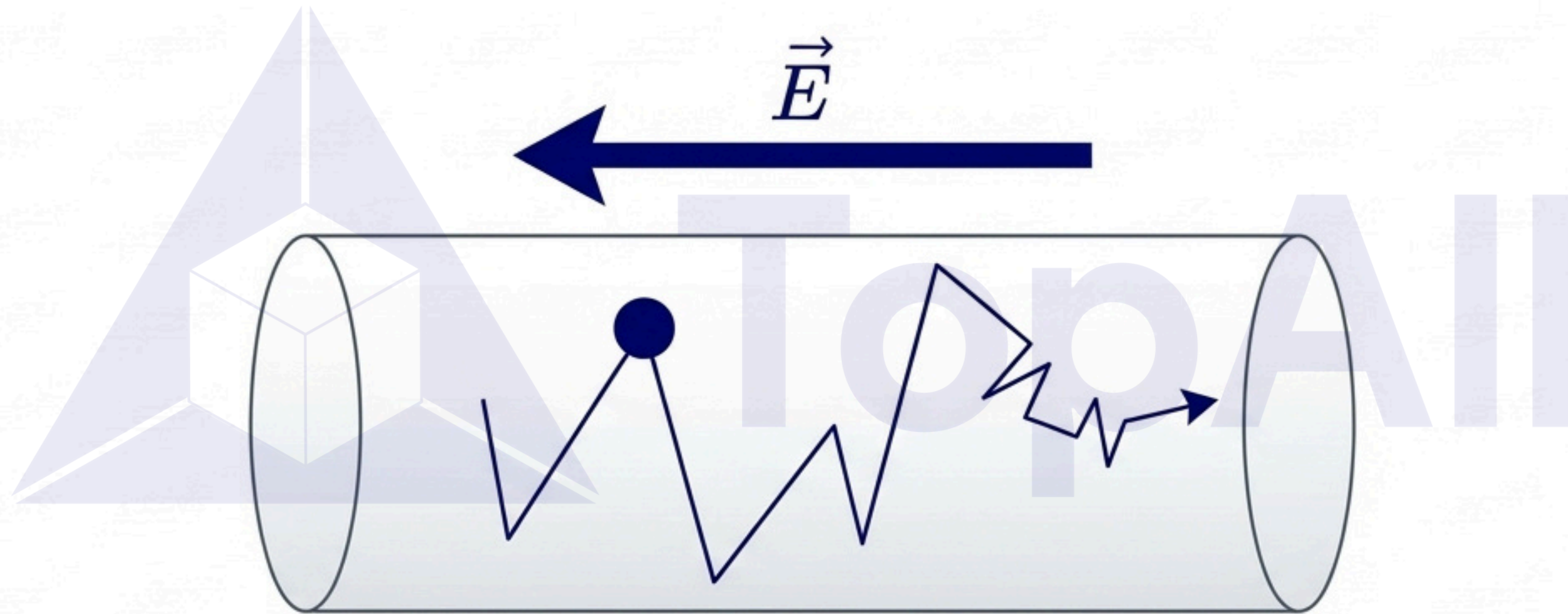


Mobility of Charge Carriers



NEET/JEE Concept Breakdown

Defining Mobility

Mobility (μ) measures the magnitude of drift velocity achieved by a charge carrier per unit of applied electric field. It indicates how responsive a carrier is to an electrical push.

Note: Mobility is a strictly positive quantity.

Charge Carriers by Medium:

- Metals Electrons
- Ionized Gases Electrons & Positive Ions
- Electrolytes Positive & Negative Ions

