Physics 102 Formula Sheet (for Midterm #1)

Coulomb's law (21-1, 2): $F = k\frac{Q_1 Q_2}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{Q_1 Q_2}{r^2}$ (magnitude)

Torque on an electric dipole (21-9a): $\tau = pE\sin\theta, \quad p = Ql$

Potential energy of an electric dipole (21-10): $U = -pE\cos\theta = -\vec{p}\cdot\vec{E}$

Gauss's law (22-1-4): $\Phi_E = \sum \vec{E}\cdot\vec{A} = \frac{Q_{encl}}{\varepsilon_0}$

Electric potential due to a point charge (23-5): $V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$ (assuming $V = 0$ at $r = \infty$)

Capacitance (24-1): $Q = CV$

Parallel-plate capacitor (24-2): $C = \varepsilon_0\frac{A}{d}$

Cylindrical capacitor (page 631): $C = \frac{2\pi\varepsilon_0 l}{ln(R_a / R_b)}$

Capacitors in parallel (24-3): $C_{eq} = C_1 + C_2 + C_3$

Capacitors in series (24-4): $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

Energy stored in a capacitor (24-5): $U = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$

Ohm's law (25-2): $I = \frac{V}{R}, \quad V = IR$

Resistivity (25-3): $R = \rho\frac{l}{A}$

Conductivity (25-4): $\sigma = \frac{1}{\rho}$

Electric power (25-6,7): $P = IV = I^2R = \frac{V^2}{R}$

Root-mean-square (rms) value (25-9): $I_{rms} = \frac{I_0}{\sqrt{2}}, \quad V_{rms} = \frac{V_0}{\sqrt{2}}$

Resistors in series (26-3): $R_{eq} = R_1 + R_2 + R_3$

Resistors in parallel (26-4): $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Time constant of RC circuits (26-7): $\tau = RC$

Charging of RC circuits (26-6b, 26-8): $V_C = \varepsilon\left(1 - e^{-t/RC}\right); \quad I = \frac{\varepsilon}{R}e^{-t/RC}.$

Discharging of RC circuits (26-9b, 26-10): $V_C = V_0 e^{-t/RC}; \quad I = I_0\, e^{-t/RC} = \frac{Q_0}{RC}e^{-t/RC}.$