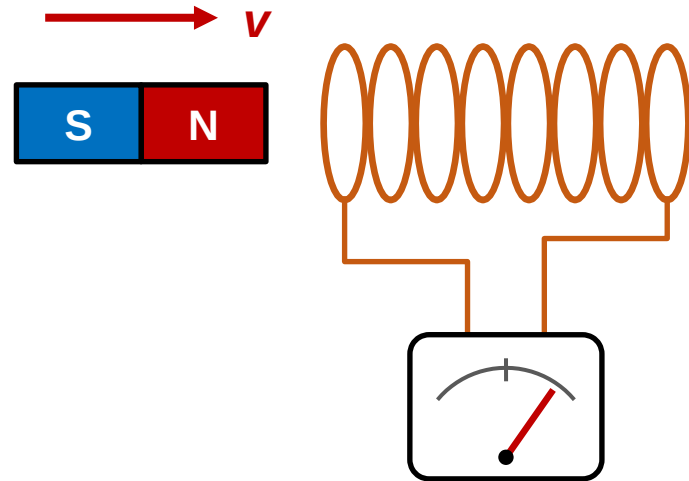


Essential Question

How can a magnet make electricity?

Faraday's Discovery

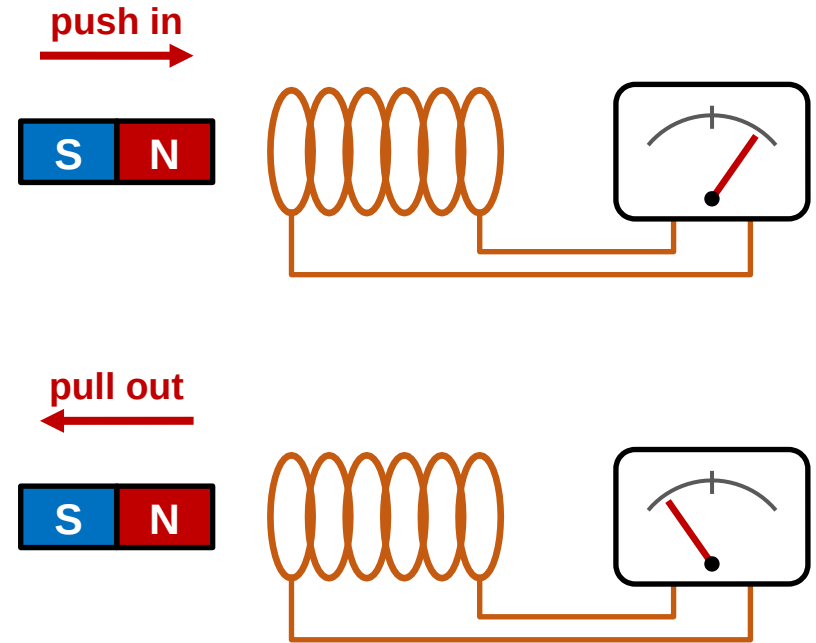
- Changing field in a coil: current
- This is called induction
- No battery needed



moving magnet makes a current

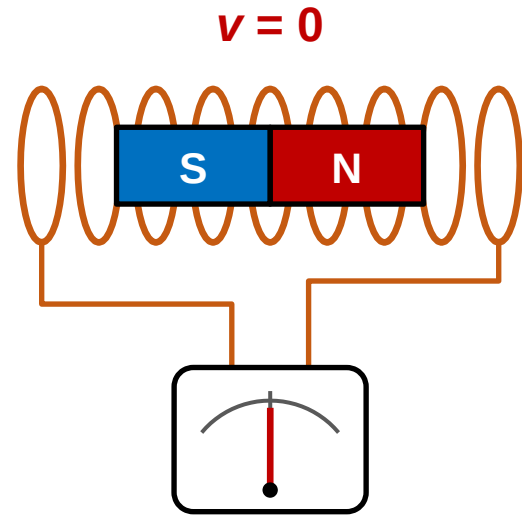
Direction Depends on Motion

- Magnet in: needle one way
- Magnet out: needle the other way
- Flip the magnet: current flips too



