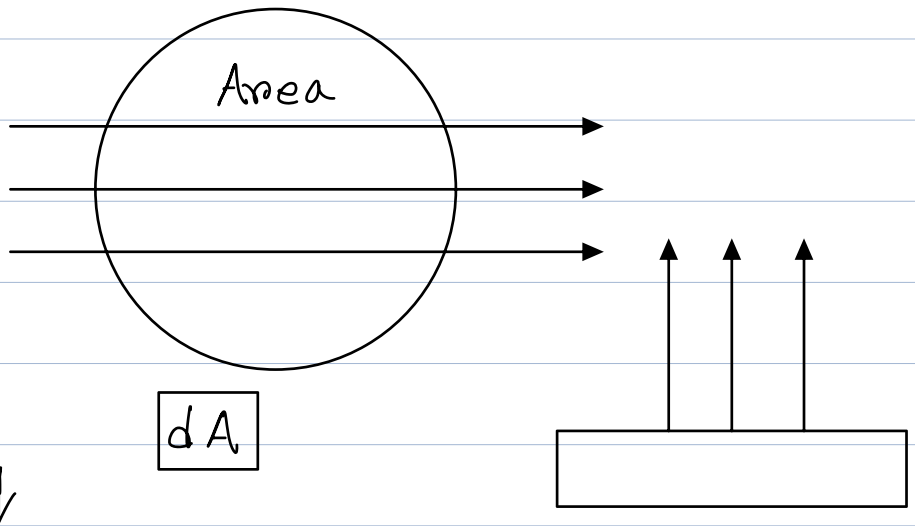
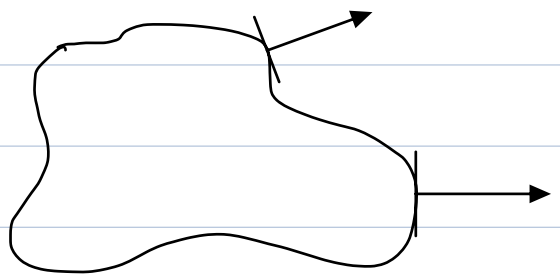
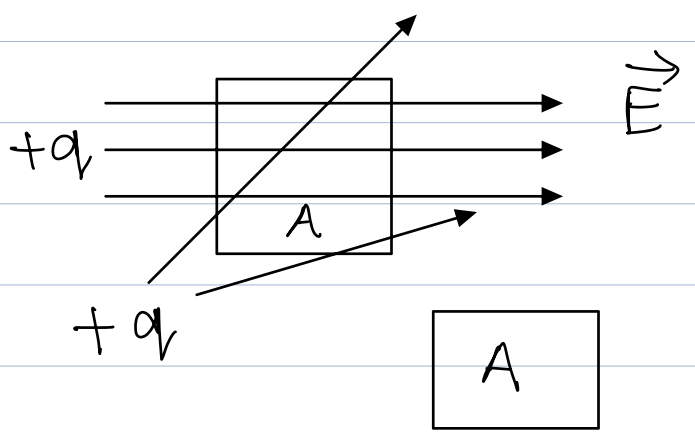
Flux = Flow

