MAGNETISM DAY 1: MAGNETIC FIELDS, SOURCES & FIELD MAPS

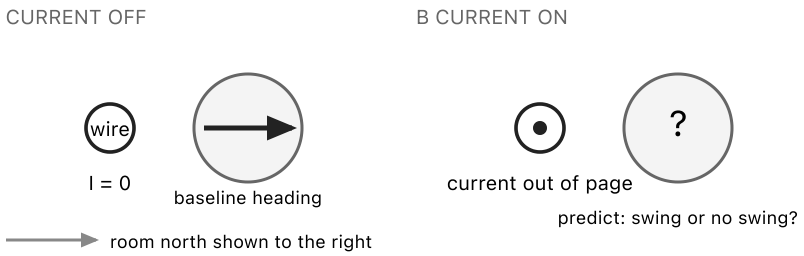
CED 12.1 · Skill 1.A · FRQ: TBR

PREDICT BEFORE SWITCHING

A compass rests beside a vertical wire. With the current off, it points along the room's magnetic field. When current is switched on, predict: **no change / the needle swings / the needle loses all direction**. Be ready to defend your choice.

Observation source: a compass and current-limited straight wire; projected Physics Aviary *Magnetic Field from a Wire Lab* for the wire-field observation; or the printed panels.

PRINTED FALLBACK — COMMIT BEFORE THE CURRENT-ON PANEL IS REVEALED



SOURCES AND MAPS

Permanent magnets and moving electric charge produce magnetic fields. An electric current is moving charge, so a current-carrying wire produces a magnetic field.

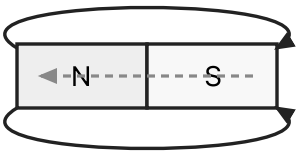
- The field direction is tangent to a field line.
- Closer line spacing represents a stronger field.
- Magnetic field lines form closed loops.

NOTES / REASONING

BAR MAGNETS AND STRAIGHT WIRES

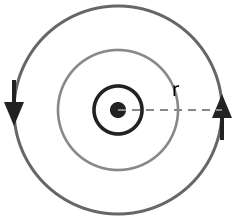
A MAGNETIC LINE CONTINUES THROUGH THE MAGNET

outside the magnet: N → S



the same lines return through the magnet

GRIP RULE FOR CURRENT OUT OF THE PAGE



• current out of the page

For a long straight wire, point your right thumb with the conventional current. Your curled fingers show the direction of the circular magnetic field.

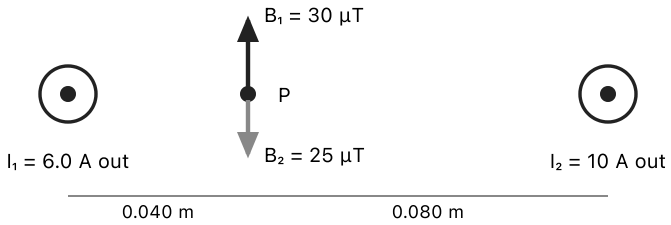
$$B = \frac{\mu_0 I}{2\pi r} \qquad \mu_0 = 4\pi \times 10^{-7}\,\mathrm{T\,m/A}$$

WE DO A long wire carries $8.0\,\mathrm{A}$. Find B at $r = 0.050\,\mathrm{m}$, then state the factor change at twice the distance.

SUPERPOSITION

Magnetic field is a vector. At a point near several sources, determine each field's direction first, then add the vectors.

POINT P LIES BETWEEN TWO OUT-OF-PAGE CURRENTS



The two contributions at P point in opposite directions.

WE DO At P, calculate each field from the labeled current and distance. Find the magnitude and direction of the net field.

Order matters: use the grip rule separately for each wire before subtracting or adding magnitudes.

PRACTICE

1. A long wire carries $4.0\ \text{A}$. Find B at $0.030\ \text{m}$.

2. Without recalculating, state how B changes if the distance from a straight wire triples while current stays fixed.

3. Draw the circular field direction for a current into the page. Use × for the current.

4. At a point, one wire contributes $35\ \mu\text{T}$ north and another contributes $20\ \mu\text{T}$ south. Find the net field.

5. Explain what is incomplete about drawing bar-magnet field lines only from N to S outside the magnet.