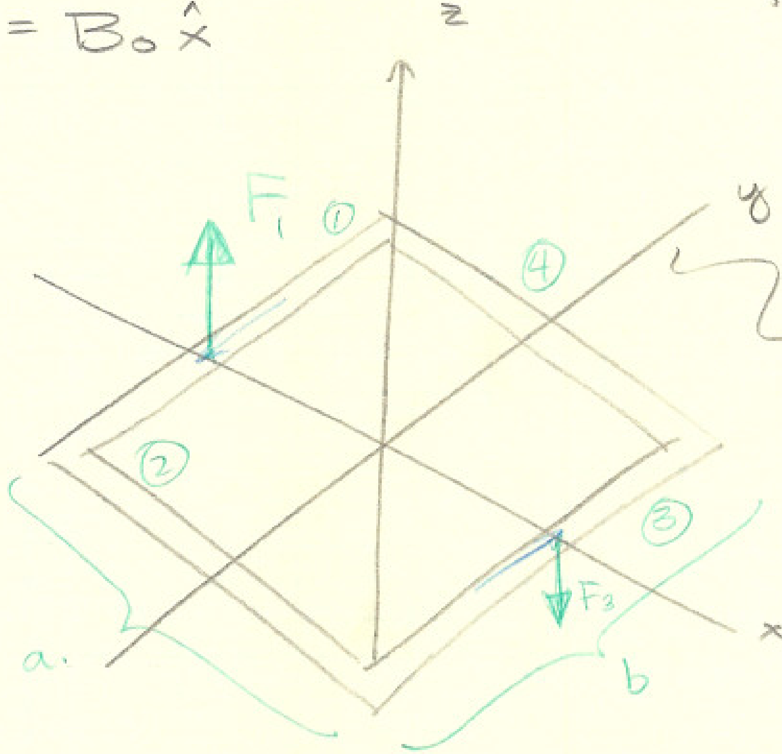
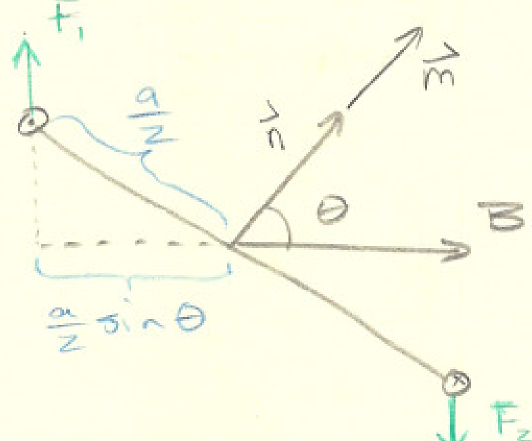
I call it mike, fine dining.

$B = B_0 \hat{x}$



pivot axis.



$$\vec{\tau}_1 = \vec{r}_1 \times \vec{F}$$

$$\vec{r}_1 = \left\langle -\frac{a}{2}\sin\theta,\ 0,\ \frac{a}{2}\cos\theta \right\rangle$$

$$\vec{F}_1 = \int_{l_1} I\, d\vec{l}_1 \times \vec{B} = \int_{l_1} (-I\, dy\, \hat{y}) \times (B_0 \hat{x})$$

$$= I_1 b B_0 \hat{z}$$

$$\vec{\tau}_1 = \begin{bmatrix} \hat{x} & \hat{y} & \hat{z} \\ -\frac{a}{2}\sin\theta & 0 & \frac{a}{2}\cos\theta \\ 0 & 0 & I_1 b B_0 \end{bmatrix}$$

$$= -\hat{y}\left(-\frac{a}{2}\sin\theta I b B_0\right)$$

$$= \frac{aIbB_0}{2}\sin\theta\ \hat{y}$$

$$\boxed{|\vec{m}| = I \cdot \text{Area}}$$ magnetic dipole moment.

$$\vec{\tau}_2 = \vec{r}_2 \times \vec{F}_2$$

$$r_2 = \frac{b}{2}\hat{y}$$

we ~~see~~ here that r_2 is parrellel with the B feild, therefore it's τ is zero.

