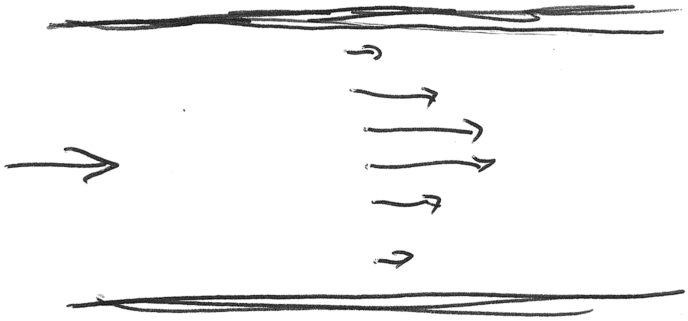
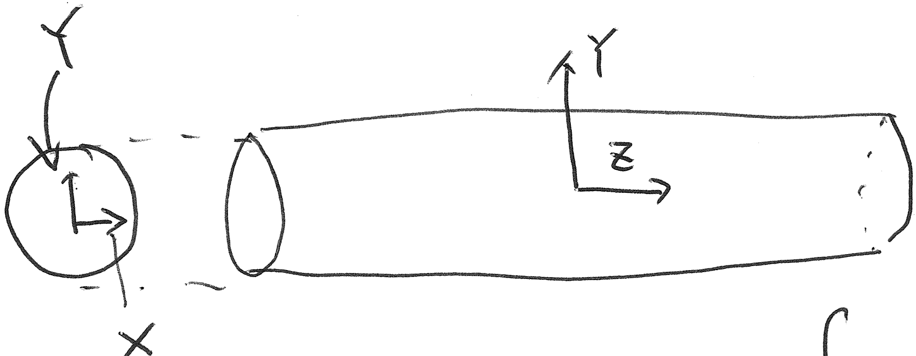
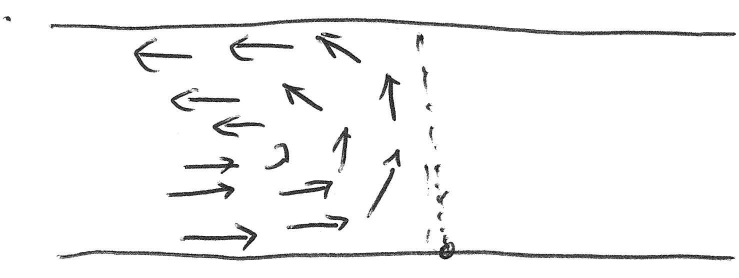
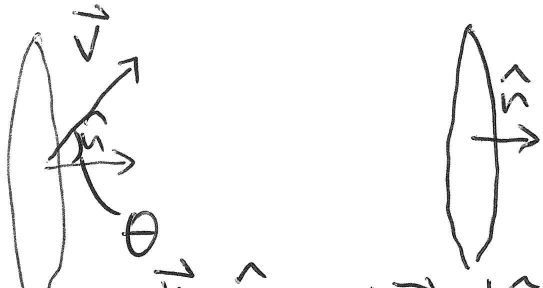




TOTAL FLOW $\sim \int V_z(x,y)\, dx\, dy$





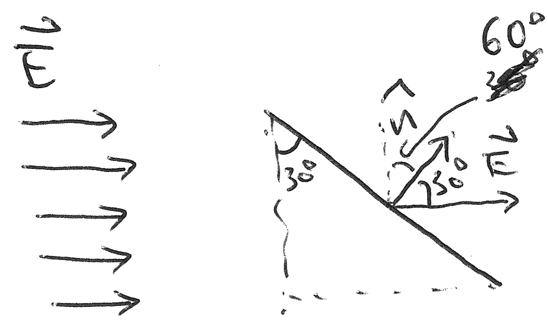
FLOW $\sim \vec{V} \cdot \hat{n}$
$\quad\;\; \shortparallel$
FLUX

