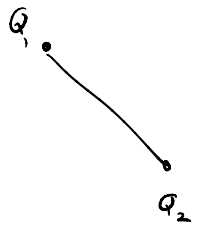
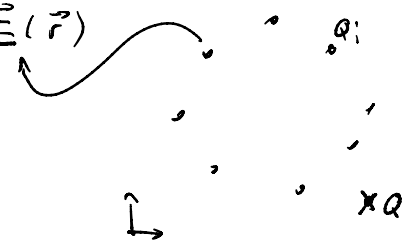
Elektrisk felt

$$\vec{F} = \frac{Q_1 Q_2}{4\pi\epsilon_0} \frac{\hat{R}}{R^2}$$

$$= Q \cdot \vec{E}(\vec{r})$$



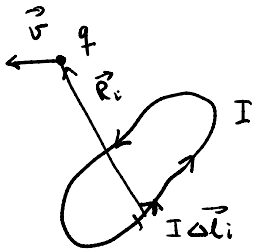


Ny - kraft : **Biot-Savarts lov**

$$\vec{F} = q\vec{v} \times \left(\sum_{i=1}^{N} \frac{\mu_0}{4\pi} \frac{I\vec{\Delta l}_i \times \vec{R}_i}{R_i^2} \right)$$

$$= q\vec{v} \times \vec{B}(\vec{r})$$

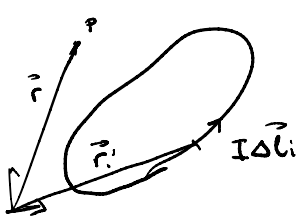
Settes opp av strømelementer



Biot-Savarts lov

$$\vec{B} = \sum_{i=1}^{N} \frac{\mu_0}{4\pi} \frac{I\vec{\Delta l}_i \times \vec{R}_i}{R_i^3}$$

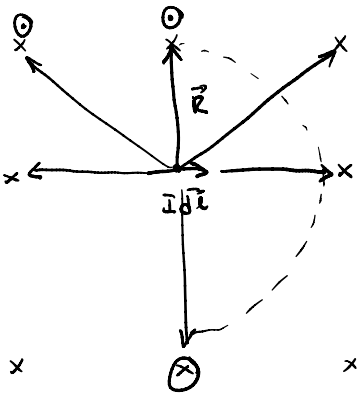
$$= \oint_C \frac{\mu_0}{4\pi} \frac{I\vec{dl} \times \hat{R}}{R^2}$$



$$\vec{R} = \vec{r} - \vec{r}'$$

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I\vec{dL} \times \hat{R}}{R^2}$$

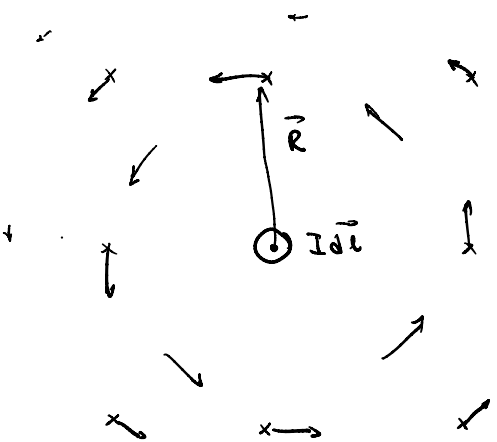
TEST



$\vec{R}$?

$d\vec{B}$?

