Gauss's law

Gauss showed that an important relationship exists between the total electric flux over a closed surface and the total charge enclosed by the surface. This relationship is known as *Gauss's law*. Using SI units the law may be stated as follows:

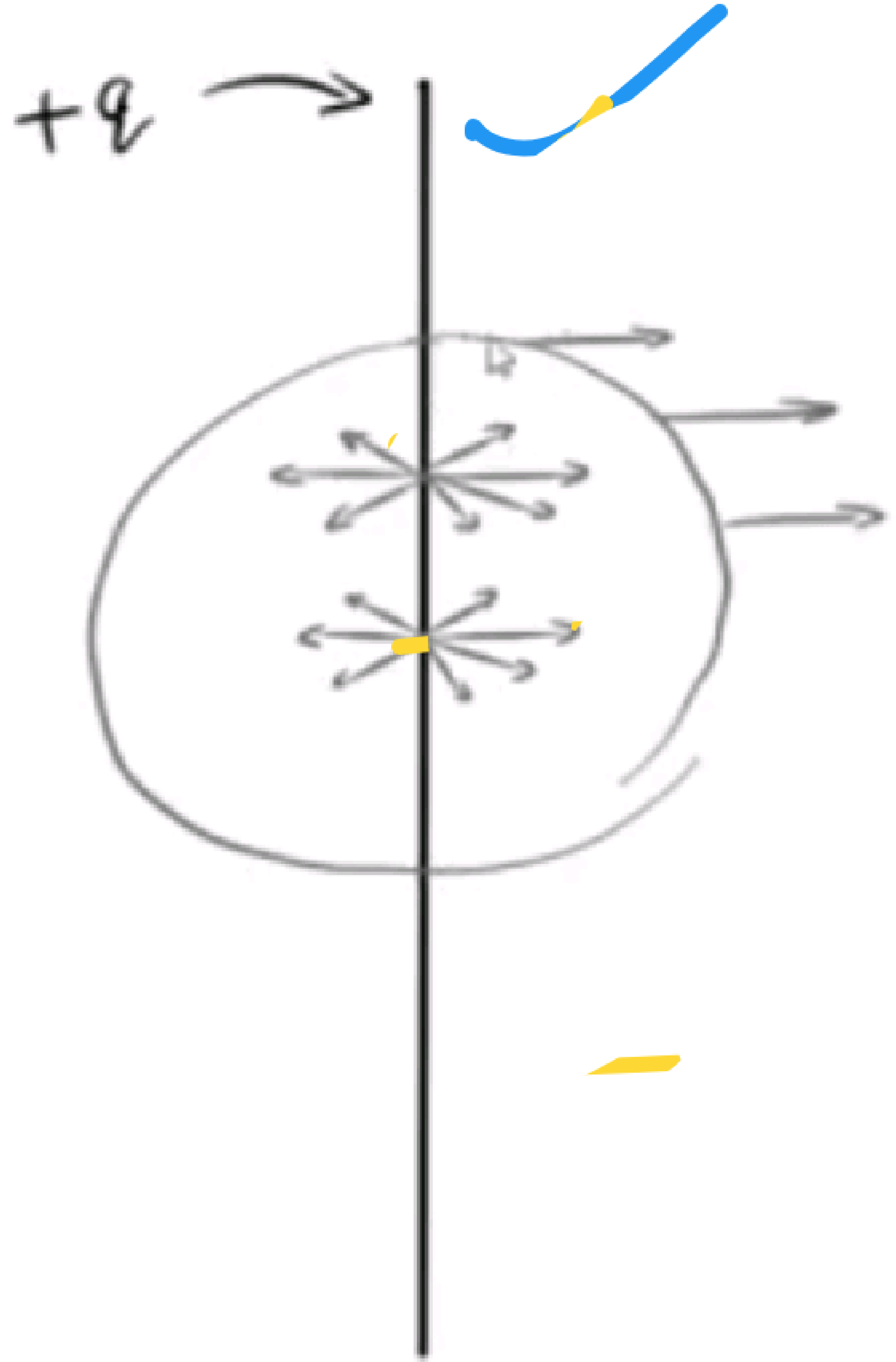
In an arbitrary electrostatic field (in vacuum) the total electric flux over any closed surface is equal to $1/\epsilon_0$ *times the total charge enclosed by the surface, where* ϵ_0 *is the free space permittivity.* For a closed surface S enclosing N number of point charges q_1, $q_2, \ldots, q_N$ the law may be expressed mathematically as

