

PHY 2049
Exam I Formulae

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

$e = 1.6 \times 10^{-19} \text{ C}$ $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 / \text{Nm}^2$ mass of electron = $9.11 \times 10^{-31} \text{ kg}$

Electric Field: $E = k \sum \frac{q_i}{r_i^2} \hat{r}_i$ here the unit vector \hat{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: $\epsilon_0 \Phi = q_{enc}$ $\Phi = \oint E \cdot dA$ line charge: $E = 2k \frac{\lambda}{r}$

Sheet: $\sigma / 2\epsilon_0$

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

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

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

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