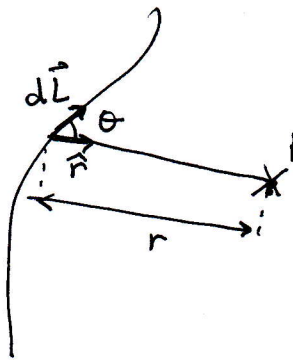


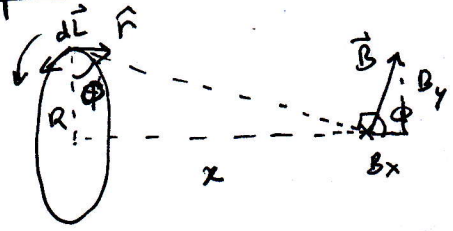
$d\vec{B}(P) = ?$

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,d\vec{L}\times\hat{r}}{r^2}$$

$$= \frac{\mu_0}{4\pi}\frac{I\,dL\sin\theta}{r^2}$$

$$\boxed{\vec{B} = \int d\vec{B} = \frac{\mu_0}{4\pi}\int\frac{I\,dL\sin\theta}{r^2}}$$

Example:



$d\vec{L} \perp \hat{r} \Rightarrow \sin\theta = 1.$

B_y cancels $\rightarrow$ B_x adds up to final answer

$$r^2 = R^2 + x^2$$

$$\cos\varphi = \frac{R}{\sqrt{x^2+R^2}}$$

$$\rightarrow B = \int dB_x = \int dB\cos\varphi.$$

$$dB = \frac{\mu_0}{4\pi} I \int\frac{dL}{R^2+x^2}$$

$$\rightarrow B = \frac{\mu_0}{4\pi} I \int\frac{R\,dL}{(R^2+x^2)^{3/2}} = \frac{\mu_0 I R}{4\pi(R^2+x^2)^{3/2}}\underbrace{\int dL}_{2\pi R}.$$

$$= \frac{\mu_0}{2}\frac{IR^2}{(R^2+x^2)^{3/2}}$$

Recall & compare:

$$E = \frac{1}{4\pi\varepsilon_0}\int\frac{dq}{r^2} \qquad B = \frac{\mu_0}{4\pi}\int\frac{I\,dL\sin\theta}{r^2}$$

$$I = \frac{dq}{dt} \Rightarrow IdL = \frac{dq}{dt}dL = dq\frac{dL}{dt} = dq\,(v).$$

$$\boxed{F = ILB\sin\theta = \frac{dq}{dt}LB\sin\theta = q\frac{dL}{dt}B\sin\theta = qvB\sin\theta}$$

$$\boxed{dqL = \lambda dL\,L = \lambda L\,dL = q\,dL}$$