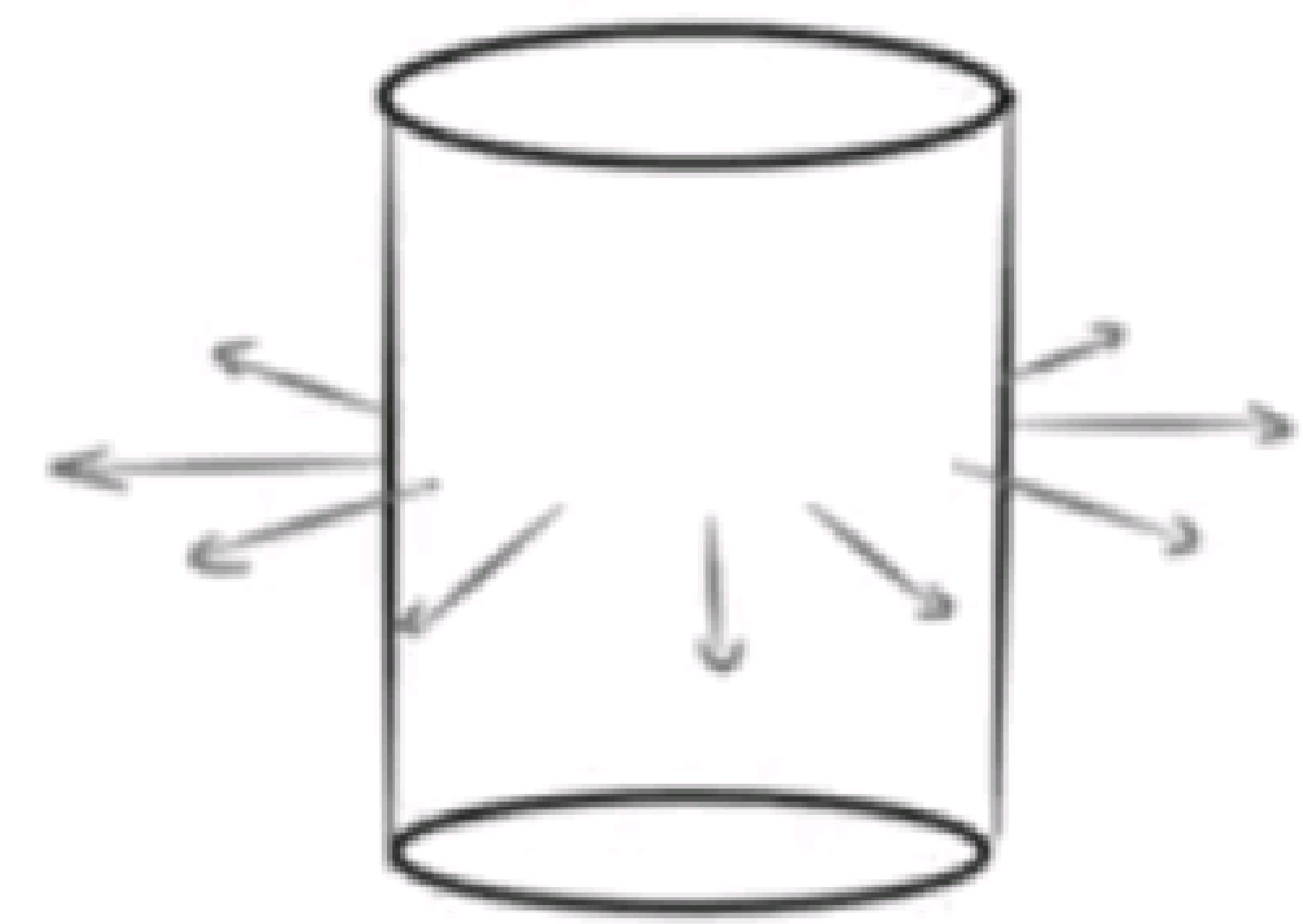
$$\oint_S \vec{E} \cdot d\vec{S} = \frac{1}{\epsilon_0} \times \sum_{i=1}^{N} q_i . \tag{1.7-2}$$

