LAB REPORT FOR EXPERIMENT 8

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Date: -----------------

Name:---

Partner's Name:---

Registration No:--- 3

Registration No:---

Physics Section:------- ------

Instructor's Name:--

PHYSICS LAB EXPERIMENT 8: THE MAGNETIC FIELD OF A CURRENT

I. PURPOSE

investigate the dependence of the
direction and magnitude of a magnetic
field on the current that produces it.

II.DATA AND DATA ANALYSIS:

1. Enter your data in Table 8.1 below:

investigate the dependence of the direction and magnitude of magnatic field on the current that produce it.

Table 8.1

Reading	I(mA)	θ_1	θ_2	θ_3	θ_4	$\bar{\theta}$	$\tan\bar{\theta}$
1	40	32	33	26	25	29	0.55
2	50	37	39	32	33	35.25	0.706
3	60	42	43	37	39	40.25	0.846
4	70	46	48	44	45	45.75	1.02
5	80	49	51	48	50	49.5	1.17
6	90	53	55	51	49	52	1.27
7							
8							
radius of the coil = 7.25 cm				N=50 turns			

2- Using Table 8.1 plot a graph between the values of **I** as a dependent variable against the corresponding values of **tan** $\bar{\theta}$ as the independent variable.

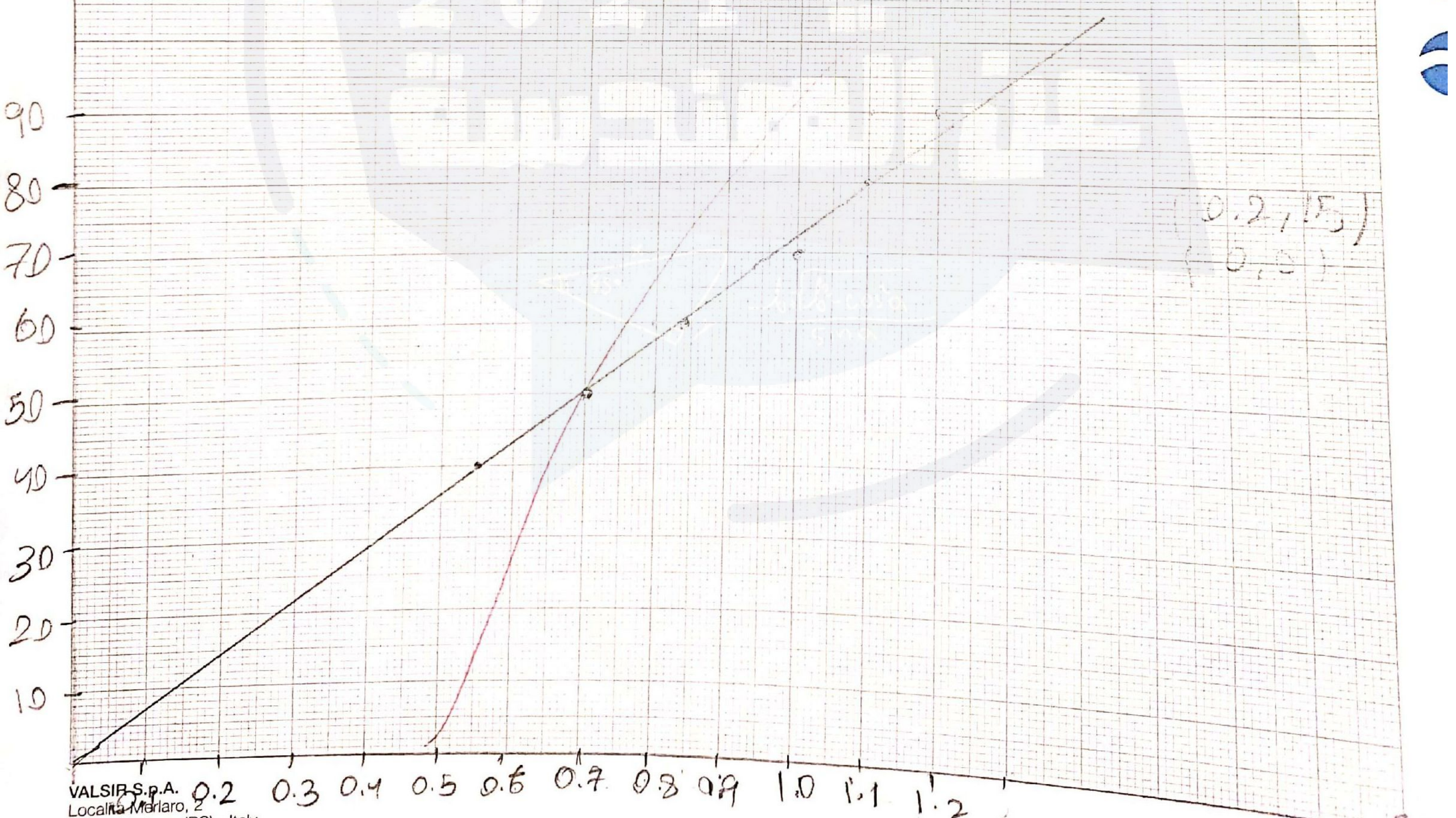
3- Use your graph to find the value of the reduction factor **K** and the error **ΔK**.

