The Force on a Current Carrying Wire in a Magnetic Field

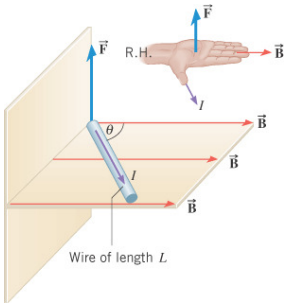
$$F = (\Delta q)vB\sin\theta$$

$$\Downarrow$$

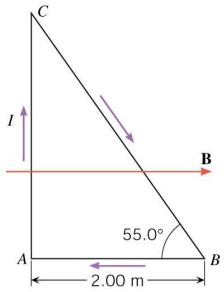
$$F = \underbrace{\left(\frac{\Delta q}{\Delta t}\right)}_{I}\underbrace{(v\Delta t)}_{L}B\sin\theta$$

$$\Downarrow$$

$$\boxed{F = ILB\sin\theta}$$

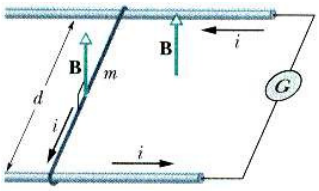


ex. If I=4.70 A and B=1.80T determine the net force on the triangle.



ex. a) Find the velocity of the wire 3 sec after a current of 3A starts flowing through it, assuming the wire starts from rest and there is no friction.

b) If the coefficient of static friction between the wire and the rails is μ_s=0.4, what is the minimum current to start the wire moving?

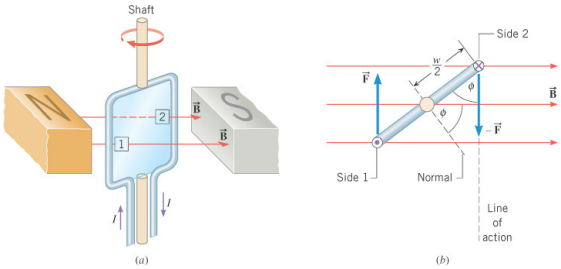


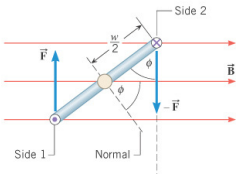
d=0.5m, *B*=0.2T, *m*=50g

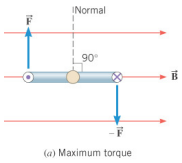
Torque on a Current-Carrying Coil: Motors

The two forces on the loop have equal magnitude but opposite directions (from RHR-1).

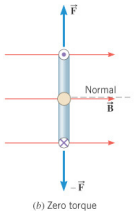
This produces a **net torque** on the loop







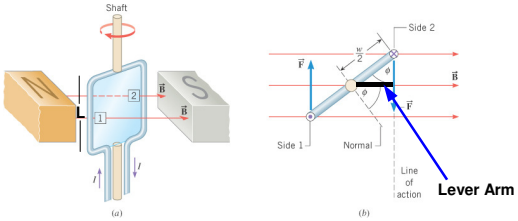
This **torque** causes the loop to rotate so that its normal becomes aligned with the magnetic field.



Torque = (magnetic force) x (lever arm)

= F_B x l = ILBsin(90) x (w/2)sin(ϕ)

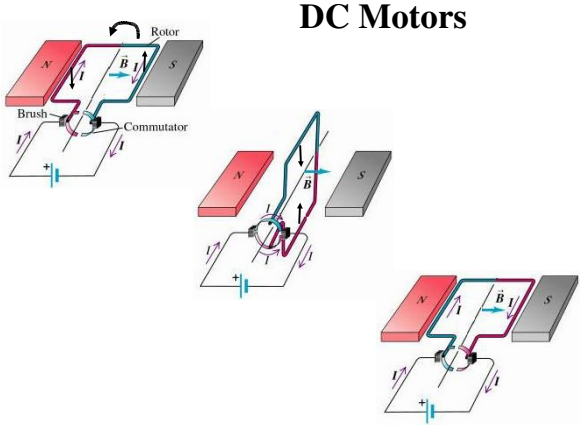
Net torque $= \tau = ILB\left(\frac{1}{2}w\sin\phi\right) + ILB\left(\frac{1}{2}w\sin\phi\right) = IAB\sin\phi$



$\tau = NIA\ B\sin\phi$

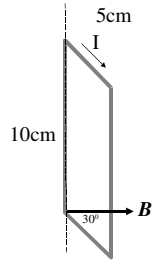
A = area of loop (= wL)
N = number of turns of wire
NIA = magnetic moment

DC Motors



ex. A vertical rectangular, 20 turn loop of wire is hinged along one side. The loop is in a 0.50T horizontal magnetic field and it carries a current of 0.10A.

What is the torque acting on the loop? (Magnitude and direction)



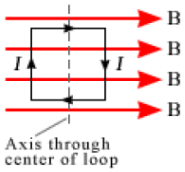
A square current-carrying loop is placed in a uniform magnetic field **B** with the plane of the loop **parallel** to the magnetic field. The dashed line is the axis of rotation. The magnetic field exerts on the loop ...

A) A net force and a net torque

B) A net force, but not a net torque

C) A net torque, but not a net force

D) Neither net torque nor net force



A square current-carrying loop is placed in a uniform magnetic field **B** with the plane of the loop **perpendicular** to the magnetic field. The dashed line is the axis of rotation.

The magnetic field exerts on the loop ...

A) A net force and a net torque

B) A net force, but not a net torque

C) A net torque, but not a net force

D) Neither net torque nor net force