$$\vec{V} \cdot \hat{n} = |\vec{V}|\,|\hat{n}| \cos\theta$$

ELECTRIC FLUX

$$\Phi = \int_{\text{SURFACE}} \vec{E} \cdot \hat{n} \cdot ds$$

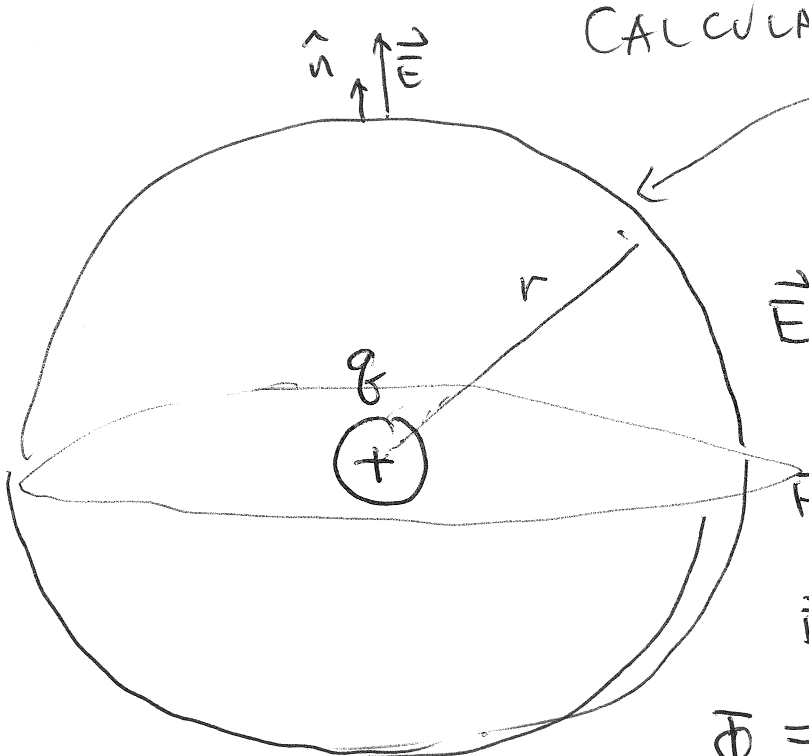
EXAMPLE: UNIFORM $\vec{E}$ EVERYWHERE



$$\vec{E} \cdot \hat{n} = |\vec{E}||\hat{n}| \cos\theta$$
$$= |\vec{E}||\hat{n}| \cos 30°$$
$$= |\vec{E}| \frac{\sqrt{3}}{2}$$

$$\Phi = \int_{\text{SURFACE}} |\vec{E}| \frac{\sqrt{3}}{2} ds = |\vec{E}| \frac{\sqrt{3}}{2} \int_{\text{SURFACE}} ds$$
$$= |\vec{E}| \frac{\sqrt{3}}{2} A$$

CALCULATE FLUX THRU THIS SURFACE



$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}$$

$$\text{FLUX} = \Phi = \int \vec{E}\cdot\hat{n}\,ds$$

$$\vec{E}\cdot\vec{n} = |\vec{E}|$$

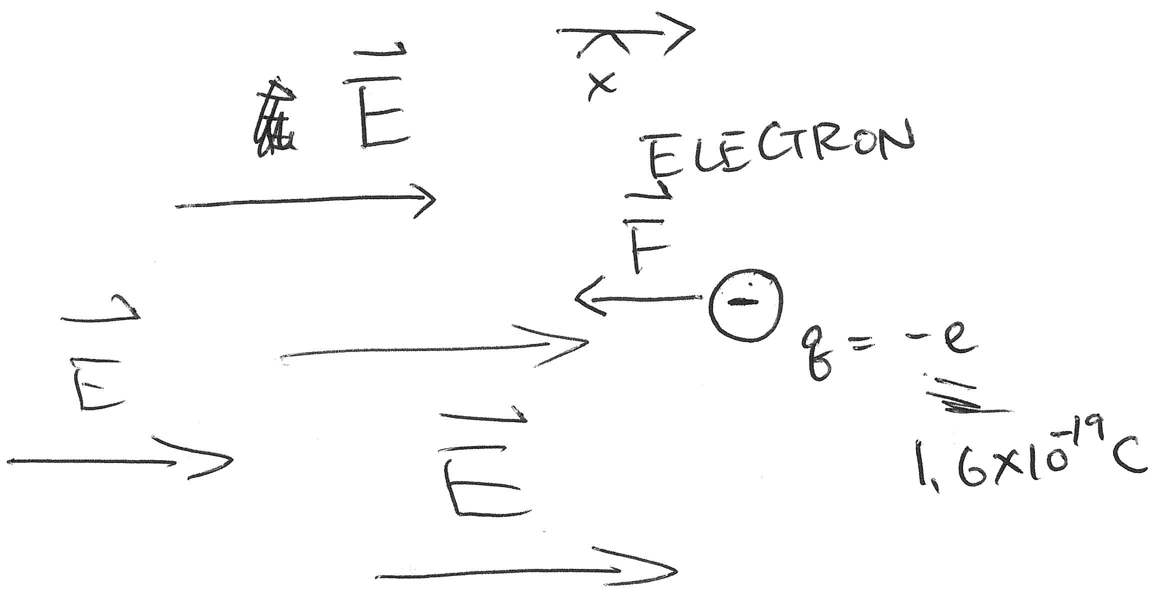
$$\Phi = \int_{\text{SURFACE}} |\vec{E}|\,ds$$

