

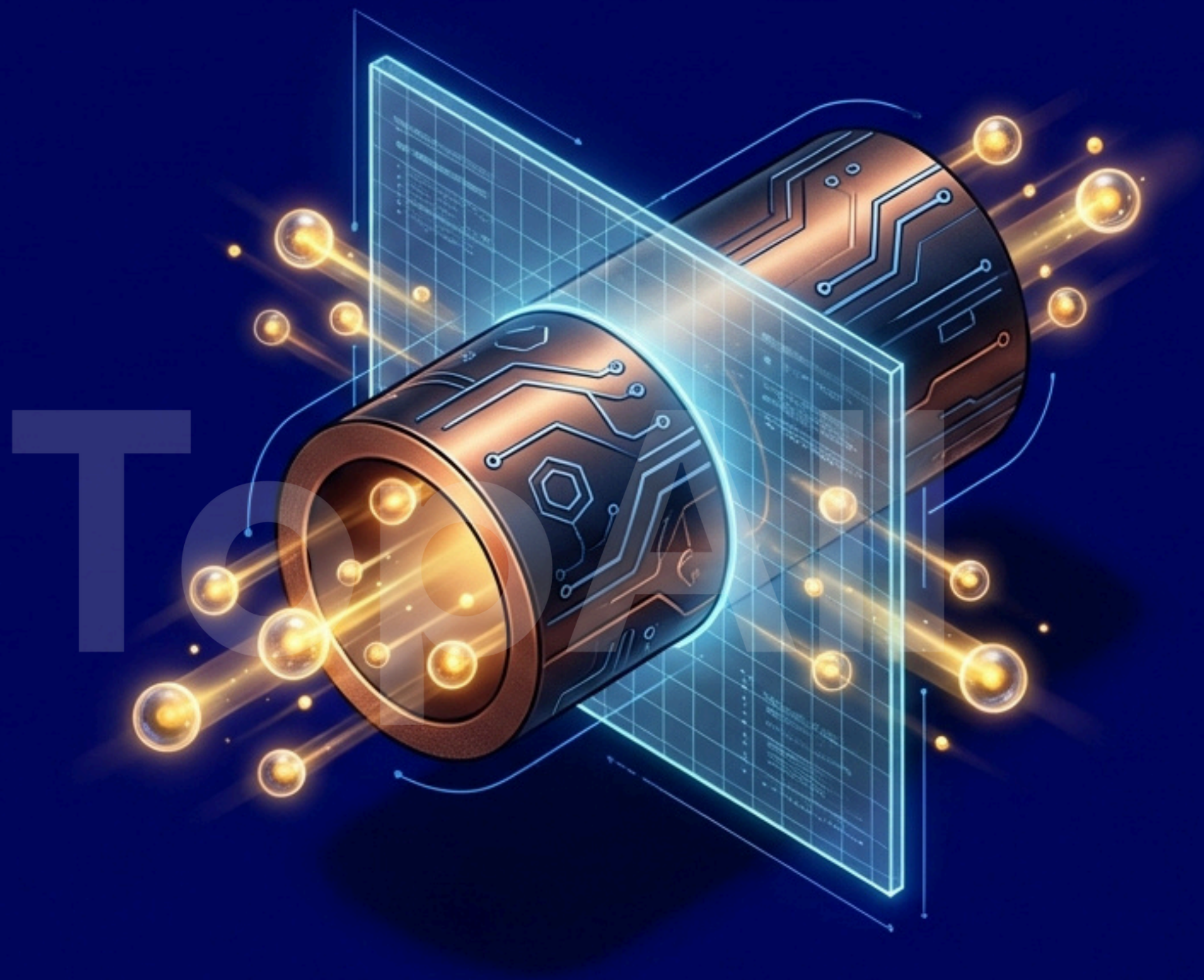


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CHAPTER 3.2 | CURRENT ELECTRICITY

Electric Current

Understanding the flow of charge, cross-sectional models, and instantaneous rates for NEET/JEE.