$$E = \frac{1}{4\pi\varepsilon}\frac{q}{r^2}$$

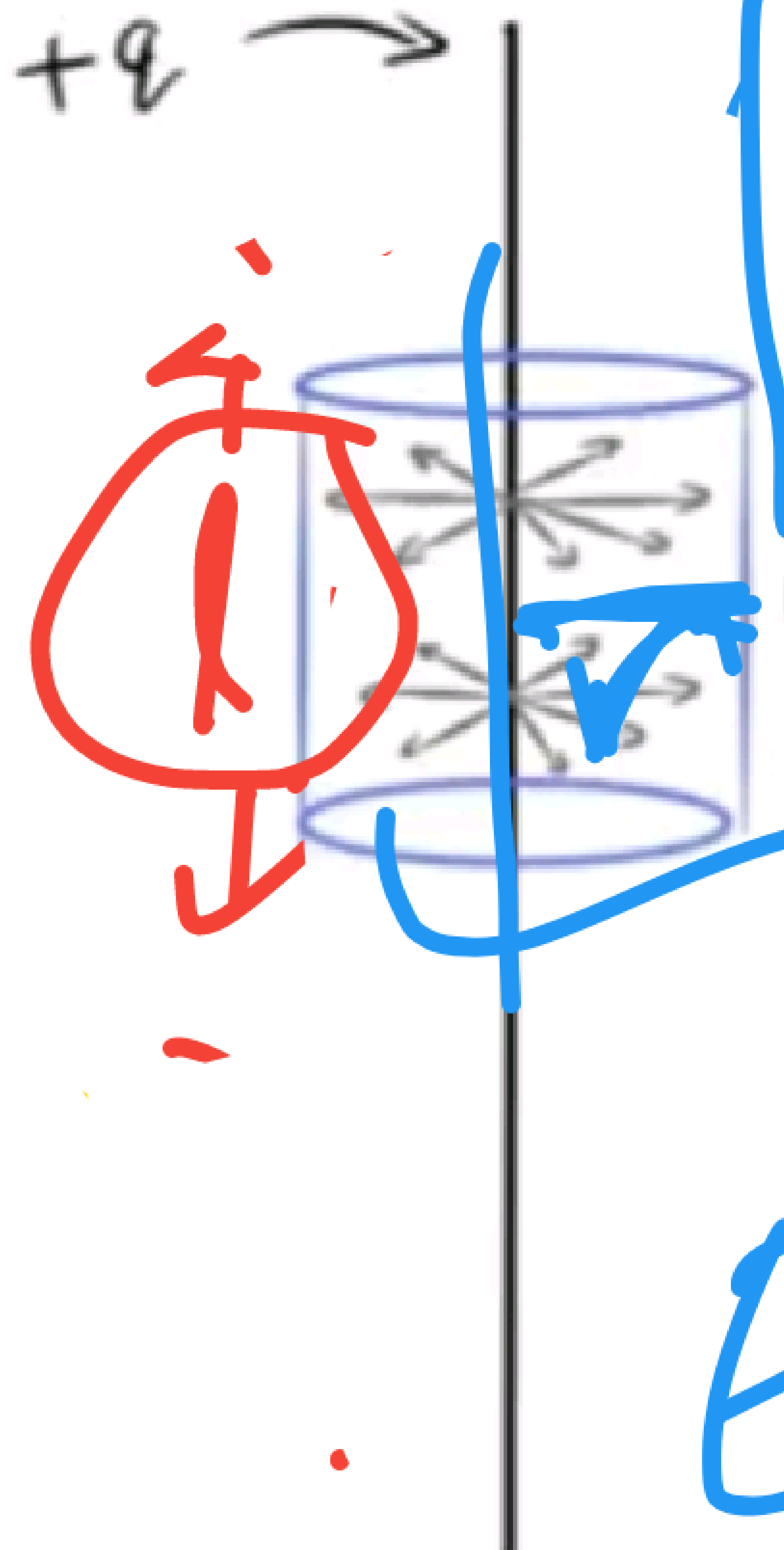
$$E\,4\pi r^2 = \frac{q}{\varepsilon}$$

Gauss' theorem – Application – 2





