Q1) $\bar{H} = \dfrac{\bar{B}}{\mu_0}$

$$\oint H \cdot dl = I_{enc}$$

for a solenoid, $dl \to L$

$$H \cdot L = I \rightarrow H = \frac{I}{L}$$

note: $\bar{B} = \mu \bar{H}$

$$\oint \bar{B} \cdot d\bar{l} = \mu_0 I_{enc}$$

$$\underbrace{\mu_r \mu_0}_{2m} \oint H \cdot dl = \mu_0 I_{enc}$$

$$\oint H \cdot dl = \frac{I_{enc}}{\mu_r} \rightarrow H = \frac{I_{enc}}{L \times \mu_r} = \frac{2}{2m}$$

$$H. = \frac{\mu_0 3}{1.5} \times \frac{1000}{2}$$

$$= 4\pi \times 10^{-4}$$

Q3) $\chi_m = 10$

$H = 1000\ A/m$

$\bar{B} = \mu \bar{H} + \bar{m}$

$\bar{m} = \chi_m \bar{H}$

↳ magnetic susceptibility

$\bar{m} = 10^4\ \hat{H}$ (same direction as $\bar{H}$)

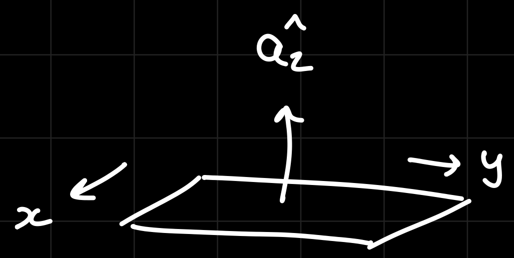
$\mu_r = 1 + \chi_m$

$\mu = \mu_0 (1 + \chi_m) = 11 \times 4\pi \times 10^{-7}$

$\bar{B} = \overline{\mu H} = \mu_0 \bar{H} + \bar{m} = 11 \times 4\pi \times 10^{-4}$

Q5) $\overline{B_{n1}} = \overline{B_{n2}}$

$\overline{H_{t2}} - \overline{H_{t1}} = K$



$\mu_{r_2} = 4$

$\mu_{r_1} = 6$

$B_2 = 5\hat{a_x} + 8\hat{a_z} \quad m\ wb/m^2$

let $B_1 = B_x\hat{a_x} + B_y\hat{a_y} + B_z\hat{a_z}$

$\overline{B_{n1}} = \overline{B_{n2}}$

so, $B_z = 8\hat{a_z}$

$K = (5\mu - B_x\mu)\hat{a_x} + (-B_y\mu)\hat{a_y}$

$B = \mu H$

$H_2 = \dfrac{B_2}{\mu_2} = \dfrac{B_2}{\mu_{r_2}\mu_0} \rightarrow$

$H_1 = \dfrac{B_1}{\mu_1} = \dfrac{B_2}{\mu_{r_1}\mu_0} \rightarrow$

and $K = \frac{1}{\mu_0} \hat{a_y}$

$$(H_2 - H_1) \times \hat{a}_z = \bar{K}$$

$$\left(\frac{1}{6\mu_0}\left(B_x \hat{a_x} + B_y \hat{a_y} + B_z \hat{a_z}\right) - \frac{1}{4\mu_0}\left(5\hat{a_x} + 8\hat{a_z}\right)\right)$$

$$\times \hat{a_z} = \frac{1}{\mu_0} \hat{a_y}$$

$$\underset{(\hat{a_y})}{-\frac{B_x}{6}} + \underset{(\hat{a_x})}{\frac{B_y}{6}} - \underset{(\hat{a_y})}{\left(\frac{-5}{4}\right)} = 1 \hat{a_y}$$

$$\left(-\frac{B_x}{6} + \frac{5}{4}\right)\hat{a_y} + \left(\frac{B_y}{6}\right)\hat{a_x} = \hat{a_y} + 0(\hat{a_x})$$