$K = \text{slope} = \frac{I}{\tan\theta} = \frac{15-0}{0.2-0} = 75 \times 10^{-3} = 0.075$ Ampere

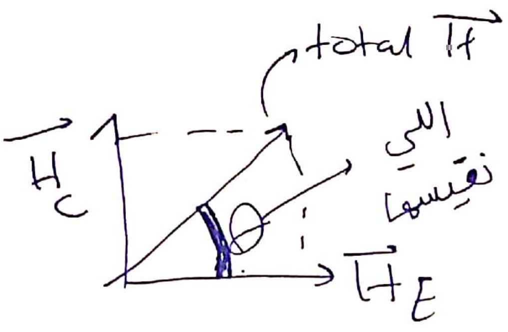
$H_E = \frac{75(2\pi \times 50) \times 10^{-3}}{10(7.25)} = \frac{K(2\pi N)}{10a}$ Gauss

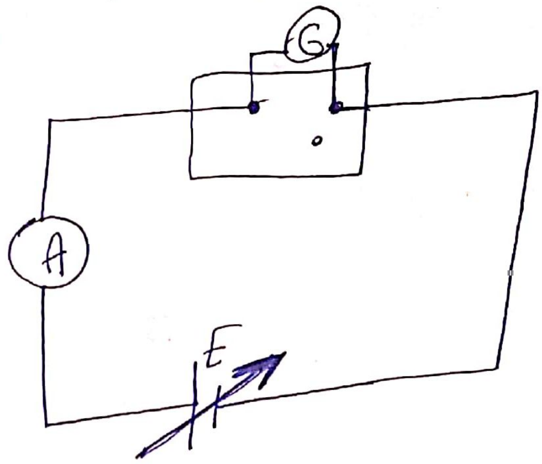
$= 0.324$ Gauss

K ± **ΔK**. =


90
80
70
60
50
40
30
20
10
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2

a Current



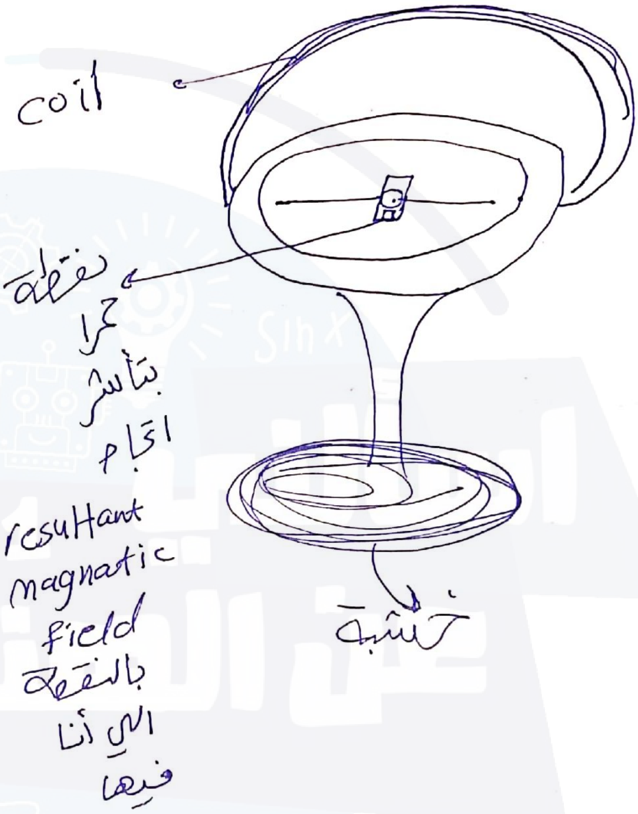


$$\tan\theta = \frac{H_C}{H_E}$$

$$\tan\theta = \frac{2\pi I N}{10a\, H_E}$$

$$\frac{10a\, H_E}{2\pi N} \cdot \tan\theta = I$$

($\tan\theta$ → constant, I → constant; $\frac{10a H_E}{2\pi N}$ → K)



من الخشبة بحرك حامل

بتنا نخلي النقطة الحمرا موازية لل coil والابرة عمودية ع ال coil

بعدها بحرك النقطة اللي فوقه لأخلي الابرة ع الصفر من الجهتين

بتنا نشغل الباور سبلاي بعدها رح يختلف اتجاه البوصلة

بطلع زوايتين ، مرة مع ومرة عكس من ال switch in / out

باخذ الأقرب الهم [θ_1 / θ_2 , θ_3 / θ_4

وباخذ $\tan\theta$

$$H_c = \frac{2\pi W I}{10 a} \quad \text{(gauss)}$$

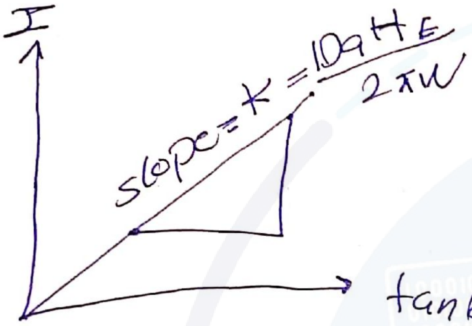
W → عدد لفات

a →

I : A , a : cm

$$\tan\theta = \frac{2\pi W I}{10 a H_E} \longrightarrow I = \frac{10 a H_E \tan\theta}{2\pi W}$$

