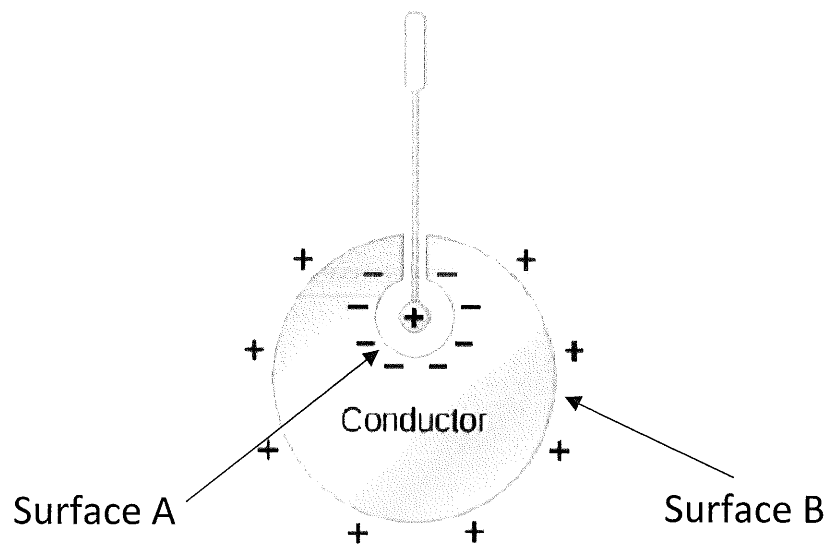
Class 10. Application of Gauss's Law II

Quiz

A *neutral conducting* sphere has a cavity inside it. A +6μC charge is dipped into the cavity (without touching the conducting sphere) as shown in the figure. What is the total charge on the outer surface (surface B) of the conducting sphere?