$$= |\vec{E}| \int_{\text{SURFACE}} ds$$

$$= |\vec{E}| \cdot 4\pi r^2$$

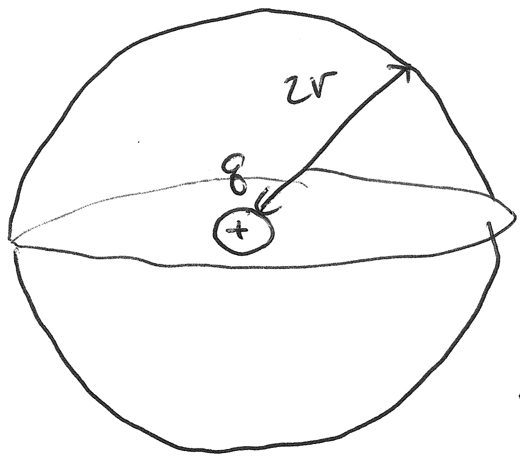
$$\Phi = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2} \cdot 4\pi r^2$$

$$\Phi = \frac{q}{\varepsilon_0}$$



$$\vec{F} = q\vec{E} = -e\vec{E}$$

$$\vec{E} = E_0\hat{x} \quad = -eE_0\hat{x}$$



$$|\vec{E}| = \frac{1}{4\pi\varepsilon_0}\frac{q}{(2r)^2}$$

$$\Phi = |\vec{E}|\, A$$

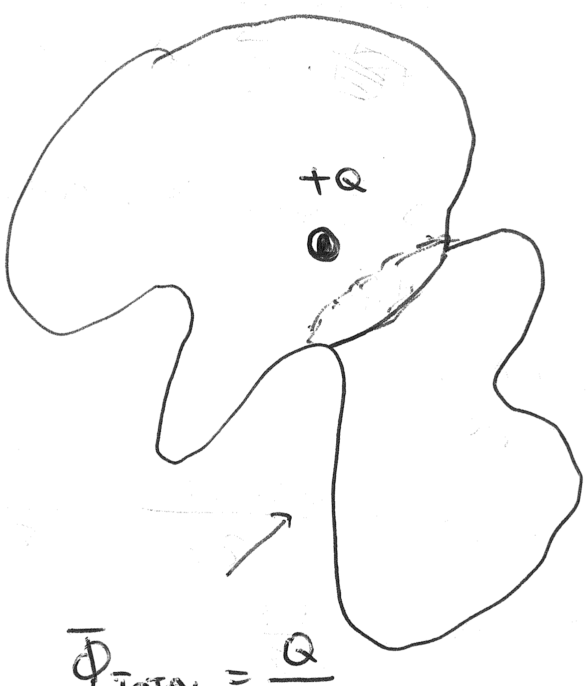
$$A = \cancel{q}\, 4\pi (2r)^2$$

$$|\vec{E}|\, A = \frac{1}{4\pi\varepsilon_0}\frac{q}{(2r)^2} \cdot 4\pi (2r)^2$$