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \hat{R}}{R^2}$$



$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \hat{R}}{R^2}$$

TEST

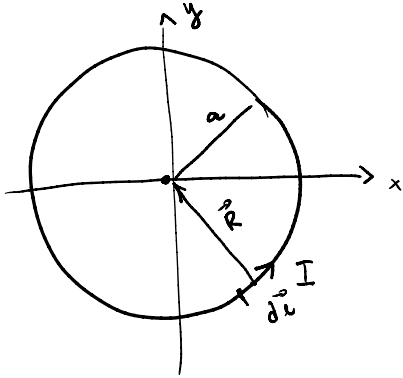
$\vec{R}$ $\quad d\vec{B} = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \hat{R}}{R^2}$

$d\vec{l}$

$d\vec{B}$ $\quad d\vec{B} = \frac{\mu_0}{4\pi} \frac{I\, dl}{a^2} \hat{z}$

$\vec{B}$

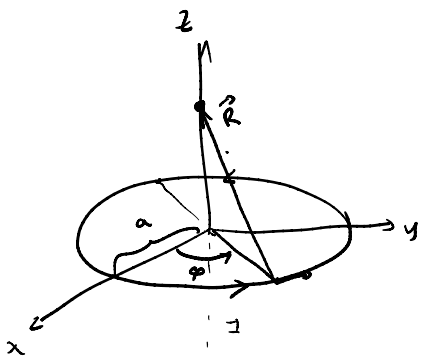
$$\boxed{\vec{B} = \frac{\mu_0}{4\pi} \frac{I 2\pi a}{a^2} \hat{z}}$$



Ring-strøm I

Radius a

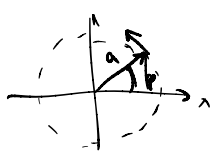
Finn $\vec{B}(0,0,z)$



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

$\vec{R} = \vec{r} - \vec{r}'$

obs punkt ↑ $\quad$ ↖ strømelement



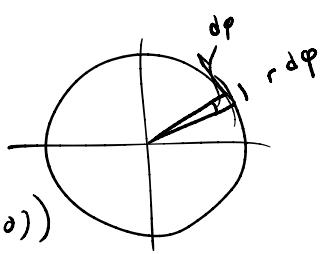
$\vec{r} = (0,0,z) \qquad \vec{r}' = (a\cos\varphi, a\sin\varphi, 0)$

$\vec{R} = \vec{r} - \vec{r}' = (0,0,z) - (a\cos\varphi, a\sin\varphi, 0) = (-a\cos\varphi, -a\sin\varphi, z)$

$d\vec{l} = a\, d\varphi \cdot \hat{\varphi}$

$= a\, d\varphi\, (-\sin\varphi, \cos\varphi, 0)$

$(\hat{z} \times \hat{r}, \quad \hat{r} = (\cos\varphi, \sin\varphi, 0))$



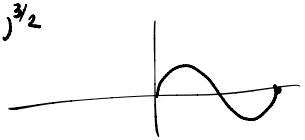
$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \vec{R}}{R^3} = \frac{\mu_0 I}{4\pi} \frac{a\, d\varphi\, (-\sin\varphi, \cos\varphi, 0) \times (-a\cos\varphi, -a\sin\varphi, z)}{R^3}$$

$$\begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ -\sin\varphi & \cos\varphi & 0 \\ -a\cos\varphi & -a\sin\varphi & z \end{vmatrix} = (z\cos\varphi,\ z\sin\varphi,\ \underbrace{a\sin^2\varphi + a\cos^2\varphi}_{a(\sin^2\varphi+\cos^2\varphi)=1}) = (z\cos\varphi,\ z\sin\varphi,\ a)$$

$$\vec{B} = \oint_c \frac{\mu_0}{4\pi}\frac{I\,d\vec{l}\times\vec{R}}{R^3} = \int_0^{2\pi} \frac{\mu_0 I}{4\pi}\frac{(z\cos\varphi,\ z\sin\varphi,\ a)}{R^3}\,a\,d\varphi$$

