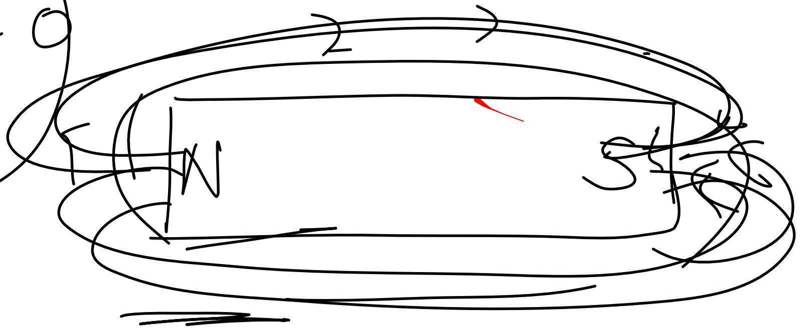
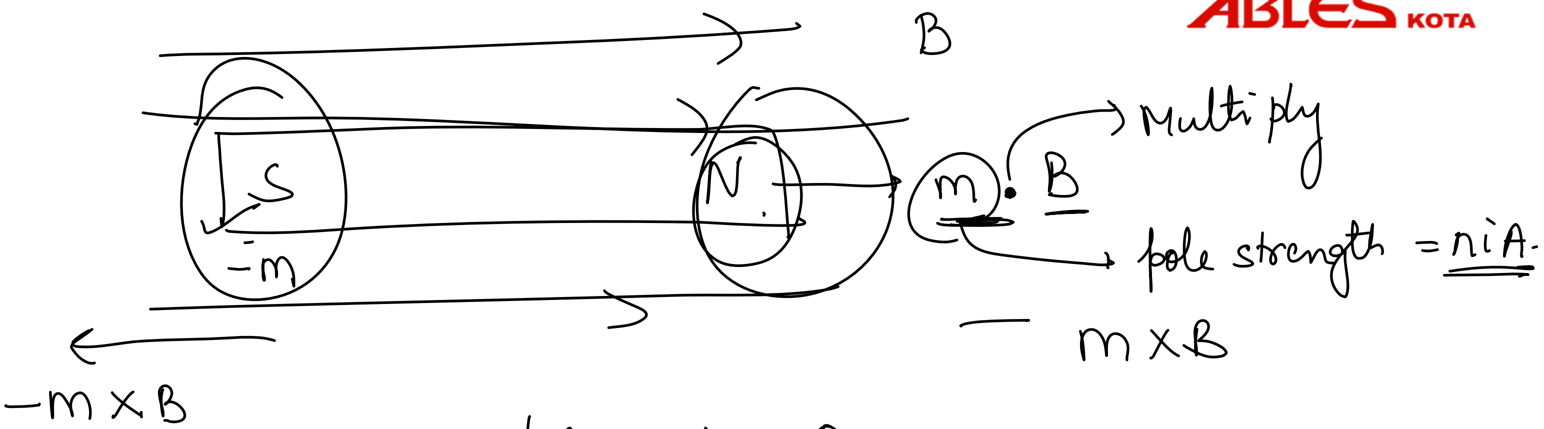
Gauss law of Magnetism:

$$\oint \vec{E} \cdot d\vec{s} = \frac{Q}{\epsilon_0}$$

The net magnetic flux through any closed surface is 0.

