

# Exam II Study Guide

## Chapter 17

- Biot-Savart Law for point charges and currents:

- $\vec{B} = \frac{\mu_0}{4\pi} \frac{q\vec{v} \times \hat{r}}{r^2}$
- $\vec{B} = \int \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \hat{r}}{r^2}$
- $|\vec{B}| = \frac{\mu_0 I}{2\pi r}$  (very long, straight wire)
- $|\vec{B}| = \frac{\mu_0}{4\pi} \frac{2\pi R^2 I}{(z^2 + R^2)^{\frac{3}{2}}}$  (loop of wire)
- Examples: P37, P45, P46

You do not need to have these memorized, but you do need to know how to use them! In particular, make sure you are VERY familiar with the cross product / right hand rule.

- Currents
  - Electron current  $i = nA\bar{v}$  (you should know what each of these terms mean!)
  - Conventional current  $I = |q|i$ . What are the directions of  $i$  and  $I$ ?
  - Examples: P24, P25, P27
- Bar Magnets and Dipoles
  - You should be able to roughly sketch the field of a bar magnet

## Chapter 18

- Be able to explain (on a qualitative level):
  - Steady state vs static equilibrium
  - The formation of the steady-state electric field and current (i.e. the field is due to the field of the battery + the field of built up surface charge)
  - The basic function of a battery (uses energy to maintain charge separation)
  - Examples: P20-21
- Know how to use the node rule and loop rule to solve for  $E$  and  $i$  everywhere throughout a circuit
  - Node rule:  $i_{\text{in}} = i_{\text{out}}$
  - Loop rule:  $\sum \Delta V = 0$  for any closed loop.
  - $i = nAv$ ,  $v = uE$ ,  $i = nAuE$
  - In order to use the Loop rule properly, you must know the direction of  $E$  everywhere in the wire, and remember how to find  $\Delta V = -\vec{E} \cdot \Delta\vec{\ell}$
  - Examples: P44, P46

## Chapter 19

- Ohm's Law and Resistors
  - $I = \Delta V/R$
  - $R = \frac{L}{\sigma A}$
  - Equivalent resistance in series:  $R_{eq} = R_1 + R_2 + R_3 + \dots$

- Equivalent resistance in parallel:  $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$
- Power dissipated in a resistor:  $P = I\Delta V$
- Internal resistance of a battery:  $\Delta V_{\text{battery}} = \varepsilon - Ir_{\text{int}}$
- Examples: P47, P51, P54, P56, P67, P68
- Use the loop and node rule to find  $\Delta V$  and  $I$  over every element in a circuit
  - Examples: P63 (ignore a-h, just know how to find  $I$  and  $\Delta V$  for each resistor), P66
- Know how to work with  $RC$  circuits
  - Know the potential difference across a capacitor:  $\Delta V = Q/C$
  - Examples: P74, P76