ASSIGNMENT NO # 4

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Subject: APPLIED PHYSICS

Applicant ID: BSCSGHR-22-0021

Date: 30-October-2022

Title: Applications of Gauss law.

Dated:

Question no 1:

Write the application of GAUSS' LAW. Explain?

GAUSS' LAW

Statement:-

"Electric flux through any surface is equal to the ratio of total charge enclose in it to the absolute permitivity."

Mathematically.

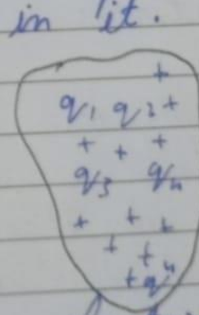
$$\phi_e = \frac{q}{\epsilon_0}$$

(Undefined)

Proof:-

Consider an arbitary shape with the total charge "q" enclosed in it.

i.e: $q_1 + q_2 + q_3 \text{ ---- } + q_n$



If we want to determine electric flux then

Dated:

take q_1 as a centre and drew a ~~shap~~ sphere around it which is called Gaussian surface. Now the electric flux due to the charge q_1 can be obtain as:

$$\phi_e = \phi_{e1} + \phi_{e2} + \phi_{e3} - \dots + \phi_{en}$$

$$\phi_e = \frac{q_1}{\epsilon_0} + \frac{q_2}{\epsilon_0} + \frac{q_3}{\epsilon_0} - \dots + \frac{q_n}{\epsilon_0}$$

$$\phi_e = \frac{1}{\epsilon_0}(q_1 + q_2 + q_3 - \dots + q_n)$$

$$\phi_e = \frac{1}{\epsilon_0}(q)$$

$$\left[\phi_e = \frac{q}{\epsilon_0}\right]$$ Proved!

APPLICATION OF GAUSS' LAW First:

Electric intensity due to the charge sphere at a point "p" outside the sphere.

Considration:-

Consider an insulating sphere with radius "r" such that charge "q" is uniformly distributed at the surface of the sphere. To determine the electric, intensity at point "p" consider an Gausion sphere with passes

Dated:

from "P".

As we know.

$$\phi_e = \vec{E} \cdot \vec{\Delta A}$$

$$\phi_e = E \Delta A \cos\theta$$

For sphere $\theta = 0^\circ$

$$\phi_e = E \Delta A \cos 0$$

$$\phi_e = E \Delta A \quad \text{——— (i)}$$

A/c to Gauses Law.

$$\phi_e = \frac{q}{\epsilon_0}$$

Sub in eq (i)

$$\frac{q}{\epsilon_0} = E \Delta A$$

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

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

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

$$\left[E = K\frac{q}{R^2} \right] \qquad \because K = \frac{1}{4\pi\epsilon_0}$$

Dated:

Part (B).

Application of Gauss Law.

Electric intensity due to when the point at the centre of the sphere then replace 'R' from 'r'.

$$\boxed{E = K\frac{q}{r^2}}$$

Part (C).

When the point inside the sphere then electric charge becomes zero.

$$\boxed{E = 0}$$

Second APPLICATION Of GAUSS LAW

Electric intensity due to infinite sheet of charge.

Considration:-

Consider a plane infinite sheet on which charge is distributed uniformaly. To determine electric intensity. Consider a Gaussian surface as a cylinder which passes from the centre

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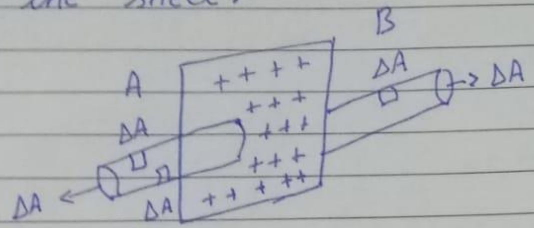
of the sheet.



The angle b/w curve surface area and infinite sheet of either skale is 90' on side and the angle b/w cross sectional area and infinite sheet is zero.

∵ The angle b/w curve surface and infinite sheet is 90' on either side.

$$\because \phi_{e_1} = E\Delta A \cos\theta$$
$$E\Delta A \cos 90^\circ$$
$$E\Delta A \ (0)$$
$$[\ \phi_{e_1} = 0\ ]$$

Side A:

ϕ_e · on cross sectional area

$$\phi_{e_2} = E\Delta A \cos 0^\circ$$
$$\phi_{e_2} = E\Delta A$$

Side B:

$$\phi_{e_3} = \phi_{e_1} + \phi_{e_2} + \phi_{e_3}$$
$$= 0 + E\Delta A + E\Delta A$$
$$\phi_e = 2E\Delta A \quad \text{—(i)}$$

Dated:

A/c to Gauss Law:

$$\phi_e = \frac{q}{\epsilon_o}$$

$$\frac{q}{\epsilon_o} = 2E\Delta A$$

$$E = \frac{q}{2\epsilon_o \Delta A}$$

$$E = \frac{1}{2\epsilon_o} \times \frac{q}{\Delta A}$$

$$\because \sigma = \frac{\text{Charge}}{\text{Area}}$$

$$\because \sigma = \frac{q}{\Delta A}$$

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

Third Application Of Gauss Law.

-Electric intensity b/w two charge plates/sheet.

-Considration :-

Consider a point P b/w two oppositly

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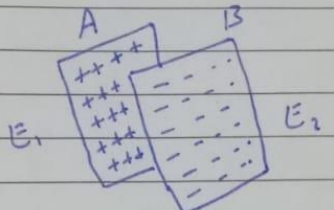
but equall charge sheet. The electric intensity at point P can be obtained as.



Electric intensity due to sheet A.

$$E_1 = \frac{q}{2\epsilon_0}$$

E due to sheet B

E_2 due to sheet B

$$E_2 = \frac{\sigma}{2\epsilon_0}$$

Total intensity at P

$$E = E_1 + E_2$$

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

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

$$\left[E = \frac{\cancel{q}\sigma}{\epsilon_0} \right]$$