$$\sum \vec{B} \cdot \Delta \vec{S} = 0$$





Force on bar magnet = 0

$\Rightarrow m \times B - m \times B$

$\Rightarrow 0.$

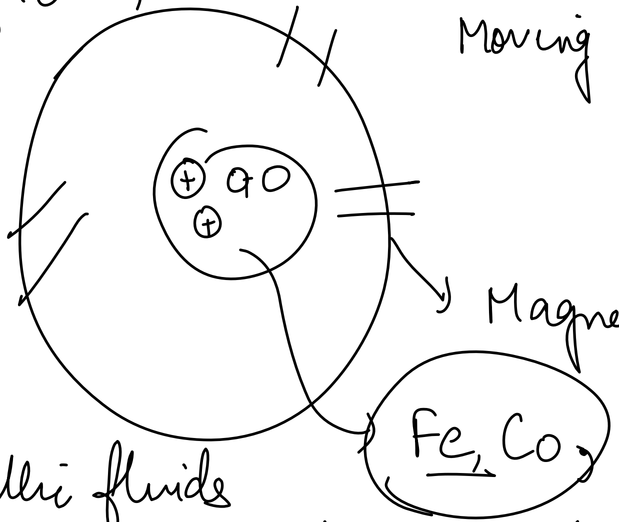
$M = NiA.$ → $n \times 2l.$

Earth Magnetism :

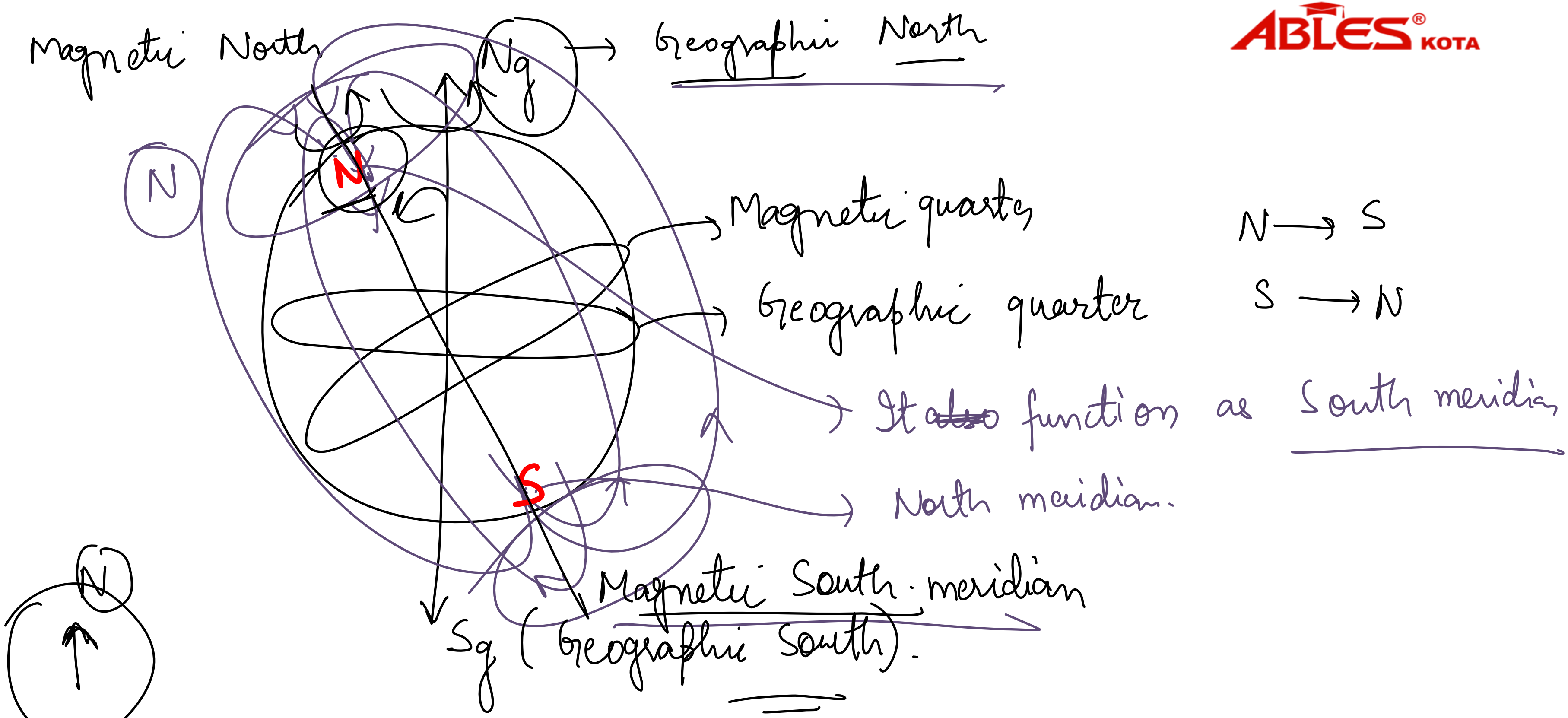
The value of earth magnetism varies from place to place.

