Guide to: Electric potential associated with charges: point particles, charged plates, batteries.

Applications: Motion of charged particles in an electric field; also in wires (conduction).
Electric circuits.

Basic idea: A scalar quantity with the same information content as the electric field.
Defines the electrostatic potential energy of a charged particle in an external field.

Concepts: 1) Electric potential associated with the field of a point charge located at $r=0$: $V = \frac{q}{4\pi\epsilon_0\ r}$, derived from the potential energy of two point charges separated by r: $U(r) = \frac{q_1 q_2}{4\pi\epsilon_0\ r}$.

2) Potential of a charged particle in a uniform electric field (large plate; capacitor) as a function of distance from the positive plate: $V = V_0 - Ex$; or: $\Delta V = -E\Delta x$; or: $\frac{dV}{dx} = -E$.

3) Lines of equal potential (in 3d these are surfaces, but we look at planar cuts): the loci where the potential energy of a charged particle (probe) doesn't change when it moves around. The electric field (represented by field lines) is perpendicular to these lines (surfaces).

Equations: For radially symmetric charge distributions (single point charge, charged sphere) the electric field is pointing radially away from the positive charge Q. The strength is $E(r) = -\frac{dV}{dr} = \frac{Q}{4\pi\epsilon_0\ r^2}$.

Problems: 18.1-38; 75-76.

Adding potentials from multiple sources is easy, since the potential is a scalar. However, the field will not be radial anymore, and calculating the electric field from the potential requires vector calculus (the gradient). Calculating the total potential energy of an additional charged particle is easy (charge times potential). Use energy conservation (kinetic energy plus potential energy = total energy = constant) for problems without dissipation of energy (friction).