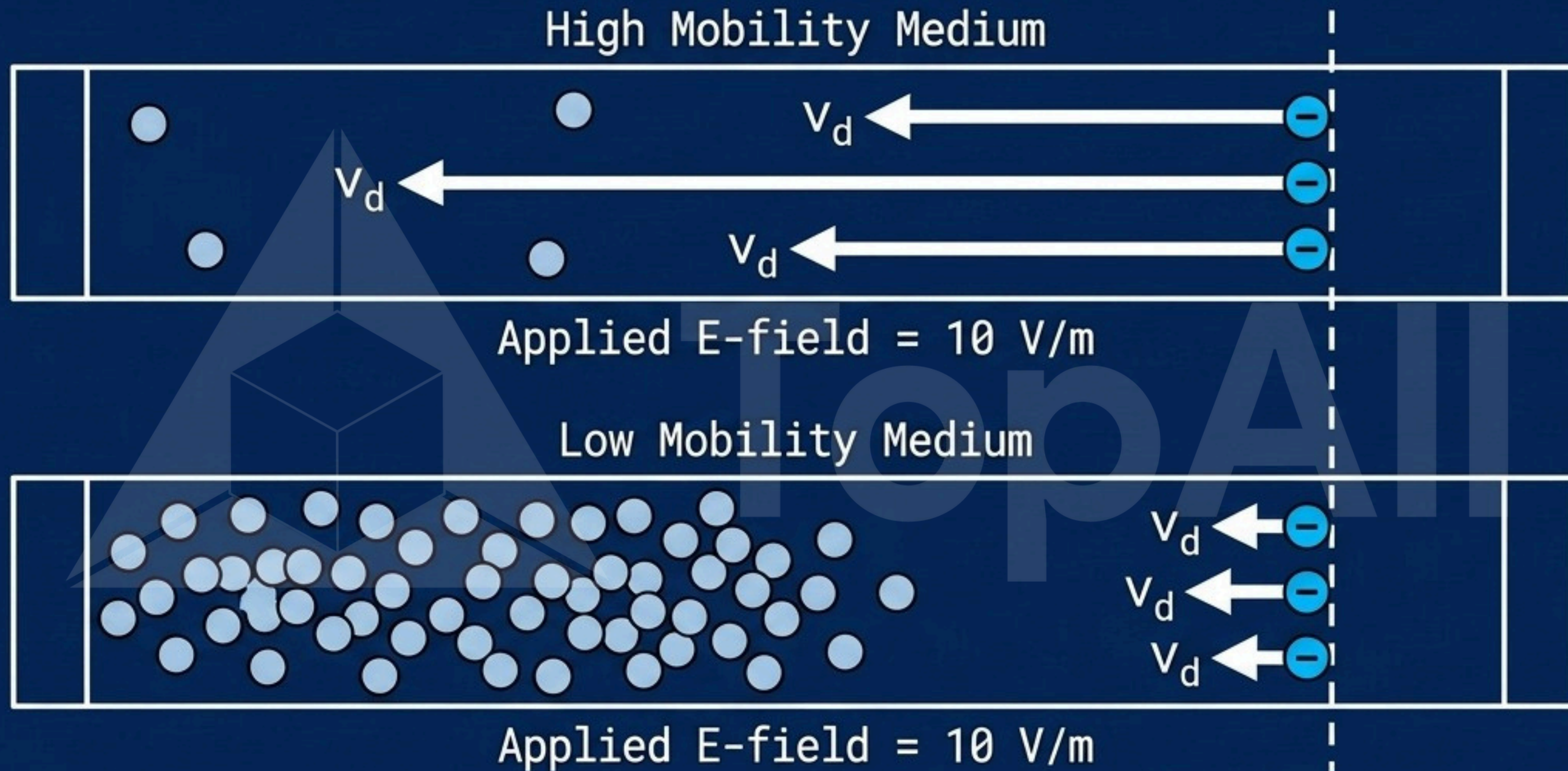
Electrolytes



Carried by Positive &
Negative Ions

Mobility is an intrinsic property of the carrier type and the environment, not just the applied field.

Same Effort, Different Output: The Need to Normalize



v_d alone is incomplete. To truly compare materials, we must calculate the drift velocity generated per unit of electric field.



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

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



The Mobility Formula Bank

The Definition

Mobility

Magnitude of Drift Velocity

$$\mu = \frac{|v_d|}{E}$$

Electric Field

Substitute
 $v_d = eE\tau / m$
to reveal the
microscopic
dependencies:

The Microscopic Derivation

Average Relaxation Time
(Directly Proportional)

$$\mu = \frac{e\tau}{m}$$

Mass of Charge Carrier
(Inversely Proportional)

