XII – PHYSICS

FIRST LESSON

ELECTROSTATICS

(2019 – 2020)

New syllabus

Important five mark

questions with

Answer key.

prepared by

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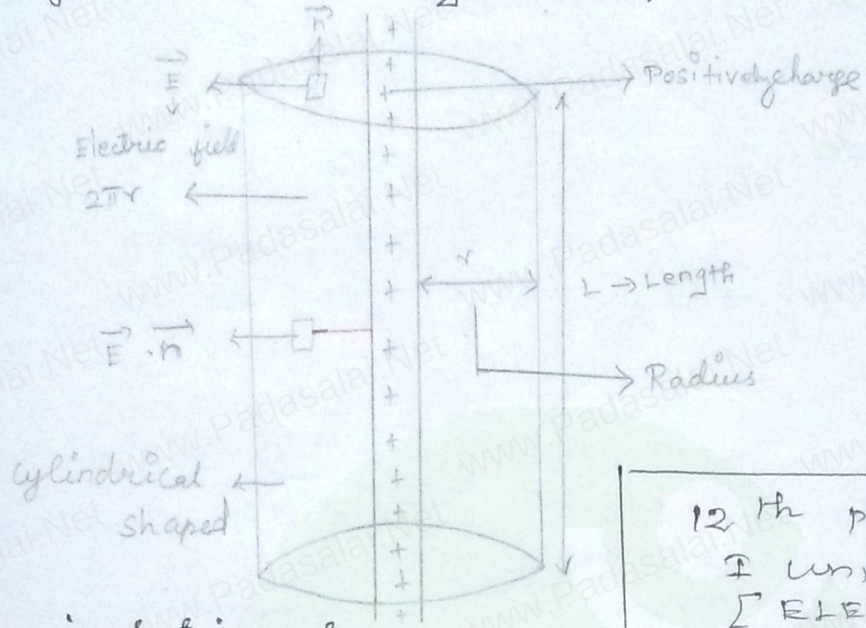
APPLICATION OF GAUSS'S LAW

i) Electric field due to an infinitely charge wire (straight line).



12 th physics
I unit
[ELECTROSTATICS]
Important five mark Question with Answer key.
(2019-2020)

i) Electric flux

ii) Gauss's Law

ELECTRIC FLUX :-

$$\phi_E = \oint d\phi$$

$$d\phi = E.dA\cos\theta$$

$$\phi_E = \oint E.dA\cos\theta$$

$$\boxed{\theta = 0^\circ}$$

$$\phi_E = \oint E.dA\cos(0^\circ)$$

$$\boxed{\cos(0^\circ) = 1}$$

$$\phi_E = \oint E.dA(1)$$

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$$\phi_E = \oint E \cdot dA$$

$$\phi_E = E \oint dA$$

$$\boxed{\oint dA = 2\pi r L}$$

$$\phi_E = E \oint dA$$

$$\boxed{\phi_E = E \cdot 2\pi r L} \rightarrow (1)$$

GAUSS'S LAW:-

$$\boxed{\phi_E = \frac{Q}{\varepsilon_0}}$$

$$\boxed{Q = \lambda L}$$

λ = Linear charge density

L = Length

$$\boxed{\phi_E = \frac{\lambda L}{\varepsilon_0}} \rightarrow (2)$$

$\varepsilon_0 \rightarrow$ Permititivity of free space

FROM EQUCATION (1) and (2)

