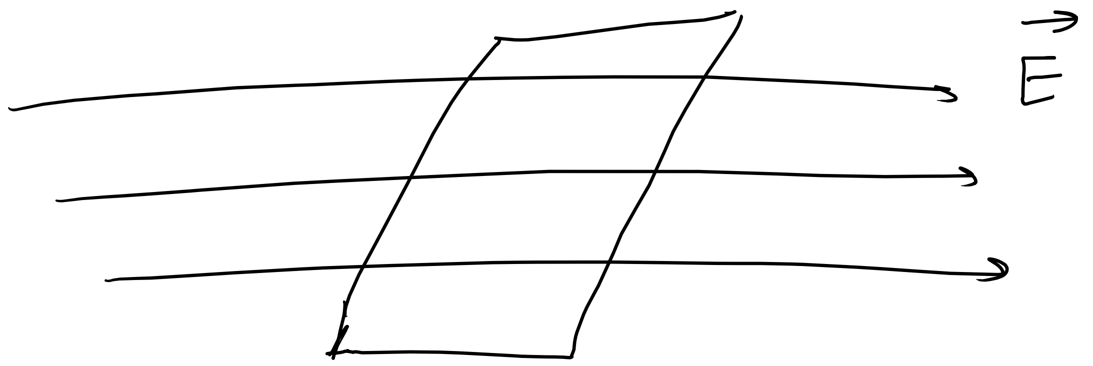
Electric flux (scalar) $\Phi_E = \oint \vec{E} \cdot d\vec{A}$ → E is not uniform

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

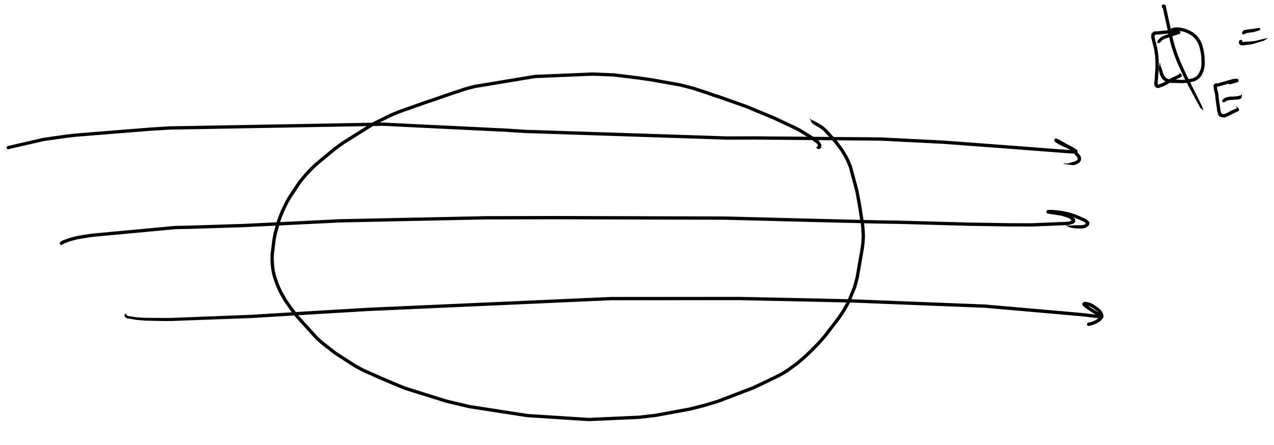
E → electric field

A → area

θ → angle between E & normal vector to the surface



Φ_E = # of electric field lines leaving the surface — # of E lines entering the surface



