Maxwell's Second eq^n :-

N ← S

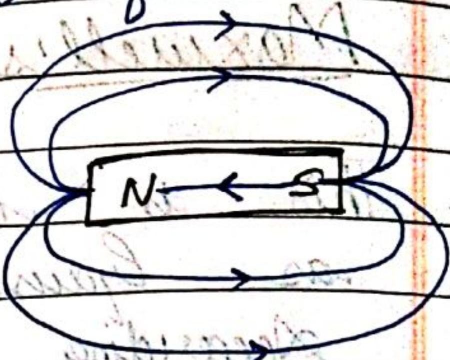
This is also known as Gauss law of Magnetostatics. According to this eq^n the divergence of magnetic field is continuous i.e; the magnetic monopole does not exists. i.e.

$$\text{Div } B = 0$$

proof :- We know that magnetic line of force for close loop for they may go to infinite, also divergence of B is equal to zero. (Div B = 0) shows that magnetic monopole does not exists. i.e; when a magnet is broken into a no. of pieces to isolate the magnetic pole then each part of the magnet behaves as the individual magnet. This means that if a magnet is broken into a no. of piece then each piece contains North and South pole.

From Gauss law of Magnetostatics

$$\int B \cdot ds = 0$$



Again by Gauss Divergence theorem, the surface integral can be converted into volume integral

$$\int Div\, B\, dV = 0$$

for any arbitrary surface

$$\int dV \neq 0$$

Then, $\boxed{Div\ B = 0}$

This is the required expression for Maxwell's second equation which shows that the divergence of magnetic field is continuous

Maxwell's Third eq^n :-

This is also known as Maxwell's eq^n in which we expressed the modification in Ampere's law. According to Ampere's law we know that, "The line integral of magnetic field inside a closed surface is equal to μ_0 times of the total current flowing inside the closed surface i.e;

$$\oint B \cdot dl = \mu_0 i \qquad \text{——— (1)}$$

also from the definition of current density we know that

$$J = \frac{di}{ds}$$

$$di = J ds$$

$$i = \int J ds$$

put in (1)

$$\int B \cdot dl = \mu_0 \int J ds$$

Now from Stoke's theorem the line integral can be converted into surface integral

$$\int \text{curl } B \, ds = \int \mu_0 J \, ds$$

$$\int (\text{curl } B - \mu_0 J) \, ds = 0$$

here, $\int ds \neq 0$

then, $\text{curl } B - \mu_0 J = 0$

$$\text{curl } B = \mu_0 J$$

we know, $B = \mu_0 H$

$$\mu_0 \text{ Curl } H = \mu_0 J$$

$$\text{curl } H = J \quad \text{—— (2)}$$

Taking divergence on both side, we get

$$\text{div Curl } H = \text{div } J$$

$$\boxed{\text{div } J = 0} \qquad [\text{div curl } H = 0] \quad \text{—— (3)}$$

This is the Ampere's law in electrostatics.

Now, from eqn of continuity we have

$$\text{div } J + \frac{\delta \rho}{\delta t} = 0 \quad \text{——} \quad (4)$$

From eq^n (3) & (4)

$$\frac{\delta \rho}{\delta t} = 0$$ {∵ volume charge density is independent of time}

which is not possible.

Hence, a modification is made in Ampere's law which can be expressed as

$$\boxed{\text{Curl } H = J + J_d}$$

where $J_d = \frac{\delta D}{\delta t}$

This is the required expression of Maxwell's III eq^n.