



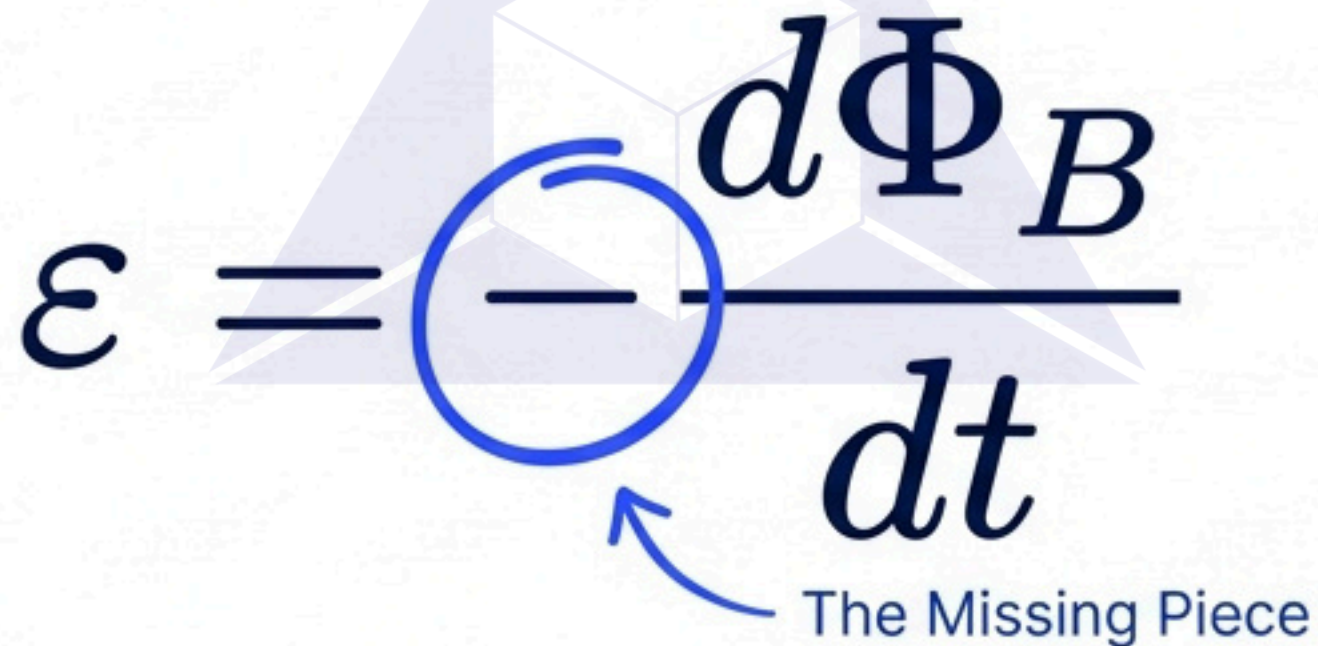
CLASS 12 PHYSICS • CHAPTER 6.5

Lenz's Law & Conservation Of Energy

Mastering the direction of induced current for NEET & JEE.

Faraday Gives The Magnitude. Who Gives The Direction?

[FORMULA]


$$\varepsilon = - \frac{d\Phi_B}{dt}$$

The Missing Piece

[CONCEPT]

- Faraday's experiments proved that a changing magnetic flux induces an electromotive force (emf).
- But which way does the current actually flow in a closed loop?
- The crucial **negative sign** holds the answer—it represents the **direction** of the induced emf.

The Law Of Opposition

“The polarity of induced emf is such that it tends to produce a current which **opposes the change in magnetic flux** that produced it.”

1. The Cause

External magnetic flux changes.



2. The Effect

Current is induced in the closed loop.



3. The Opposition

The new current creates its own magnetic field to fight the original change.