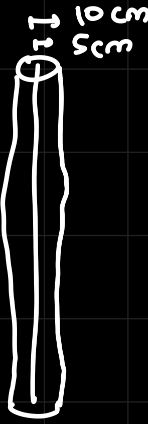
$$\frac{B_y}{6} = 0 \quad \text{and} \quad \frac{B_x}{6} = \frac{5}{4} - 1$$

$$B_y = 0 \qquad B_x = \frac{1}{4} \times 6 = \underline{1.5}$$

$$\bar{B_1} = (1.5)\hat{a_x} + 8\hat{a_z} \quad mWb/m^2$$

$$\bar{H_1} = \frac{\bar{B_1}}{\mu_1} = \frac{1}{6\mu_0} \times \bar{B_1}$$

Q2) $\mu_r = 2000$



$\bar{B}$ at $r = 8cm$?

$I = 5A$

$$\oint \bar{B} \cdot d\bar{l} = \mu_0 I_{enclosed}$$

$$\oint H \cdot dl = I_{enc}$$

$$H \cdot 2\pi r = I = 5A$$

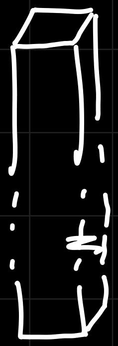
$$H = \frac{5}{2\pi r} \quad \text{at } r = 8cm$$

$$H = \frac{5}{16\pi \times 10^{-2}} = 9.94 \text{ A/m}$$

$$\bar{B} = \mu H = 2\cancel{000} \times 4\pi \times 10^{\cancel{-7}\,-3} \times \frac{5}{16\pi} \times 10^2$$

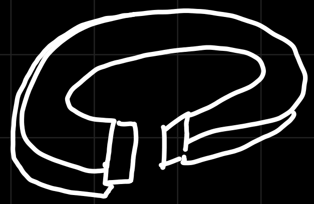
$$= \frac{10^{-1}}{4} = 2.5 \times 10^{-2} = 25mT$$

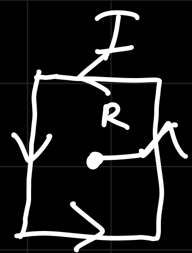
Q4)

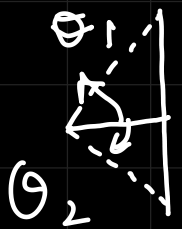


$\to \bar{M} = \chi_m \bar{H}$

$\bar{B} =$







$\to B = \dfrac{\mu_0 I}{4\pi r}(\sin\theta_1 - \sin\theta_2)$

$w \leq a \leq L \qquad |\theta_1| = |\theta_2| = 45^\circ$

$$B = \frac{\mu_0 I}{\pi r}\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right) = \boxed{\frac{\sqrt{2}\mu_0 I}{\pi r}}$$

$\vec{K}_b = \vec{M} \times \hat{n}$

always $\parallel$ar to $\vec{M}$, so $\boxed{\vec{K}_b = \vec{M}}$

or, for now, $|\vec{K}_b| = |\vec{M}|$

$I = Mw \qquad \left(R = \frac{a}{2}\right)$

$$\therefore \vec{B} = \frac{\mu_0 \sqrt{2} M w}{\pi r}$$

$$\boxed{\vec{B}_{sq} \Rightarrow \frac{\mu_0 \sqrt{2} M w}{\pi \cdot \frac{a}{2}} \Rightarrow \frac{2\sqrt{2}\mu_0 M w}{\pi \cdot a}}$$

$$\vec{B}_m = \mu \vec{H}$$

$$\vec{M} = \chi_m \vec{H} \to \vec{H} = \frac{\vec{M}}{\chi_m}$$

$$\boxed{\vec{B} = \frac{\mu_0 \mu_я}{\mu_я - 1} \vec{M}}$$