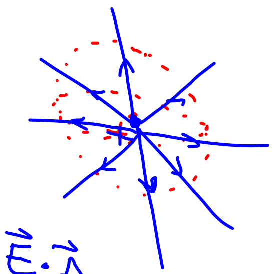
Maxwell's Equations for ELECTROMAGNETISM

i) Gauss' Law for electricity

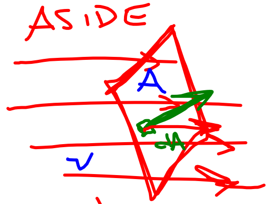
$$\oint \vec{E}\cdot d\vec{A} = q/\varepsilon_0$$

Relates net Electric flux to net enclosed electric charge



$\Phi_E = \vec{E}\cdot\vec{A}$

ASIDE



$\frac{\text{Volume}}{t} = \frac{d}{t} A$

$= (\text{velocity}) A$

flux = "to flow"

$(\text{Vel})(\text{Area})\cos\theta = \vec{v}\cdot\vec{A}$

$$\oint \vec{E}\cdot d\vec{A} = \oint E\, dA\, \cancel{\cos\theta}$$, by symmetry

$$= E \oint dA$$

$$= E A$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2} \cancel{4\pi r^2}$$

$E = \frac{F}{q}$

$$\oint \vec{E}\cdot d\vec{A} = q/\varepsilon_0$$

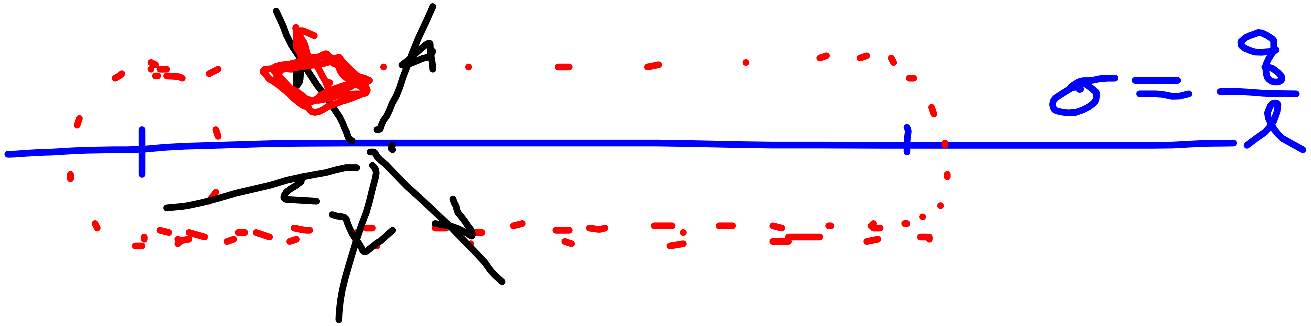
$\int dx = \cancel{x}$

$\int x\, dx = \frac{1}{2}x^2$

$\int x^3 dx = \frac{1}{4}x^4$