Its value is of the order of 10^{-5} T.

Moving charge generates magnetic field



Magnetic field is thought to arise due to the electrical current produced by convective motion of metallic fluids [Fe/Ni] in the outer effect of the Earth. This is called Dynamo effect.



Axis of both magnetic & geographic meridian does not coincido.

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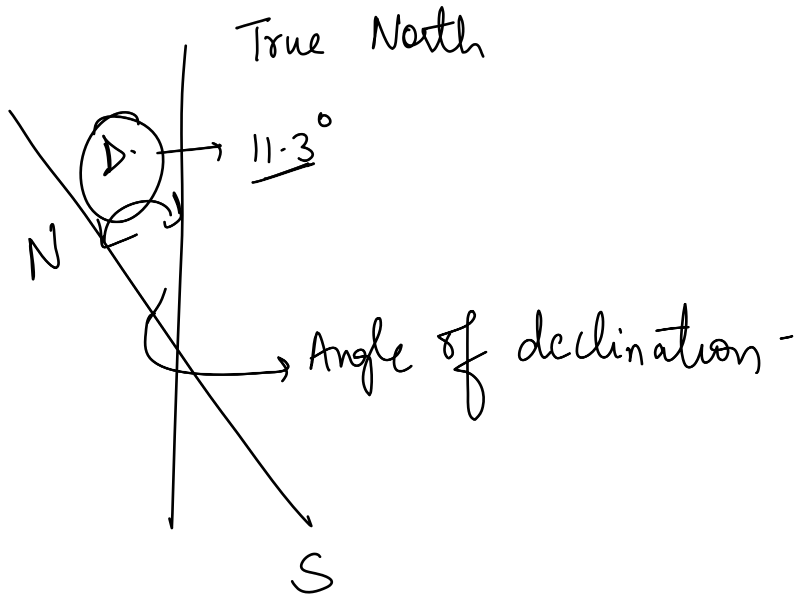
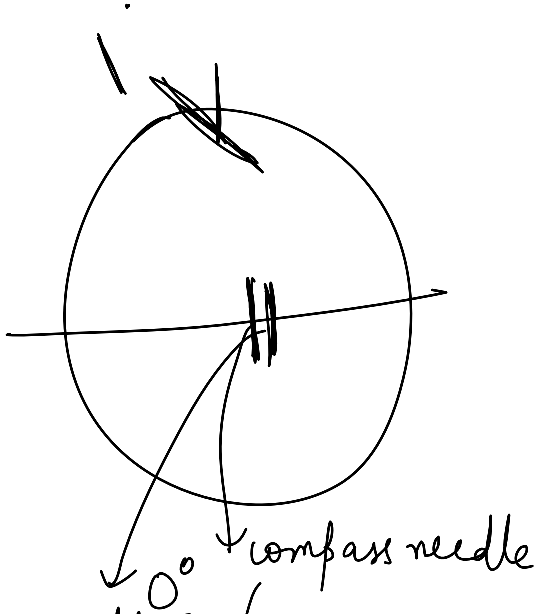
In reality, the north pole behaves like the south pole of magnet, of bar magnet inside the Earth & vice versa

Magnetic Elements of Earth :

Magnetic declination : 'D'

It is the angle between the true geographic needle and the north north shown by the compass needle. This angle is called magnetic declination.





The declination is greater at higher latitudes and smaller near the equator.

it is showing in the direction of ~~magnetic~~ geographic north.