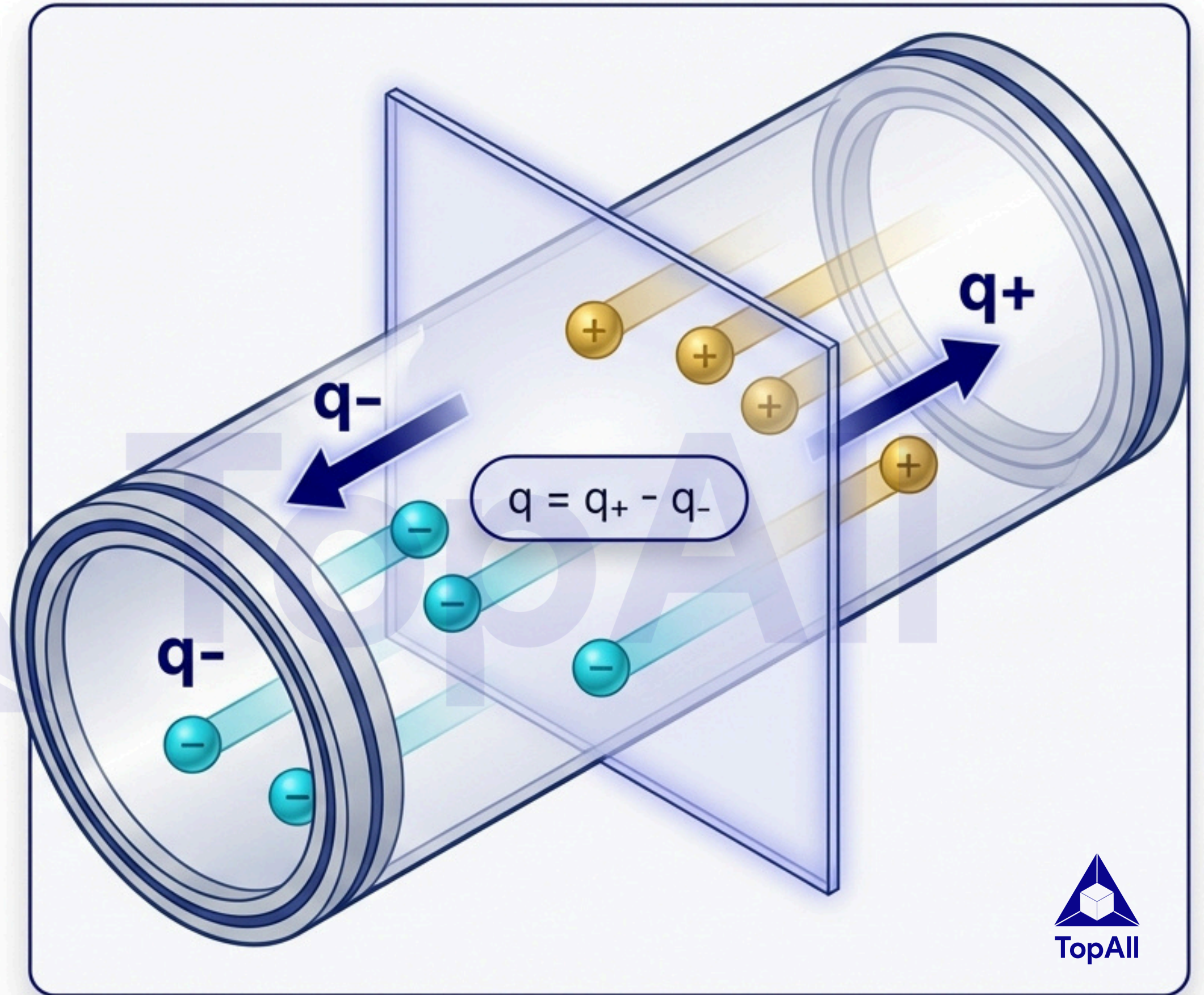


The Flow of Net Charge

Charges in motion constitute an electric current. To measure it, we observe a specific area held normal to the direction of flow.

