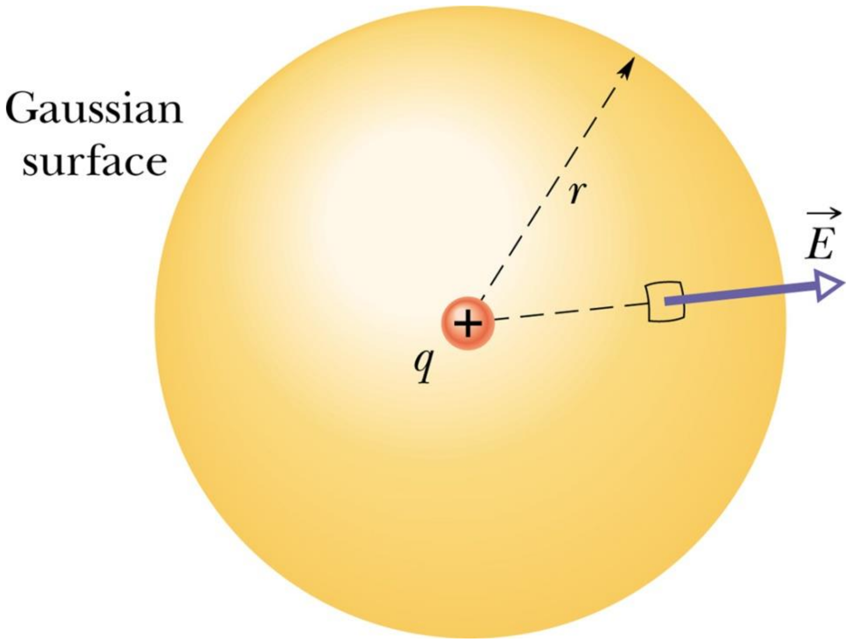
Copyright statement

- The images and the pictures in this lecture are provided by the CDs accompanied by the books
  1. University Physics, Bauer and Westfall, McGraw-Hill, 2011.
  2. Principles of Physics, Halliday, Resnick, and Walker, Wiley, 8th and 9th Ed.
- The rest is made by me.

Gauss law & Coulomb's law



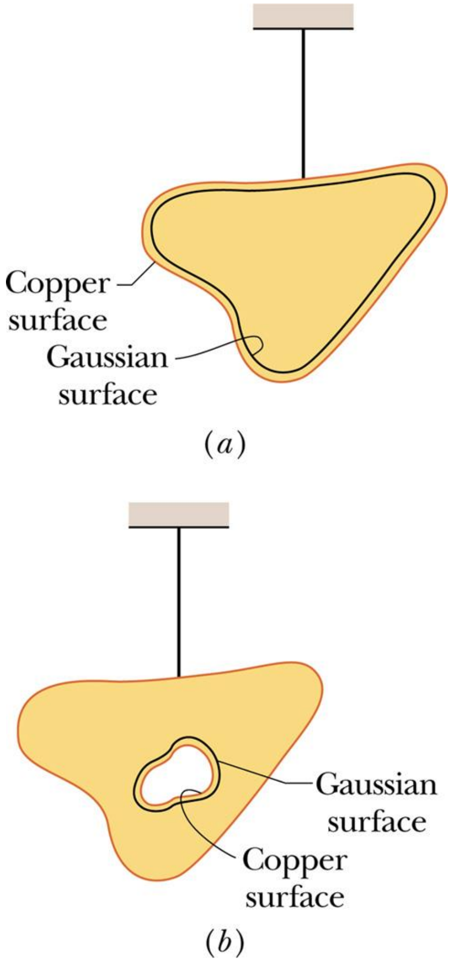
$$\epsilon_0 \oint \vec{E} \cdot d\vec{A} = \epsilon_0 \oint E dA = q_{\text{enc}}$$

$$\epsilon_0 E \oint dA = \epsilon_0 E (4\pi r^2) = q$$

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

Gauss 폐곡면 똑똑하게 잡기
(1) 대칭성을 생각할 것
(2) $\vec{E} \cdot d\vec{A}$를 계산하기 쉽게 잡을 것
(3) 계산하기