FROM (1) EQUCATION:-

$$\phi_E = E \cdot (2\pi r L)$$

FROM (2) EQUCATION:-

$$\phi_E = \frac{\lambda L}{\varepsilon_0}$$

$$\phi_E = E(2\pi r L)$$

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

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

$$E = \frac{\lambda \cancel{L}}{2\pi r \cancel{L} \cdot \varepsilon_0}$$

$$\boxed{E = \frac{\lambda}{2\pi r \varepsilon_0}}$$

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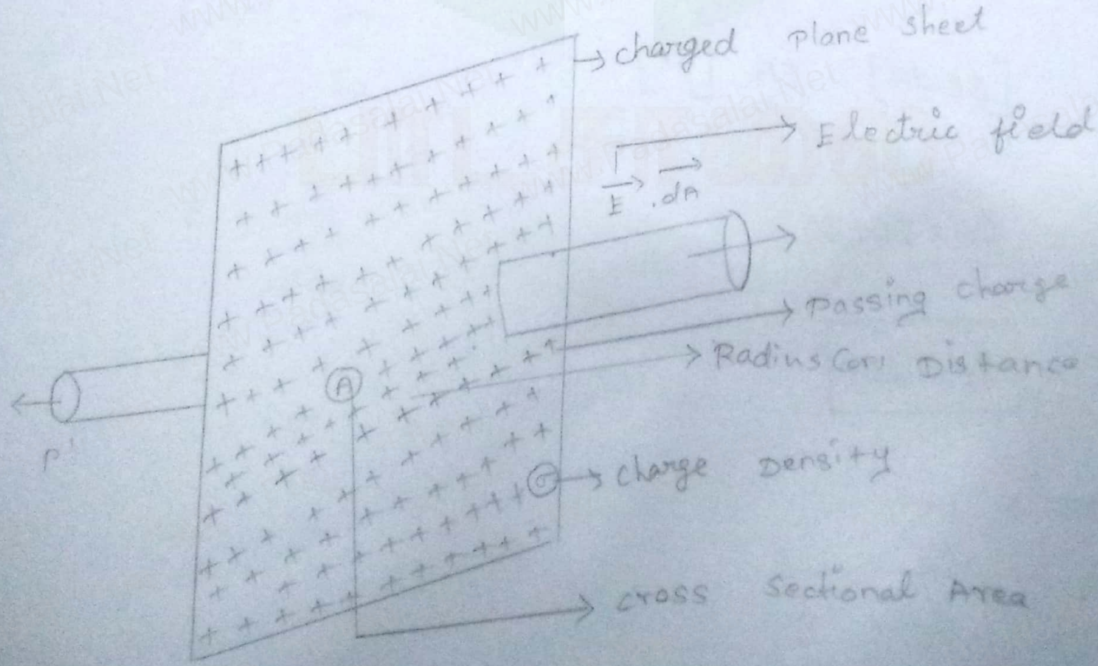
i) Electric field due to an charged infinite plane sheet.



ELECTRIC FLUX :-

$$\boxed{\phi_E = \oint d\phi}$$

$$d\phi = E \cdot dA \cos\theta$$

$$\phi_E = \oint E \cdot dA \cos\theta$$

$$\boxed{\theta = 0^\circ}$$

$$\phi_E = \oint E \cdot dA \cos(0^\circ)$$

$$\boxed{\cos(0^\circ) = 1}$$

$$\phi_E = \oint E \cdot dA(1)$$

$$\phi_E = \oint E \cdot dA$$

$$\phi_E = \left[\oint E \cdot dA\right]_{P} + \left[\oint E \cdot dA\right]_{P'}$$

