Summary of Lecture 6 Magnetostatics

Magnetostatics corresponds to the regime: $\frac{\partial \underline{j}}{\partial t} = 0; \nabla . \underline{j} = 0; \frac{\partial \rho}{\partial t} = 0$

Vector Potential: $\underline{A}(\underline{r}) = \frac{\mu_0}{4\pi} \int \frac{\underline{j}(\underline{r}')}{R} \, d\tau' = \frac{\mu_0}{4\pi} \int \frac{\rho(\underline{r}')\underline{v}(\underline{r}')}{R} \, d\tau'$

Corresponds to three equations relating A_x to j_x, etc, with the same form as the equation for V in terms of ρ in Electrostatics!

Sometimes convenient to write $I \, \underline{dl}' = \underline{j} \, d\tau' \Rightarrow \underline{A}(\underline{r}) = \frac{\mu_0 I}{4\pi} \int \frac{\underline{dl}'}{R}$

Magnetic Field: $\underline{B} = \nabla \times \underline{A} = \frac{\mu_0}{4\pi} \int \underline{j}(\underline{r}') \times \frac{\hat{\underline{R}}}{R^2} \, d\tau' = \frac{\mu_0 I}{4\pi} \int \underline{dl}' \times \frac{\hat{\underline{R}}}{R^2}$

Circulation of $\underline{B}$: $\oint \underline{B} . \underline{dl} = \mu_0 I$ or $\nabla \times \underline{B} = \mu_0 \underline{j}$

Divergence $\nabla . \underline{B} = \nabla . (\nabla \times \underline{A}) = 0$