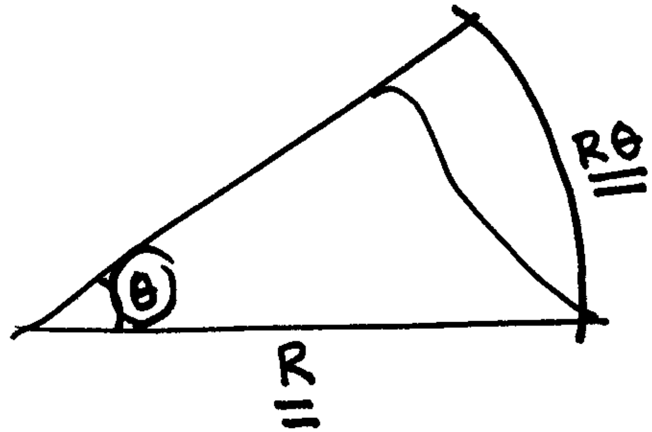
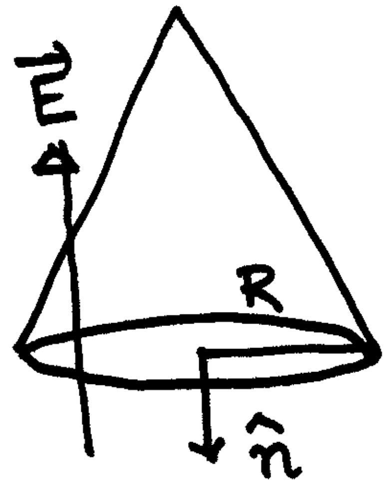
Prof. D. Ghosh.
Lec. 7
Date. 30-8-10

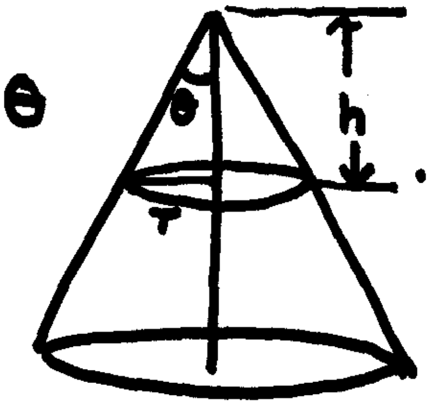


# Steradians.




$$\int \underline{\underline{\vec{E}\cdot\hat{n}}}\, ds$$
$$= -|E| \int ds$$
$$= -|E|\, \pi R^2$$

$$\vec{E}\cdot\vec{ds} = |E|\, 2\pi r\, dl \sin\theta$$




$$r = h\tan\theta$$

$$l = \frac{h}{\cos\theta}.$$

$$dl = \frac{dh}{\cos\theta}$$

$$\vec{E}\cdot\vec{ds} = |E|\; 2\pi h \tan^2\theta \,.\, dh$$

$$\phi = |E|\, 2\pi \tan^2\theta \int^{H} dh$$

$$= |E|\, 2\pi \frac{H^2}{2} \tan^2\theta \,. \quad : \quad H\tan\theta = R$$

$$= |E|\, \pi R^2$$

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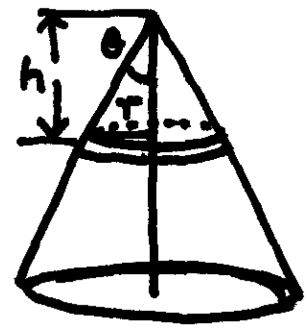
$$E.ds = |E|\ 2\pi r\, dl\ \sin\theta$$




$$r = h\tan\theta\ .$$

$$l = \frac{h}{\cancel{\sin\theta}\cos\theta}\ .$$

$$\vec{E}\cdot\vec{ds} = |E|\ .\ 2\pi\cdot h\ .\ \underline{\underline{\tan\theta}}\ .\ dh\ .$$

$$\underline{\underline{\phi = |E|\,\pi R^2}}$$

$$\oint E \cdot dS = \frac{q}{\epsilon_0} \;;\quad q \text{ inside}$$

$$= 0 \;;\quad q \text{ outside}.$$

$$\boxed{\Phi = \frac{Q_{enclosed}}{\epsilon_0}}$$

<u>Gauss's Law</u>

$$\oint_S \vec{E} \cdot \vec{dS} = \int_V (\vec{\nabla} \cdot \vec{E})\, dv = \frac{1}{\epsilon_0} \int_V \rho(\vec{r})\, dv$$

$$\boxed{\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\epsilon_0}}$$

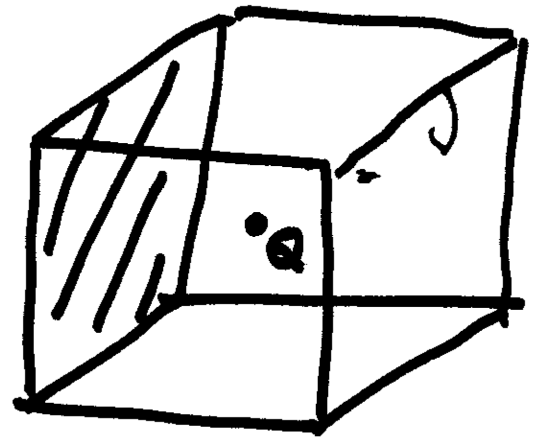
$$\vec{E} = \frac{1}{4\pi\epsilon_0} \int \rho(r') \frac{\vec{r}-\vec{r}'}{|\vec{r}-\vec{r}'|^3} d^3r'$$

$$\vec{\nabla}\cdot\vec{E} = \frac{1}{4\pi\epsilon_0} \int \rho(\vec{r}') \nabla\cdot\left(\frac{\vec{r}-\vec{r}'}{\underbrace{|\vec{r}-\vec{r}'|}^3}\right) d^3r'$$

$$= -\frac{1}{4\pi\epsilon_0} \int \rho(r') \underbrace{\vec{\nabla}'\cdot\vec{\nabla}'}\left(\frac{1}{|r-r'|}\right) d^3r'$$