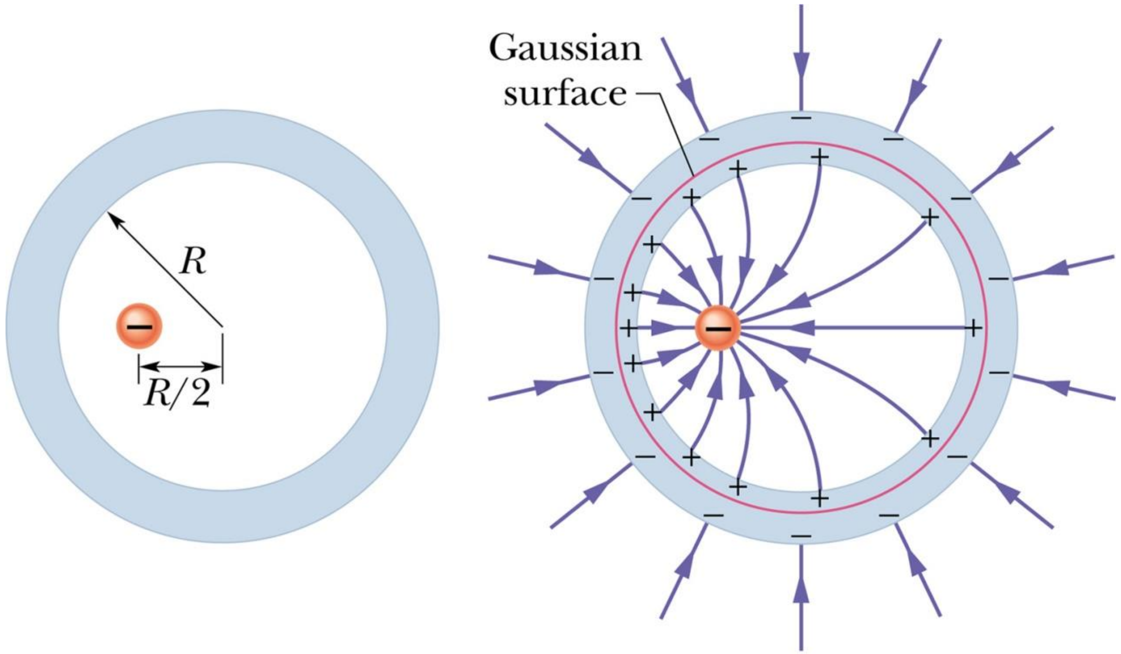
Isolated conductor



No electric field inside a conductor.

