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 ::

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

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

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

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

Uniformly Charged Disk ::

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

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

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

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

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 ::

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

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