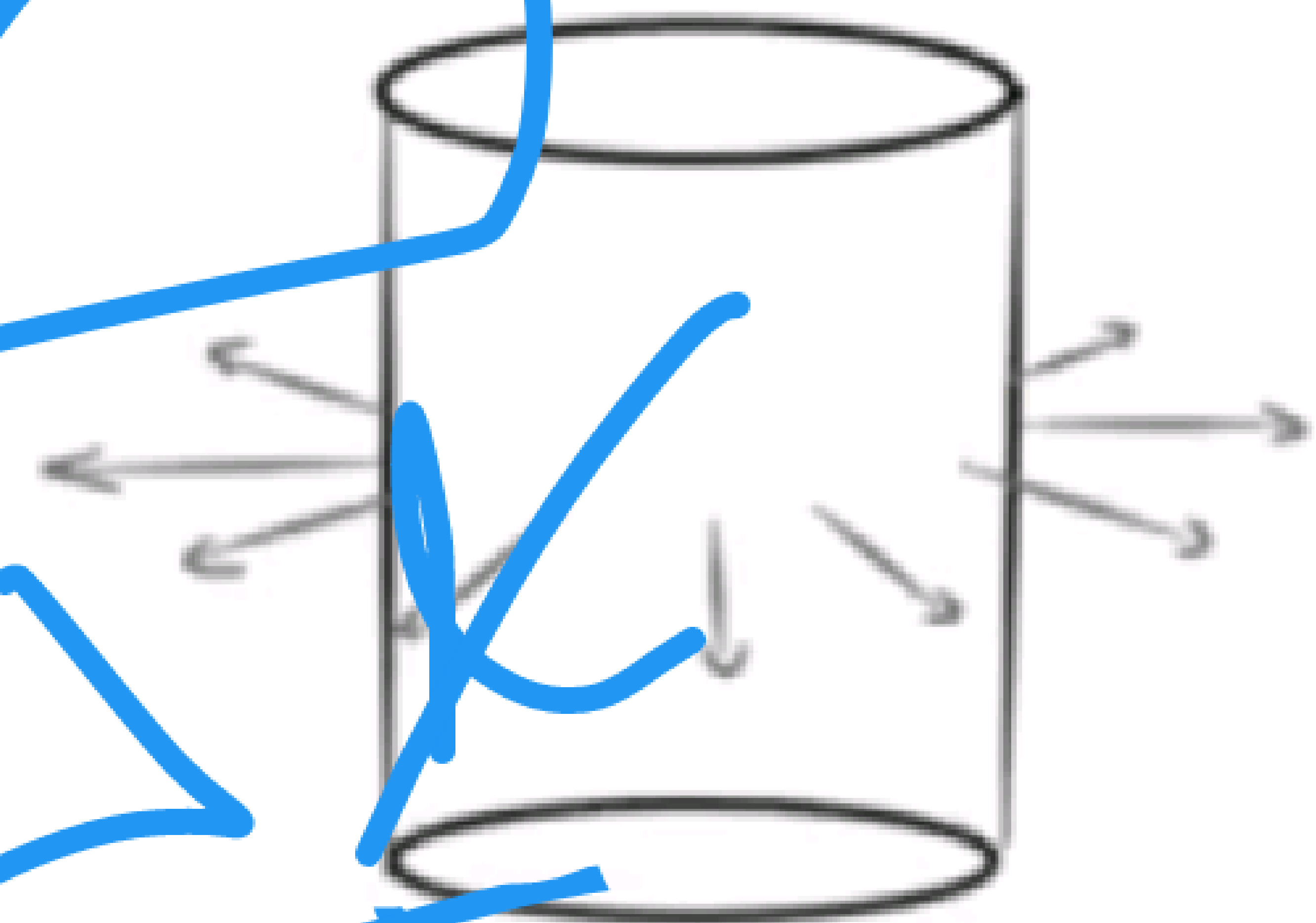
Gauss' theorem – Application - 2



$$\boxed{E = \frac{1}{4\pi\varepsilon_0}\cdot\frac{2\lambda}{r}}$$

