8. Magnetic Fields

a) Oersted discovers in 1820 that a current creates a magnetic field

- No magnetic monopoles
- Smallest unit: dipole

Experimental results

\[ \oint \mathbf{F} = \mathbf{I} (\mathbf{d} \times \mathbf{B}) \]

What is a magnetic field?

Something in the air such that an current element feels a force

- Field created by current

\[ d\mathbf{B} = \frac{\mathbf{I}}{c} \mathbf{d} \times \frac{x - \mathbf{x}_e}{|x - \mathbf{x}_e|^3} \]

Force on a single charge

\[ \mathbf{I} \mathbf{d} \mathbf{e} = q \mathbf{U} \]

\[ \mathbf{I} \mathbf{d} \mathbf{e} = q \mathbf{U} (\mathbf{s} \times \mathbf{d} \mathbf{e} \times \mathbf{r}) \]

\[ \Rightarrow \mathbf{F} = \frac{1}{c} \mathbf{\dot{U}} \times \mathbf{B} \] Lorentz Force