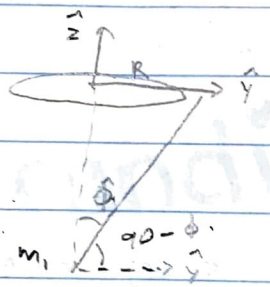
Erandi
Macias

Electro hw 6 6.3, 6.7, 6.16

6.3 -

a)



$$|\vec{F}| = I \oint |d\vec{l} \times \vec{B}|$$

$$= I(B\cos\theta) \oint dl = 2\pi R I |B| \cos\theta$$

$$\vec{B} = \frac{\mu_0}{4\pi} \frac{1}{r^3} [3(\vec{m}_1 \cdot \hat{r})\hat{r} - \vec{m}_1]$$

$$B\cos\theta = \frac{\mu_0}{4\pi} \frac{1}{r^3} [3(\vec{m}_1 \cdot \hat{r})(\hat{r} \cdot \hat{y}) - \vec{m}_1 \cdot \hat{y}]$$

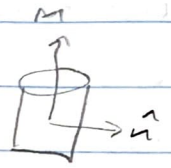
$$\vec{m}_1 \cdot \hat{y} = 0$$

$$\hat{r} \cdot \hat{y} = \sin\phi = \cos(90 - \phi)$$

$$B\cos\theta = \frac{\mu_0 I}{4\pi} \frac{1}{r^3} 3\sin\phi\, |\vec{m}_1| \cos\phi \Rightarrow B\cos\theta = \frac{\mu_0}{4\pi} \frac{1}{r^3} 3|\vec{m}_1| \cos\phi \sin\phi$$

b) $F = \vec{\nabla}(m \cdot \vec{B}) = (m \cdot \vec{\nabla})\vec{B}$

6.7 -



$$\vec{J}_b = \vec{\nabla} \times M = 0 \; ; \; \vec{k}_b = M \times \hat{n} = M\hat{\phi}$$

$$k_b = M\hat{\phi}$$

The field outside is zero; inside $B = \mu_0 K_b = \mu_0 M$

$$B = \mu_0 M$$

6.16 -

$$\oint \vec{H} \cdot d\vec{l} = I_{fenc} = I$$

$$\vec{H} = \frac{I}{2\pi s}\hat{\phi}$$

$$B = \mu_0 (1 + \chi_m)\vec{H} = \mu_0 (1 + \chi_m)\frac{I}{2\pi s}\hat{\phi} \qquad M = \chi_m \vec{H}$$