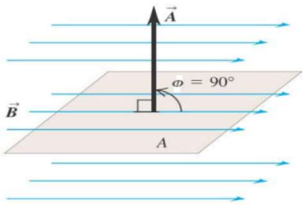
Case 2: If $\theta = 90^0$, $\emptyset = BA\cos 90 = 0$ $(Minimum)$

If the direction of magnetic field is perpendicular to direction of area vector i.e., when surface lies parallel to direction of field, magnetic flux crossing the surface is zero.



Case 3: If $\theta = 180^0$, $\emptyset = BA\cos 180 = -BA$, If the direction of magnetic field is anti-parallel to area vector, maximum flux is linked with the surface but in opposite direction of the surface.

Flux Linkage: If a coil has N number of turns, same flux passes through every turn. So, flux linkage is the total flux passes through N turns, i.e.

$$Flux\ Linkage = N\emptyset$$

Faradays Law of Electromagnetic Induction:

Based on his studies on the phenomenon of electromagnetic induction, Faraday proposed the following two laws.

Faraday's first law (Qualitative statement)

Whenever the amount of magnetic flux linked with a closed circuit changes, an emf is induced in the circuit. The induced emf lasts so long as the change in magnetic flux continues.

Faraday's second law (Quantitative statement)

The magnitude of emf induced in a closed circuit is directly proportional to the rate of change of magnetic flux linked with the circuit.

i.e. $$E = -\frac{d\emptyset}{dt}$$

The negative sign is used to indicate the opposition to the change of flux by induced emf.

If the closed loop is a coil of N turns, induced emf appears in every turn. The total emf induced is the sum of these individual emfs.

For a tightly wound coil of N turns, same flux passes through every turn and hence the flux changes at same rate. So, total emf induced is written as, (flux linkage is $N\emptyset$)

$$E = -N\frac{d\emptyset}{dt}$$

General ways of changing magnetic flux:

The magnetic flux linked with the coil can be changed by any one or all of the following methods.

1. Changing the magnitude of the magnetic field within the closed loop.
2. Changing either the total area or the portion of the area that lies within the magnetic field.
3. Changing the angle between the direction of field and plane of closed loop. For example; by rotating it.