No Change, No Current

- Magnet held still: no current
- Even when it sits inside the coil
- Only a changing field counts



still magnet: no current

Making More Current

- More turns in the coil
- A stronger magnet
- Faster motion

More turns

each loop adds its own push

Stronger magnet

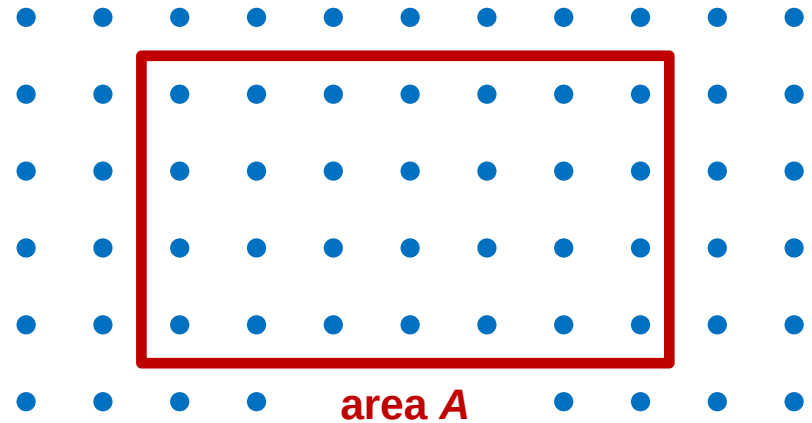
a bigger change in the field

Faster motion

the same change in less time

Magnetic Flux

- Flux: how much field passes through a loop
- $\Phi = BA$ (field $\perp$ loop)
- Unit: weber (Wb) = T·m²



$$\Phi = BA$$

Faraday's Law

$$\varepsilon = N \Delta\Phi / \Delta t$$

ε

induced voltage (V)

N

number of turns

$\Delta\Phi$

change in flux (Wb)

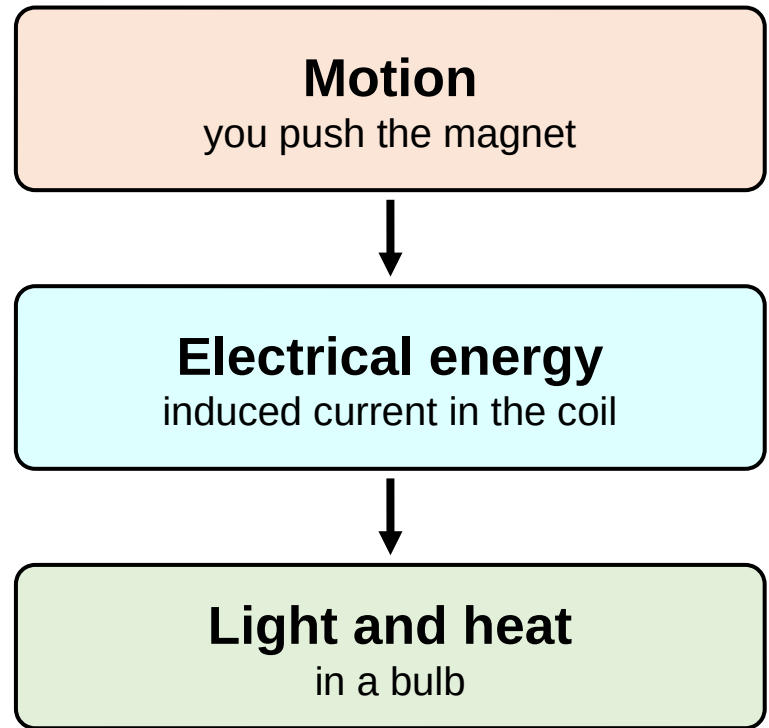
Δt

time for the change
(s)

Then the induced current comes from Ohm's law: $I = \varepsilon / R$

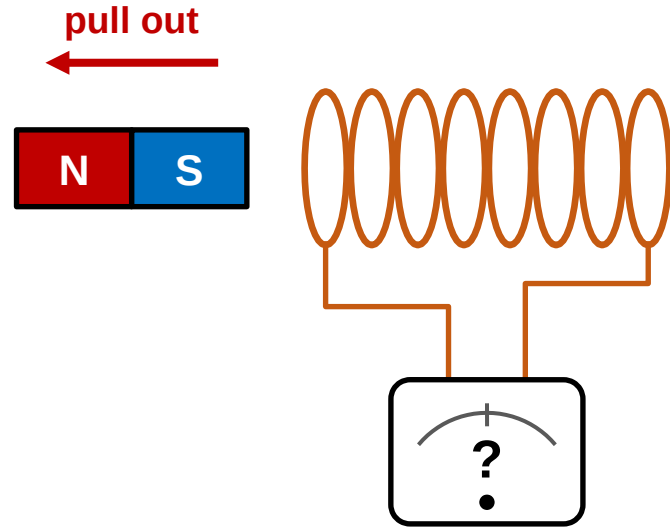
Motion Becomes Electricity

- The coil pushes back on the magnet
- You do work to move it
- Your work becomes electrical energy



