PHYSICS 231 – CHAPTER 28: SOURCES OF MAGNETIC FIELD

Magnetic field

• due to point charge:

$$\vec{B} = \frac{\mu_0}{4\pi} \frac{q\vec{v} \times \vec{r}}{r^3} , \quad \frac{\mu_0}{4\pi} = 10^{-7} \ T \cdot m/A$$

• due to wire (Biot-Savart law):

$$\vec{B} = \frac{\mu_0 I}{4\pi} \int \frac{d\vec{l} \times \vec{r}}{r^3}$$

Ampère's law:

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$$

Magnetic field

• outside infinite straight wire:

$$B = \frac{\mu_0 I}{2\pi r}$$

• at distance x along axis from center of circular wire of radius a:

$$B_x = \frac{\mu_0 I a^2}{2(x^2 + a^2)^{3/2}}$$

• at center of *N* circular loops:

$$B_x = \frac{\mu_0 NI}{2a}$$

• inside solenoid of *n* turns per unit length:

$$B = \mu_0 n I$$