$$E\,2\pi r \cancel{l} = \frac{\lambda \cancel{l}}{\varepsilon_0}$$

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



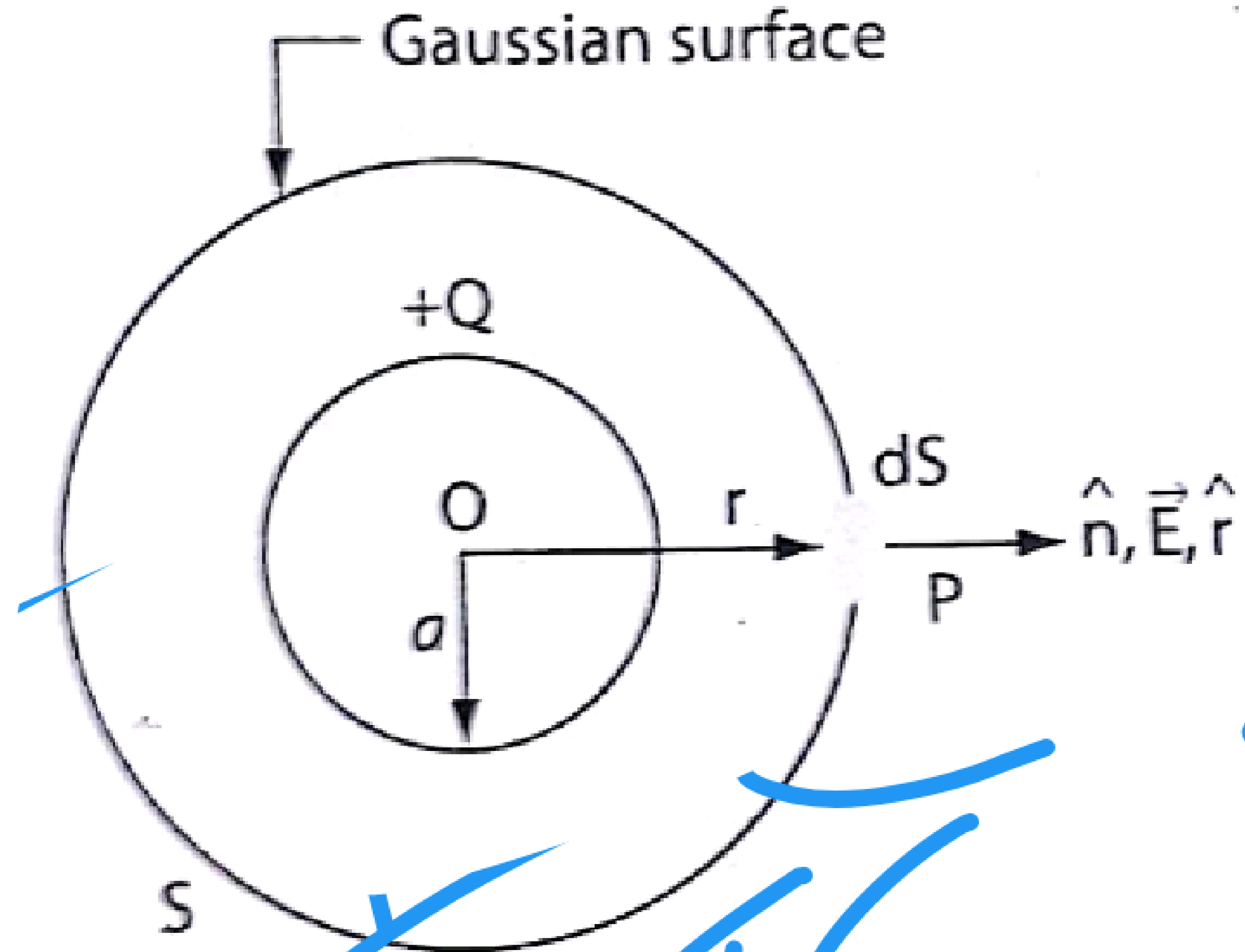


