PHY 2049
Exam I Formulae

Coulomb's Law $F = k\frac{q_1 q_2}{r^2}$ where k = 9×10^9 Nm^2/C^2, r in meter.

e = 1.6×10^{-19} C $\varepsilon_o = 8.85\times10^{-12}$ C^2/Nm^2 mass of electron = 9.11×10^{-31} kg

Electric Field: $E = k\sum \frac{q_i}{r_i^2}\hat{r}_i$ here the unit vector r^ is away from the i-th charge whose magnitude is q_i and which is located at a distance r_i from the point of Observation.

Electric field from a dipole along the axis of the charges: $E = 2k\frac{p}{z^3}$

Gauss' Law: $\varepsilon_o \Phi = q_{enc}$, $\Phi = \oint E.dA$ line charge: $E = 2k\frac{\lambda}{r}$

Sheet: $\sigma/2\varepsilon_o$

The electric field *outside* a spherical shell of radius R and charge q: $E = k\frac{q}{r^2}$

Uniform charge q on a sphere of radius R:

$$E = k\frac{q}{R^3}r \qquad r < R$$
$$= k\frac{q}{r^2} \qquad r > R$$

Potential: $V = U/q = k\sum_i \frac{q_i}{r_i}$ $V(f) - V(i) = -\int_i^f E.ds$

Capacitance: q = CV; Parallel C = $\sum C_i$ Series 1/C = $\sum 1/C_i$

$$\int \frac{xdx}{\left(x^2+a^2\right)^{3/2}} = -\frac{1}{\left(x^2+a^2\right)^{1/2}}; \qquad \int \frac{dx}{\left(x^2+a^2\right)^{3/2}} = \frac{x}{a^2\left(x^2+a^2\right)^{1/2}}; \qquad \int \frac{dx}{\left(x^2+a^2\right)^{1/2}} = \ln\left(x+\sqrt{x^2+a^2}\right)$$