PHYS226 : Electricity and Magnetism

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Electric Forces :: P = dipole moment

$$F_{ab} = k_e \frac{q_a q_b}{d^2}$$
$$F_e = qE$$
$$E = k_e \frac{q}{r^2}$$
$$E = \frac{F_e}{q_b}$$
$$E_{dipole} = \frac{p}{2\pi\epsilon_0 x^3} \approx 1 - \frac{d}{x}$$

Ring of Charge ::

$$\lambda = \frac{Q}{2\pi a} : dQ = \lambda ds : a \text{ is the height from the origin to the top of the ring.}$$
$$dE = k\frac{dQ}{x^2 + a^2} : x \text{ is the distance from the origin to the point charge.}$$
$$dE = k\frac{\lambda x}{(x^2 + a^2)^{\frac{3}{2}}} ds : \text{Simplified } dE_x$$
$$E = k\frac{Qx}{(x^2 + a^2)^{\frac{3}{2}}}$$

Uniformly Charged Disk ::

$$dQ = \sigma dA = 2\pi\sigma r dr : \sigma \text{ is the charge per unit area.}$$
$$dE_x = k\frac{2\pi\sigma r x}{(x^2 + a^2)^{\frac{3}{2}}} dr$$
$$E_x = \frac{\sigma}{2\epsilon_0}[1 - \frac{1}{\sqrt{R^2/x^2+1}}]$$

$$E = \frac{\sigma}{2\epsilon_0} : \text{ for R >> x}$$

Line Charge / Conducting Cylinder ::

$$dE = k\frac{\lambda x}{(x^2+a^2)^{\frac{3}{2}}}ds : k\lambda a \int \frac{dx}{(x^2+a^2)^{\frac{3}{2}}}$$

$$dq = \lambda dx$$

$$\Phi_E = E2\pi rL = \frac{\lambda L}{\epsilon_0}$$

$$E = \frac{\lambda}{2\pi r\epsilon_0}$$

Potential Energy and Work ::

$$W = U_a - U_b = -(U_b - U_a) = -\Delta U$$

$$\Delta U = q_0 Ed$$

$$W_{a\to b} = Fd = -q_0 Ed$$

$$W_{a\to b} = \int_a^b Fcos\phi \, dl$$

$$U = \frac{kq_a q_b}{r}$$

$$V = \frac{U}{q_0}$$

$$V_a - V_b = -(V_b - V_a) = -\frac{\Delta U}{q_0} = \frac{W_{a\to b}}{q_0}$$

$$V = \frac{\lambda}{2\pi\epsilon_0} ln\frac{R}{r} : \text{ For infinite line charge.}$$

$$V = k\frac{Q}{\sqrt{x^2+a^2}} : \text{ For ring of charge.}$$

$$E = \frac{V}{d}$$

$$E = -\Delta V$$

$$q\frac{V}{d} = mg$$

Electric Flux ::

$$\Phi_E = EA = EAcos(\theta) = \frac{q_{encl}}{\epsilon_0} = \oint E * da$$

Charge Density $\lambda = \frac{Q}{L}$

Capacitors and Capacitance ::

$$U = \tfrac{1}{2}\frac{Q^2}{C} = \tfrac{1}{2}QV = \tfrac{1}{2}CV^2$$

Capacitors in series : $C_{eq}^{-1} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + ...$

Capacitors in parallel : $C_{eq} = C_1 + C_2 + ...$

$$C = \frac{Q}{V}$$

- Dipole moment points in the positive x direction, the positive side of the dipole is to the right of the negative side of the dipole