$\vec{\tau}_3$ is quite clearly $+\vec{\tau}_1$

$$\vec{\tau}_3 = \vec{r}_3 \times \vec{F}_3$$

$$\vec{r}_3 = \left\langle \frac{a}{2}\sin\theta, 0, -\frac{a}{2}\cos\theta \right\rangle = -\vec{r}_1$$

$$\vec{F}_3 = \int_{l_3} (I\,dy\,\hat{y}) \times \vec{B} = -\vec{F}_1$$

$$\tau_3 = \tau_1$$

$$\vec{\tau}_{net} = \vec{\tau}_1 + \vec{\tau}_3 = I a b B_0 \sin\theta \, \hat{y}$$

$$\boxed{\vec{F} \sim \vec{\nabla}(\vec{M} \cdot \vec{B})}$$

Magnetic Materials

Magnetism is a quantum magnetic effect

Paramagnets
Dia magnets } Proportional to the $\vec{B}$-feild

idiot

Ferromagnets } very non-proportional to magnetic feild

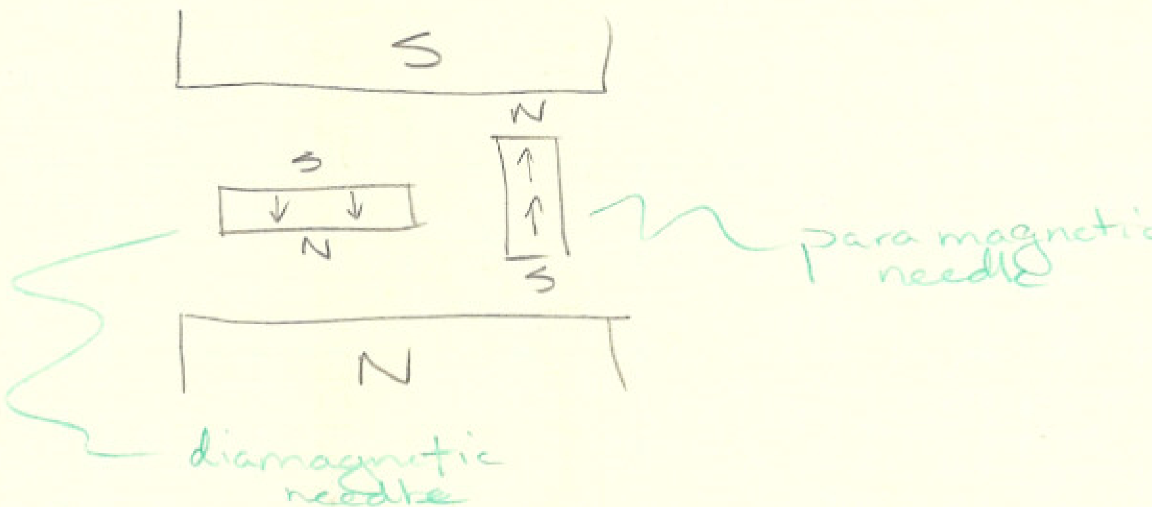
idiot

$\vec{M}$ ~ can be expressed in terms on angular momentum of e^- circulating about the neucleus.

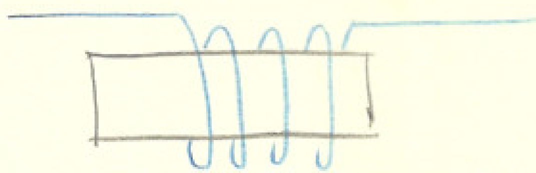
"After vigourous handwaving"

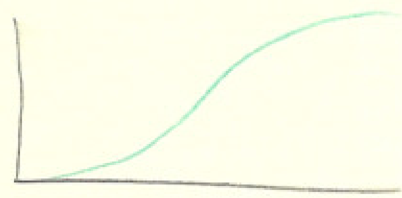
In dia magnets, $\vec{m}$ is in the reverse direction of $\vec{B}$ ($l=0$; even atomic #'s)

Spin of electrons is also a source of angular momentum. This spin is what makes paramagnetism work.



We magnetise an iron rod by placing it in a solinoid; we reach a saturation point





We