Φ_E for closed surfaces $= 0$

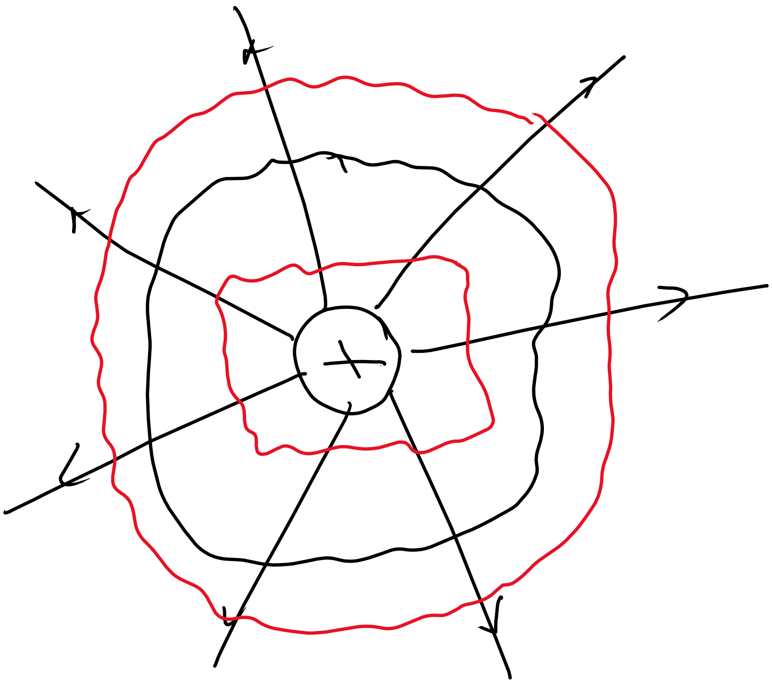
Gauss's Law:

