PHYS 212, Honors Section – Review Material

Chapter 27: Current and Resistance

- <u>Electric current</u>: The amount of charge flowing per unit time,

  $$I = dQ/dt \text{ , or } Q = \int I(t)\, dt \text{ ;}\quad \text{The unit is the ampere, 1 A = 1 C/s.}$$

- <u>Current density</u>: Defined by $I = \int \mathbf{J} \cdot d\mathbf{A}$, and related to microscopic quantities by $\mathbf{J} = ne\mathbf{v}_d$.

- <u>Ohm's law</u>: The relationship between electric potential difference and current,

  $$I = V/R \text{ ,}\quad \text{same as}\quad V = IR \text{ and } R = V/I \text{ ;}\quad \text{The unit is the ohm, 1 } \Omega = 1 \text{ V/A.}$$

- <u>Resistivity</u>: Relates the electric field and current density in a material,

  $$\mathbf{E} = \varrho\mathbf{J}, \quad \text{or}\quad \mathbf{J} = \sigma\mathbf{E}$$

  in terms of the conductivity $\sigma = 1/\varrho$.

- <u>Resistance</u>: The resistance depends on the type of material and the size and shape of the resistor. For a uniform block of length L and cross-sectional area A,

  $$R = \varrho L/A \text{ .}$$

- <u>Power needed to maintain a current</u>: In general, for any device, $P = IV$. If the current goes through a resistor and V is the voltage across that resistor, then the equation can be rewritten as $P = I^2 R = V^2/R$.

<u>Note</u>: You are not required to know the topics and equations inside square brackets.