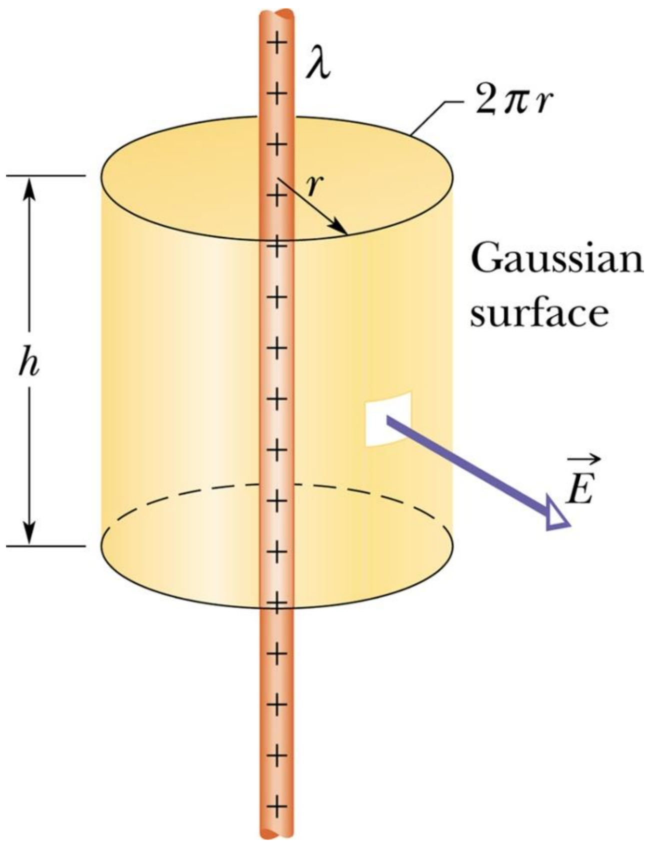
$$E = 0$$

Example 2



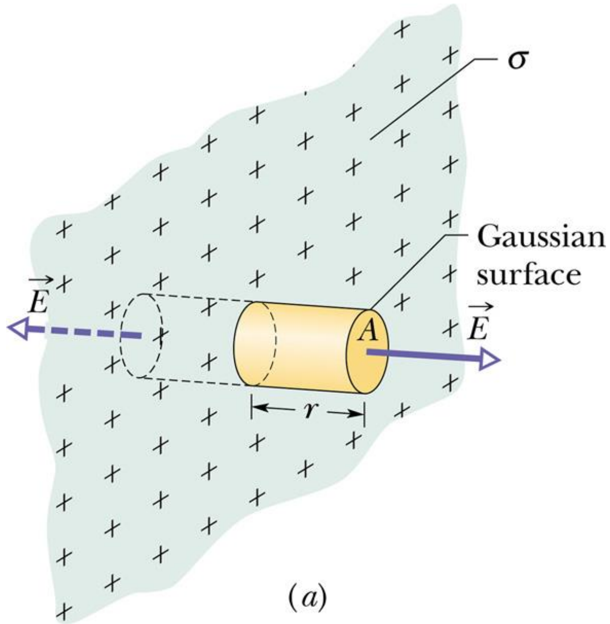
(a) (b)

Line charge: cylindrical symmetry



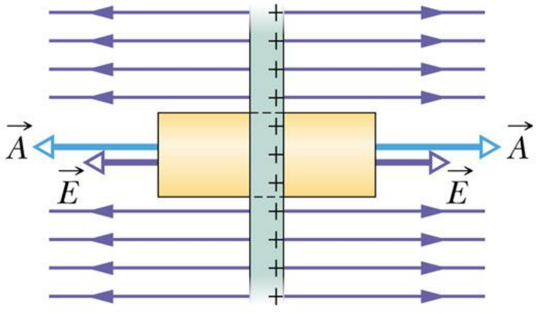
$$E = \frac{\lambda}{2\pi\epsilon_0 r}$$

Surface charge: planar symmetry



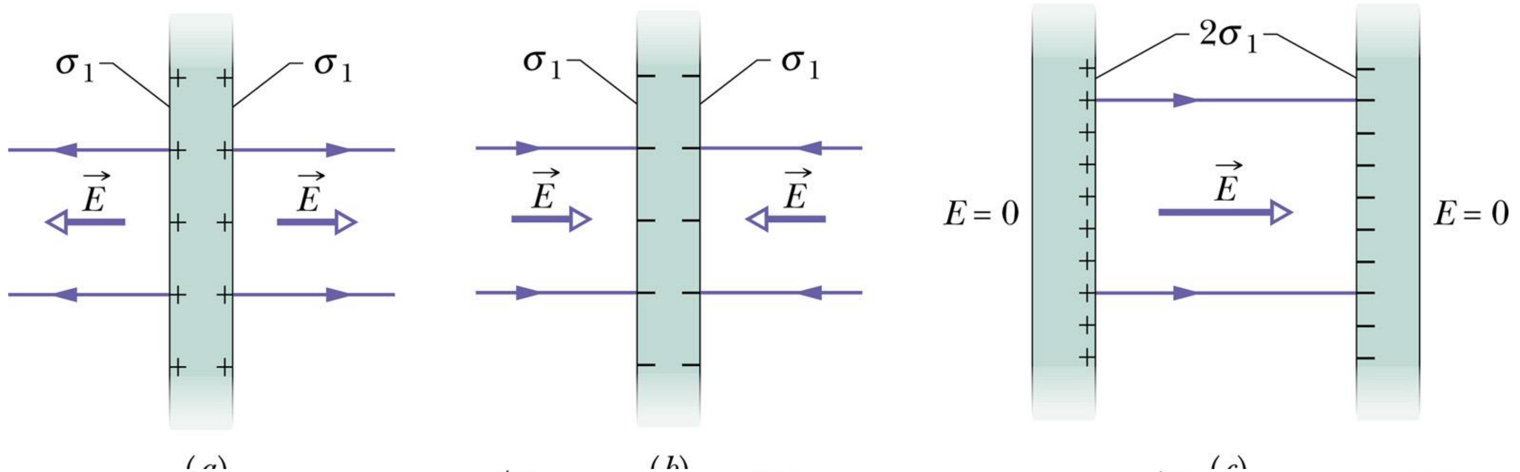
(a)

