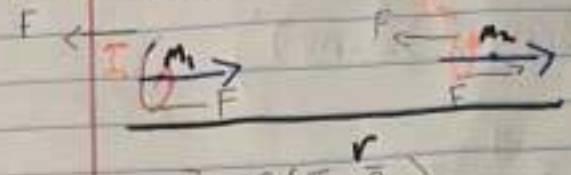
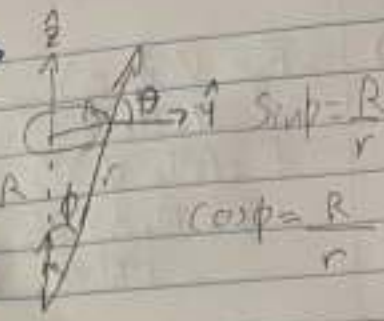
Hwk 6

6.3, 6.7, 6.16

6.3) F of Attraction





$\bar{F} = I\oint(d\bar{l} \times \bar{B})$

$F = I(\oint dl) \cdot B \cdot 0$

$B\cos\theta = \langle \bar{B}\hat{r} \rangle$

$m_2 = \pi I R^2$

$|F_1| = 2\pi I_1 R B \cos\theta$

$F_1 = 2\pi I_1 r B \cos\theta$

$$\bar{B} = \frac{\mu_0}{4\pi} \frac{3(m_1 \cdot \hat{r})\hat{r} - m_1}{r^3}$$

$$\hat{r} \cdot (\bar{B}\hat{r}) = \left(\frac{\mu_0}{4\pi} \frac{3(m_1 \cdot \hat{r})\hat{r} - m_1}{r^3}\right)\hat{r}$$

$$B\cos\theta = \frac{\mu_0}{4\pi} \frac{3(m_1 \cdot \hat{r})\hat{r} \cdot \hat{r} - m_1 \cdot \hat{r}}{r^3}$$

$$B\cos\theta = \frac{\mu_0}{4\pi} \frac{3m_1 \cos\phi \sin\phi}{r^3}$$

$$F = \frac{3\mu_0}{2\pi} \frac{m_1 m_2 \sqrt{R^2 - r^2}}{r^5}$$

$$\boxed{F = \frac{3\mu_0}{2\pi} \frac{m_1 m_2}{r^4}}$$

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

$\bar{F} = \nabla(\bar{m}_2\cdot\bar{B})$

$F = (m_2\cdot\nabla)B$

$F = m_2 \frac{d}{dz}\left(\frac{M_0}{4\pi}\frac{1}{z^3}\left(3(m_1\hat{z})\hat{z} - m_1\right)\right)$ $\quad z = r$

$F = m_2 \frac{M_0}{4\pi} \cdot 3 z^{-4} \cdot 2m_1$

$$\boxed{\bar{F} = \frac{-3M_0}{2\pi}\frac{m_1 m_2}{r^4}\hat{z}}$$

(6.7) Inside

$\bar{M}$

$(M\times\nabla) = 0$

$B = ?$

$K_b = \nabla\times\hat{n} = M\phi$

$\bar{M} = M\hat{z}$

$B = \mu_0 K_b \hat{z}$

$B = \mu_0 M \hat{z}$

(6.16)

χ_m

$B = ?$

$\oint \bar{H}\cdot d\bar{l} = I_{enc}$

$H\,2\pi s = I$

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

$B = \mu_0(1+\chi_m)H$

$$\boxed{\bar{B} = \frac{\mu_0(1+\chi_m)I}{2\pi s}\hat{\phi}}$$