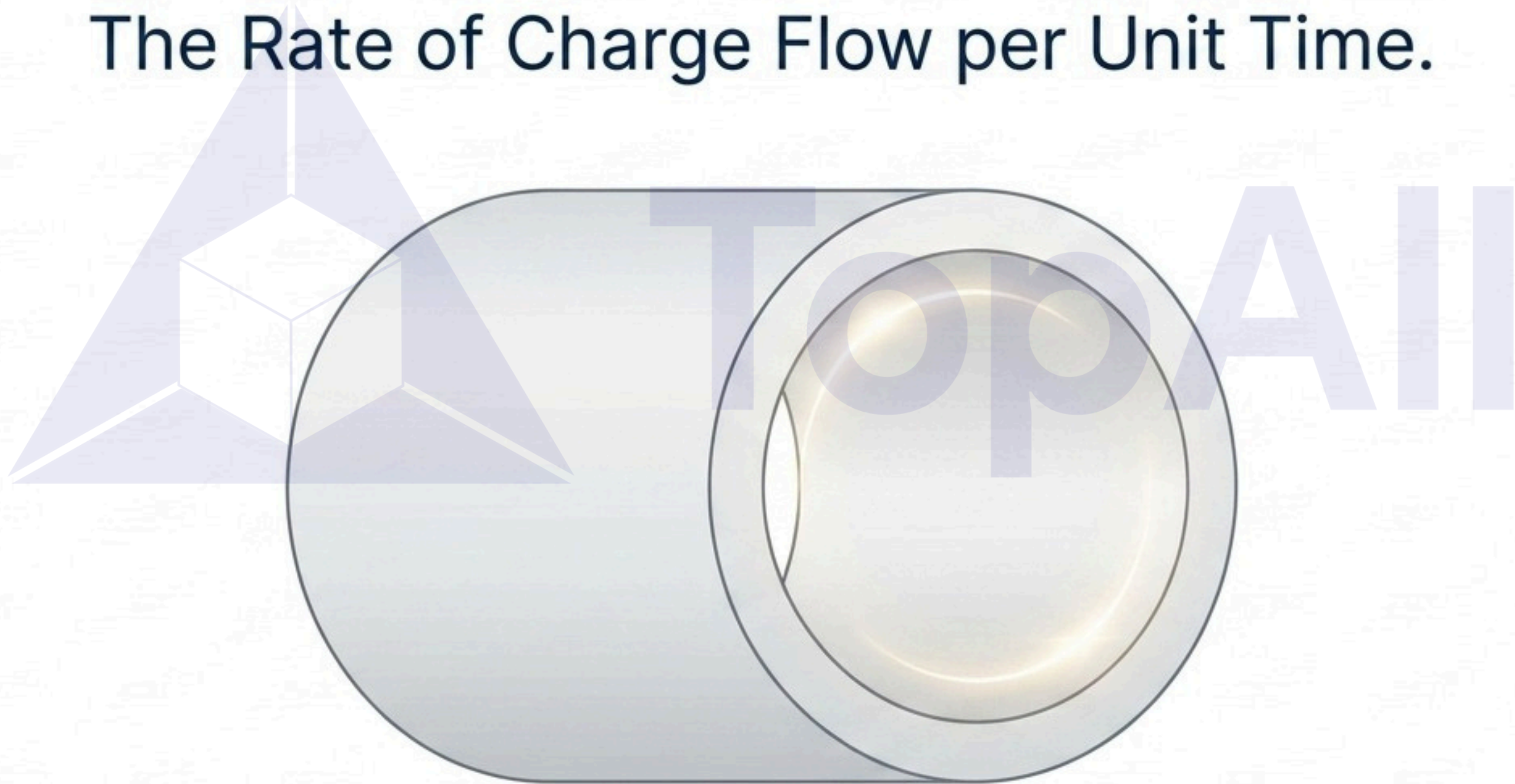


Electric Current

The Rate of Charge Flow per Unit Time.