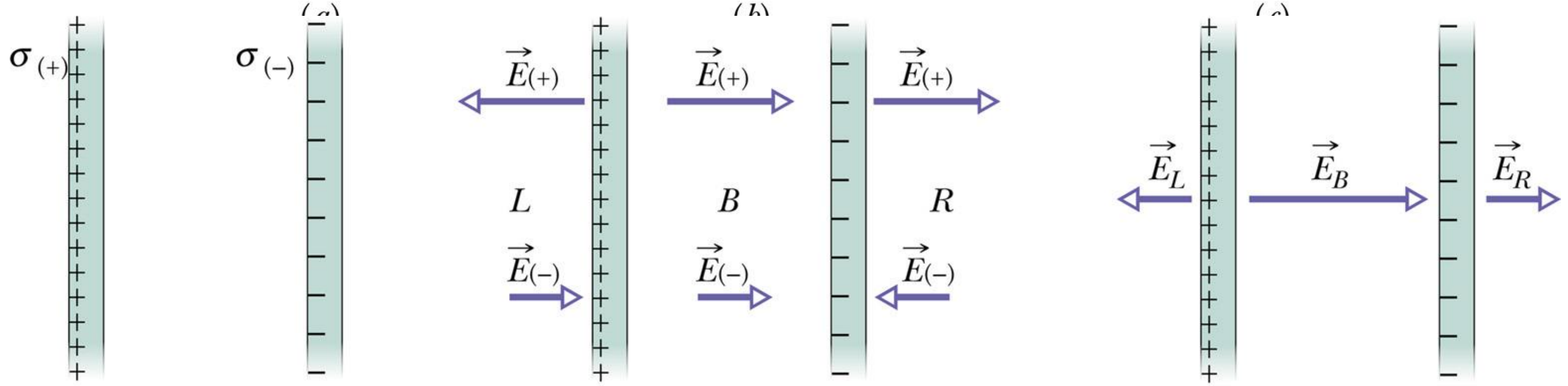
$$E = \frac{\sigma}{2\epsilon_0}$$



(b)

Example 3

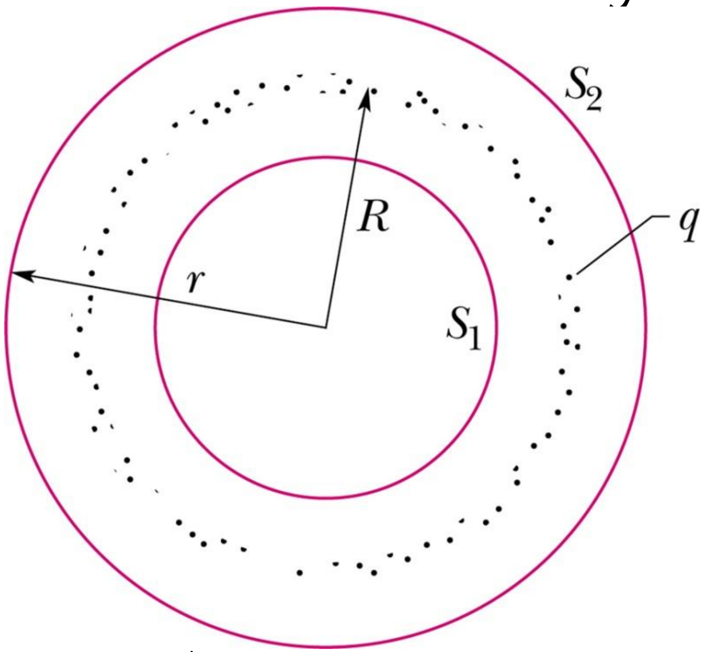


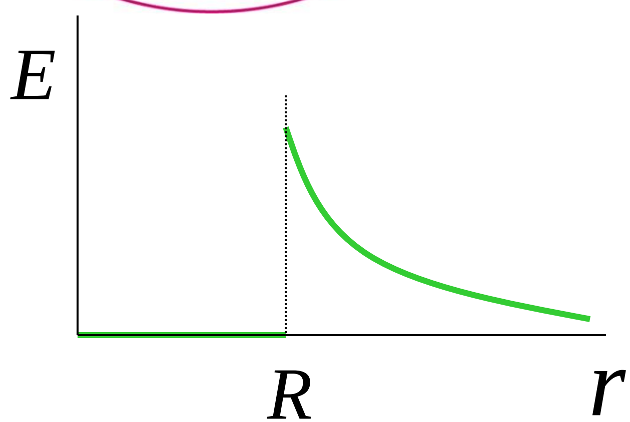


(a) (b) (c)

$$E_+ = \frac{\sigma_{(+)}}{2\epsilon_0} \qquad E_- = \frac{\sigma_{(-)}}{2\epsilon_0}$$

