# Worksheet 2B: **Gauss's Theorem**

SI Leader: Stephen Iota (siota001@ucr.edu)
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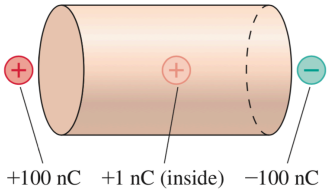
## 1 Conceptual Questions

(a) A metallic sphere of radius $r = 5$ $\mu$m with a total charge of $-12.3$ nC is placed in an electric field $\vec{E}(\vec{r}) = 3.2\hat{x} + 5.7\hat{y} - 7.3\hat{z}$ N/C. What is the electric field strength inside ($r < R$) the sphere?

(b) Is Gauss's Law only valid for symmetric charge distributions?

## 2 What the Flux

(a) What is the net electric flux through the cylinder below?

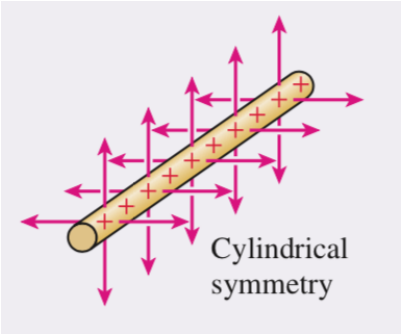



(b) What is the surface area of a sphere? What is the volume of a sphere?

(c) For a symmetric sphere, prove:

$$\Phi_e = \oint_S \vec{E} \cdot \mathrm{d}\vec{A} = E \cdot 4\pi r^2$$

## 3 Cylindrical Symmetry




(a) What is the surface area of the rod of length $L$?

(b) The net electric flux coming out through the cylinder is $-1000$ Nm$^2$/C. How much charge is enclosed within the cylinder?