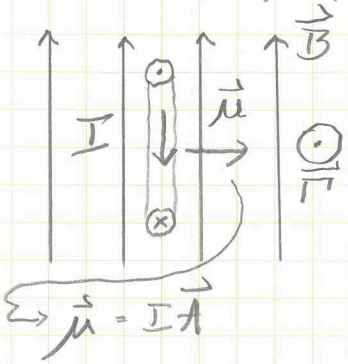
9.9) For a 1-cm radius loop with $I = 0.4\,A$, find

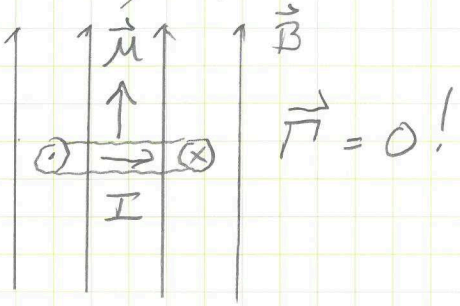
a) $\vec{\mu}$

b) The torque when μ is perpendicular to $\vec{B} = 1.5\,T\,\hat{z}$

c) The energy difference between $\vec{\mu}$ being parallel and antiparallel to $\vec{B}$.

For a loop with area ∥ and ⊥ to $\vec{B}$ $\quad \vec{\mu} = I\vec{A}$





a) Find μ

$$\mu = IA = (0.4)\left[\pi(0.01)^2\right] = 1.26\times10^{-4}\ A\cdot m^2 \text{ RIGHT IN DIAGRAM}$$

b) Find Γ

$$\vec{\Gamma}_\perp = \vec{\mu}\times\vec{B} = \mu B \sin(90^\circ) = (1.26\times10^{-4})(1.5)$$

$$\vec{\Gamma}_\perp = 1.88\times10^{-4}\ N\cdot m, \text{ OUT OF PAGE IN DIAGRAM}$$

c) Find ΔU Difference between ∥ and anti-∥

$$U = -\vec{\mu}\cdot\vec{B} = -\mu B\cos\theta$$

Parallel: $\theta = 0 \Rightarrow U_{\parallel} = -\mu B$

Antiparallel: $\theta = \pi \Rightarrow U_{A\parallel} = +\mu B$

The Difference is

$$\Delta U = U_{A\parallel} - U_{\parallel} = \mu B - (-\mu B)$$

$$\Delta U = 2\mu B = 2(1.88\times10^{-4})(1.5)$$

$$\Delta U = 3.77\times10^{-4}\ J = 37.7\ \mu J$$

Not insignificant but fairly small.