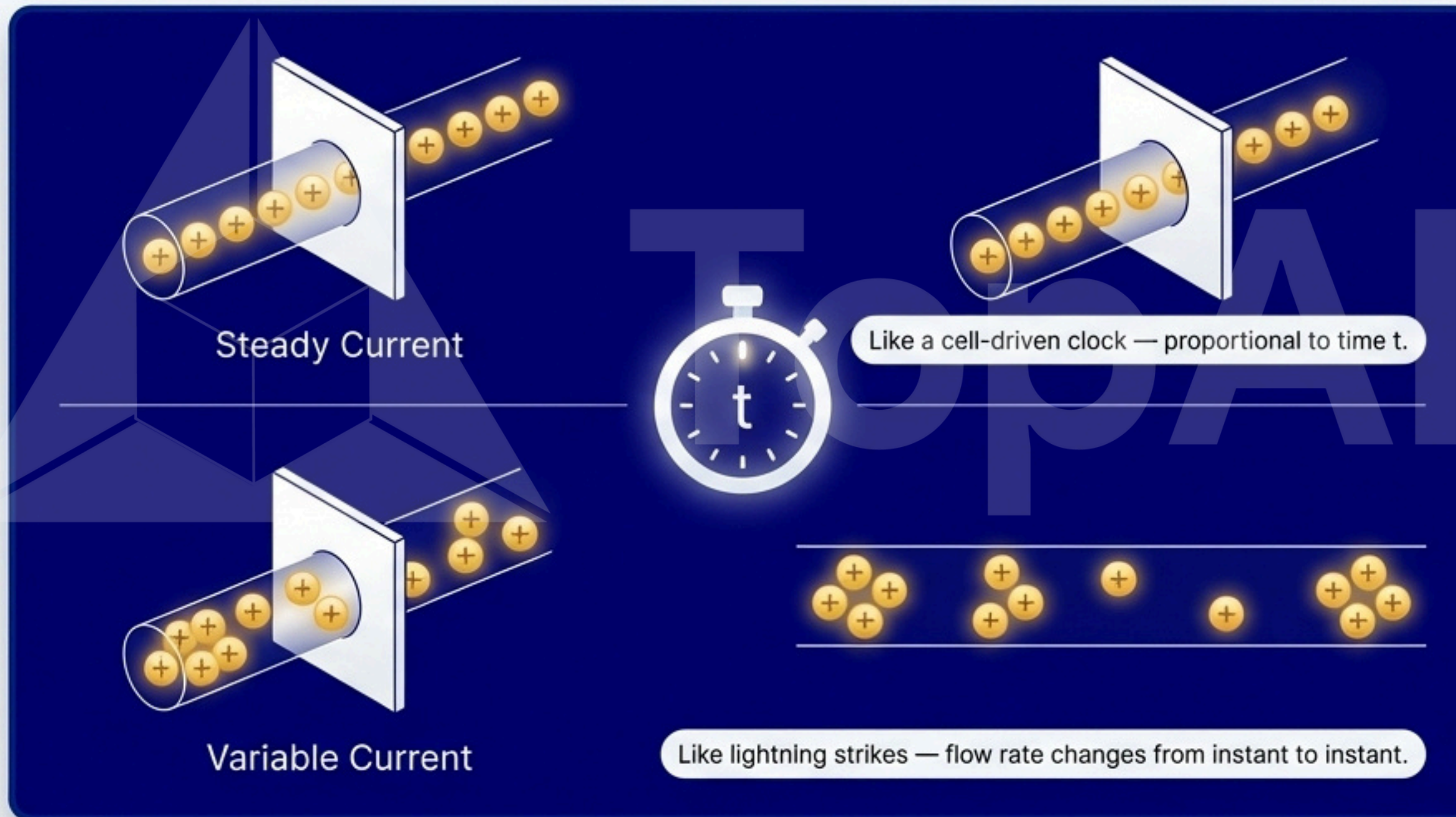
Net Charge (q)

The forward flow of positive charge minus the backward flow of negative charge across the given area in time interval t .



