SEM :- IV MJC PHY 06

Unit :- 01.

Dr. Usha Kumari
Maharaja College
Ara.

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"Scalar potential"

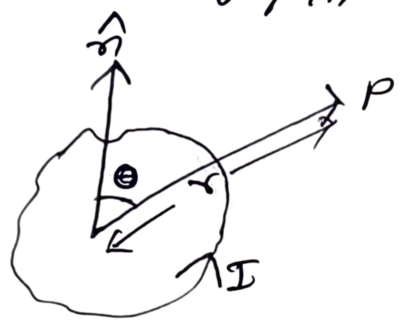
The electrostatic potential is single valued.

But $$\frac{\mu_0 I}{4\pi}(\Omega + 4\pi - \Omega) = \mu_0 I$$

Thus the magnetic scalar potential V_m is multiple valued.

$$V_m = -\int_{\infty}^{P} \vec{B}\, d\vec{l}$$

$$V_m = \mu_0 I \Omega / 4\pi$$



If θ is the angle between $\hat{n}$ and the vector from the loop to a point P, as shown in figure. The solid angle subtended by A at potential will be given by

$$V_m = \frac{\mu_0 I}{4\pi}\frac{A\cos\theta}{r^2}$$

This expression depends on position of the point P, just like the potential of an electic dipole.

These expressions bear the same general relationship to each other that Gauss law in electric field.

$$\oint \vec{E} \cdot d\vec{s} = \frac{Q}{\epsilon_0}$$

or, $\text{div} \cdot \vec{E} = \frac{\rho}{\epsilon_0}$

$$\left.\begin{aligned} \text{div} \cdot \vec{B} &= \nabla \cdot \vec{B} = 0 \\ \& \text{ curl } \vec{B} &= \nabla \times \vec{B} = \mu_0 J \end{aligned}\right\} \quad \text{———} \quad (1)$$

in electrostatic

$$\text{div} \cdot \vec{E} = \nabla \cdot \vec{E} = \rho/\epsilon_0$$

and $\text{curl } \vec{E} = \nabla \times \vec{E} = 0$

from equn (1) $\nabla \times \vec{B} = \mu_0 J$ that in a region containing no current flow curl $\vec{B} = 0$. but this does not hold within a conductor. In empty space where curl $\vec{B} = 0$. The scalar potential for a single loop of current was multiple - valued. like $n\mu_0 I$.

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