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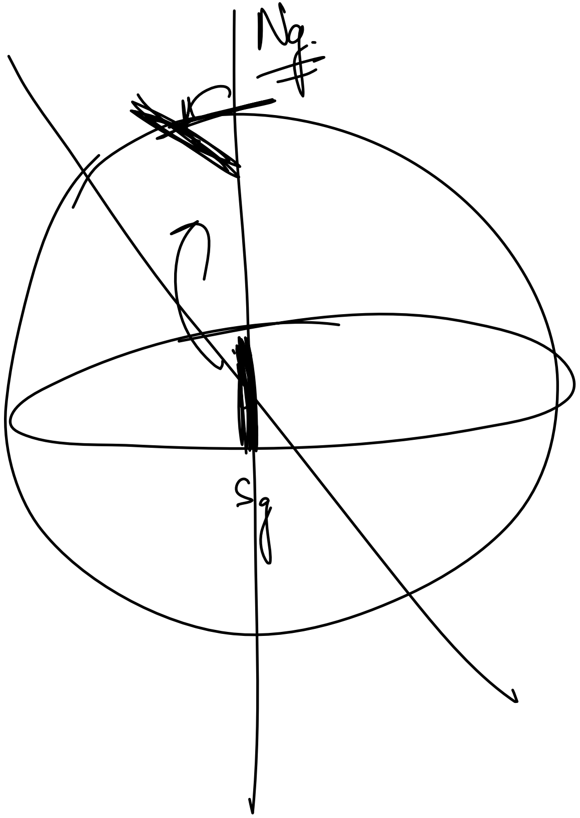
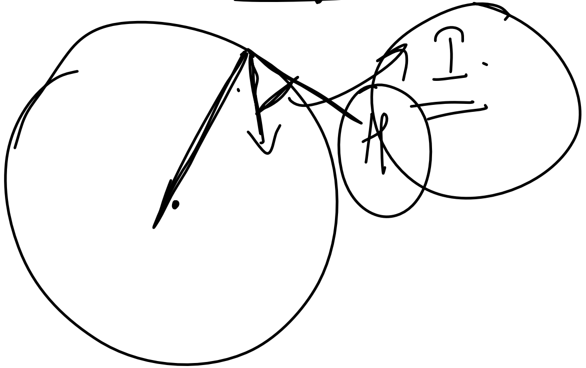
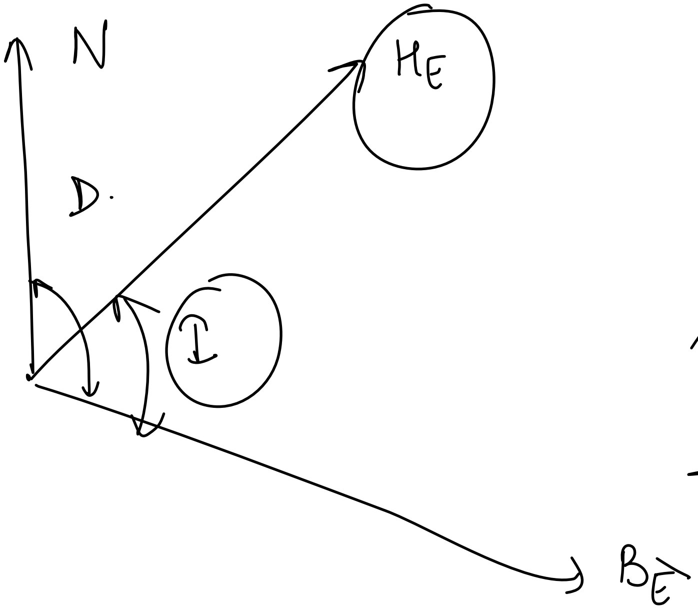
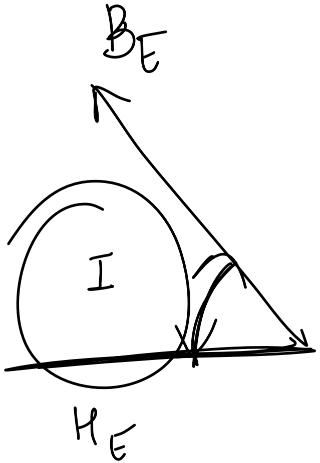


Angle of dip: (I).

