Review notes for Exam 3 (Serway 26-28)
This is a list of concepts that will be tested, not a list of potential exam problems.

1) Capacitance.
   a. Definition of capacitance: \( C = Q/V \).
   b. Field, energy, and energy density in a capacitor.
   c. Perform parallel and series capacitance calculations.
   d. The capacitance of physical objects (plates, sphere, cylinder, coax).
   e. The capacitance of a network of capacitors.
   f. The behavior of charge and voltage on a pair of capacitors that have been shorted together after charging. Recall the crossed capacitor problem from lab 3 as well as the case where the two capacitors are charged separately.
   g. The effect of plate separation on capacitance, charge, voltage, energy for constant charge and constant voltage cases.
   h. The effect of a dielectric on capacitance, charge, voltage, energy for constant charge and constant voltage cases.
   i. Alter the properties of a capacitor (\( \kappa, A, d \)) within a circuit and predict how other related quantities (e.g. \( R, I, V, P \)) will change. Consider both fixed \( V \) and fixed \( I \) cases.

2) Dipoles
   a. Dipoles lower their potential energy in an by aligning with the field.
   b. The net force on a dipole is zero in a uniform electric field.
   c. Determine the torque and the potential energy of a dipole in an electric field.
   d. A material containing microscopic dipoles has a dielectric constant \( \kappa > 1 \).

3) Current and Resistance
   b. Current density: \( J = I/A \).
   c. Resistivity vs resistance.
   d. Ohm’s law: \( J = \sigma E \) and \( E = \rho J \) (geometry independent) or \( V = IR \) (geometry dep).
   e. For ohmic materials, \( R = V/I \) is constant. For non-ohmic materials, \( R \) can depend on \( I \) or \( V \).
   f. Microscopic model of resistivity.
   g. Temperature dependence of resistivity.
   h. Series and parallel resistance.
   i. Find the effective resistance of a network of resistors
   j. The resistance of a wire: \( R = \rho L/A \).
   k. The resistance of physical objects. Break the object up into a series sum of differential resistances: \( R = \int dR \).
   l. Energy dissipation and power in resistive elements. \( P = IV = I^2R = V^2/R \).
   m. The internal resistance of a battery.
   n. Kirchhoff’s laws and multiloop circuits.
   o. For a resistive network attached to a emf source, find the potential at each point and the current in each branch.
   p. Alter the properties of a resistor (\( \rho, L, A \)) within a circuit and predict how other related quantities (e.g. \( R, I, V, P \)) will change. Consider both fixed \( V \) and fixed \( I \) cases.
4) RC circuits
   a. The mathematical expression of exponential decay.
   b. RC time constant.
   c. $Q, V,$ and $I$ as a function of time during charging and discharging.
   d. Energy flow during charging and discharging.