Charged sphere: spherical symmetry





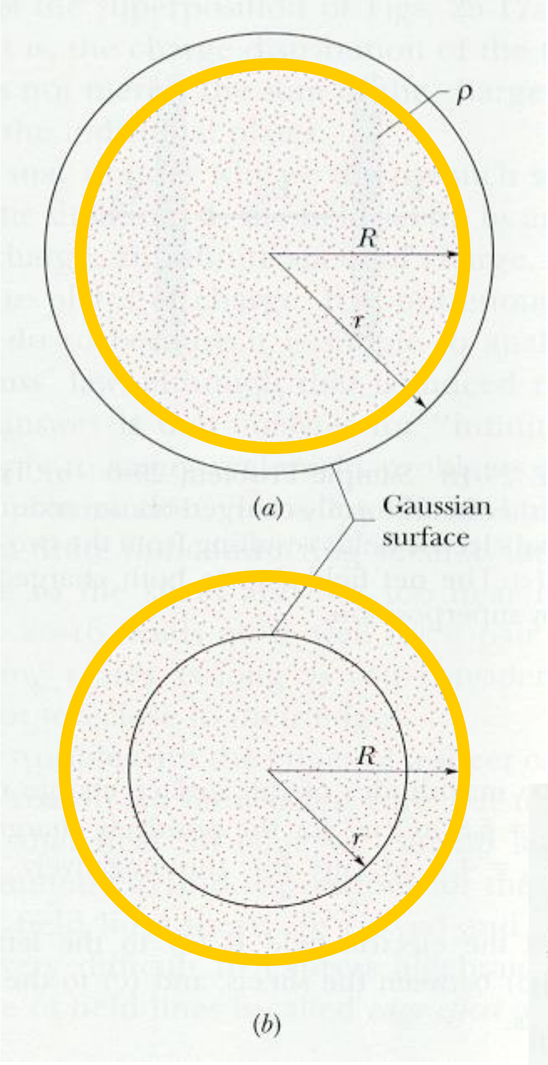
$$q = \epsilon_0 \oint \vec{E} \cdot d\vec{A}$$

1) $r > R$일 때 $\quad E = \dfrac{1}{4\pi\epsilon_0}\dfrac{q}{r^2}$

2) $r < R$일 때 $\quad E = 0$

Shell theorem

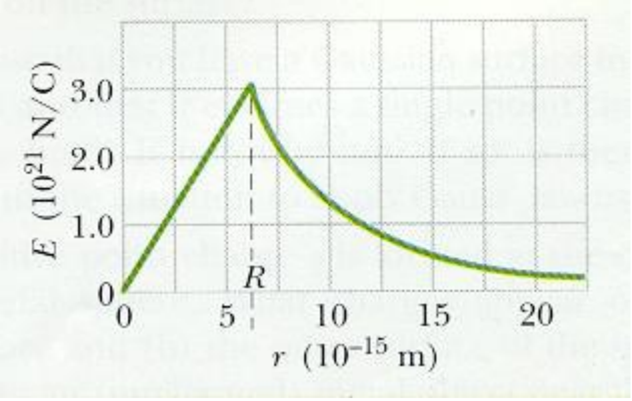
Charged solid sphere



$$r > R; \qquad E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

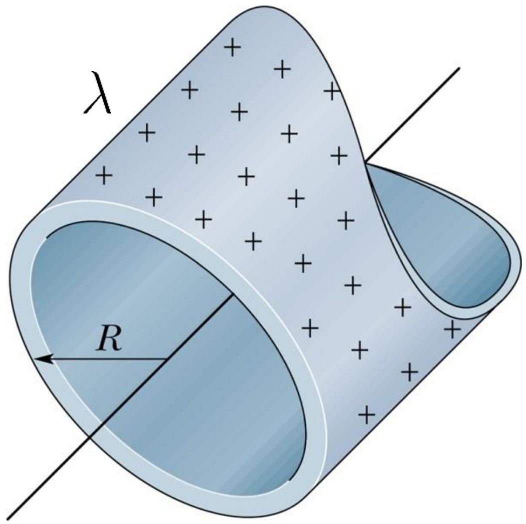
$$r < R; \qquad E = \frac{1}{4\pi\varepsilon_0}\frac{q'}{r^2}$$