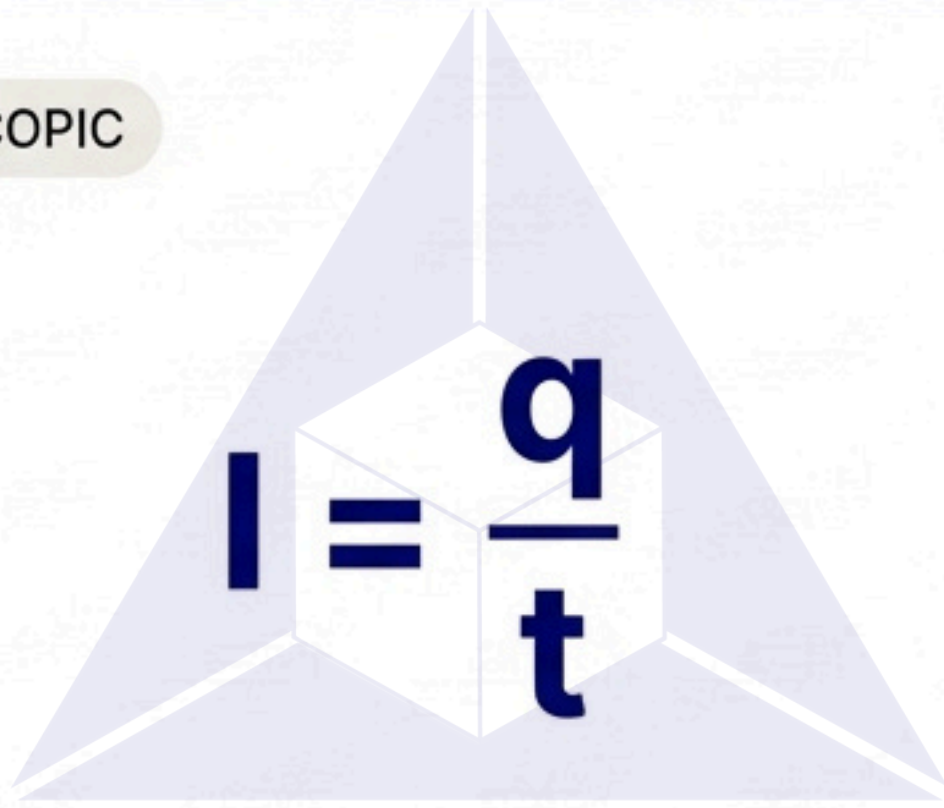
The “Counting Gate” Concept

Imagine a microscopic tollbooth inside the conductor. Current is the rate at which net charge passes through this gate over a given time interval.



Mathematical Formulation of Current

MACROSCOPIC


$$I = \frac{q}{t}$$

Steady Current: Used when the flow of charge is uniform. The net charge q is directly proportional to the time interval t .

MICROSCOPIC


$$I = \lim_{\Delta t \rightarrow 0} \frac{\Delta Q}{\Delta t} = \frac{dQ}{dt}$$

Instantaneous Current: Used when the current is variable. Defines the exact ratio of charge ΔQ to time Δt as the interval approaches zero.

Measurement and Conventions

SI Unit: Ampere (A)

$$1 \text{ A} = 1 \frac{\text{C}}{\text{s}} \text{ (1 Coulomb per second)}$$



Nerves ~ μA (Microamperes)

