PHYS226 : Electricity and Magnetism

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Electric Forces ::

$$F_{ab} = k_e \frac{q_a q_b}{d^2}$$

$$E = k_e \frac{q}{r^2}$$

$$E = \frac{F_e}{q_b}$$

$$\tau = p * E = (qE)(dsin(\phi))$$

Ring of Charge ::

$\lambda = \dfrac{Q}{2\pi a}$: $dQ = \lambda ds$: a is the height from the origin to the top of the ring.

$dE = k\dfrac{dQ}{x^2 + a^2}$: x is the distance from the origin to the point charge.

$dE = k\dfrac{\lambda x}{(x^2 + a^2)^{\frac{3}{2}}} ds$: Simplified dE_x

$$E = k\frac{Qx}{(x^2 + a^2)^{\frac{3}{2}}}$$

Uniformly Charged Disk ::

$dQ = \sigma dA = 2\pi\sigma r dr$: σ is the charge per unit area.

$$dE_x = k\frac{2\pi\sigma r x}{(x^2 + a^2)^{\frac{3}{2}}} dr$$

$$E_x = \frac{\sigma}{2\epsilon_0}[1 - \tfrac{1}{\sqrt{R^2/x^2+1}}]$$

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

Potential Energy and Work ::

$$W = U_a - U_b = -(U_b - U_a) = -\Delta U$$
$$\Delta U = q_0 E d$$
$$W_{a\to b} = Fd = -q_0 E d$$
$$W_{a\to b} = \int_a^b F cos\phi \; dl$$
$$U = \frac{k q_a q_b}{r}$$
$$V = \frac{U}{q_0}$$
$$V_a - V_b = -(V_b - V_a) = -\frac{\Delta U}{q_0} = \frac{W_{a\to b}}{q_0}$$
$$V = \frac{\lambda}{2\pi\epsilon_0} ln\frac{R}{r} : \text{ For infinite line charge.}$$
$$V = k\frac{Q}{\sqrt{x^2+a^2}} : \text{ For ring of charge.}$$
$$E = \frac{V}{d}$$
$$E = -\Delta V$$
$$q\frac{V}{d} = mg$$

Electric Flux ::

$$\Phi_E = EA = EAcos(\theta) = \frac{q_{encl}}{\epsilon_0} = \oint E * da$$
$$\text{Charge Density } \lambda = \frac{Q}{L}$$

Capacitors and Capacitance ::

$$U = \tfrac{1}{2}\frac{Q^2}{C} = \tfrac{1}{2}QV = \tfrac{1}{2}CV^2$$
$$\text{Capacitors in series : } C_{eq}^{-1} = \frac{1}{C_1} + \frac{1}{C_2} + ...$$
$$\text{Capacitors in parallel : } C_{eq} = C_1 + C_2 + ...$$
$$C = \frac{Q}{V}$$