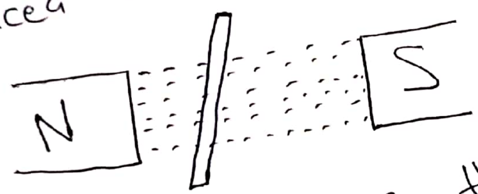
Types of Induced Emf:-

1):- Dynamically Induced Emf.
2):- Stationary Induced Emf
a). Mutually Induced Emf
b). Self Induced Emf.

Dynamically Induced EMF:-

i). "when magnetic field is stationary and conductor cuts across it, the emf induced is known as dynamically induced emf".



→ In the above case, the magnetic field is stationary. Now to induce emf in the conductor, we have to move it up and down (i.e at right and to the field) in order to induce the emf across it.

→ Note that in order to induce maximum emf, the angle b/w the field and movement of conductor Should be 90°.

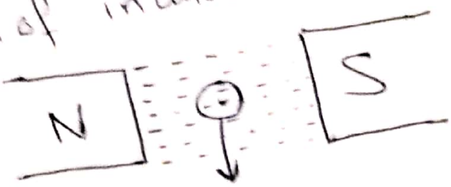
Fleming's Right Hand Rule

"when a conductor moves in a uniform magnetic field and cuts the magnetic lines of force, an emf is induced"

Thumb = Force
First finger = Field
middle finger = Induced Emf (or current)

→ suppose motion of the conductor (o) is upward Then, according to fleming's R.H.R, direction of induced emf (current) will be inward i.e {(±) ↑I}

→ Suppose if motion of the conductor is downward. Then, direction of induced emf will be outward. i.e {(∓) ↓}



• Equation of Emf induced in a moving conductor in a uniform magnetic field:-

Suppose we move the conductor by a small distance (dx) in a uniform magnetic field (B). Then movement of conductor is:-

movement = dx
also length of the conductor = L
also ~~length of the~~ conductor = $L\,dx$

Total area covered by the conductor = $L\,dx$

Also, flux density (ϕ) = $B \cdot A$
$= B(L\,dx)$

also, $e = N \frac{d\phi}{dt}$

Here $N = 1$ (As we have considered only 1 conductor).

Hence $e = BL\frac{dx}{dt}$

Also velocity $= \frac{\text{distance}}{\text{time}}$

So the velocity of the conductor $= \frac{dx}{dt}$

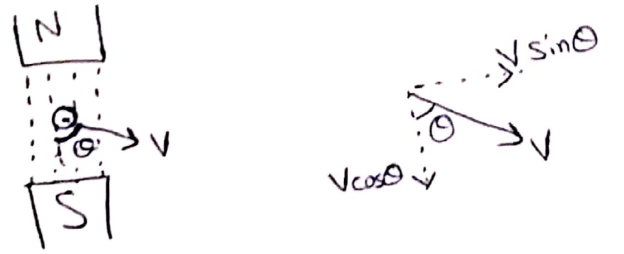
Hence $e = BLV\sin\theta$

- where θ is the angle b/w B & L and e will be maximum when $\theta = 90°$

$$\boxed{e = BLV}$$

Why $\sin\theta$?

- → The equation $e = BLV$ is the induced emf when plane of motion is exactly perpendicular to the plane of flux.
- → But if conductor is moving with a velocity (v) but at a certain angle (θ) measured with respect to the plane of the flux as shown below:-



→ Then the component of the velocity which is, $V\sin\theta$, is perpendicular to the direction of flux and hence is responsible for the induced emf.

→ The other component, $V\cos\theta$, is parallel to the plane of the flux and hence, will not contribute to the dynamically induced emf.

- under this condition, magnitude of induced emf is, thus, given by:-

$$e = BLV\sin\theta$$

Q:- A conductor of 2m moves with a uniform velocity of 1.27m/s under a magnetic field having a flux density of $1.2 wb/m^2$. If conductor moves, calculate the magnitude of induced emf.

a):- at right angle to the axis of field.

b):- at an angle 60° to the direction of field.

Given Data:-

$L = 2m$

$V = 1.27 m/S$

$B = 1.2 wb/m^2$

a):- $\theta = 90°$ b) $\theta = 60°$

Required:-

$e = ?$

Solution:-

a):- for $\theta = 90^\circ$

$e = BLV \sin\theta$

$e = (1.2)(2)(1.27) \sin 90^\circ$

$e = 3.048V$

b):- for $\theta = 60^\circ$

$e = (1.2)(2)(1.27) \sin 60^\circ$

$e = 2.6397V$