SI Unit: m^2/Vs

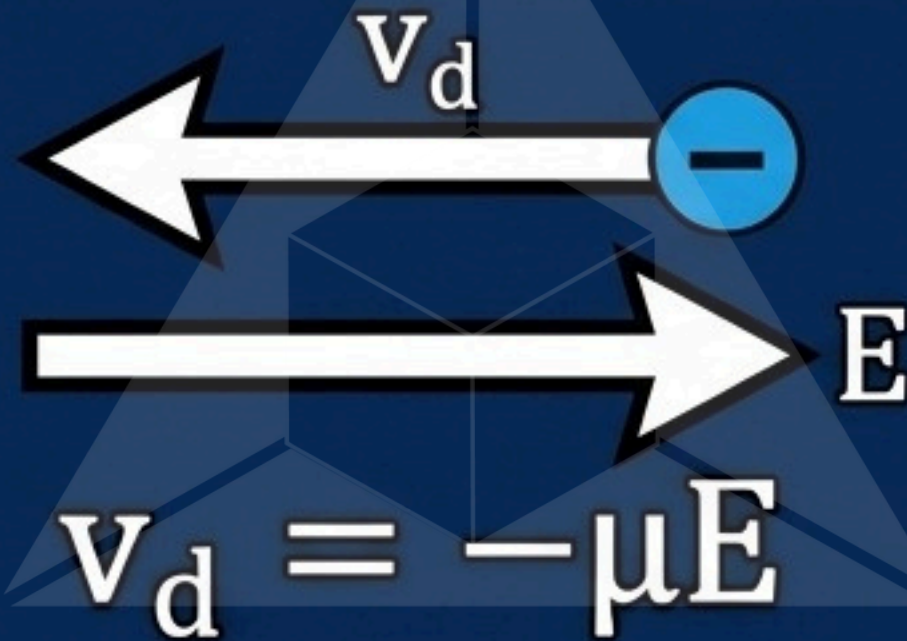
Practical Unit: cm^2/Vs ($10^4 \times$ smaller than SI)



JEE TRAP: THE POSITIVITY RULE

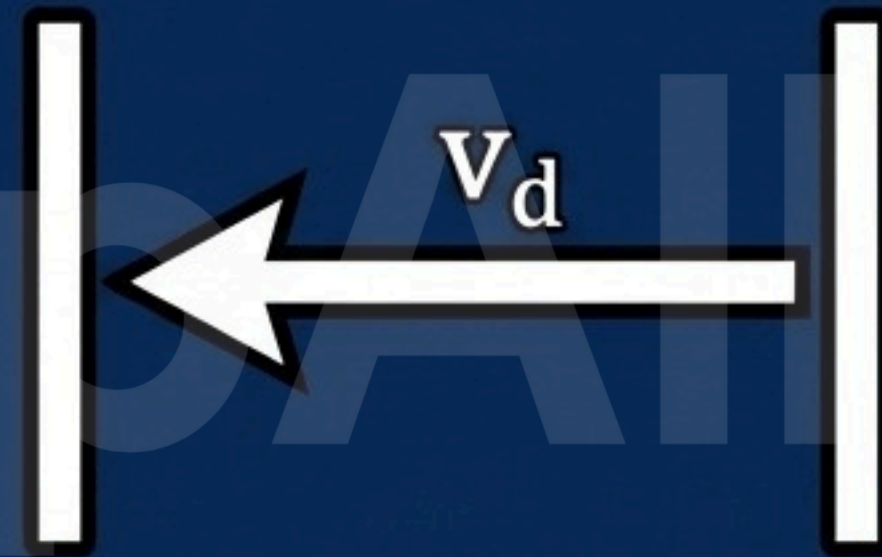


The Vector Reality



Because of its negative charge, an electron's velocity vector opposes the field.

The Mobility Calculation



Mobility relies ONLY on the magnitude of the drift velocity.

Do not assign a negative sign to μ . Mobility is strictly a positive scalar quantity representing responsiveness, regardless of the direction of motion.

Mini Application: Extracting μ



GIVEN (The Observation)

- An electric field $E = 1.0 \times 10^{-2} \text{ V/m}$ is applied to a copper wire.
- Measured electron drift speed $v_d = 1.1 \text{ mm/s}$.

APPLY (The Setup)

- Convert units:
 $v_d = 1.1 \times 10^{-3} \text{ m/s}$.
- Select tool:
Use the magnitude ratio: $\mu = \frac{|v_d|}{E}$.

SOLVE (The Execution)

$$\mu = \frac{1.1 \times 10^{-3}}{1.0 \times 10^{-2}}$$
$$\mu = 0.11 \text{ m}^2/\text{Vs}$$

Notice how v_d values are tiny ($\sim \text{mm/s}$), but the μ calculation normalizes this against the small E-field to give a clean material constant.

Synthesis

Unshakeable Truths: Mobility

1. **The Concept:** Mobility is not velocity; it is the response (velocity) per unit of effort (electric field).
2. **The Core Ratios:** Defined macroscopically as $\mu = |\mathbf{vd}| / E$ and microscopically as $\mu = e\tau / m$.
3. **The Dependency:** It acts as a see-saw—directly proportional to **relaxation time** (τ) and inversely proportional to **carrier mass** (m).
4. **The Trap:** Mobility is strictly a **positive scalar**, even for negatively charged electrons moving opposite to the field.



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