$V = \frac{4}{3}\pi r^3$ $SA =$

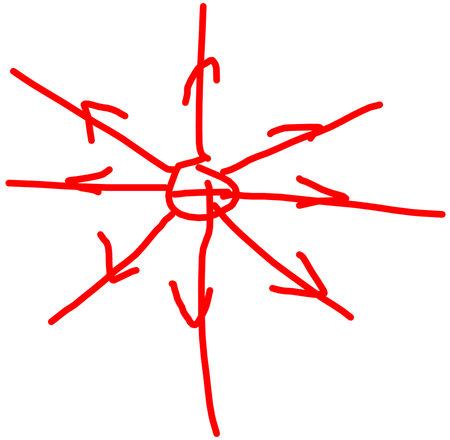
Gaussian Cylinder



$$\oint \vec{E} \cdot d\vec{A} = \frac{q_{enc.}}{\varepsilon_0}$$

S_1

$$\Phi_E = \oint \vec{E}\cdot d\vec{A} = \frac{+q}{\varepsilon_0}$$



S_2

$$\Phi_E = \oint \vec{E}\cdot d\vec{A} = -q/\varepsilon_0$$

S_3 & S_4

0

$$\varepsilon_0 = 8.85\times10^{-12}\ \frac{C^2}{N\cdot m^2}$$

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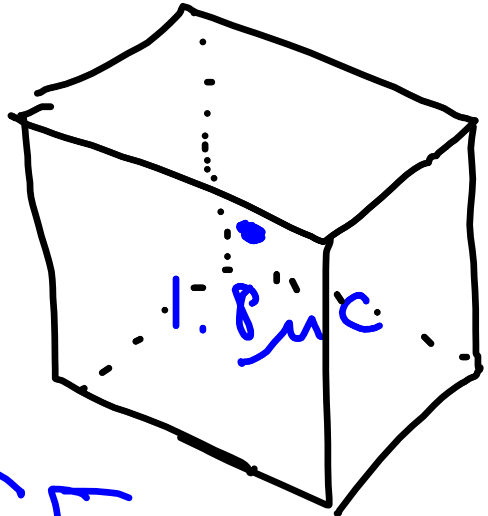

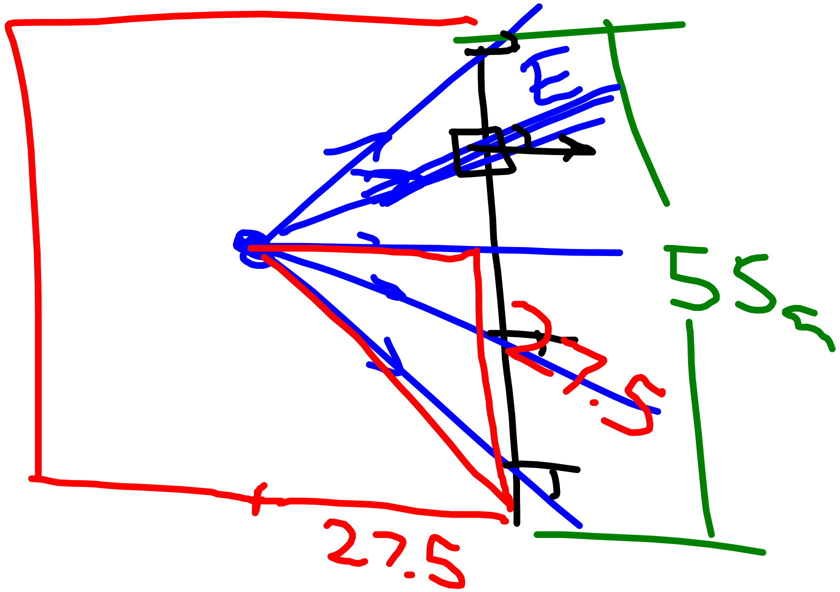

$$\Phi = \oint E\, dA \cos\theta = \frac{q_{encl}}{\varepsilon_0}$$

$$= \frac{1.8\,\mu C}{8.85 \times 10^{-12}}$$

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$$\Phi = \oint \vec{E}\cdot d\vec{A} = E\oint dA$$

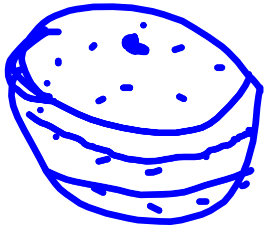
$$\Phi = EA\cancel{\cos\theta} \quad 1$$