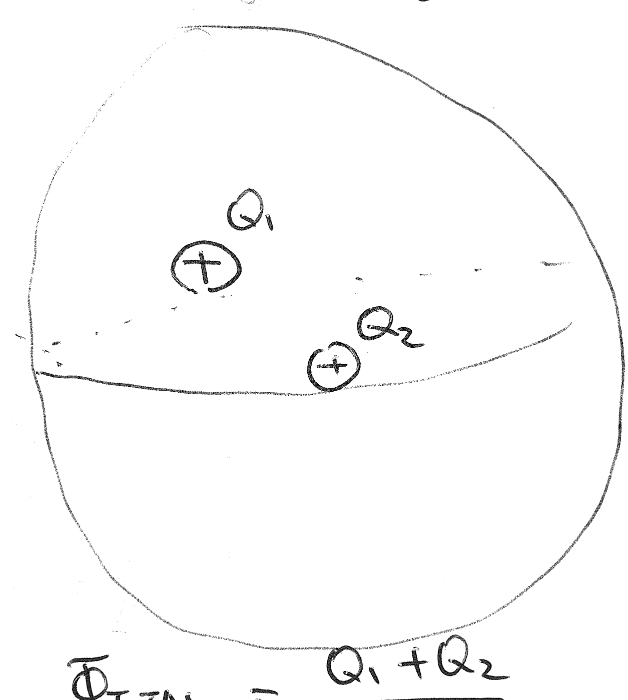
$$= \frac{q}{\varepsilon_0}$$

GAUSS'S LAW

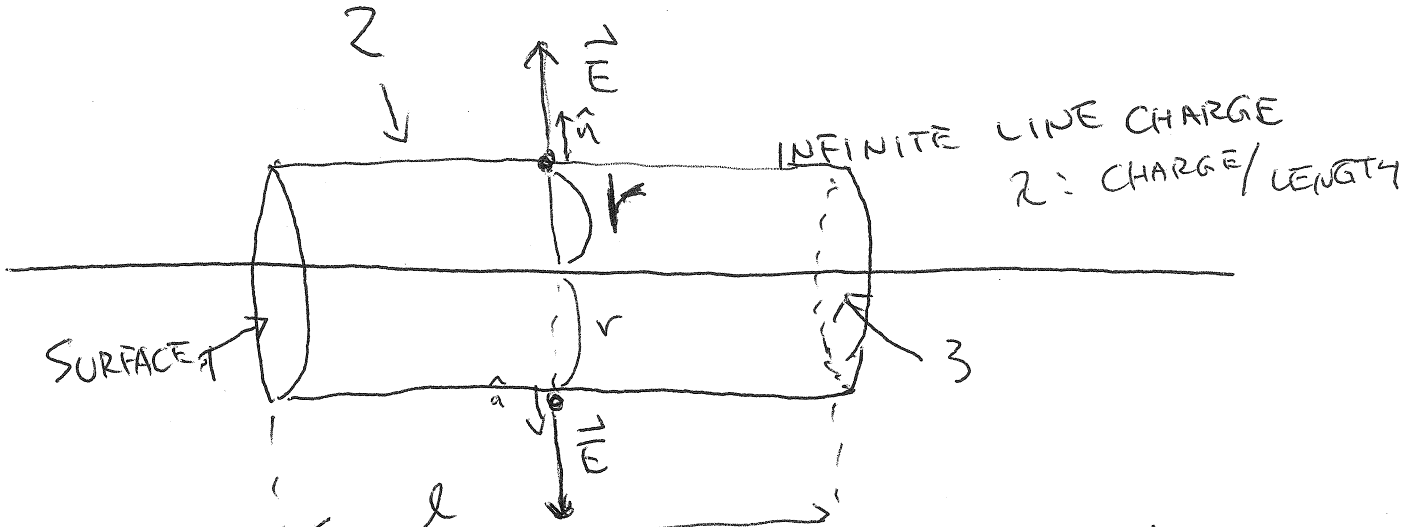
$$\Phi = \oint \vec{E} \cdot \hat{n}\, ds = \frac{Q_{ENCLOSED}}{\varepsilon_0}$$



$$\Phi_{TOTAL} = \frac{Q}{\varepsilon_0}$$



$$\Phi_{TOTAL} = \frac{Q_1 + Q_2}{\varepsilon_0}$$



1. DRAW SURFACE W/ CONSTANT $\vec{E}\cdot\hat{n}$ OR $\underline{\vec{E}\cdot\hat{n} = 0}$

SURFACE 1, 3 : $\Phi_1 = \vec{E}_1 \cdot \hat{n}_1 = 0$

$$\Phi_3 = \vec{E}_3 \cdot \hat{n}_3 = 0$$

SURFACE 2 : $\vec{E}\cdot\hat{n}$ IS CONSTANT

$$\Phi = |\vec{E}| \cdot A = |\vec{E}| \cdot 2\pi r \ell = \frac{Q_{ENCLOSED}}{\varepsilon_0}$$

$$Q_{ENCLOSED} = \underbrace{\lambda}_{\text{CHARGE/LENGTH}} \ell$$

$$2\pi r \cancel{\ell} \cdot |\vec{E}| = \frac{\lambda \cancel{\ell}}{\varepsilon_0}$$

$$|\vec{E}| = \frac{\lambda}{2\pi r \varepsilon_0}$$