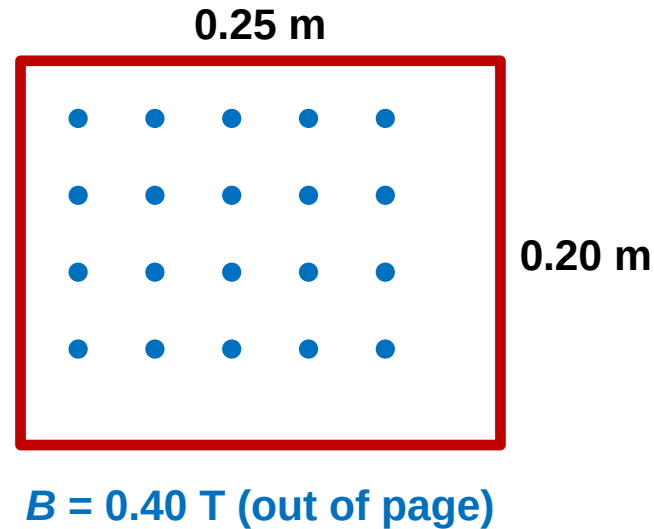
Example: Reading the Meter

When a magnet's N pole is pushed into a coil, the meter swings right. The magnet is turned around, and its S pole is pulled out of the coil. Which way does the meter swing?



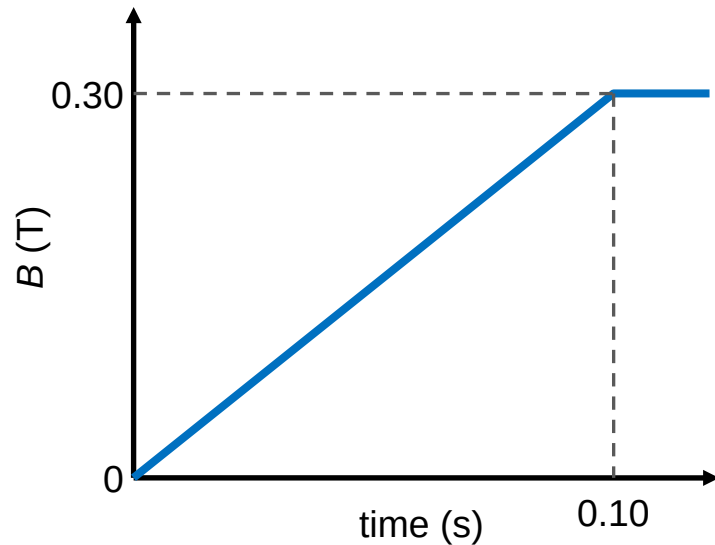
Example: Magnetic Flux

A rectangular loop of wire measures 0.20 m by 0.25 m. A 0.40 T magnetic field points straight through it. What is the magnetic flux through the loop?



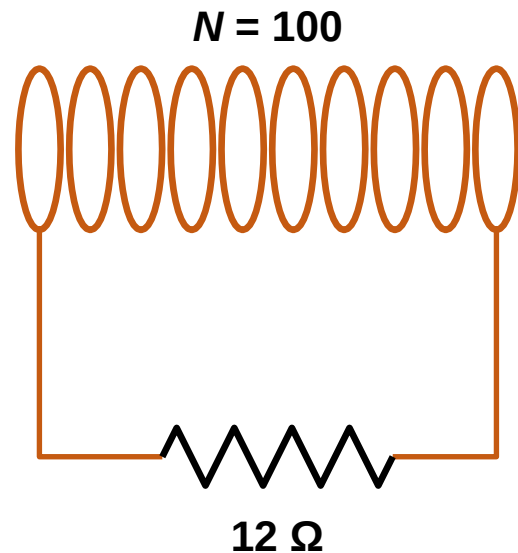
Example: Induced Voltage

A coil has 50 turns, each with an area of 0.020 m^2 . The field through it increases steadily from 0 T to 0.30 T in 0.10 s . What voltage is induced in the coil?



Example: Induced Current

The flux through a 100-turn coil changes by 0.012 Wb in 0.20 s. The coil is connected to a circuit with a total resistance of $12\ \Omega$. Find the induced current.



Big Ideas

- A changing field through a coil induces current
- Reverse the change: reverse the current
- No change: no current
- $\Phi = BA$ and $\varepsilon = N \Delta\Phi / \Delta t$