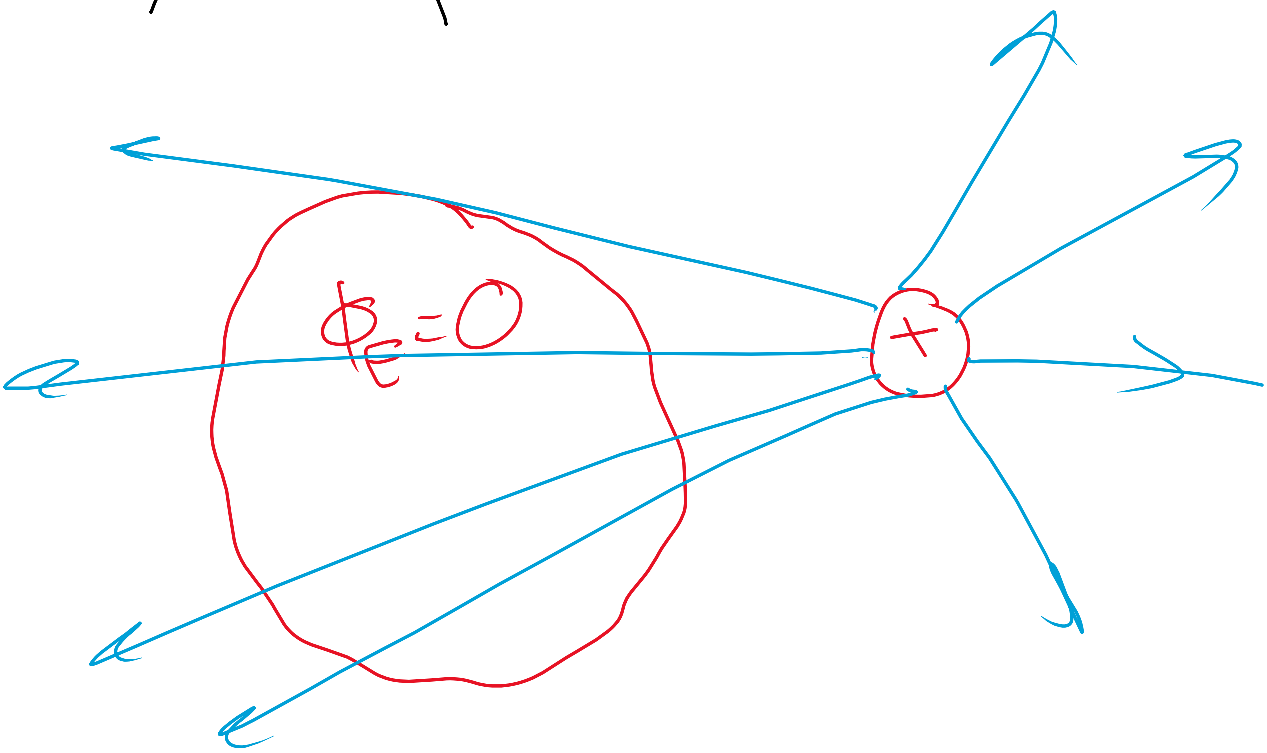
$$k_e = \frac{1}{4\pi\epsilon_0}$$

$$\Phi_E = \oint \vec{E} \cdot d\vec{A} = \frac{q_{in}}{\epsilon_0}$$

$\rightarrow$ permitivity free space

8.5×10^{-12}





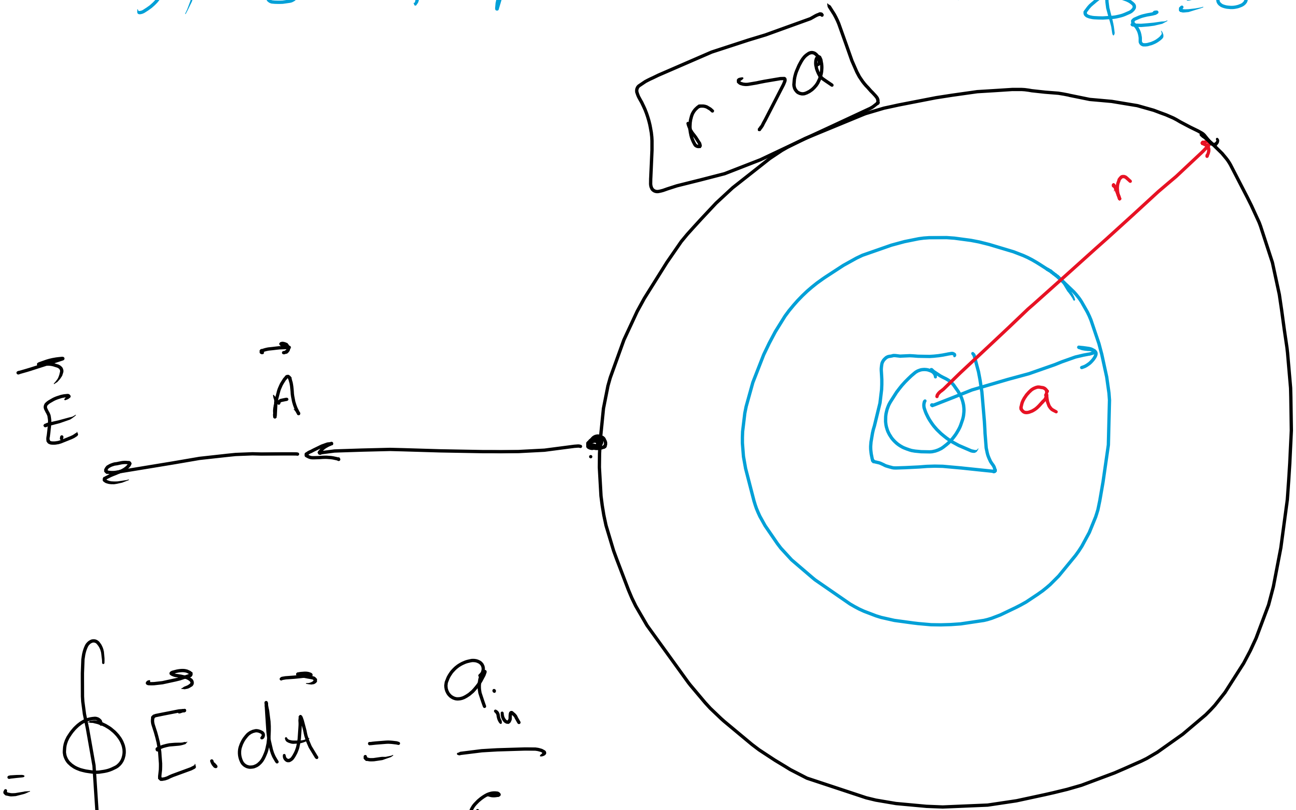
Apply Gauss's law:

To define Gaussian Surface

1) $\vec{E}$ is the same at every point on the surface

2) $\vec{E}$ parallel to $\vec{A}$, $\cos\theta = 1$

3) $\vec{E}$ perpendicular to $\vec{A}$, $\cos\theta = 0$
$\Phi_E = 0$



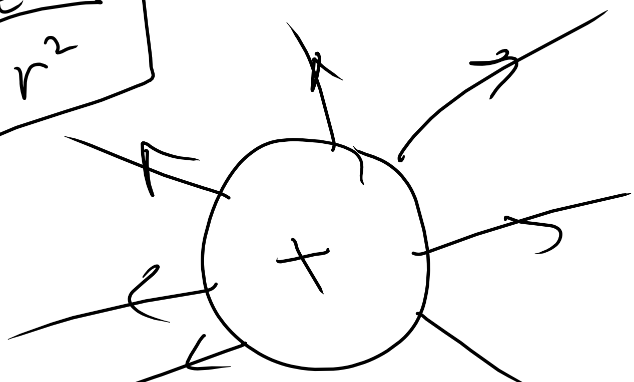
$$\Phi_E = \oint \vec{E}\cdot d\vec{A} = \frac{q_{in}}{\epsilon_0}$$

Gaussian surface

$$E\oint d\vec{A} = \frac{Q}{\epsilon_0}$$

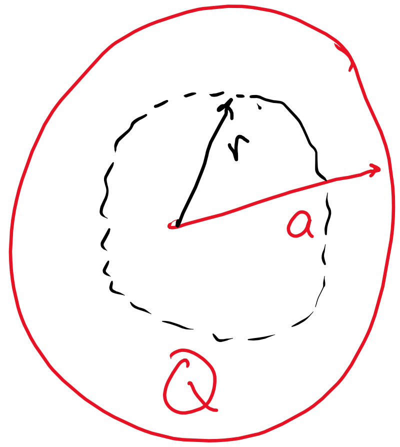
$$E\left[4\pi r^2\right] = \frac{Q}{\epsilon_0} \Rightarrow E = \frac{Q}{4\pi r^2 \epsilon_0}$$

$$\boxed{\frac{K_e Q}{r^2}}$$



$$\oint \vec{E}\, d\vec{A} = \frac{q_{in}}{\epsilon_0}$$

$r < a$



$$EA = \frac{q_{in}}{\epsilon_0}$$

$$E(4\pi r^2) = \frac{\rho V}{\epsilon_0}$$

volume charge density

$$E(4\pi r^2) = \frac{\rho\left[\frac{4}{3}\pi r^3\right]}{\epsilon_0}$$

$$\rho = \frac{Q}{V} \Rightarrow Q = \rho V$$

Electrostatic Equi.

