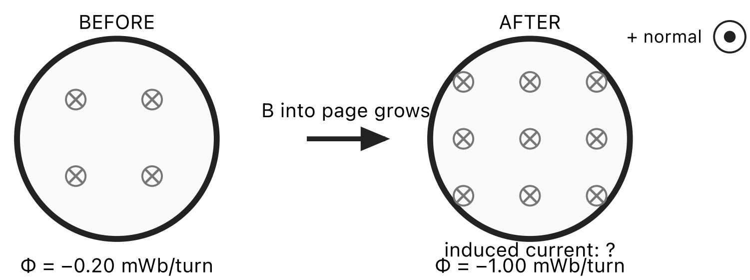
MAGNETISM DAY 9: FARADAY'S LAW & LENZ'S LAW

CED 12.4 · Skill 3.C · FRQ: QQT

PREDICT BEFORE MOVING

A bar magnet is held motionless inside a coil connected to a sensitive meter. What does the meter show: **steady positive / steady negative / zero**? Be ready to defend your choice before the magnet moves.

A STRONGER EXTERNAL FIELD CHANGES THE SIGNED FLUX



WHAT PRODUCES AN INDUCED EMF?

A changing magnetic flux produces an emf. A magnetic field or flux that remains constant does not.

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

The minus sign records Lenz's law: the induced effect opposes the **change** in external flux.

NOTES / REASONING

SIGNED ANCHOR CALCULATION

Viewed from above, choose the positive area normal out of the page. Positive current is counterclockwise. The external field into the page grows, so the flux per turn changes from −0.20 mWb to −1.00 mWb in 0.20 s. The coil has 120 turns.

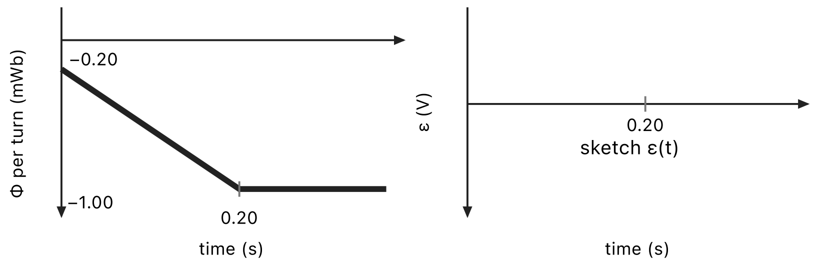
WE DO

1. Find $\Delta\Phi$ per turn using final minus initial.
2. Find the signed induced emf.
3. Use Lenz's law to find the induced field and current direction.

Direction chain: external flux change → opposing induced field → current direction that makes that field.

TRANSLATE THE REPRESENTATION

FLUX PER TURN AND INDUCED EMF



1. Sketch ε(t) while the flux decreases linearly, then while it is constant.

2. The same flux change occurs in 0.10 s instead of 0.20 s. Compare the emf magnitude and explain using the graph slope.

PRACTICE

3. An 80-turn coil has $\Delta\Phi = -0.60$ mWb per turn in 0.20 s. Find the signed emf using the same positive convention.

4. Repeat if the same change occurs in 0.10 s.

5. An out-of-page flux decreases from +1.40 mWb to +0.40 mWb per turn in 0.25 s through a 50-turn coil. Find ε and the current direction.

6. State the emf after the external flux stops changing, even if its final magnitude is large.