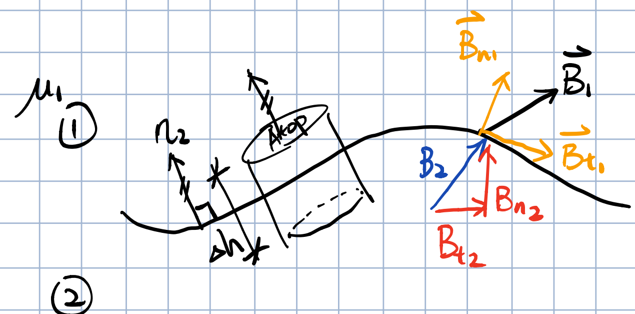
magnetic boundary conditions at interface b/w 2 media.



μ_2

Let $\Delta h \to 0$

1. Apply "Gauss" law for magnetostatics

$$\oint_S \vec{B}\cdot d\vec{s} = 0$$

$$\cancel{\int_{side}} + \int_{top} + \int_{bottom} = 0$$

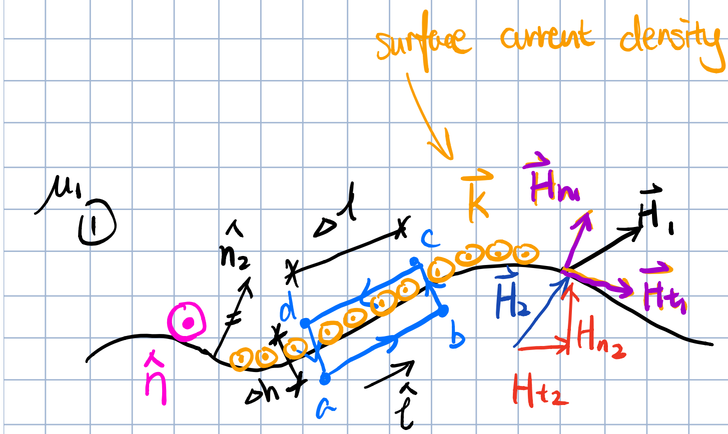
$$B_{n_1}\cancel{A_{top}} - B_{n_2}\cancel{A_{bottom}} = 0$$

$$\boxed{B_{n_1} = B_{n_2}}$$

normal comp. of $\vec{B}$ continuous.

$$\boxed{\hat{n}_1\cdot\vec{B}_1 = \hat{n}_2\cdot\vec{B}_2}$$

B.C. #1



Let $\Delta h \to 0$

μ_2 ②

Ampere's Law

$$\oint_C \vec{H}\cdot d\vec{l} = I$$

current enclosed in C

$$\int_a^b + \cancel{\int_b^c} + \int_c^d + \cancel{\int_d^a}$$

$$\vec{H}_2\cdot\Delta l\,\hat{l} - \hat{H}_1\cdot\Delta l\,\hat{l} = \underbrace{\vec{K}\cdot\Delta l\,\hat{n}}$$

only get normal component of K

$$\hat{l} = \hat{n}\times\hat{n}_2$$

$$\Delta l\,\hat{l}\cdot(\hat{H}_2 - \hat{H}_1) = \vec{K}\cdot\Delta l\,\hat{n}$$

$$\Delta l\,(\hat{n}\times\hat{n}_2)\cdot(\vec{H}_2 - \vec{H}_1) = \vec{K}\cdot\Delta l\,\hat{n}$$

$$\because\ \vec{A}\cdot(\vec{B}\times\vec{C}) = \vec{B}\cdot(\vec{C}\times\vec{A})$$

$$\cancel{\Delta l}\;\cancel{\hat{n}}\cdot\left(\hat{n}_2\times(\vec{H}_2-\vec{H}_1)\right)=\vec{K}\cdot\cancel{\Delta l}\;\cancel{\hat{n}}$$

$$\boxed{\hat{n}_2\times(\vec{H}_2-\vec{H}_1)=\vec{K}}$$

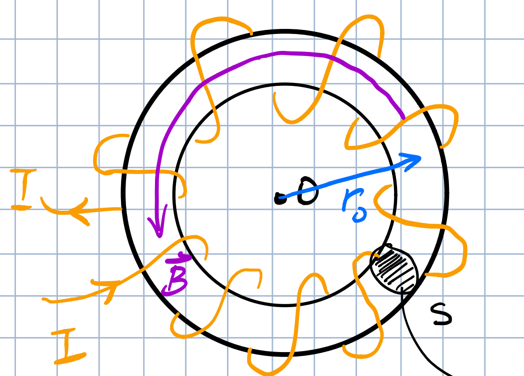
H is discontinuous across boundary.

Special Case: if medium ① & ② are dielectrics

$$H_{2t}-H_{1t}=0$$

Inductance

Recall: magnetic flux. ψ

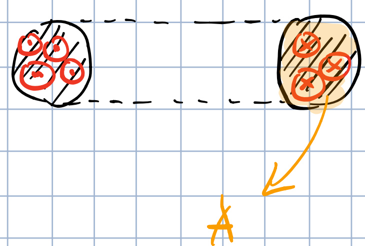


$$\vec{H}=\frac{NI}{2\pi r}\hat{\phi}$$

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

$$=\hat{\phi}\frac{\mu NI}{2\pi r}$$

flux passed through S



$$\psi=\iint_S\vec{B}\cdot d\vec{s}$$

$$=\iint\hat{\phi}\frac{\mu NI}{2\pi r}\cdot\hat{\phi}\,ds$$

means $\vec{B}$ is uniform $\Big\{$ Assume that mean radius of the toroid $r_0 \gg$ cross sectional dimensions of toroid.

$$\simeq\frac{\mu NI}{2\pi r}\cdot A$$

Flux linkage. Λ = product of the # of turns and flux linking each of them.

$$\Lambda = N\psi$$

Define <u>inductance</u>

$$L = \frac{\Lambda}{I} = \frac{N\psi}{I} \quad [H]$$

$$\boxed{\text{toroid:} \quad L = \frac{\mu N^2 A_{cross}}{2\pi r_0}} \quad [H]$$

Example: Solenoid.