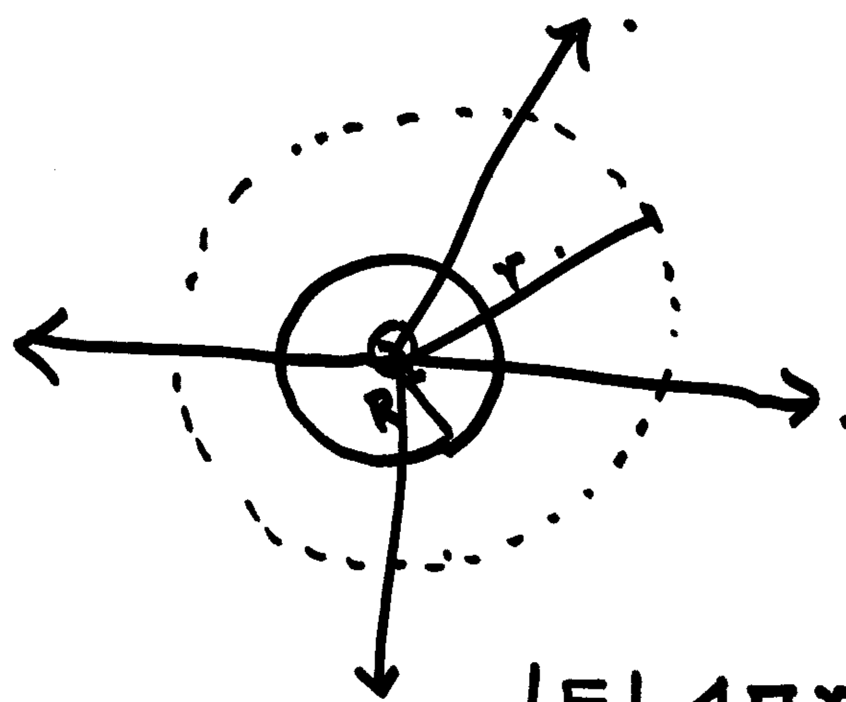
$$= -\frac{1}{4\pi\epsilon_0} \int \rho(r') \underbrace{\nabla'^2\left(\frac{1}{|r-r'|}\right)}_{-4\pi\delta^3(\vec{r}-\vec{r}')} d^3r'.$$

$$= \frac{1}{\epsilon_0}\rho(\vec{r}).$$




$$\frac{Q_{encl}}{\epsilon_0} \Rightarrow \frac{q}{\epsilon_0}$$

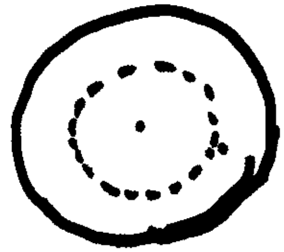
Flux through one face $= \frac{1}{6} \cdot \frac{q}{\epsilon_0}$.




$$|E| \cdot 4\pi r^2 = \frac{Q}{\epsilon_0}.$$

$$|E| = \frac{Q}{4\pi\epsilon_0 r^2}$$

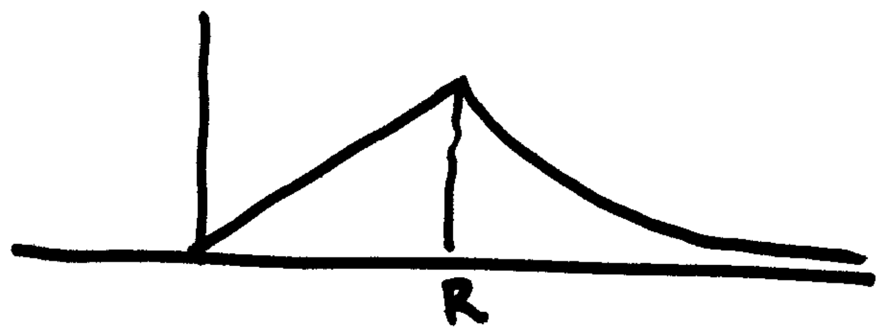
$$\vec{E} = \frac{Q}{4\pi\epsilon_0 r^2}\hat{r}.$$



$r < R$

$$|E| \cdot 4\pi r^2 = \frac{Q \cdot \frac{r^3}{R^3}}{\epsilon_0}$$

$$|\vec{E}| = \frac{Q}{4\pi\epsilon_0}\frac{\vec{r}}{R^3}.$$



$$\rho = \frac{k}{r^2}$$

$$Q = \int \rho \cdot d^3 r$$

$$= 4\pi \int_a^b \frac{k}{r^2} \cdot r^2 \, dr$$

$$= 4\pi k (b-a)$$

$\underline{\underline{r > b}}$

$$\frac{1}{\epsilon_0} \cdot \frac{\cancel{4\pi} k (b-a)}{\cancel{4\pi} r^2} = \frac{k}{\epsilon_0} \cdot \frac{b-a}{r^2}$$

$r < a$ $\qquad \vec{E} = 0$

$a < r < b$