DC Circuits

Equations:
Voltage across Capacitor:

$$V = Q/C$$

Capacitance for a given geometry:(A is area of plates, d is separation, κ=relative permeability)

$$C = \epsilon_0 \frac{A}{d} \kappa$$

Energy Stored in Capacitor:

$$U = \frac{1}{2} C V^2 \qquad = \frac{1}{2} \frac{Q^2}{C}$$

Voltage across Resistor:

$$V = RI$$

Resistance of a wire for a given geometry:(A is cross-sectional area, L is length,ρ=resistivity of the material)

$$R = \frac{\rho L}{A}$$

Power through any circuit element:

$$P = IV$$

Power dissipated in resistor:

$$P = I^2 R \qquad = \frac{V^2}{R}$$

Elements in Series:

$$R = R_1 + R_2 \qquad \frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$$

Elements in Parallel:

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \qquad C = C_1 + C_2$$

Assorted Facts:

1. In steady state, no current flows through a capacitor.
2. Relative permeability, $\kappa = 1.0$ for vacuum, ≥ 1.0 for all other materials.
3. In isolated capacitor, charge does not change.
4. Sum of voltages around closed loop is zero. (Kirchoff's law #1)
5. Sum of currents into a node is zero. (Kirchoff's law #2)
6. Capacitors in Series must store equal charges.

Units:

Quantity	Units	Conversion
Electric Field	(N/C), (V/m)	$1(N/c) = 1(V/m)$
Charge	(C), (e)	$1e = 1.6 \cdot 10^{-19} C$
Voltage	(V)	$1(V) = 1(J/C)$
Current	(A)	$1(A) = 1(C/s)$
Capacitance	(F)	$1(F) = 1(C/V)$
Resistance	(Ω)	$1(\Omega) = 1(V/A)$