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$$E=mc^2$$



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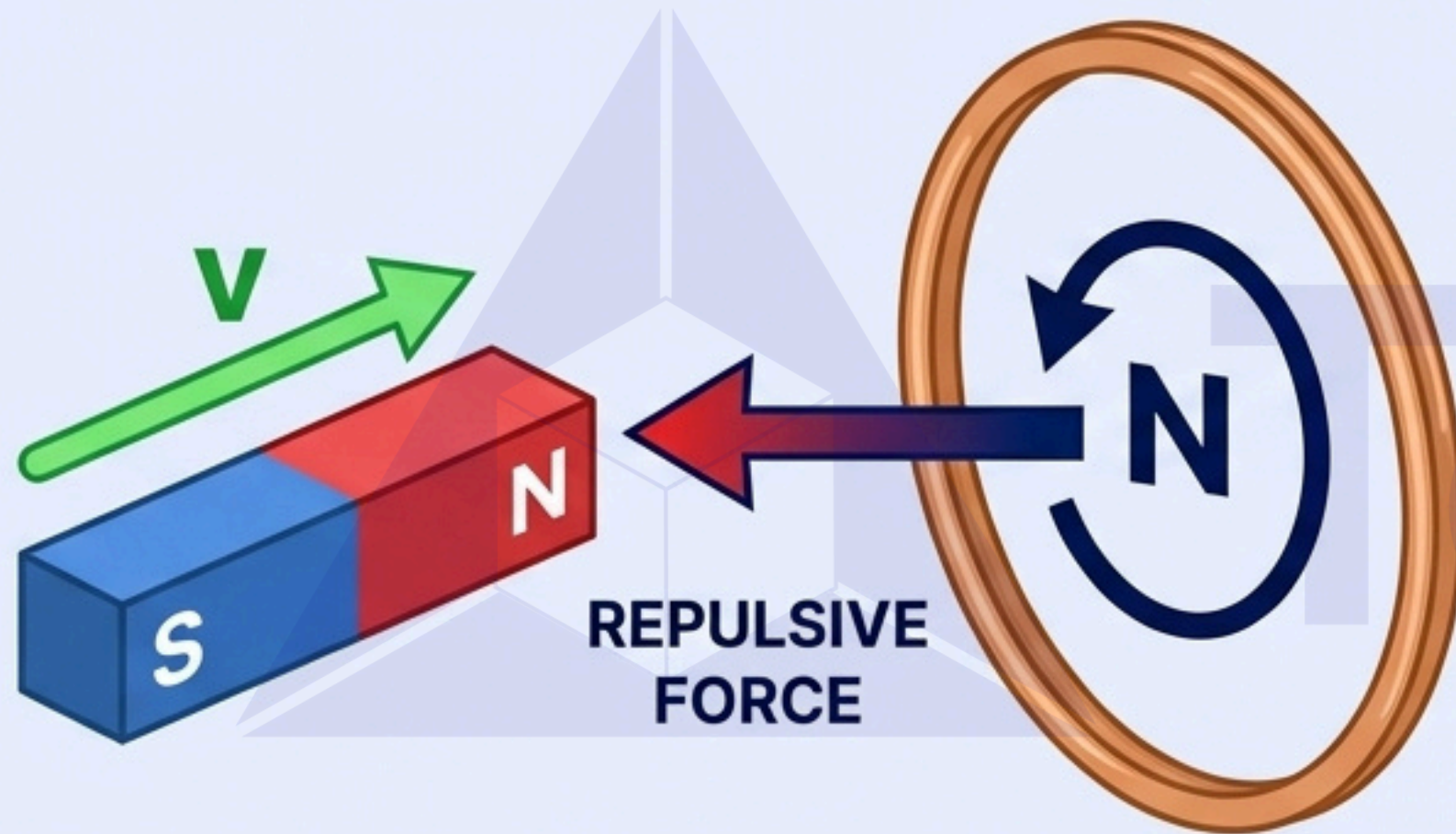
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FIGURE 6.6 (a)