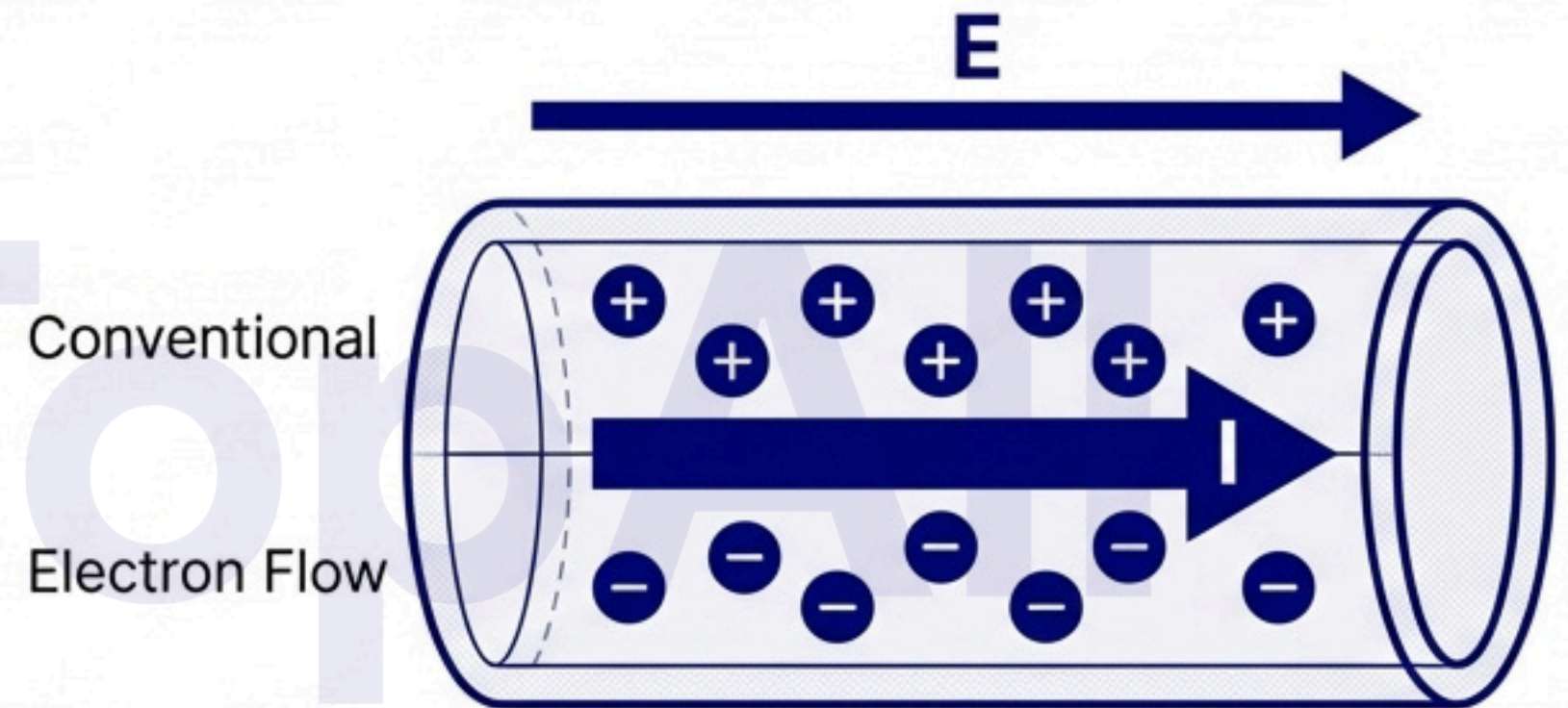


Domestic Appliances ~ 1A to 10A



Lightning ~ 10,000A

Current Direction



Exam Tip Badge

By convention, current direction is the direction of positive charge flow. A negative charge moving backward mathematically implies a current in the forward direction.

Chapter 3.2 Summary Matrix

- ✓ **Physical Definition:** Current is the net charge ($q = q^+ - q^-$) flowing across a normal cross-section per unit time.
- ✓ **Steady vs. Variable:** Use $I = q/t$ for steady flows (clocks) and $I = \frac{dQ}{dt} / dt$ for variable flows (lightning).
- ✓ **The Ampere (A):** The SI unit, equal to 1 Coulomb per second. Spans from microamperes in nerves to tens of thousands of amperes in lightning.
- ✓ **Direction Convention:** The direction of I is strictly the direction of positive charge flow (which is opposite to electron drift).