MAGNETISM DAY 7: UNIT REVIEW

BIG IDEAS TO REMEMBER

- **F = qv×B** (qvB sinθ) — ⊥ to both, does NO work; right hand, flip for negatives.
- **Circles:** r = mv/qB; T = 2πm/qB has no v — the period is independent of speed. Selector: v = E/B.
- **F = IL×B** (BIL) on wires; parallel same-direction currents attract, F/L = $(2\times10^{-7})I_1I_2/d$.
- **Biot–Savart:** loop center $\mu_0 I/2R$ (×N turns, ×arc fraction); straight wire $\mu_0 I/2\pi d$.
- **Ampère:** $\oint B\cdot dl = \mu_0 I_{enc}$ — outside 1/r, inside r/a^2 profile, solenoid $\mu_0 nI$ uniform.

A Rapid-Fire Directions

One line each (set up axes!): **(a)** proton east, B up → F? **(b)** electron east, B up → F? **(c)** current north, B down → F on wire? **(d)** two wires, opposite currents → attract or repel? **(e)** why can't a magnetic field change a particle's KE?

MIXED PRACTICE

B Orbit Chain

A proton at 1.0×10^{6} m/s enters B = 0.5 T (⊥). Find F = qvB, the radius r = mv/qB, and the period T — then state which of the three would change if the proton were twice as fast.

C Field-Builder Chain

Find B at the center of a 50-turn coil (R = 0.10 m, I = 2.0 A); then B at 0.05 m from a straight wire carrying 10 A; then B inside a solenoid (n = 1500 turns/m, I = 2.0 A). Rank the three.

D Spectrometer Chain

An ion ($q = 1.6\times10^{-19}$ C) passes a selector at $E = 2.0\times10^{5}$ V/m, B = 0.4 T, then bends through r = 0.15 m in the same 0.4 T. Find v, then m.

AP-STYLE PRACTICE

E Short FRQ: Ampère Inside and Out

A cylindrical wire of radius a carries current I, uniformly distributed.

a. **Derive** B(r) for r > a using Ampère's law (state the symmetry argument).

b. **Derive** B(r) for r < a (how much current does your loop enclose?).

c. **Sketch** B(r) and mark the maximum.

F Reflection

Which of these can you least reliably do on your own — right-hand rules, the cyclotron formulas, Biot–Savart setups, or Ampère profiles? Name it, and write your plan to fix it before the test:

Test Reminder: magnetic forces never do work; T has no v in it; loop-center B uses $\mu_0 I/2R$ (NOT $2\pi R$); and Ampère needs symmetry before it's solvable — say so on the FRQ.