Opposing An Increase In Flux

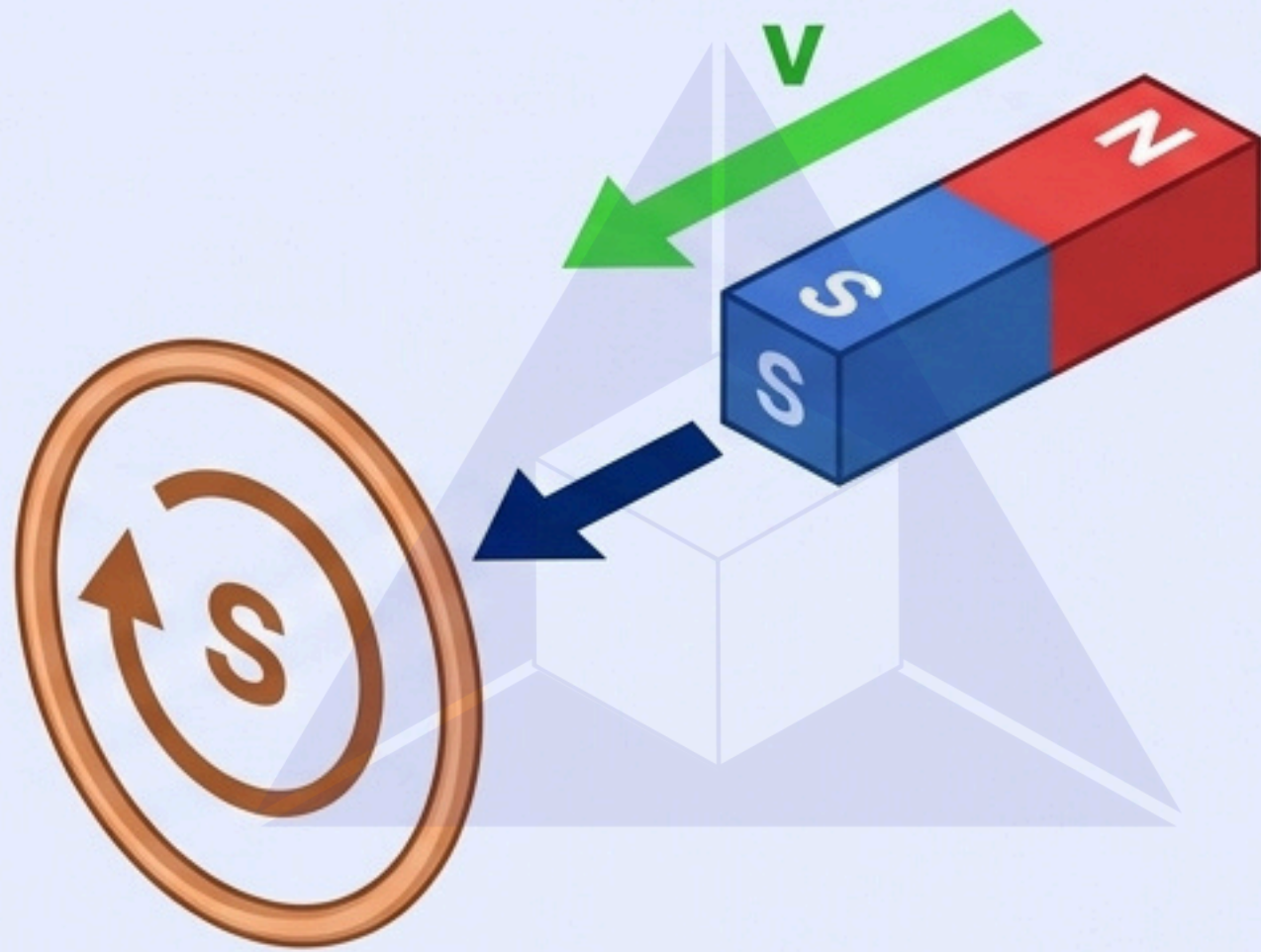


Approaching N-Pole → Repulsive Force →
Counter-Clockwise Current.

- **Action:** The North pole is pushed toward the closed coil.
- **Flux:** Magnetic flux through the coil **increases**.
- **Reaction:** Induced current flows **counter-clockwise**, turning the coil face into a North pole.
- **Result:** The coil **repels** the approaching magnet, opposing the change.