$$R = (a^2 + z^2)^{1/2}$$

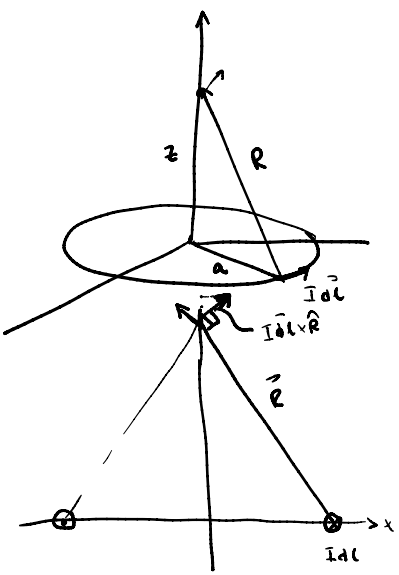
$$\boxed{\vec{B} = \frac{\mu_0 I}{4\pi}\frac{a^2 2\pi}{(a^2+z^2)^{3/2}}\hat{z}}$$



$z = 0$ $\quad \boxed{\vec{B} = \frac{\mu_0 I}{4\pi}\frac{2\pi a}{a^2}\hat{z}}$

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

$$dB_z = \frac{\mu_0}{4\pi} I\,dl$$

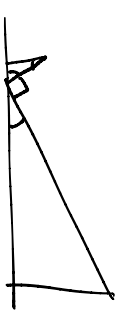


$$\frac{(I\,d\vec{l})_z}{|I\,d\vec{l}|} = \frac{a}{R}$$

$$d\vec{B}_z = \frac{\mu_0}{4\pi}\frac{a}{R}\frac{|I\,d\vec{l}|}{R^2}$$

$$dB_z = \frac{\mu_0}{4\pi}\frac{a}{R} I\frac{|d\vec{l}|}{R^2}$$

$$B_z = \int dB_z = \oint_c \frac{\mu_0}{4\pi}\frac{a}{R} I\frac{|d\vec{l}|}{R^2} = \frac{\mu_0}{4\pi}\frac{a I 2\pi a}{R^3}$$



El. fält

$$\vec{E} = \sum \frac{Q_i}{4\pi\epsilon_0} \frac{\hat{R}_i}{R_i^2}$$

$$\vec{F} = q\vec{E}$$

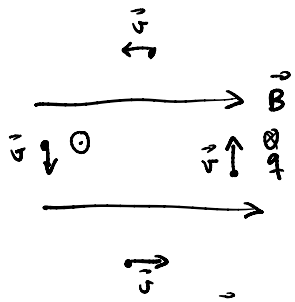
Magn. fält

$$\vec{B} = \sum \frac{\mu_0}{4\pi} \frac{I\Delta\vec{l}_i \times \vec{R}_i}{R_i^3}$$

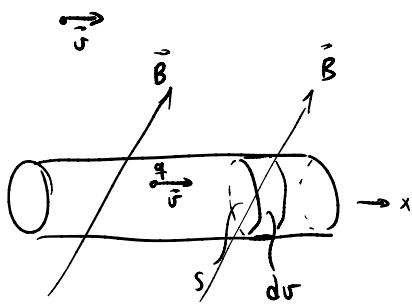
$$\vec{F} = q\vec{v} \times \vec{B}$$

$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$$

TEST



Leder



$$d\vec{F}_1 = q\vec{v} \times \vec{B}$$

laddningar : $dr = N\,dv$

$$d\vec{F} = N\,dv\,q\vec{v} \times \vec{B}$$

$$d\vec{F} = \underbrace{Nq\vec{v}}_{\vec{j}}\,dv \times \vec{B} = \vec{j}\,dv \times \vec{B}$$

$I\,d\vec{l}$ $\qquad \vec{v} = \frac{m}{s}$

$$d\vec{F} = \vec{j}\,dv \times \vec{B} \;;\; \vec{j} = \frac{I}{S}\hat{x} \;,\; dv = S\,dl$$

$$d\vec{F} = \frac{I}{S}\hat{x}\,S\,dl \times \vec{B} = I\,dl\,\hat{x} \times B = I\,d\vec{l} \times \vec{B}$$

Netto kraft = 0

Netto $\vec{\tau}$ $\vec{m}$

$\vec{\tau} = \vec{m} \times \vec{B}$

