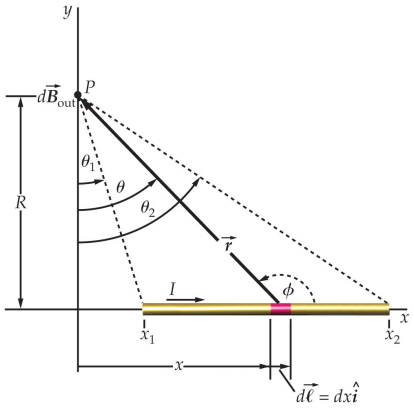
# Magnetic Field Generated by Current in Straight Wire (1)

Consider a field point $P$ that is a distance $R$ from the ax

- $dB = \dfrac{\mu_0}{4\pi}\dfrac{Idx}{r^2}\sin\phi = \dfrac{\mu_0}{4\pi}\dfrac{Idx}{r^2}\cos\theta$
- $x = R\tan\theta \;\Rightarrow\; \dfrac{dx}{d\theta} = \dfrac{R}{\cos^2\theta} = \dfrac{R}{R^2/r^2} = \dfrac{r^2}{R}$
- $dB = \dfrac{\mu_0}{4\pi}\dfrac{I}{r^2}\dfrac{r^2 d\theta}{R}\cos\theta = \dfrac{\mu_0}{4\pi}\dfrac{I}{R}\cos\theta d\theta$
- $B = \dfrac{\mu_0}{4\pi}\dfrac{I}{R}\displaystyle\int_{\theta_1}^{\theta_2}\cos\theta d\theta$
  $= \dfrac{\mu_0}{4\pi}\dfrac{I}{R}(\sin\theta_2 - \sin\theta_1)$
- Length of wire: $L = R(\tan\theta_2 - \tan\theta_1)$




Wire of infinite length: $\theta_1 = -90^\circ,\ \theta_2 = 90^\circ \;\Rightarrow\; B = \dfrac{\mu_0 I}{2\pi R}$