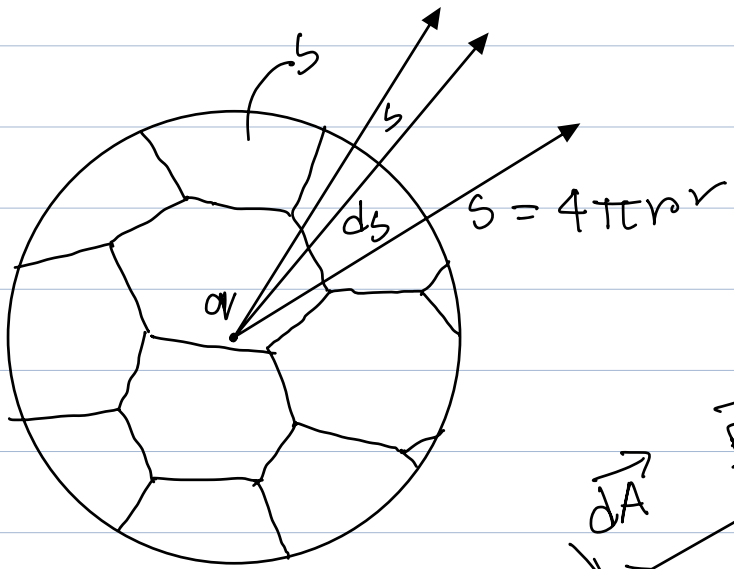
↳

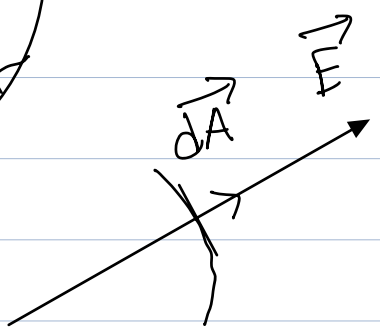






$$\boxed{\varphi_E = \vec{E} \cdot \vec{A}}$$





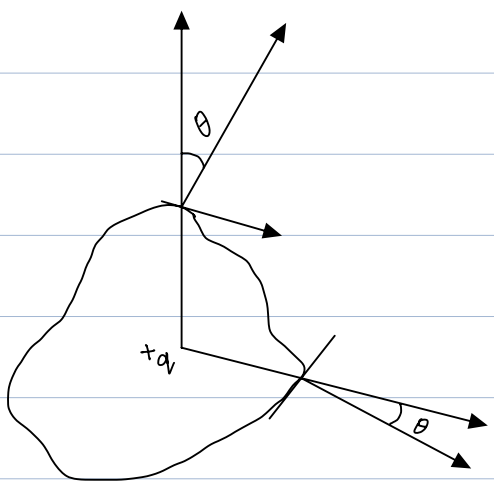
$$d\varphi_E = \vec{E} \cdot \vec{dS}$$

$$\varphi_E = \oint_S d\varphi_E$$

$$= \oint_S \vec{E} \cdot \vec{dS}$$

$$= \oint_S E\, dS \cos 0^\circ$$

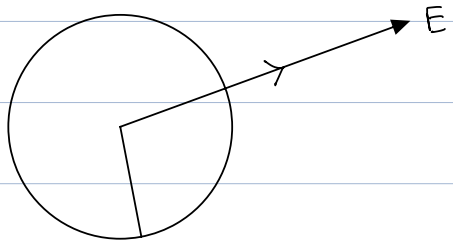
$$= \oint_S E\, dS$$



$$E = \frac{1}{4\pi\epsilon_0} \frac{q}{R^2}$$

$$= E \oint_S ds$$

$$= E\, 4 \cdot \pi \cdot R^2$$



$$\varphi_E = E\, 4\pi r^2$$

$$= \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} 4\pi R^2$$

$$= \frac{q}{\epsilon_0}$$

$$\boxed{\varphi_E = \oint \vec{E} \cdot \vec{ds} = q/\epsilon_0}$$

Gauss law

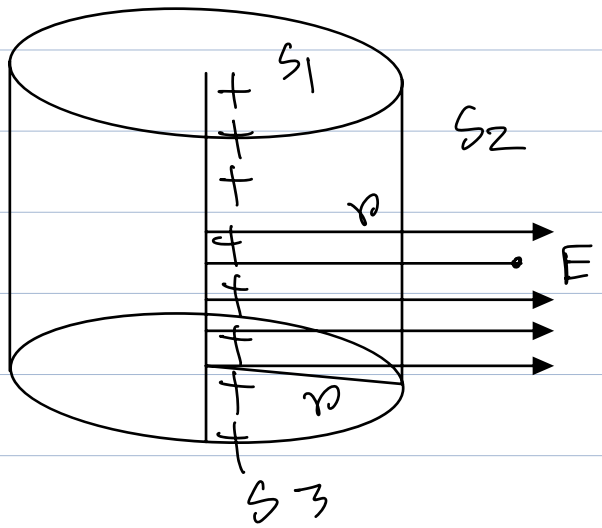
$$\oint_S \vec{E}\, \vec{ds} = \frac{q}{\epsilon_0}$$

$$\Rightarrow \oint_S E\, ds = \frac{q}{\epsilon_0}$$

$$\Rightarrow E \oint_S ds = \frac{q}{\epsilon_0}$$

$$\Rightarrow E \cdot 4\pi r^2 = \frac{q}{\epsilon_0}$$

$$E = \frac{1}{4\pi\epsilon_0} \times \frac{q}{R^2}$$



$$\oint_S \vec{E} \cdot \vec{dS} = \frac{q}{\epsilon_0}$$

$$= \int_{S1} \vec{E}\,\vec{dS} + \int_{S2} \vec{E}\,\vec{dS} + \int_{S3} \vec{E}\,\vec{dS} = q/\epsilon_0$$

$$\Rightarrow \int_{S2} \vec{E} \cdot \vec{dS} = q/\epsilon_0$$

$$\Rightarrow \int_{S2} E\,dS = \frac{\lambda L}{\epsilon_0}$$

$$\Rightarrow E \int_{S2} dS = \frac{\lambda L}{\epsilon_0}$$

$$\Rightarrow E \cdot 2\pi r L = \frac{\lambda L}{\epsilon_0}$$

$$E = \frac{\lambda}{2\pi \epsilon_0 r}$$