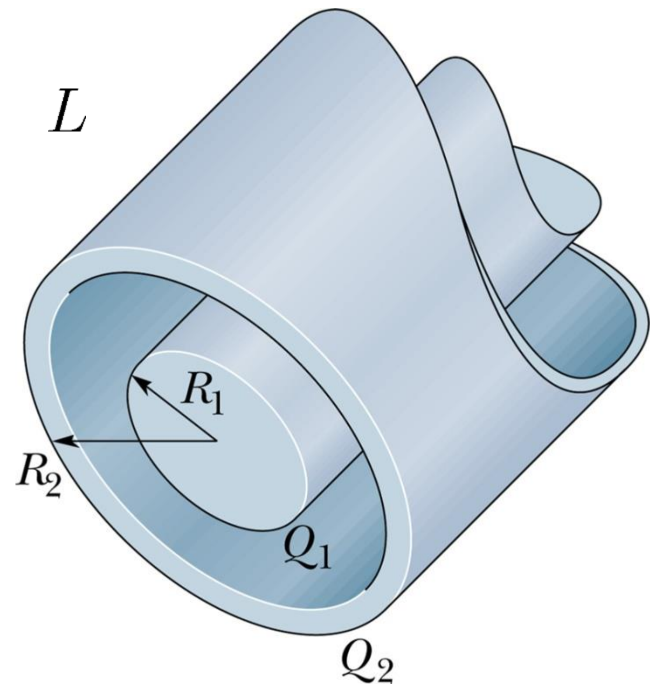
$$\frac{q'}{(4\pi/3)r^3} = \frac{q}{(4\pi/3)R^3}$$



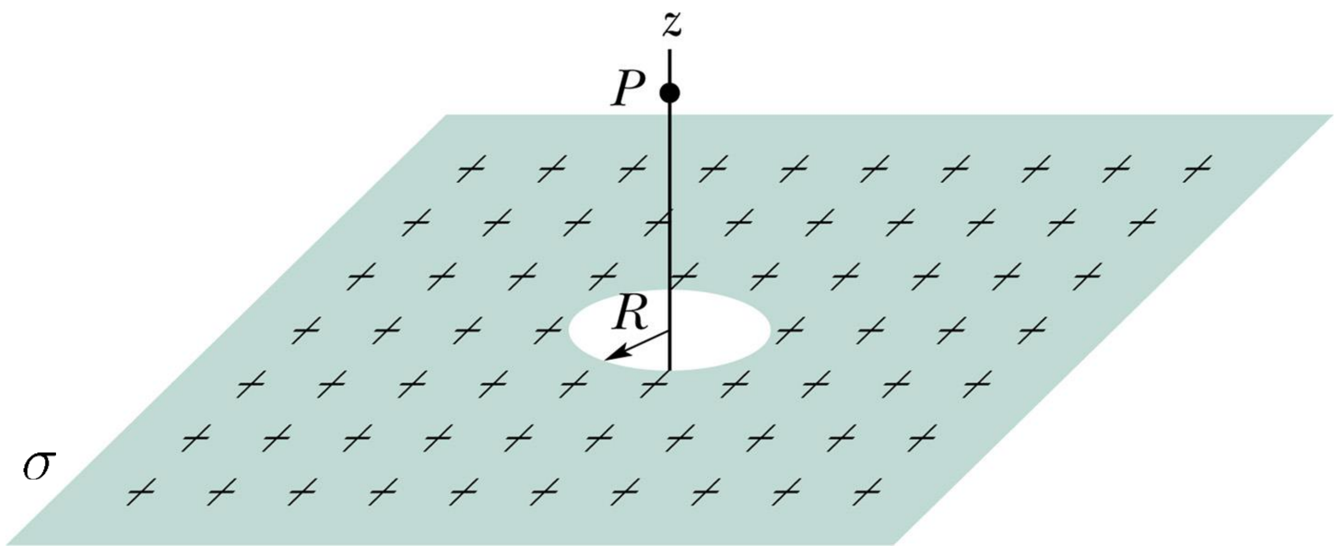
$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{R^3}r$$