$$\cos 0^\circ = 1$$

$$\Phi = E\pi a^2$$

11 a) EA

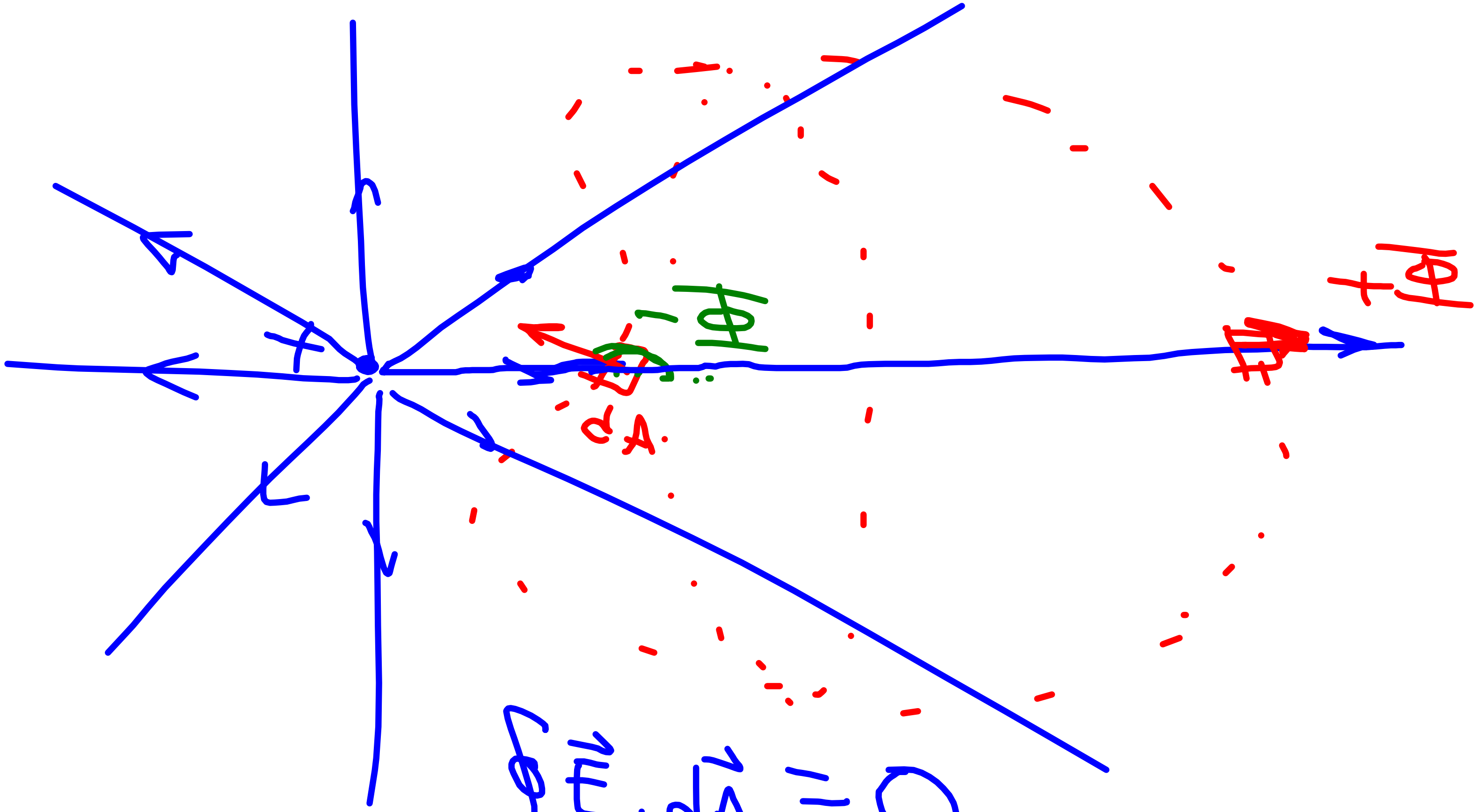
b)



$$\oint d\vec{A} = A$$

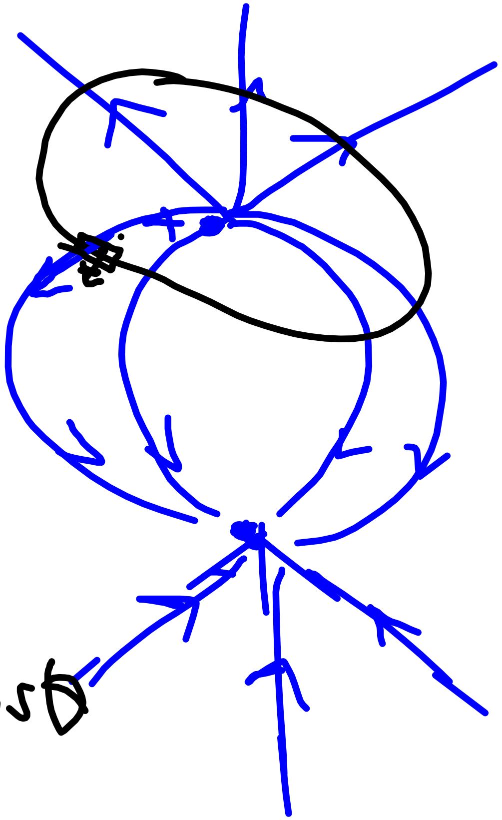
$$A_{sphere} = 4\pi r^2$$

$$A_{hemisphere} = 2\pi r^2$$



$$\oint \vec{E} \cdot d\vec{A} = 0$$

http://www.haverford.edu/physics-astro/songs/emsongs.htm



$E\,dA\cos\theta$