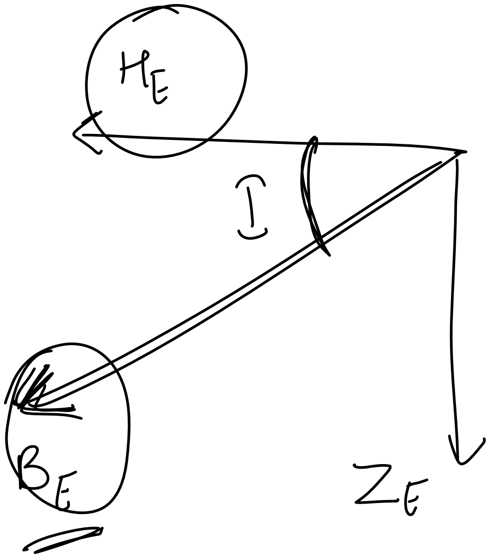
This is the angle that the total magnetic field of the Earth makes with the horizontal axis




N
D.
H_E
I
B_E


B_E
I
H_E

Horizontal Component of Earth magnetic field:



$$\cos I = \frac{H_E}{B_E}$$

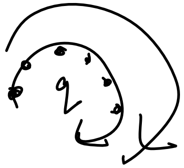
$$H_E = B_E \cos I.$$

$$Z_E = B_E \sin I.$$

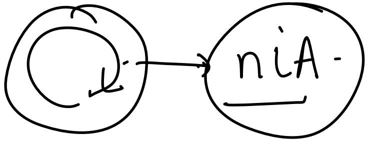
$$\frac{\sin I}{\cos I} = \frac{Z_E}{H_E} = \tan I.$$

Magnetisation & Magnetic Intensity:

(Moments add up vectorially).



Magnetisation: Total net magnetic moments per unit volume.



$$M = \frac{m_{net}}{V}.$$

$L^{-1}A$ | Unit: A/m.

↑ Dimension

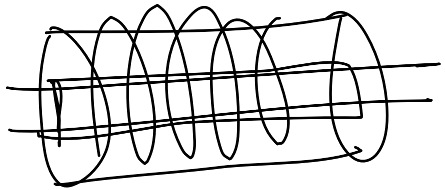
Magnetic Intensity :

$$H = \frac{B}{\mu_0} - M.$$

→ Magnetic field

$\mu_0 n i$

$\mu_0 \mu_r n i$



μ_r

$B = B_0 + B_m$ → Magnetic field due to magnet.

$$H = \frac{B}{\mu_0} - M$$

Magnetic Intensity (H)

$$B = \mu_0 (H + M)$$

B → Magnetic field

M → material

Susceptibility:

It is the property of the material which describes how a material responds to the applied magnetic field.

Diamagnetic materials repelled by the magnetic field

$$\chi = \frac{M}{H}$$

$$B = \mu_0 (H + M)$$

$$= \mu_0 (H + \chi H)$$

$$= \mu_0 H (1 + \chi)$$

The field contributed by the magnetic core.

$B_m = \mu H$

$= \mu_0 (1 + \chi) H.$

$H = \frac{B}{\mu_0} - B.$

$\Rightarrow B = \mu_0 [H + M]$ $\quad M = \chi H.$

$\mu_r = (1 + \chi).$

Relative permeability of the substance.

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$$M = \frac{m}{V}$$

Magnetisation

$$B = B_0 + B_m$$

$\mu_0 n i$

$$B = B_0 + \mu_0 M$$

$$\Rightarrow \frac{B}{\mu_0} = \frac{B_0}{\mu_0} + M$$

$\frac{B_0}{\mu_0} \rightarrow H$

$$B_m = \mu_0 M$$

Magnetic field intensity

$$B = \mu_0 (H + M)$$

$$M = \chi H$$

$$B = \mu H$$

$\mu_0 \mu_r$

Permeability : It shows the ability of the material to get magnetized

Diamagnetic $\longrightarrow$ χ $\longrightarrow$ negative

Paramagnetic $\longrightarrow$ χ $\longrightarrow$ ~~neo~~ positive | Small

Ferromagnetic $\longrightarrow$ χ $\longrightarrow$ Larger & positive