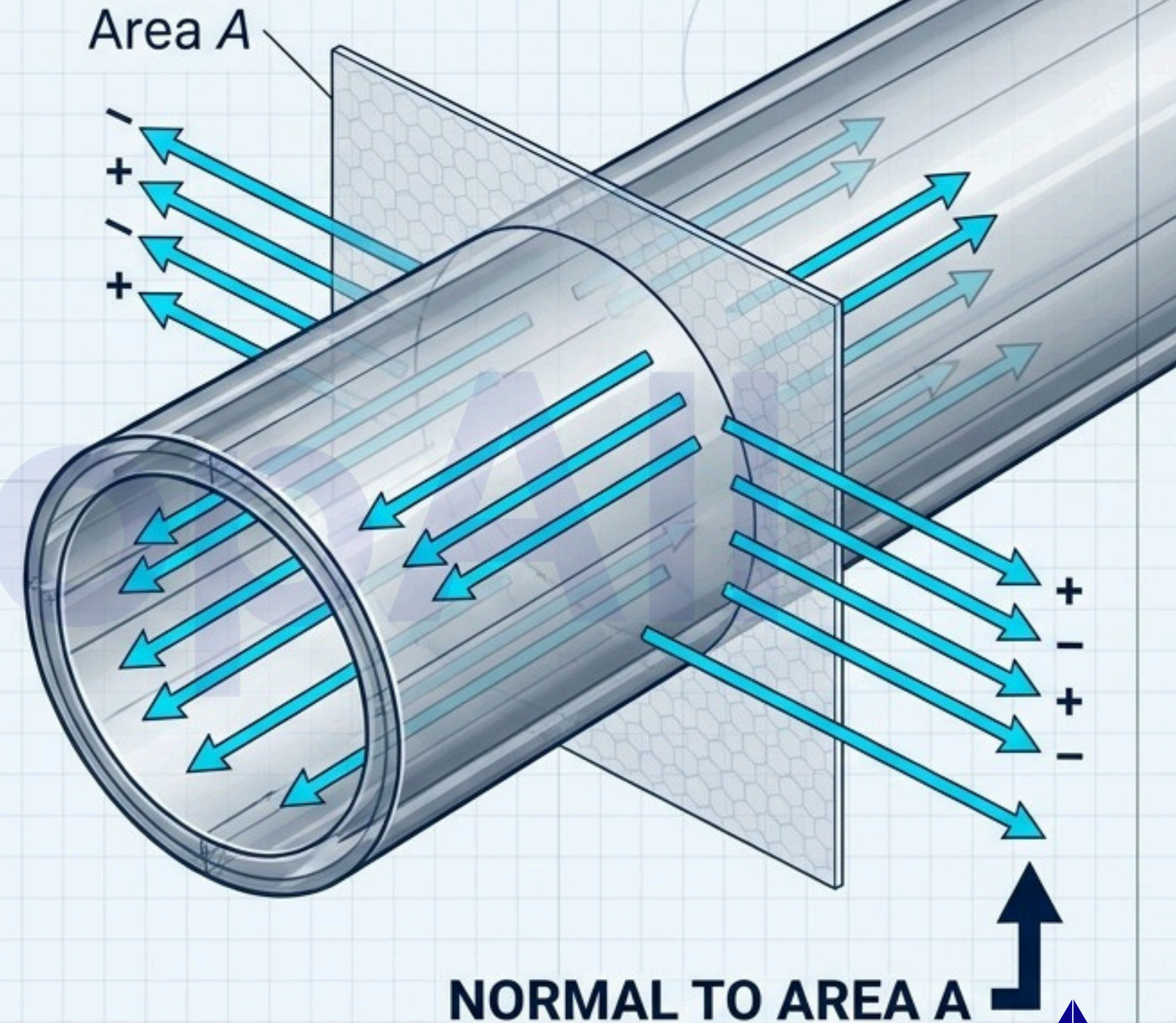


Defining the Flow

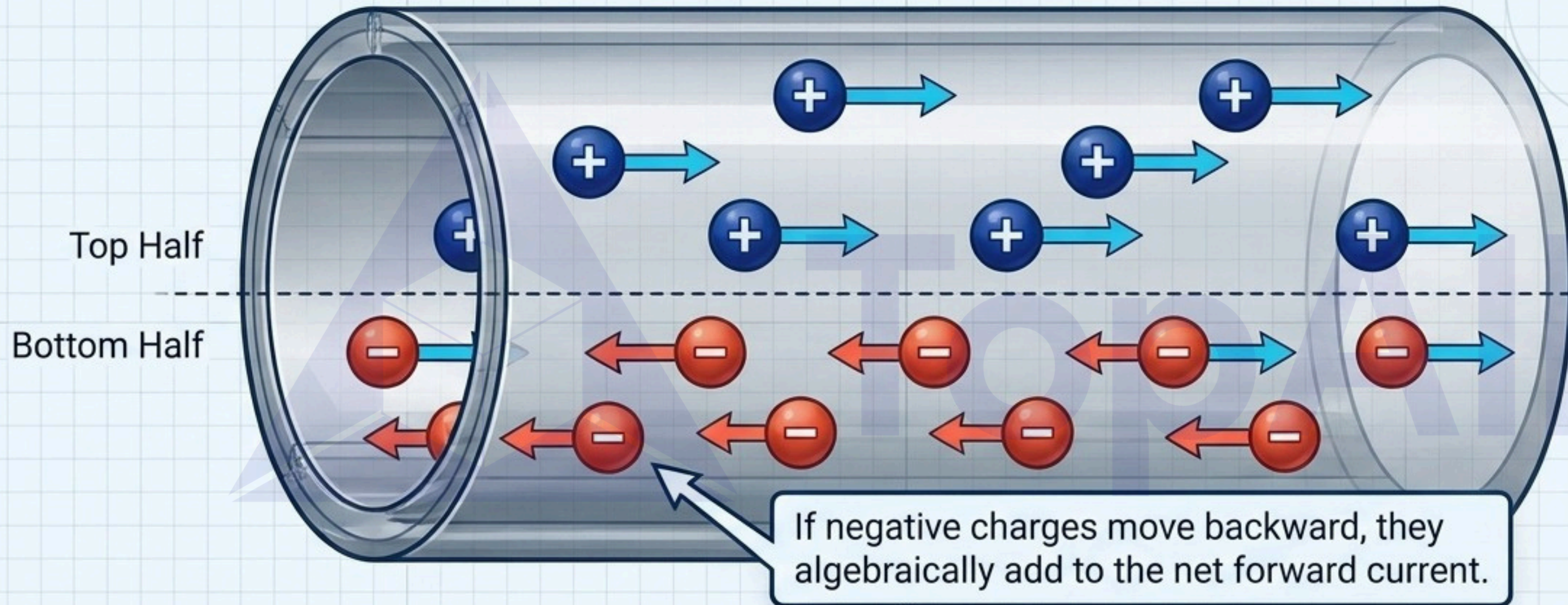
Current isn't just “moving charges”—it is the **net** amount of charge crossing a specific **normal area** in a given time interval t .

Baseline parameters:

- q_{++} - net positive charge moving forward
- q_{--} - net negative charge moving forward



The Mechanics of Net Charge



$$\text{Total Net Charge (q)} = q_+ - q_-$$



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$$E=mc^2$$



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Essential Formula Bank

Total Net Forward Charge

$$q = q_+ - q_-$$

Varying, Time-Dependent Flow

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

Unit: Ampere (A)

