Physics 132 Quiz # 4

1. If the electric field on a Gaussian surface is constant, then
   (a) the electric field is proportional to the charge inside the surface
   (b) the electric field has spherical symmetry
   (c) the net flux through the surface is positive

2. The electric field of an infinitely long charge distribution has
   (a) spherical
   (b) planar
   (c) cylindrical symmetry.

3. The electric field at the surface of a uniformly charged sphere
   (a) is smooth (continuous first derivative)
   (b) has a cusp
   (c) is discontinuous
LECTURE 5

Concepts & Topics

• Gauss’s law
• Calculation of electric field using Gauss’s Law
Gauss’s Law

\[ \phi_{net} = \oint dA E_n = 4\pi kQ_{inside} \]

Gaussian surface

Karl Friedrich Gauss (1777–1855)
Concept Test:
A cylindrical piece of insulating material is placed in an external electric field, as shown. The net electric flux through the surface of the cylinder is:

1. positive
2. negative
3. zero


**Concept test:**
Consider the two Gaussian surfaces $A_1$ and $A_2$. The only charge present is the charge $Q$ at the center of the surface $A_1$.

I. The net flux through $A_1$ is
(1) Positive,
(2) Negative,
(3) Zero

II. The net flux through $A_2$ is
(1) Positive
(2) Negative
(3) Zero
**Problem solving strategy**

**Goal:** Find the electric field $E$

- Determine the *symmetry* of the charge distribution
- Draw gaussian *surface* through the point of interest
- Obtain *direction* of $E$ from the symmetry of the charge distrib.
- Calculate the *flux through* the surface and *charge inside* surf.
- Gauss: \[ \text{flux through surface} = (4\pi k) \text{ charge inside surface} \]

**SOLVE EQUATION FOR $E$**
Example: Infinite line of charge

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\[ E = ? \quad r \]

1. Symmetry?
2. Gaussian surface?
3. Dir. of E at point \( r \)?
4. Calculate flux
5. Calculate charge \( Q \) inside
6. Find \( E \) from Gauss’s Law
Exercise
Sketch the dependence of the electric field on the distance from the center of the spherical shell.