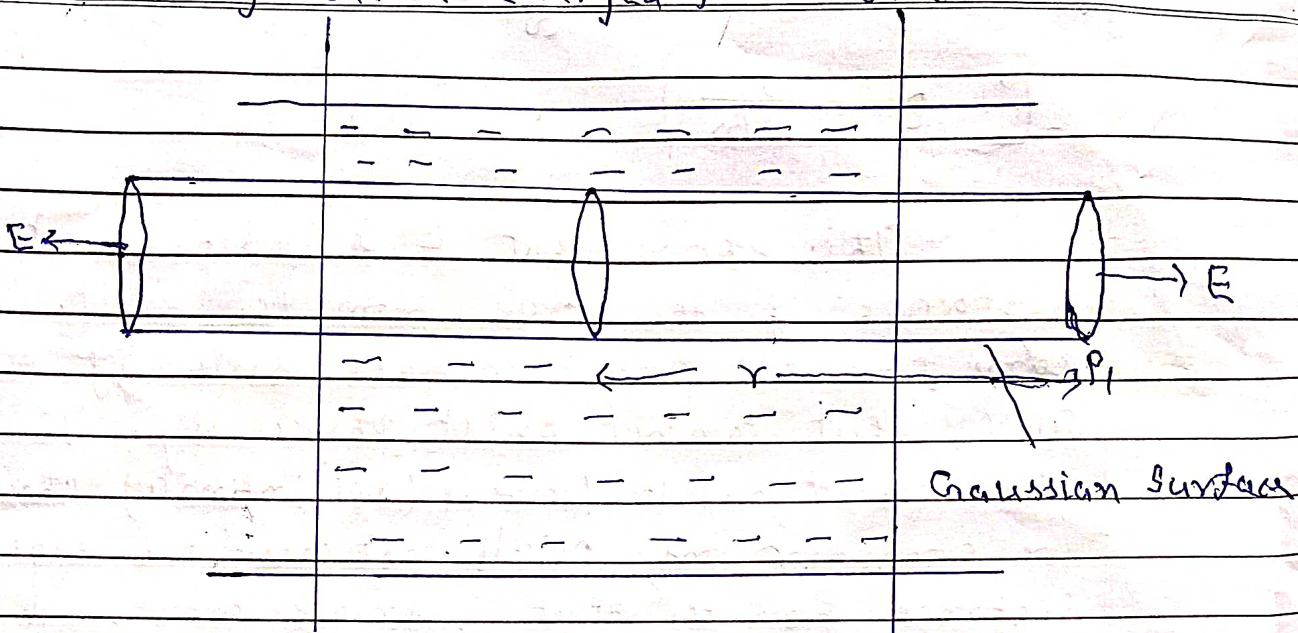
Page
Date

* Electric Intensity near a charged plane sheet :—



Let us consider a portion of thin, non-conducting, infinite sheet charged as shown in fig. Let σ be the surface density of charge.

From symmetry, E is everywhere perpendicular to the plane and the field must have the same magnitude on both sides of the sheet. Let P_1 and P_2 be the two equi-distant points on opposite sides of the sheet.

In order to use Gauss's law, let us construct a cylindrical Gaussian surface of cross-sectional area A, that cuts the sheet with P_1 and P_2 as shown in fig. $\vec{E}$ is normal to end faces and is away from the plane. E is parallel to cylidrical surface, therefore the curved cylidrical does not contribute to the flux.

$$\therefore \vec{E} \cdot \vec{dS} = 0$$

Hence the total flux is equal to the sum of contribution from the two end surface

$$\therefore \oint \vec{E} \cdot \vec{dS} = EA + EA = 2EA$$

The total charge enclosed by the cylinder surface is σA. Hence, according to Gauss's law

Bimal
Page
Date

$$\oint \vec{E}\cdot\vec{ds} = 2EA = \frac{\sigma A}{\epsilon_0}$$

$$\boxed{\therefore\ E = \frac{\sigma}{2\epsilon_0}} \quad \text{— (i)}$$

This shows that E is independent of the distance of the points from the sheet. So, that E is same from all points on each side of the plane. Such sheet cannot exist physically. The eqn (i) yield correct result for real (not infinite) charge sheets, if we consider only points not near the edges, whose distance from the sheet is small compared to the dimensions of the sheet.