$$\left[\oint E \cdot dA\right] = EA\,[P]$$

$$\left[\oint E \cdot dA\right] = EA\,[P']$$

$$\phi_E = EA + EA$$

$$\boxed{\phi_E = 2EA}$$

ii) GAUSS'S LAW :-

$$\boxed{\phi_E = \frac{Q}{\varepsilon_0}}$$

$$\boxed{Q = \sigma A}$$

$\sigma \rightarrow$ charge Density

$A \rightarrow$ cross sectional Area

$$\boxed{\phi_E = \frac{Q}{\varepsilon_0}}$$

$$\boxed{\phi_E = \frac{\sigma A}{\varepsilon_0}} \rightarrow ②$$

FROM ① AND ②

$$\boxed{\phi_E = 2EA}$$

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

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

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

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

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

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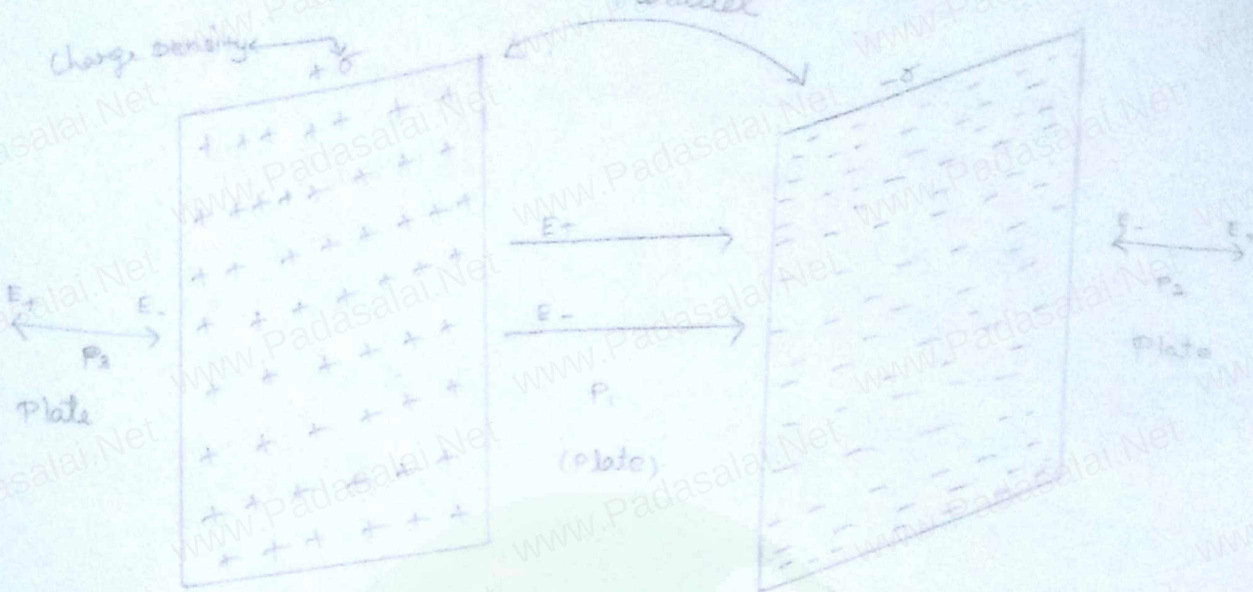
III Electric field due to an two Parallel charged Plane sheet. ⑥



σ → charge density

i) SAME DIRECTION

ii) OPPOSITE DIRECTION

i) Same Direction

$$E_{Total} = E_+ + E_-$$

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

$$E_{Total} = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0}$$

$$E_{Total} = \frac{\sigma + \sigma}{2\varepsilon_0}$$

$$\boxed{E_{Total} = \frac{2\sigma}{2\varepsilon_0}}$$

$$E_{Total} = \frac{\cancel{2}\sigma}{\cancel{2}\varepsilon_0}$$

$$\boxed{E_{Total} = \frac{\sigma}{\varepsilon_0}}$$

ii) opposite Direction:-

$$E_{Total} = E_+ - E_-$$

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

$$E_{Total} = \frac{\sigma}{2\varepsilon_0} - \frac{\sigma}{2\varepsilon_0}$$

$$\boxed{E_{Total} = 0}$$

Electric field due to an uniformly charged spherical shells.

i) At a point outside shell $(r > R)$

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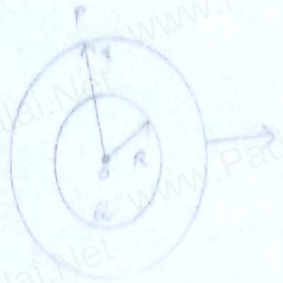