No movement

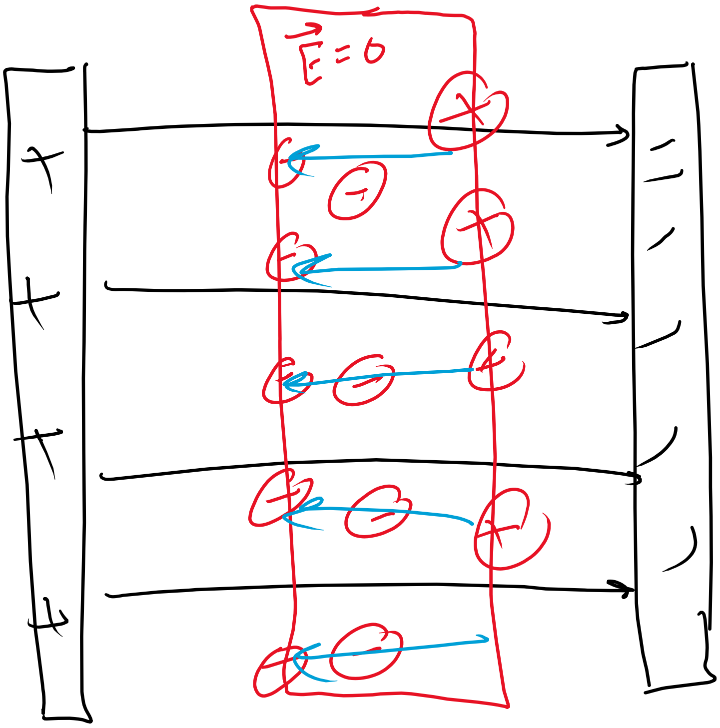
1) $\vec{E} = 0$

2) The charge is on the surface

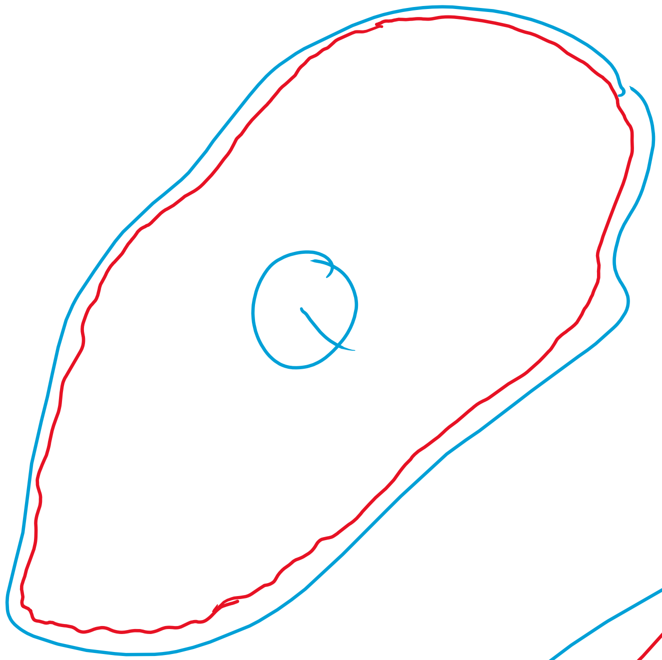
3) $\vec{E}$ is normal to the surface $= \sigma / \epsilon_0$

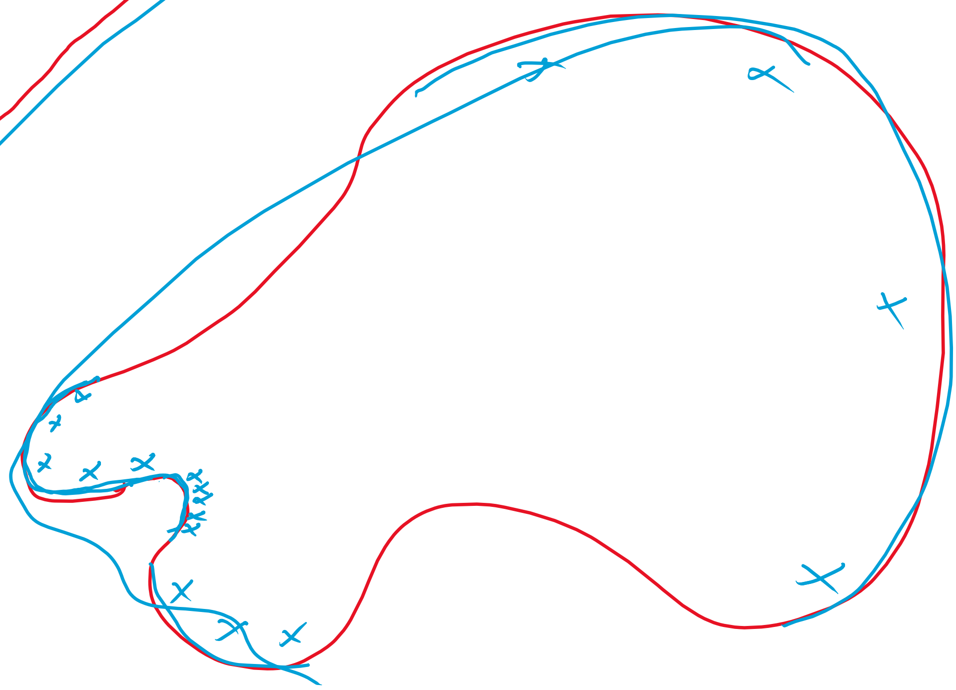
4) Irregular shapes σ is bigger where the radius is smaller

$$\vec{a} = \frac{qE}{m}$$



$$\oint E \cdot dA = \frac{q_{in}}{\epsilon_0}$$





Gauss's law is useful for uniform distribution