

Things you should know for Prelim 1

To prepare for exams, including the first prelin, we recommend challenging yourself with basic knowledge. Can you recall/reconstruct the fundamental equations? What are the general principles? Can you recall/reconstruct the definitions that apply to devices and their behavior? You need to have in place a mental map to navigate this knowledge because the exams are closed-book, closed-notes, and there will not be a formula sheet. The list below was prepared to help you construct such a map for yourself.

- Everything about point charges: field, potential, potential energy.
- Gauss's law, both the integrated and local forms.
- Calculating the electric field using Gauss's law when there is symmetry (spherical, cylindrical, planar).
- General relationships between field, potential, and potential energy.
- Poisson and Laplace equations.
- Electric energy density.
- Properties of conductors in static equilibrium.
- Definitions that apply to conductors with free charges moving in a steady-state: number density (of free charges), current density, current, mobility, drift velocity, resistivity, collision time.
- Local charge conservation.
- Divergence theorem in two and three dimensions.
- Field line diagrams. Field patterns of point charges, dipoles, with and without a uniform field.
- Field and surface charge density at the surface of a conductor, both flat and with a sharp tip.
- Circuit concepts covered so far: voltage, current, resistance, Ohm's law, EMF, power, Kirchhoff's laws.
- How EMF arises in a battery.
- Definition of capacitance.