Constant, Steady Flow

$$I = q / t$$

Sign Conventions & Direction

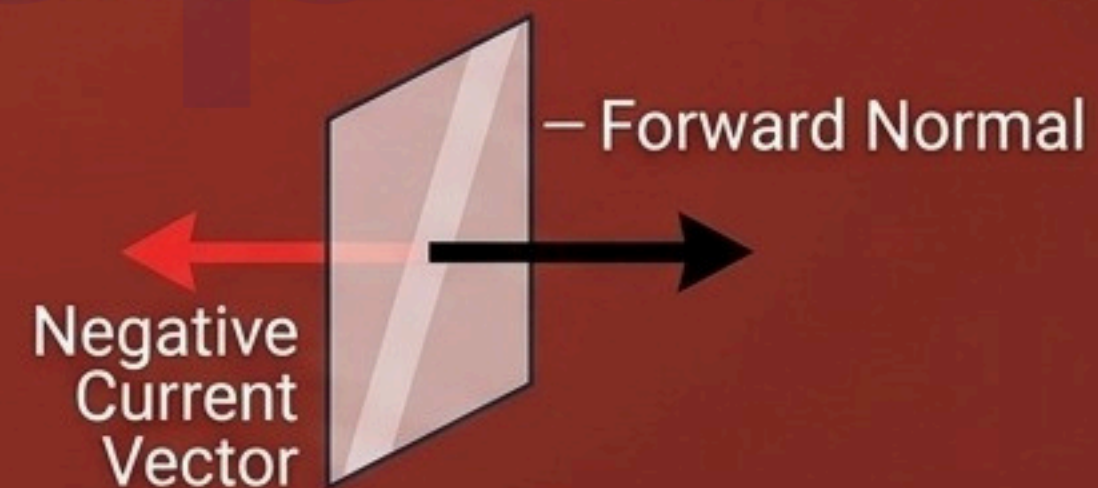
! JEE TRAP ALERT

✗ THE TRAP

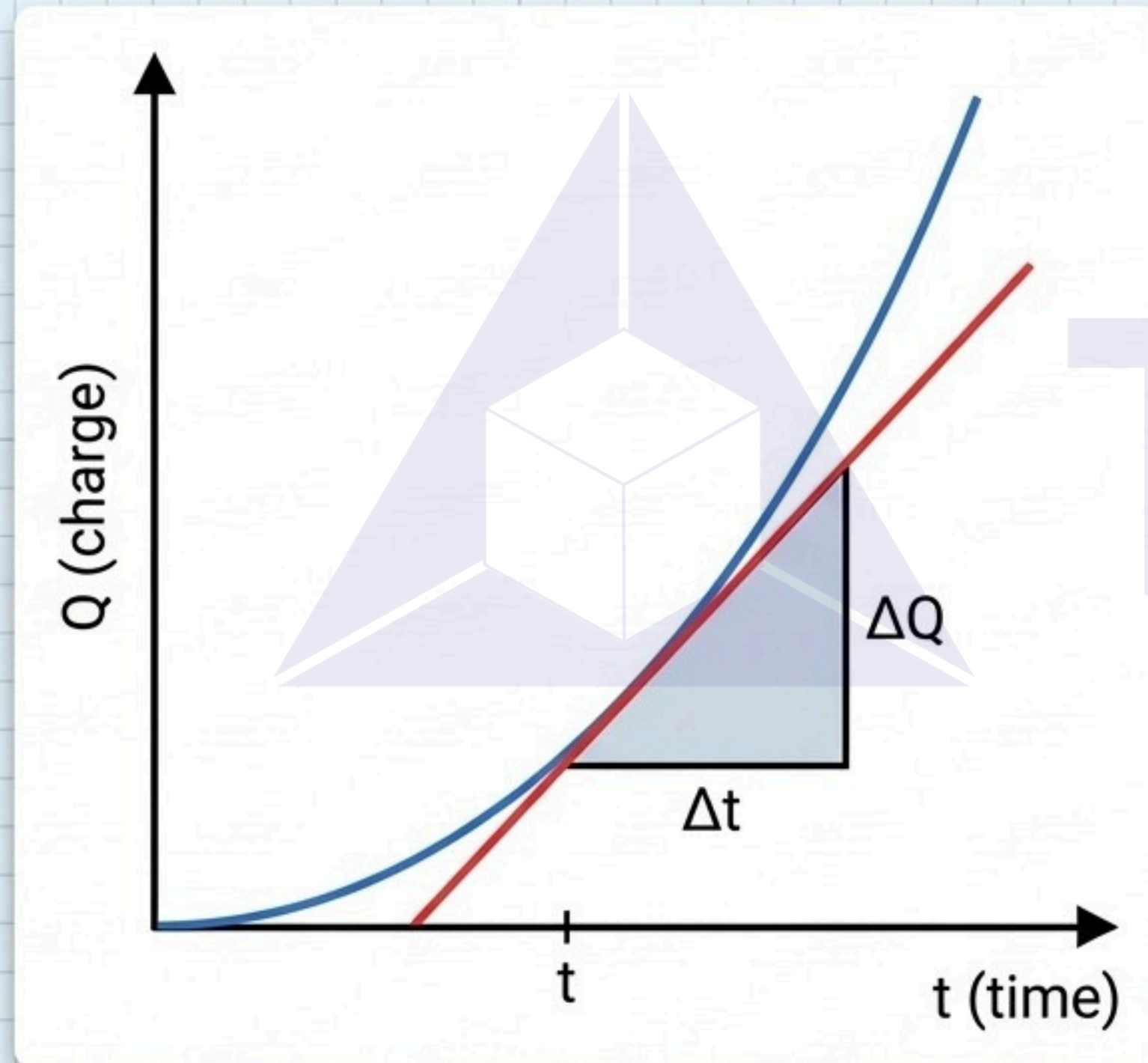
Calculating a negative current ($I < 0$) and assuming the calculation is wrong, or that the magnitude is zero.

✓ THE CORRECTION

A negative number simply implies the net current is flowing in the backward direction relative to the area's chosen forward normal.



Graphical Application: Current as a Derivative



Instantaneous current is the slope of the Q-t graph.

If charge flows such that $Q(t) = 3t^2 + 2t$, what is the current at $t = 2s$?

$$I = dQ/dt = 6t + 2$$

At $t = 2s$:

$$I = 6(2) + 2 = 14 \text{ A}$$

Module Summary



REVISION SUMMARY

- Current is the rate of net charge flow strictly across a normal area.
- Net charge is defined as $q = q_+ - q_-$. Direction dictates the sign.
- For steady flow, $I = q/t$. For variable flow, use calculus:
 $I = dQ/dt$ (Current is the slope of the Q-t graph).



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