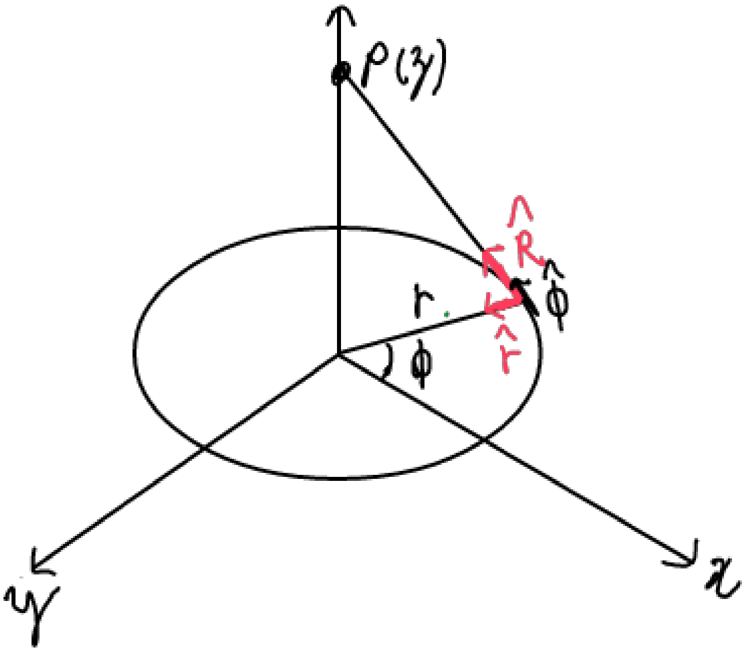
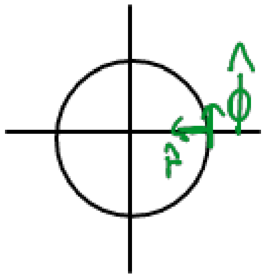
# Effect of Magnetic Field




$$\vec{B} = \frac{\mu_0 I}{4\pi} \int_{\text{wire}} \frac{\vec{dl} \times \hat{R}}{R^2}$$

$$= \frac{\mu_0 I}{4\pi} \int \frac{r\,d\phi\,\hat{\phi} \times (-r\hat{r} \cancel{+ z\hat{z}})}{(z^2 + r^2)^{3/2}}$$

$$= \frac{\mu_0 I}{4\pi} \int \frac{r^2\,d\phi\,\hat{z}}{(z^2 + r^2)^{3/2}}$$




$\hat{\phi} \times -\hat{r} = \hat{z}$

$$= \frac{\mu_0 I}{4\pi} \left( \frac{r^3}{(z^2+r^2)^{3/2}} \right) \hat{z} \int_0^{2\pi} d\phi$$

$$\vec{B}(P) = \frac{\mu_0 I}{2} \left( \frac{a^2}{(z^2+a^2)^{3/2}} \right) \hat{z}$$

if $z >> a$, $\vec{B} \simeq \frac{\mu_0 I a^2}{2z^3}$

$z << a$, $\vec{B} \simeq \frac{\mu_0 I}{2a}$

Read ch. 30, and then 29