Problem 5

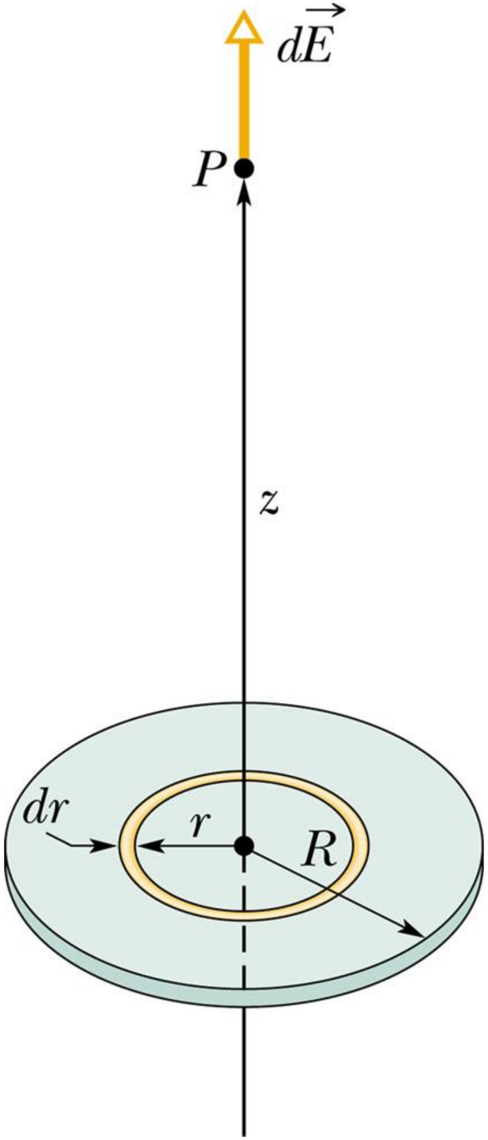




Problem 5

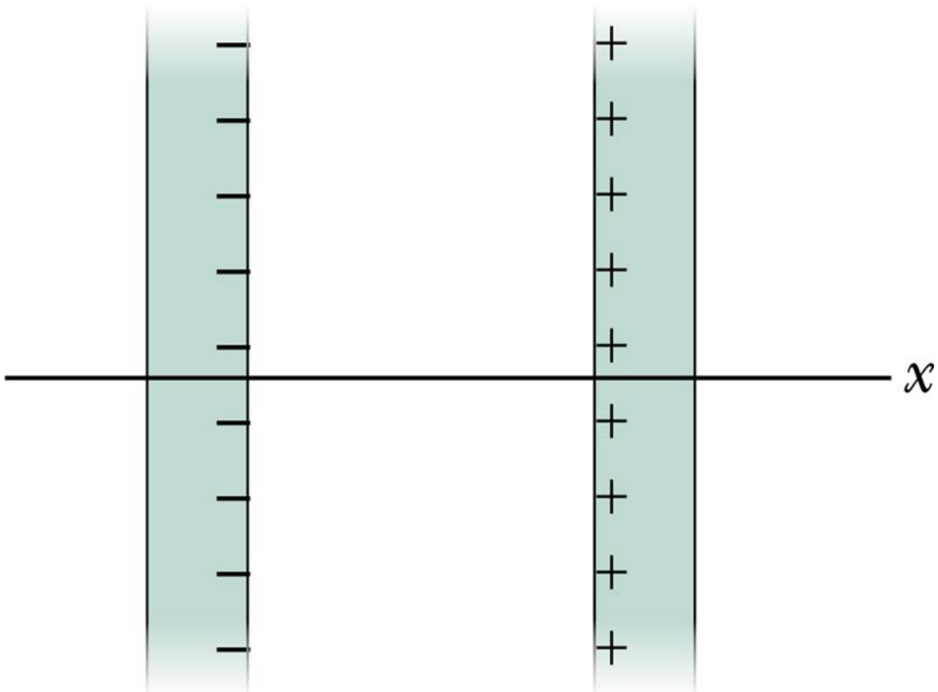


charged disk

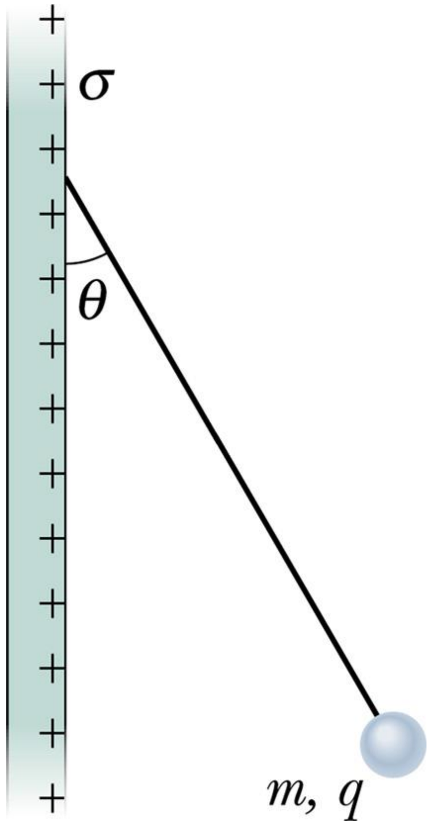


$$E = \frac{\sigma}{2\epsilon_0}\left(1 - \frac{z}{\sqrt{z^2 + R^2}}\right)$$

