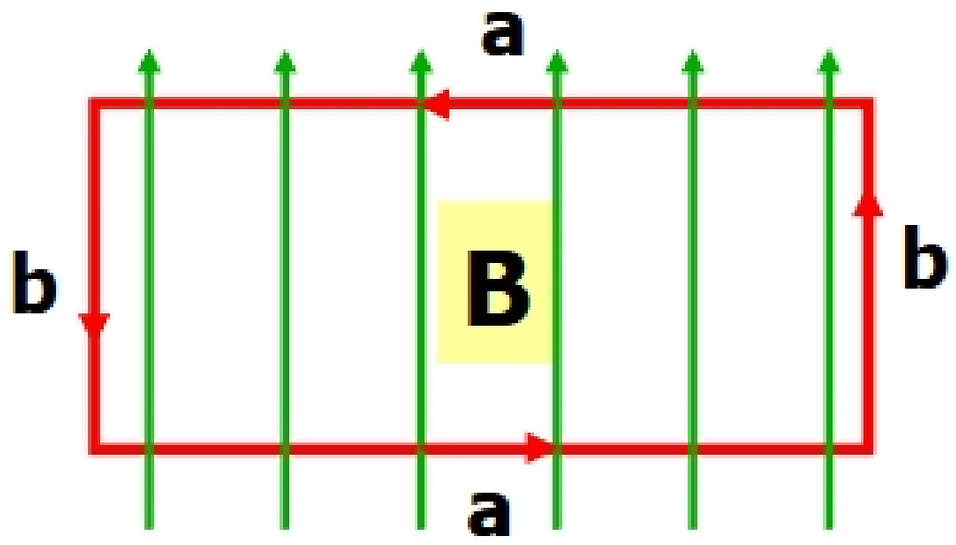
Torque on Current Loop

- Consider rectangular current loop
  - Forces in left, right branches = 0
  - Forces in top/bottom branches cancel
  - No net force! (true for any shape)
- But there is a net torque!
  - Bottom side up, top side down (RHR)
  - Rotates around horizontal axis



Plane normal is ⊥ B here

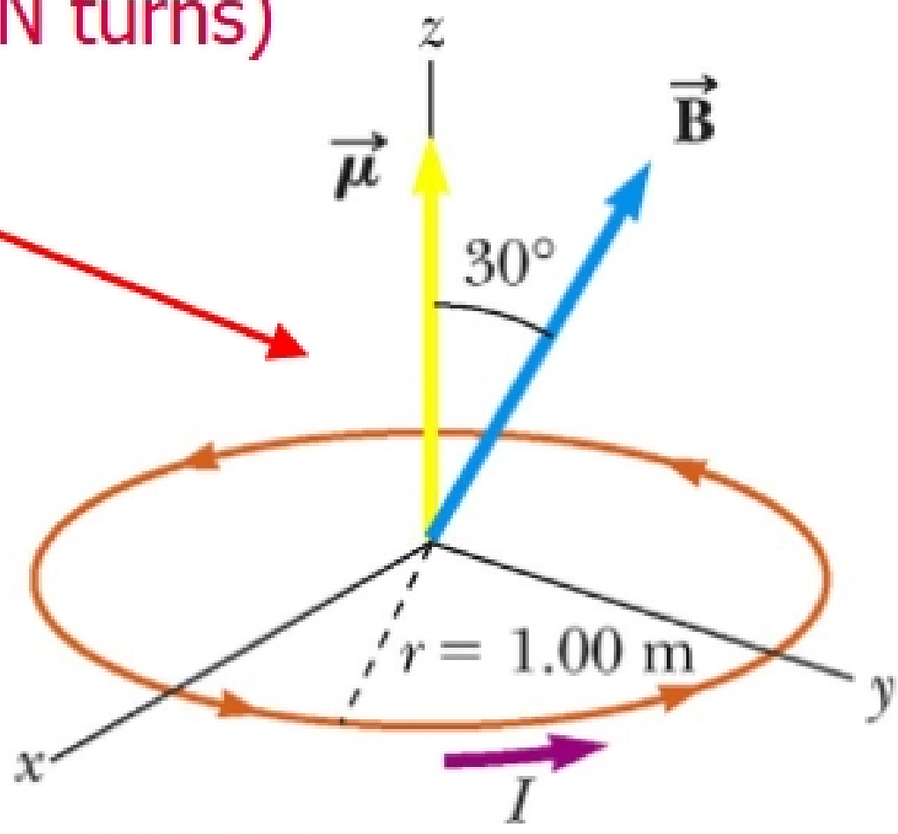
$$\tau = Fd = (iBa)b = iBab = iBA$$

- μ = NiA ⇒ "magnetic moment" (N turns)
  - True for any shape!!
  - Direction of μ given by RHR

General Treatment of Magnetic Moment, Torque

➔μ = NiA is magnetic moment (with N turns)

- Direction of μ given by RHR

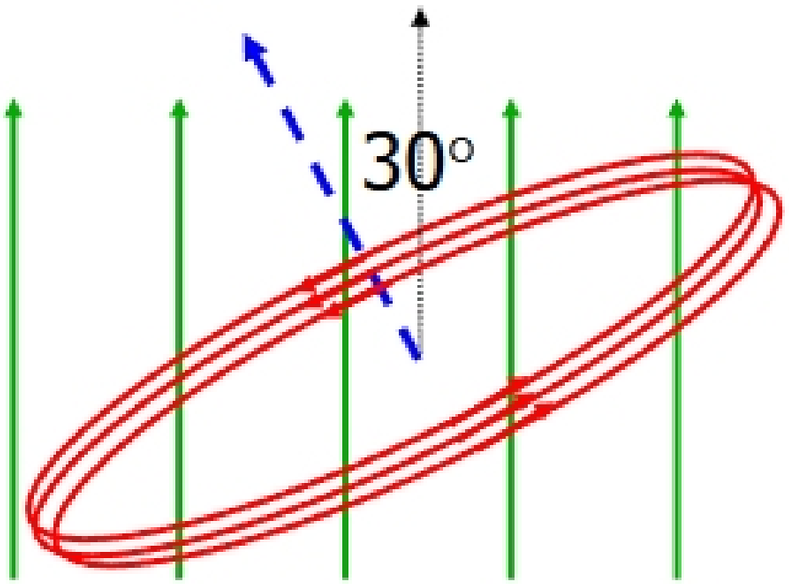


➔Torque depends on angle θ between μ and B

$$\tau = \mu B \sin\theta$$

Torque Example

➔A 3-turn circular loop of radius 3 cm carries 5A current in a B field of 2.5 T. Loop is tilted 30° to B field.



➔ $\mu = 3i\pi r^2 = 3\times 5\times 3.14\times (0.03)^2 = 0.0339\,\mathrm{A\cdot m^2}$

➔ $\tau = \mu B\sin 30 = 0.0339\times 2.5\times 0.5 = 0.042\,\mathrm{N\cdot m}$

➔Rotation *always* in direction to align μ with B field