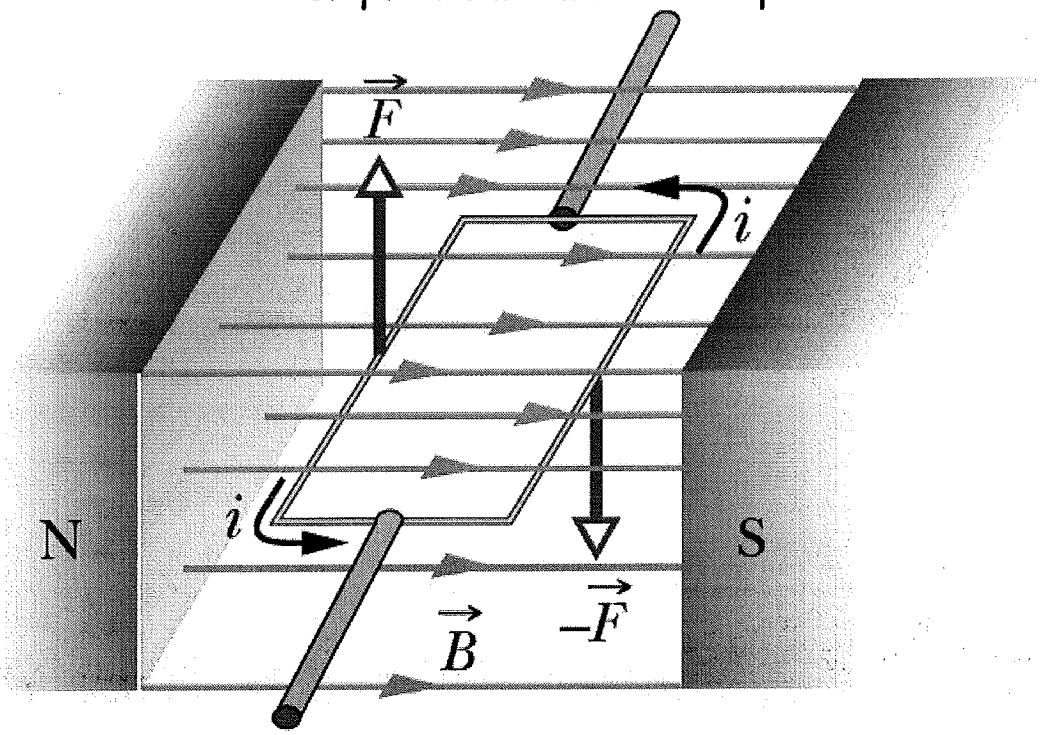
Physics 12 Section 20-9
Torque on a Current Loop



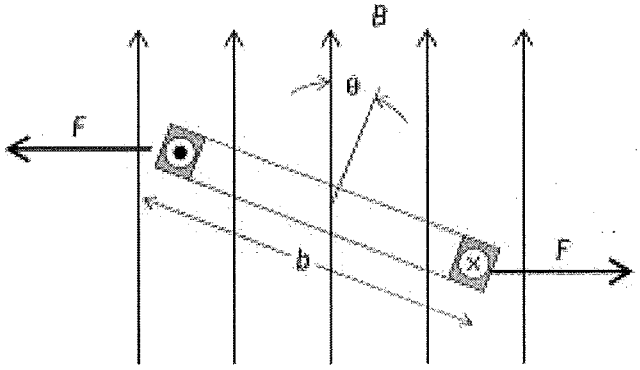
1. Torque is the product of force and distance. $\tau = F \times d$.

From 20-2 we have $F = BIl\sin\theta$.

$\Theta = 90°$

$F = BIl$

$\tau = BIl \times d$, but τ and d need to be perpendicular



$$\tau = BIl\sin\theta \times \frac{d}{2} + BIl\sin\theta \times \frac{d}{2}$$

$\tau = BIl\sin\theta \times d$

The d is twice the lever arm of the axis of rotation

l x d is the area of the loop (A)

$\tau = BIl\sin\theta\ A$

And if you have multiple loops then just multiple the above by N (the number of loops)

$\tau = N\ I\ A\ B\ \sin\theta$

Example: A circular coil of wire has a diameter of 20.0cm and contains 10 loops. The current in each loop is 3.00A and the coil is placed in a 2.00T magnetic field. Determine the maximum and minimum torque exerted on the coil by the field.

$\tau = N\ I\ A\ B\ \sin\theta$

$\tau = 30 \times\ 3.00A \times\ \pi(0.10m)^2\ 2.00T\ \sin90^\circ$

1.88Nm (Max)

$\tau = 30 \times\ 3.00A \times\ \pi(0.10m)^2\ 2.00T\ \sin0^\circ$

0m (Min)

Do# 44 and 46 p. 619