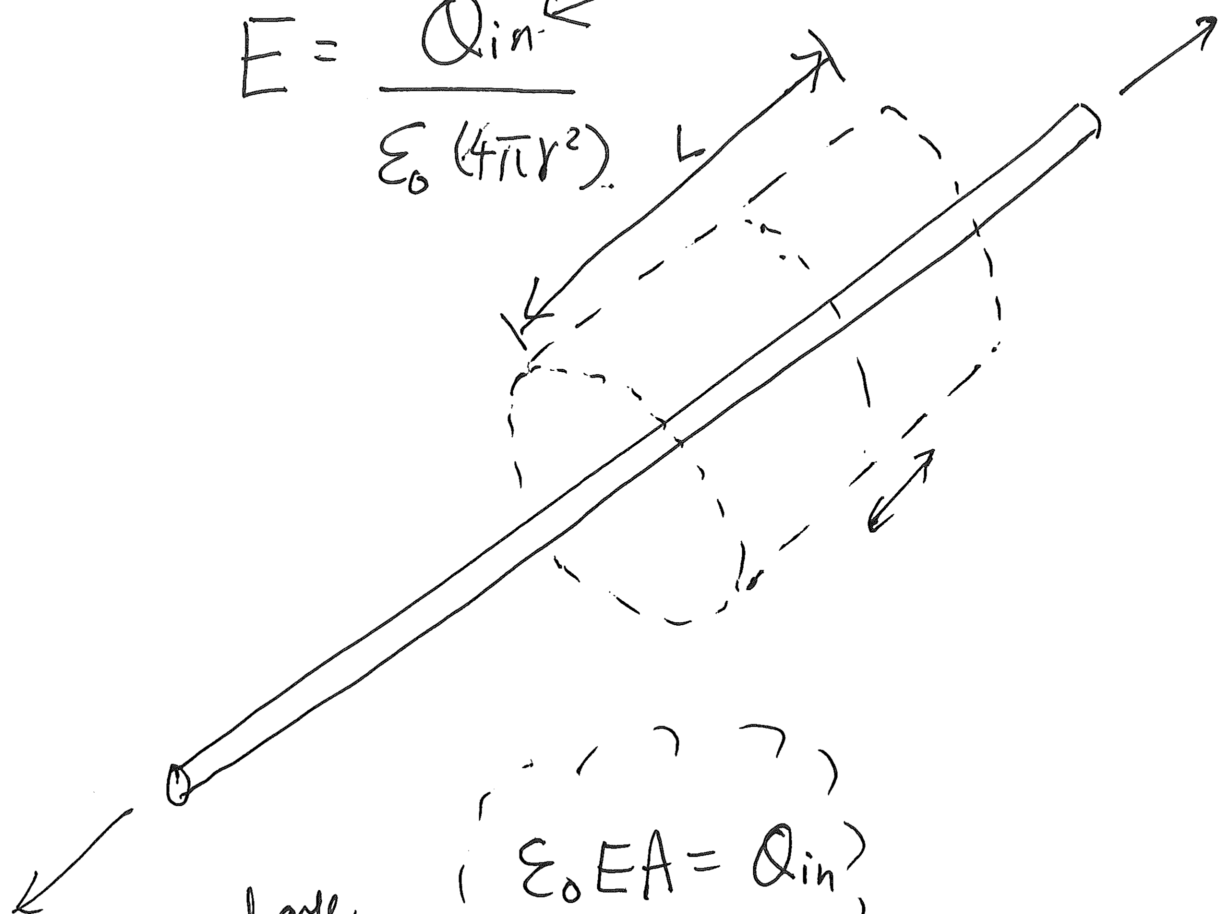


a) 0
b) +3μC
c) -3μC
d) +6μC
e) -6μC
f) +12μC
g) -12μC
h) None of above

$$\varepsilon_0 E A = Q_{in}$$

$$\Downarrow$$

$$E = \frac{Q_{in}}{\varepsilon_0 (4\pi r^2)}$$

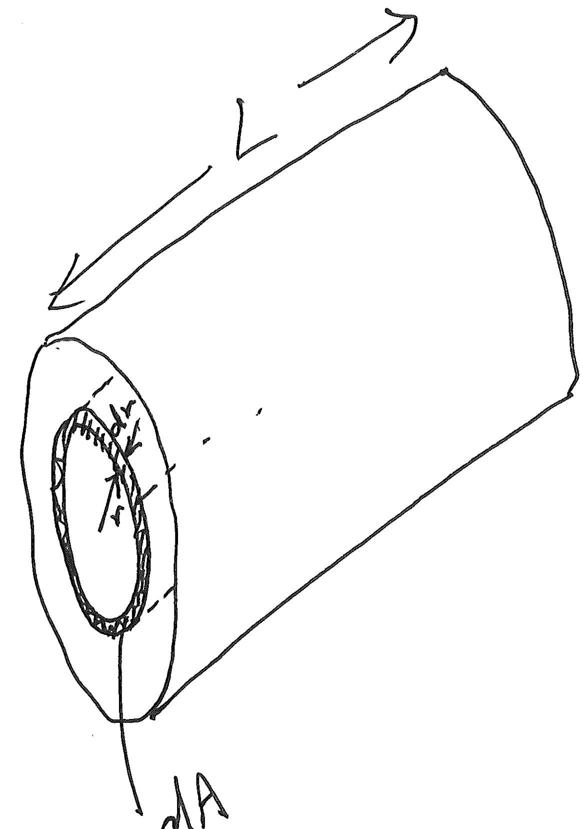


$$\varepsilon_0 E A = Q_{in}$$

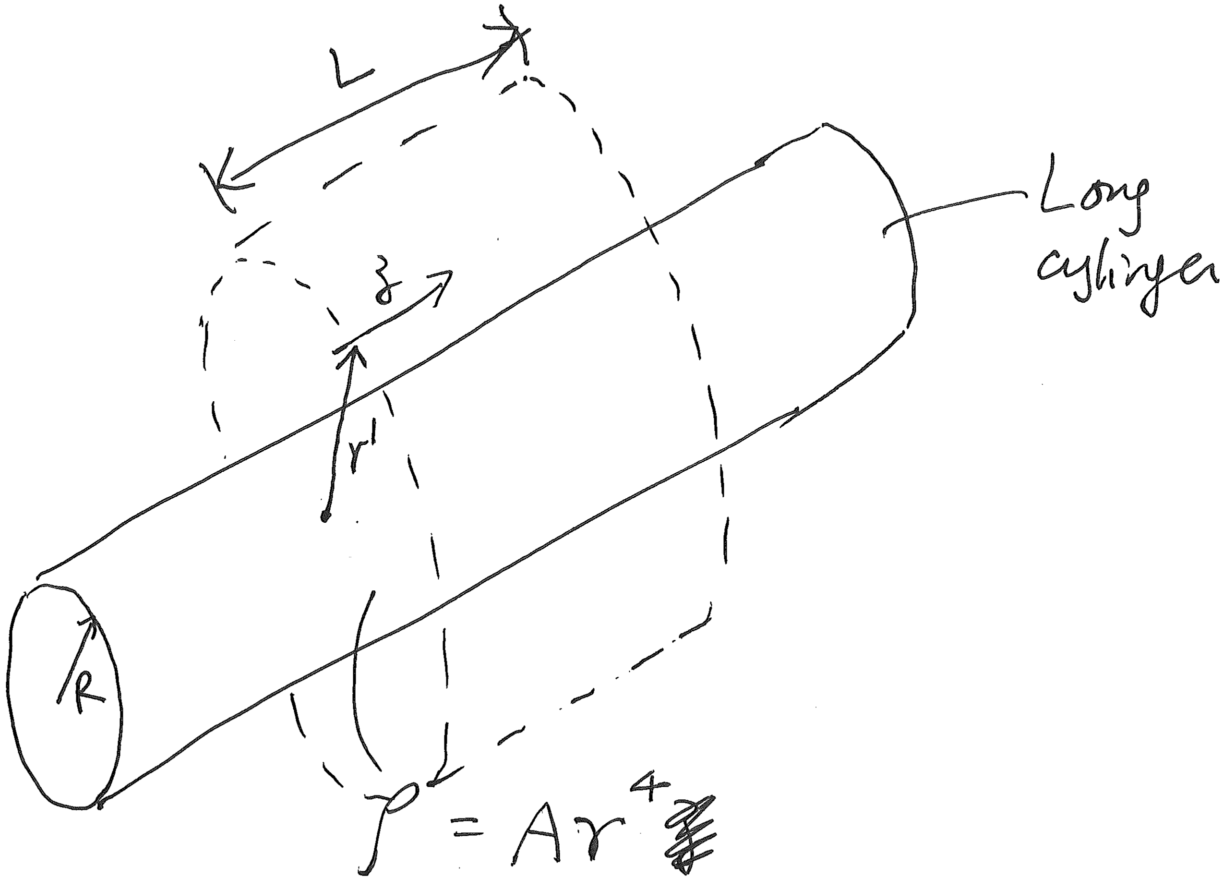
If ~~λ =~~ linear charge density = λ.