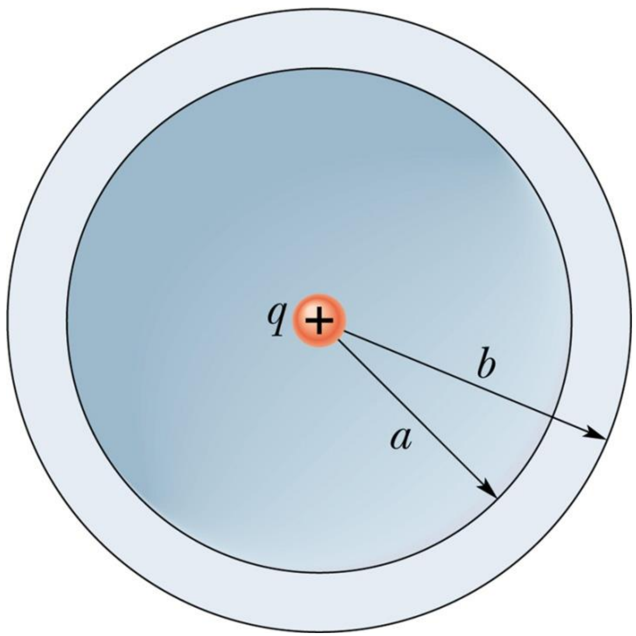
Problem 6



Problem 7



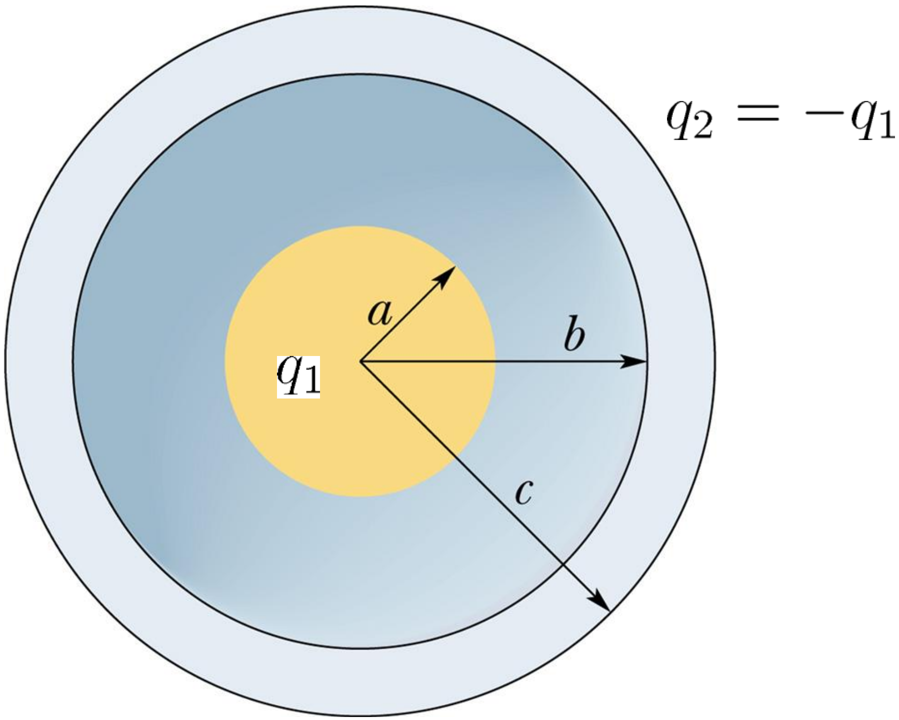
Problem 8



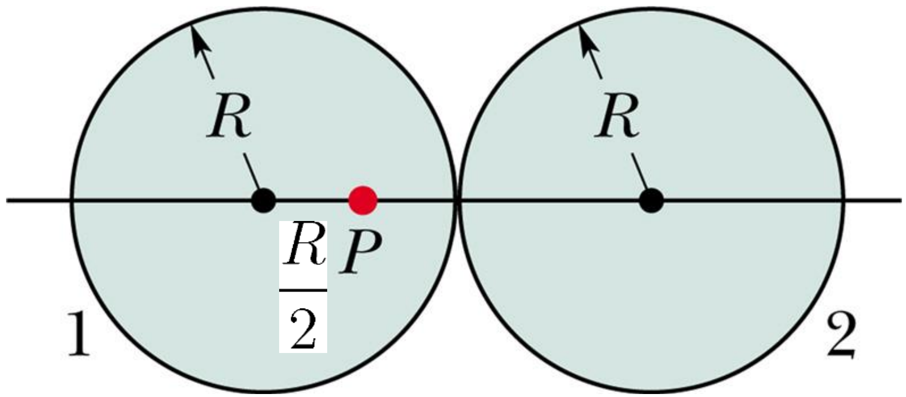
$$\rho = \frac{A}{r}$$

Problem 9

All conductors



Problem 10



$q_2/q_1 = ?$