Math UI

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

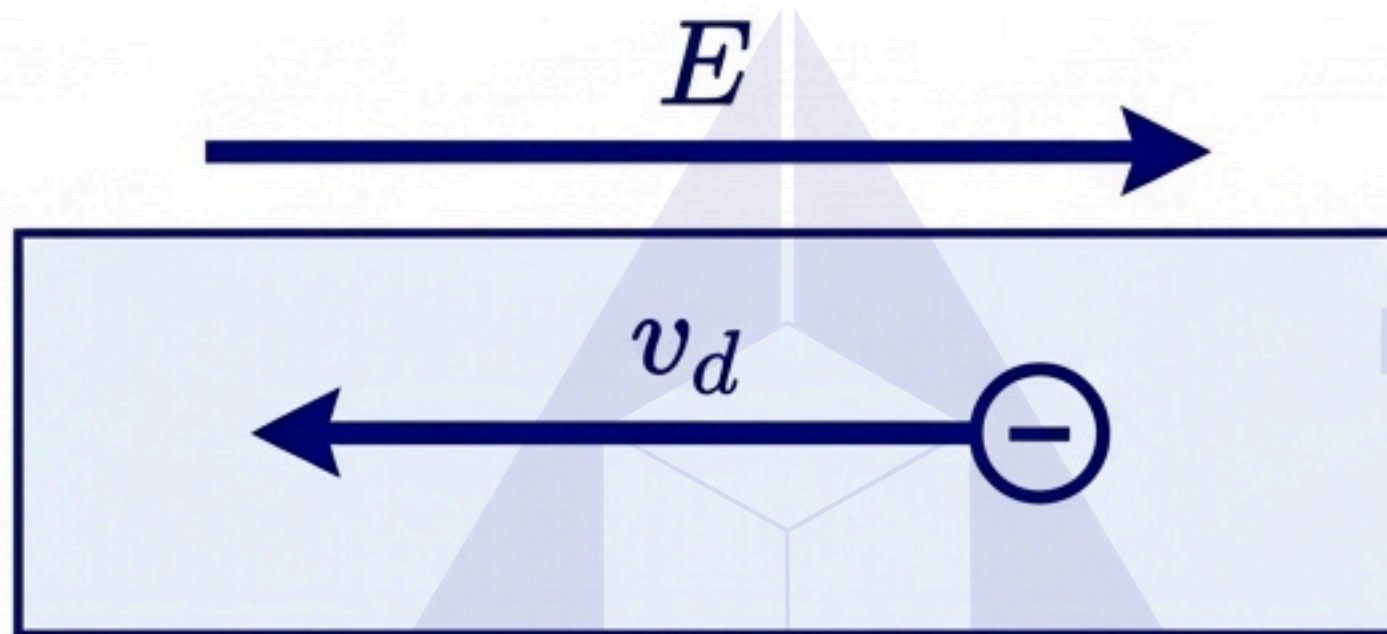
SI Unit: m^2/Vs

Practical Unit: cm^2/Vs

$$1 \text{ m}^2/\text{Vs} = 10^4 \text{ cm}^2/\text{Vs}$$

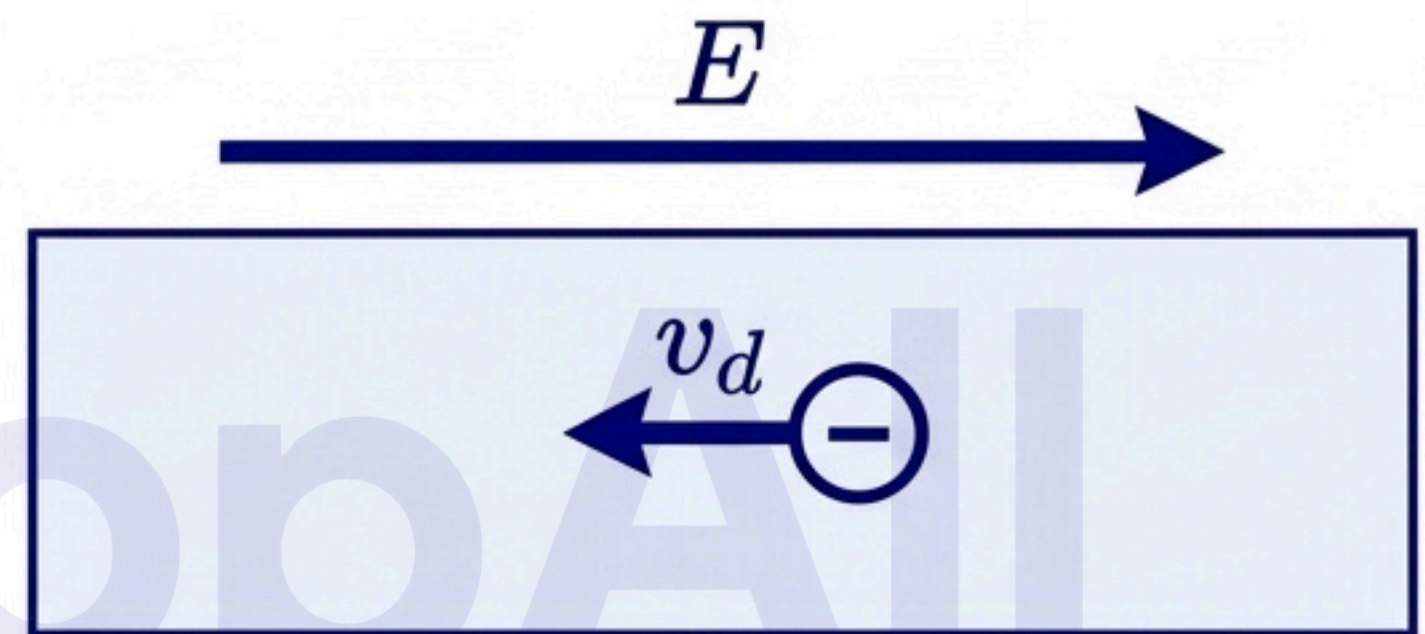
The Physical Intuition: Drift Response

High Mobility Material



Strong Drift Response $\rightarrow$ High μ

Low Mobility Material



Weak Drift Response $\rightarrow$ Low μ

Under the same applied Electric Field (E), a greater Drift Velocity (v_d) means higher Mobility (μ).

Microscopic Relation: $\mu = e\tau/m$

Recall Drift Velocity:

$$v_d = \frac{eE\tau}{m}$$

Substitute into Definition:

$$\mu = \frac{v_d}{E} = \frac{eE\tau}{mE}$$

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

e (Charge):
Magnitude of
carrier charge
(Constant).

τ (Relaxation Time):
Average time
between collisions.
(Higher τ = Higher
Mobility)

m (Mass): Mass of
the charge carrier.
(Lighter particle =
Higher Mobility)

Exam Summary: Mobility

Key Takeaways

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

Measures drift velocity achieved per unit electric field.
It is always a positive quantity.

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

Directly proportional to relaxation time (τ) and
inversely proportional to carrier mass (m).

$$\frac{m^2}{Vs} \text{ \& \; } \frac{cm^2}{Vs}$$

SI Unit is m^2/Vs .
Practical unit is cm^2/Vs .

Multiply SI unit by 10^4 to
get practical units.

Remember: Charge carriers differ by medium (Electrons in metals; Ions in electrolytes).