$$\Downarrow$$

$$E = \frac{Q_{in}}{\varepsilon_0 (2\pi r L)} = \frac{\lambda L}{\varepsilon_0 (2\pi r L)}$$



$$dV = dA \cdot L$$
$$= 2\pi r\, dr \cdot L$$



$$E = \frac{Q_{in}}{\varepsilon_0 (2\pi r' L)}.$$

Outside $r' > R$.

$$Q_{in} = \int \rho \, dV$$

$$= \int_0^R Ar^4 \cdot 2\pi r \, dr \cdot L$$

$$= 2\pi AL \int_0^R r^5 dr. = \frac{2\pi AL}{6} R^6.$$

~~Q~~

$$E = \frac{\frac{2\pi AL}{6} R^6}{\varepsilon_0 (2\pi r' L)},$$

$$= \frac{AR^6}{6\varepsilon_0 r'}$$ ✓

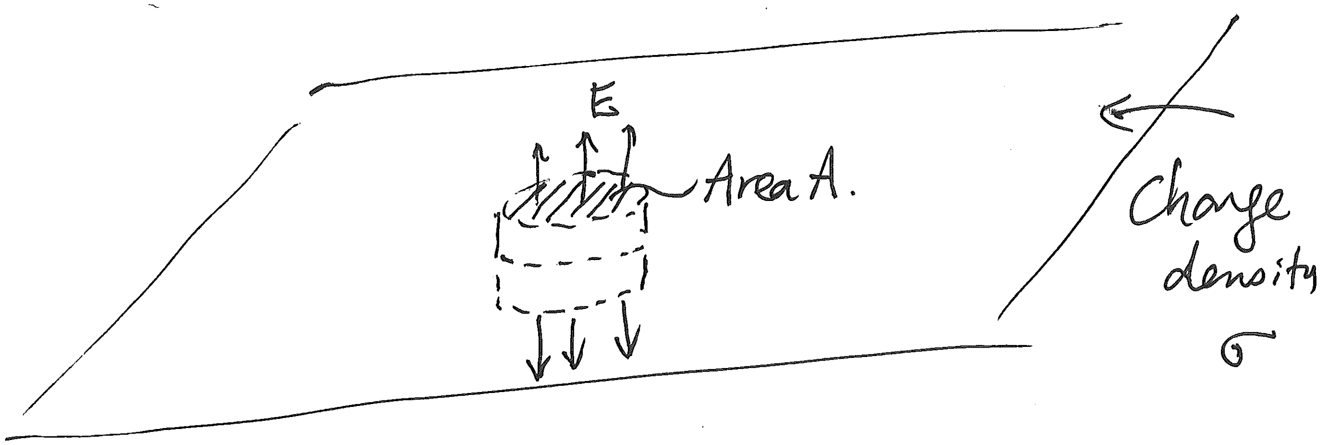
Inside $r' < R$.

$$Q_{in} = \int \rho dV$$

$$= 2\pi AL \int_0^{r'} r^5 dr.$$

$$= \frac{2\pi AL}{6} r'^6.$$

$$E = \frac{\frac{2\pi AL}{6} r'^6}{\varepsilon_0 (2\pi r' L)}, = \frac{Ar'^5}{6\varepsilon_0}$$ ✓



$$E = \frac{Q_{in}}{\varepsilon_0 (2A)}$$

$$= \frac{\sigma A}{2\varepsilon_0 A}$$

$$= \frac{\sigma}{2\varepsilon_0}$$