PHYS1120 Exam III review

Things to remember for PHYS1110: algebra, trig (sin, cos, ..)

vector math, especially vector addition, $\mathbf{F}_{net} = m\mathbf{a}$ problems, free-body diagrams

Exam1 and Exam2 Material : **E**-fields, Gauss's Law, voltage, capacitors, circuits.

Last part of Chapter 26 : RC circuits

- Voltage across a capacitor is always $V_C = \frac{q}{C}$.
- An uncharged capacitor has $\Delta V = 0$, acts like a wire, as short (does not resist the flow of current).
- A fully charged capacitor has I = 0, acts like an open switch.
- time constant is $\tau = RC$

Ch. 27 Magnetic fields

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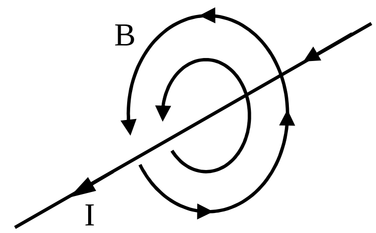
- $\vec{F}_{\text{on q}} = q\,\vec{v}\times\vec{B}$ This is the definition of **B .**
- When both E-field and B-field are present: $\vec{F}_{tot} = \underbrace{\vec{F}_E}_{q\vec{E}} + \vec{F}_B$
- Motion of charge in magnetic field and in velocity selector.
- $\vec{F}_{\text{on wire}} = I\,\vec{L}\times\vec{B}$, force and torque on a current loop

Ch. 28 Sources of Magnetic fields

- Currents cause magnetic fields (B-fields)
- Biot-Savart Law: $d\vec{B} = \frac{\mu_0 I}{4\pi}\frac{d\vec{\ell}\times\hat{r}}{r^2}$ (Know what <u>all</u> the symbols mean)

- Ampere's Law: $\oint_{\mathcal{L}} \vec{B}\cdot d\vec{\ell} = \mu_0 I_{enclosed}$



Be able to use Ampere to *derive*

  - B-field outside long straight wire: $B = \dfrac{\mu_0 I}{2\pi r}$,
  - B-field inside long wire: $B = \dfrac{\mu_0 I r}{2\pi R^2}$
  - B-field inside solenoid: $B = \mu_0 n I$

(No need to memorize these formulas; know how to *derive* them)

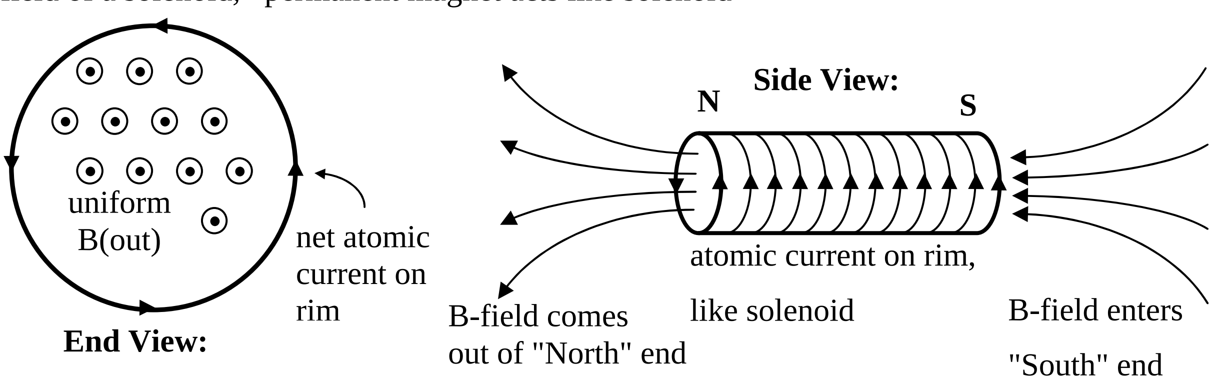
- "modified right-hand rule" point thumb in direction of straight thing, fingers curl in sense of circular thing.

- B-field is a vector: $\vec{B}_{tot} = \vec{B}_1 + \vec{B}_2$

- parallel currents attract; anti-parallel currents repel

- Gauss's Law for B-fields: $\oint \vec{B}\cdot d\vec{a} = 0 \Rightarrow$ Magnetic monopoles do not exist.

- field of a solenoid, permanent magnet acts like solenoid



Ch. 29 Faraday's Law

- Faraday's Law: An emf (= battery voltage) is caused by a *changing* magnetic flux:

$$\mathcal{E}_{(N\ loops)} = -N\frac{d\Phi}{dt} \quad \text{(where } \Phi \text{ is the flux through 1 loop)}$$

magnetic flux $\Phi = \int \vec{B}\cdot d\vec{a}$, emf around a loop $\mathcal{E} = \oint_{\mathcal{L}} \vec{E}\cdot d\vec{\ell}$

Be able to use Faraday's Law to derive E-field inside or outside a solenoid.

- Lenz's Law: $I_{induced}$ creates $B_{induced}$ in direction that *opposes the change* in flux.

- Motors and generators

- Eddy current forces always oppose the motion

To prepare for any exam:

- Study my online lecture Notes.
- Review Concept Tests, CAPA problems, and Tutorial HW. (Read question and try to remember reasoning that gets to the answer)
- Prepare your formula sheet. Prioritize: which are the <u>important</u> equations?
- Take the practice exam.
- It is no good to memorize answers. You have to understand and remember how you got the answers.