FIGURE 6.6 (b)

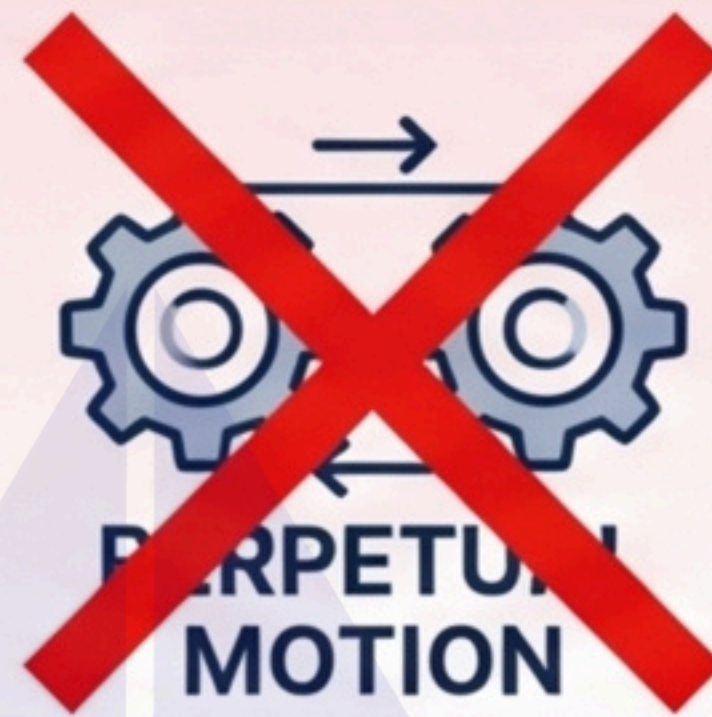
Opposing A Decrease In Flux



**Receding N-Pole → Attractive
Force → Clockwise Current.**

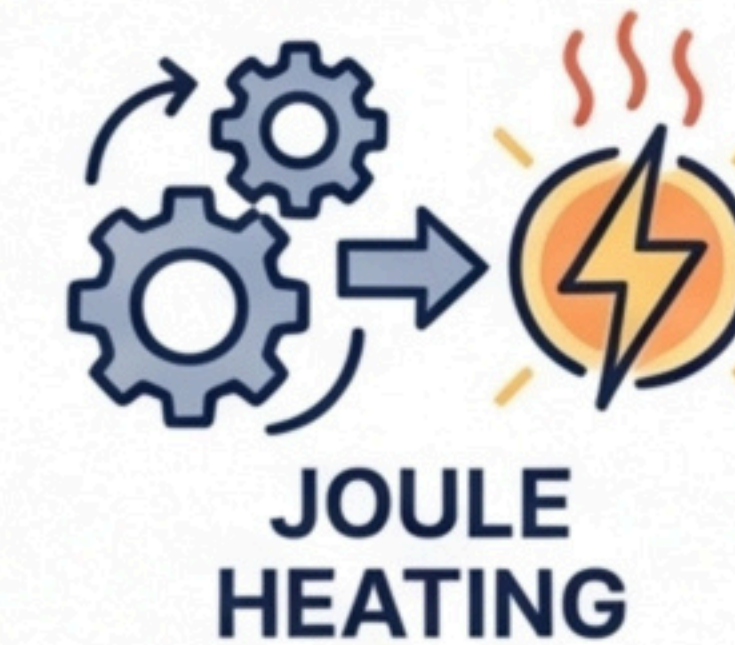
- **Action:** The North pole is pulled away from the coil.
- **Flux:** Magnetic flux through the coil decreases.
- **Reaction:** Induced current flows clockwise, turning the coil face into a South pole.
- **Result:** The coil attracts the receding magnet, trying to pull it back and maintain the flux.

Why Lenz's Law Is Structurally Necessary



If current aided the change (Wrong)

- The magnet would be continually attracted to the coil.
- It would accelerate infinitely with just a gentle push.
- Result: A perpetual-motion machine (Violates Conservation of Energy).



Because current opposes the change (Reality)

- You must do physical work to overcome the repulsive/attractive forces.
- Where does this mechanical work go?
- Result: Mechanical energy is converted into Joule heating (electrical energy).

KEY TAKEAWAYS

Mastering Lenz's Law at H1

- ✓ The Negative Sign: Indicates that the induced emf opposes the change in magnetic flux ($\varepsilon = -d\Phi_B/dt$).
- ✓ The Rule of Thumb: The coil will always generate a magnetic pole that fights the motion of the external magnet.
- ✓ The Physics Principle: Lenz's Law is a direct consequence of the Law of Conservation of Energy.

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