$k = 9.00 \times 10^9\ Nm^2/C^2 = 1/(4\pi\varepsilon_0)$ $\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/Nm^2$ $\mu_0 = 4\pi \times 10^{-7}$ T-m/A σ=Q/area ρ=Q/volume

$e = 1.6 \times 10^{-19}$ C $\left|\vec{A} \times \vec{B}\right| = AB \sin \theta$ $\left|\vec{A} \bullet \vec{B}\right| = AB \cos \theta$ $s = r\theta$ $V_{sphere} = \frac{4}{3}\pi r^3$ $A_{sphere} = 4\pi r^2$

$$\vec{F}_{12} = \frac{kq_1q_2}{r_{12}^2}\hat{r}_{12}$$

$$\vec{E} = \frac{\vec{F}}{q_0}$$

$$\vec{E}_{point} = \frac{kq}{r^2}\hat{r}$$

$$E_{line} = 2k\frac{\lambda}{r}$$

$$E_{sheet} = \frac{\sigma}{2\varepsilon_0}$$

$\Phi_E \equiv \int \vec{E} \cdot d\vec{A}$ (flux)

$$\Phi_E = \oint \vec{E} \cdot d\vec{A} = \frac{q_{enclosed}}{\varepsilon_0}$$

$$\Delta U_{A\to B} \equiv -W_{A\to B} = -\int_A^B \vec{F}_E \cdot d\vec{l}$$

$\Delta U_r \equiv -\Delta U_{\infty\to r} = k\frac{q_1q_2}{r}$ (point charges only)

$$U_{system} = \sum_{all\ pairs} \frac{kq_iq_j}{r_{ij}}$$

$\Delta U_{A\to B} \equiv -W_{A\to B} = -q\int_A^B \vec{E} \cdot d\vec{l}$ (electr potential energy)

$\Delta V_{A\to B} \equiv \frac{\Delta U_{A\to B}}{q} = -\int_A^B \vec{E} \cdot d\vec{l}$ (electric potential)

$$V_{point} = \frac{kq}{r}$$

$$\Delta V_{capacitor} = E\Delta y$$

$\vec{E} = -\vec{\nabla} V$ $E_x = \frac{\partial V}{\partial x}$

$C \equiv \frac{Q}{V}$ $C = \frac{\kappa\varepsilon_0 A}{d}$ (*where* κ *is dielectric constant*)

$$U_{capacitor} = \frac{Q^2}{2C} = \frac{QV}{2} = \frac{CV^2}{2}$$

$C_p = C_1 + C_2 + C_3 + \ldots$ (parallel)

$C_s = \left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots\right)^{-1}$ (series)

$V_p = V_1 = V_2 = V_3 = \ldots..$

$V_s = V_1 + V_2 + V_3 + \ldots.$

$Q_p = Q_1 + Q_2 + Q_3 + \ldots\ldots..$

$Q_s = Q_1 = Q_2 = Q_3 = \ldots\ldots.$

$$R_s = R_1 + R_2 + R_3 + \ \ldots.$$

$$R_p = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ \ldots.\right)^{-1}$$

$I \equiv \frac{dq}{dt}$ $V = IR$ $R = \frac{\rho L}{A}$ (ρ = resistivity)

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

$\sum \Delta V_n = 0$ $\sum I_{in} = \sum I_{out}$

$q(t) = CV\left(1 - e^{\frac{-t}{RC}}\right)$ (charging) $\tau = RC$

$V(t) = V_{max}\left(1 - e^{\frac{-t}{RC}}\right)$ (charging)

$q(t) = CV\left(e^{\frac{-t}{RC}}\right)$ (discharging)

$I(t) = \frac{V}{R}e^{\frac{-t}{RC}}$ (charging & discharging)

$\vec{F} = I\vec{L} \times \vec{B}$ $\vec{F} = q\vec{v} \times \vec{B}$ $R = \frac{mv}{qB}$

$B_{wire} = \frac{\mu_0 I}{2\pi r} = \frac{2x10^{-7}I}{r}$ $\vec{\tau} = \vec{\mu} \times \vec{B}$ $\vec{\mu} = NI\vec{A}$

$\varepsilon_{mf} = vLB$ $U = -\vec{\mu} \bullet \vec{B}$ $F = \frac{\mu_0}{2\pi d}I_1I_2$ L

$u_{e=\frac{1}{2}\varepsilon_0 E^2}$ (energy density)

$\varepsilon_{mf} = -\frac{d\Phi_B}{dt} = -\frac{d}{dt}\int \vec{B} \bullet d\vec{A}$ $\omega = 2\pi f = \frac{2\pi}{T}$

$\Phi_B \equiv \int \vec{B} \cdot d\vec{A}$ (flux) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enclosed}$

<u>Check for negatives & radians vs. degrees mode</u>

$\varepsilon_{mf} = vL\left(B_{close} - B_{far}\right)$ $B_{sheet} = \frac{1}{2}\mu_0 \frac{N}{L} I = \frac{\mu_0}{2} nI$