i) ELECTRIC FLUX:-

$$\phi_E = \oint d\phi$$

$$d\phi = E\, dA \cos\theta$$

$$\phi_E = \oint E . dA \cos\theta$$

$$\boxed{\theta = 0^\circ}$$

$$\phi_E = \oint E . dA \cos(0^\circ)$$

$$\boxed{\cos(0^\circ) = 1}$$

$$\phi_E = \oint E . dA \,(1)$$

$$\phi_E = \oint E\, dA$$

$$\phi_E = E \oint dA$$

$$\boxed{\oint dA = 4\pi r^2} \qquad \boxed{\phi_E = E . 4\pi r^2}$$

ii) GAUSS'S LAW:-

$$\boxed{\phi_E = \frac{Q}{\varepsilon_0}}$$

Equation ① and ②

$$\boxed{\phi_E = E \cdot 4\pi r^2}$$

$$E \cdot 4\pi r^2 = \frac{Q}{\varepsilon_0}$$

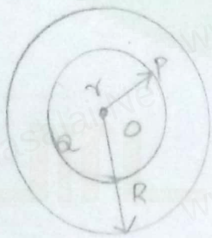
$$E = \frac{Q}{4\pi \varepsilon_0 r^2}$$

$$\boxed{E = \frac{1}{4\pi \varepsilon_0} \frac{Q}{r^2}}$$

VECTOR FORM:-

$$\boxed{\vec{E} = \frac{1}{4\pi \varepsilon_0} \frac{Q}{r^2} \hat{r}}$$

b) At a point surface of shell $(r = R)$



ELECTRIC FLUX:-

$$\boxed{\phi_E = \oint d\phi}$$

$$d\phi = E\, dA \cos\theta$$

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$$\phi_E = \oint E\,dA\cos\theta$$

$$\boxed{\theta = 0}$$

$$\phi_E = \oint E\,dA\cos(0^\circ)$$

$$\boxed{\cos(0^\circ) = 1}$$

$$\phi_E = \oint E\,dA \quad (1)$$

$$\phi_E = \oint E\,dA$$

$$\phi_E = \oint E\,dA$$

$$\phi_E = E\oint dA$$

$$\boxed{\oint dA = 4\pi r^2}$$

$$\boxed{\phi_E = E \cdot 4\pi r^2} \rightarrow (1)$$

ii) GAUSS'S LAW:-

$$\boxed{\phi_E = \frac{Q}{\varepsilon_0}}$$

Equation (1) and (2)

$$\boxed{\phi_E = E \cdot 4\pi r^2}$$

$$E \cdot 4\pi r^2 = \phi_E$$

$$E \cdot 4\pi r^2 = \frac{Q}{\varepsilon_0}$$

$$E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{r^2}$$

$$\boxed{r = R}$$

$$E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{R^2}$$

Vector Form

$$\boxed{\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{Q}{R^2} \hat{r}}$$

At a Point Inside shell $(r < R)$

Electric flux :-

$$\phi_E = \oint d\phi$$

$$d\phi = E . dA \cos\theta$$

$$\phi_E = \oint E\, dA \cos\theta$$

$$\boxed{\theta = 0}$$

$$\phi_E = \oint E\, dA \cos(0^\circ)$$

$$\boxed{\cos(0^\circ) = 1}$$

Inside shell $(r < R)$

$$\phi_E = \oint E \, dA (1)$$

$$\phi_E = \oint E dA$$

$$\phi_E = E \oint dA$$

$$\boxed{\oint dA = 4\pi r^2}$$

$$\boxed{\phi_E = E \cdot 4\pi r^2} \rightarrow (1)$$

GAUSS'S LAW:-

$$\boxed{\phi_E = \frac{Q}{\varepsilon_0}}$$

From (1) and (2) equation

$$E \cdot (4\pi r^2) = \phi_E$$

(That is Electric field Zero)

$$E \cdot (4\pi r^2) = \frac{Q}{\varepsilon_0}$$

$$E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{r^2}$$

$$E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{r^2} \hat{r}$$

Inside $\boxed{Q = 0}$

$$\boxed{E = \frac{1}{4\pi\varepsilon_0} \frac{0}{r^2} \cdot \hat{r}}$$

Therefore

$$\boxed{E = 0}$$

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