Fig 1.8-1

$E = \frac{Q}{4\pi\varepsilon\, r^2}$

Field inside the sphere

$$\vec{E} = \frac{1}{4\pi\varepsilon} \cdot \frac{Qr}{a^3}$$

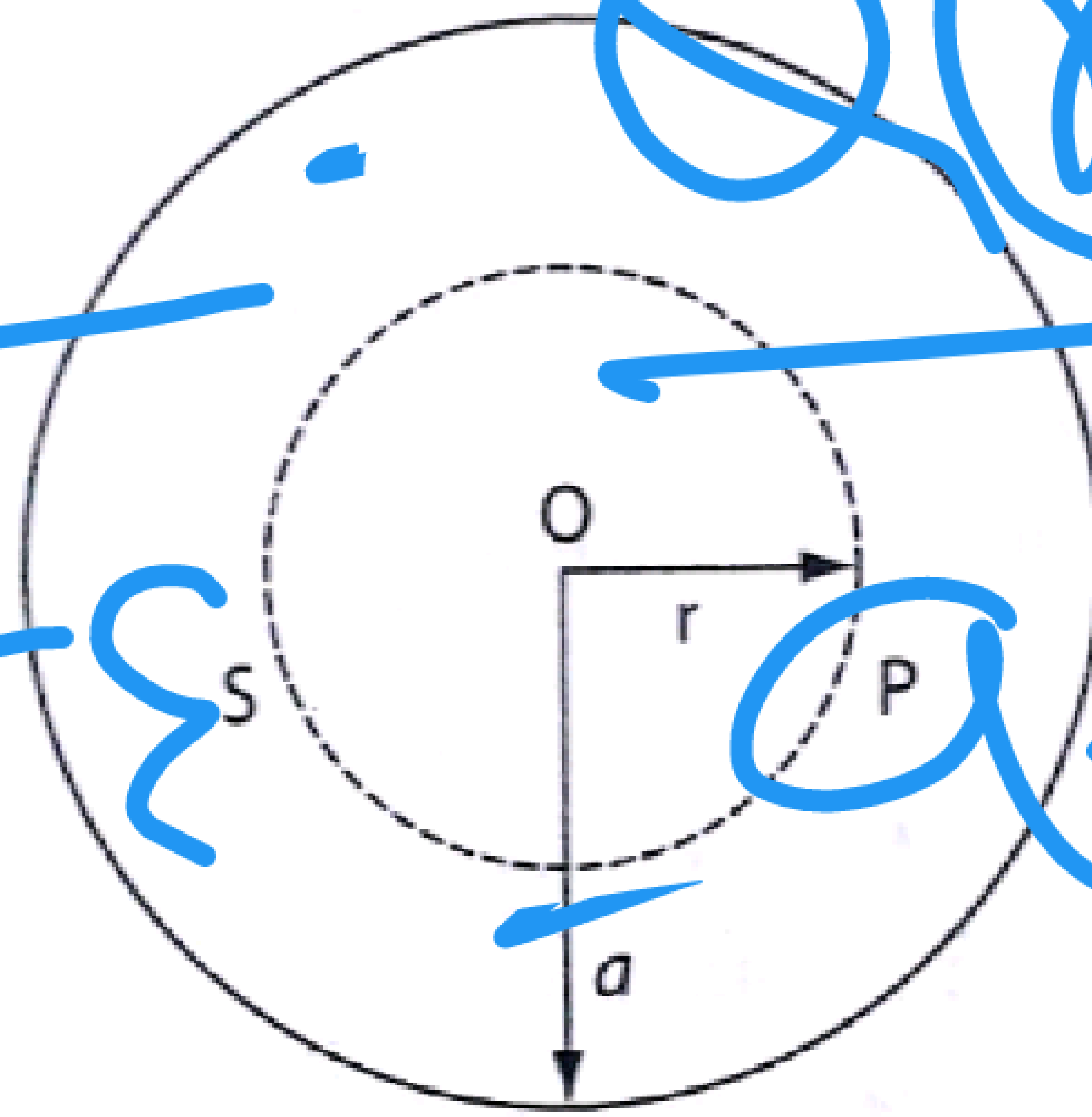


Fig 1.8-2

E

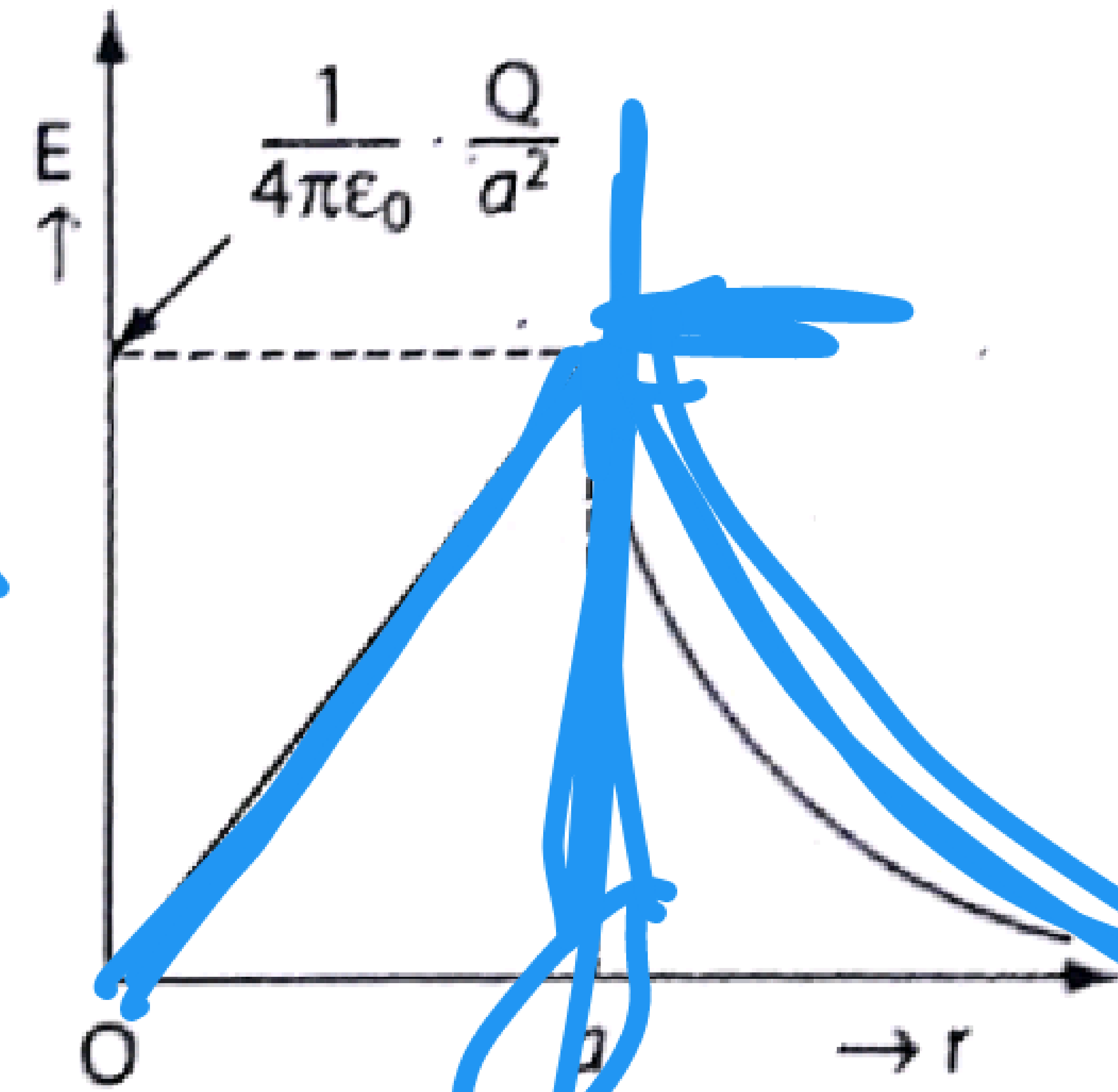
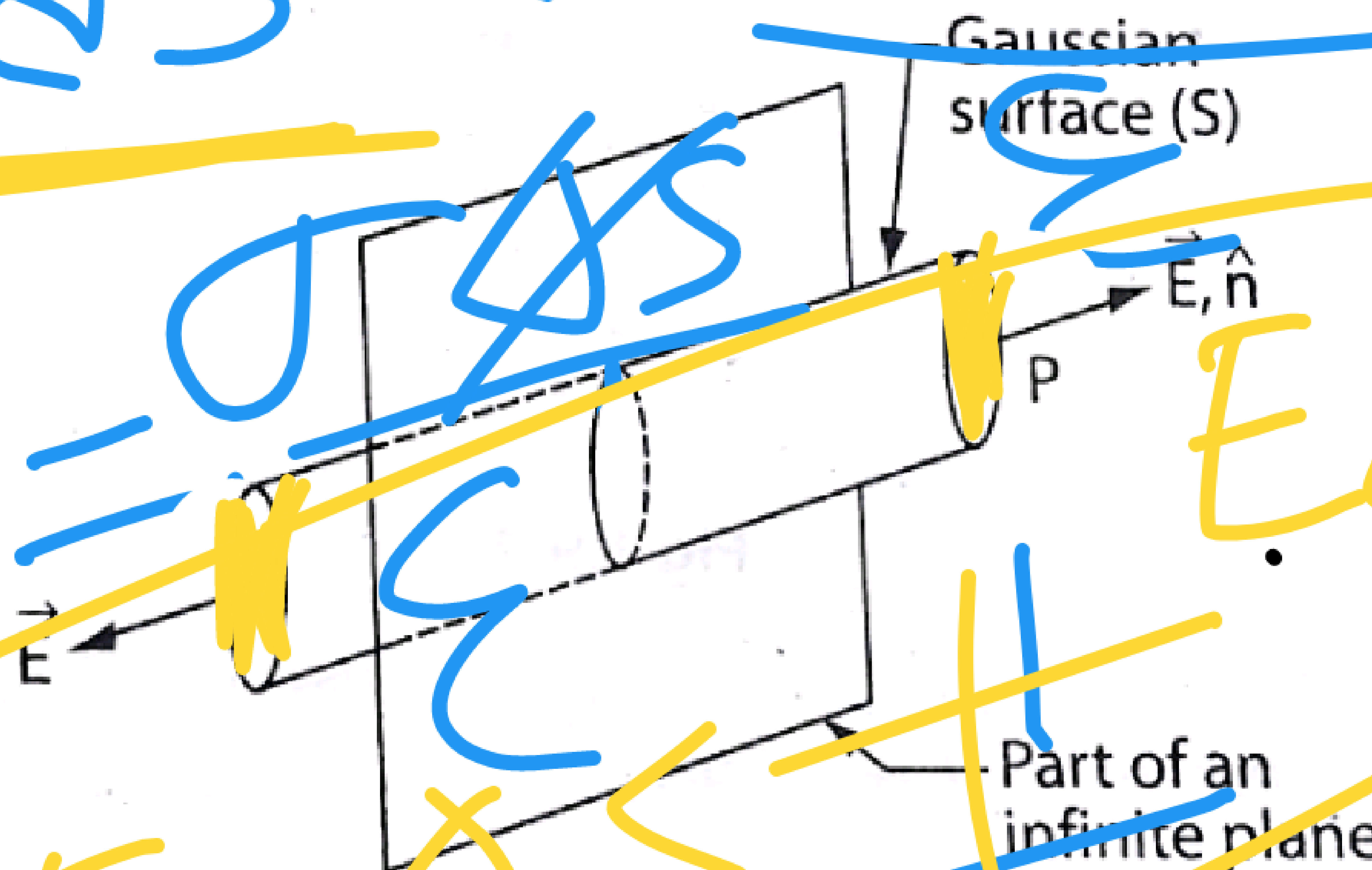


Fig 1.8-3

$$\int \vec{E}\cdot d\vec{S} = \frac{\sigma \Delta S}{\varepsilon}$$

$$2E\cdot\Delta S = \frac{\sigma \Delta S}{\varepsilon}$$



$$E\Delta S$$

$$E = \frac{\sigma}{2}$$