

Lecture 3

1 Current density and Charge density

1.1 Current

Current in terms of moving charges

$$I d\vec{l} = q \vec{v}$$

1.2 Current density

$$\vec{J} = \lim_{A \rightarrow 0} \frac{\vec{I}}{A}$$

2 Coulomb's law

2.1 For a point charge Q at the origin

$$\vec{E}(\vec{r}) = \frac{Q}{4\pi r^2} \hat{r}$$

2.2 For a point charge Q at the location \vec{r}_o

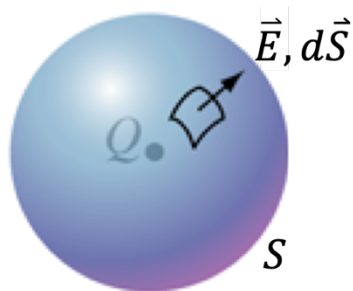
$$\vec{E}(\vec{r}) = \underline{\hspace{10cm}}$$

2.3 Superposition

For a system of n charges $\sum_n Q_n$

$$\vec{E}(\vec{r}) = \underline{\hspace{10cm}}$$

3 Gauss's Law



3.1 For a point charge of Q sitting in the center of a sphere of radius r

Surface area of sphere $S =$ _____

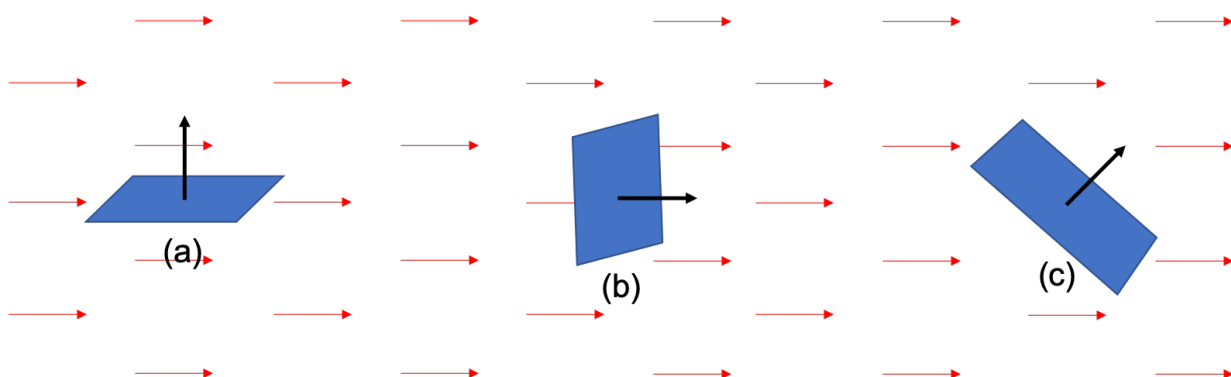
Direction of \vec{E} is _____

Direction of $d\vec{S}$ is _____

Gauss's Law $\epsilon_o \oint_S \vec{D} \cdot d\vec{S} =$ _____

3.2 Example, which of the following three case has more flux?

Compare $\vec{E} \cdot \vec{A}$



3.3 Constitutive Relation

Displace field $\vec{D} \equiv$ _____

$\oint_S \vec{D} \cdot d\vec{S} =$ _____