$$I = K\tan\theta$$



هيعني أعرف K لأطلع H_E

Horizontal component of magnetic field of Earth

Reading	I	θ_1	θ_2	θ_3	θ_4	$\bar{\theta}$	$\tan\bar{\theta}$
1	.						
2	.						
3	.						
4	.						

~~$I = K\tan\theta$~~

$$\tan\theta = \frac{H_c}{H_E} = \frac{\frac{2\pi W I}{10 a}}{H_E} = \frac{2\pi W I}{10 a H_E} = K$$

EXPERIMENT 8

THE MAGNETIC FIELD OF A CURRENT

I. INTRODUCTION:

It is known that when a current flows in a conductor it creates a magnetic field which can be simply detected by the deflection of the needle of a magnetic compass. We shall investigate in this experiment the **dependence of the direction and magnitude of a magnetic field on the current that produces it.** A compass will indicate the direction since it aligns itself in the field;and the magnitude of the field can be measured by comparing it with the constant field of the earth.

The magnetic field H_c produced at the center of a circular coil is theoretically given by:

$$H_c = \frac{2\pi NI}{10a} \text{ (Gauss)} \qquad (1)$$

where I is the current flowing in the coil **in amperes**, N is the number of turns, and "a" is the radius of the coil **in centimeter**.

The field at the center of the coil is normal to the plane of the coil.

Therefore, if the plane of the coil is aligned to coincide with the direction of the magnetic north, H_c will be **perpendicular** to the horizontal component H_E of the earth's magnetic field at the location, and the resultant magnetic field at the center will be at an angle θ with respect to H_E as shown in Fig.8.1, and θ will be given by :

$$\tan\theta = \frac{H_c}{H_E} \qquad (2)$$

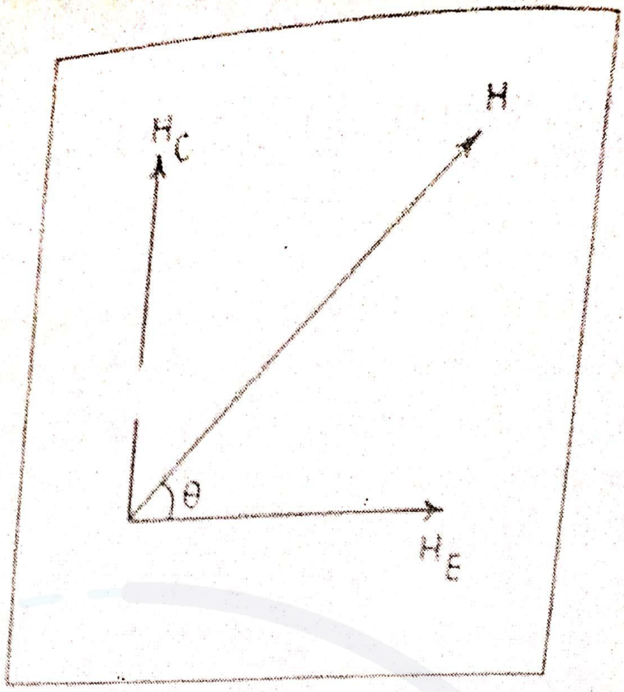


Fig.8.1

Since the compass needle always aligns itself along the resultant field, will be deflected an angle θ from its original direction (when $H_c = 0$).

substituting equation (2) in (1), we get

$$I = K \tan\theta \qquad (3)$$

where, $K = \dfrac{10\, a\, H_E}{2\pi N}$ is a constant for a **given coil** used in a **particular location** with a certain value of H_E. K is called the **reduction factor of the galvanometer**.

II. EQUIPMENT:

Tangent Galvanometer G, ammeter A, rheostat, reversing switch R_S, variable power supply.

The **"tangent galvanometer"** in its simplest form **consists of a magnetic compass situated horizontally at the center of a vertical circular coil.** However, the ordinary laboratory form of the galvanometer is constructed with three coils instead of one, all wound on the same framework; each coil having a different number of turns. This causes the galvanometer to have different sensitivities suitable for measuring currents of several orders of magnitude.

III. PROCEDURE:

Determination of K and H_E :

1- Adjust the galvanometer leg screws to set the galvanometer in a horizontal level. **Now connect** the circuit as shown in Fig.8.2 **using the 50 turns terminals** on the galvanometer. The galvanometer G should be connected to the **reversing key R_s** by a long piece of twin flex so that the current in the rest of the circuit exerts little magnetic effect on the compass needle.

1. connect the circuit as shown :-)

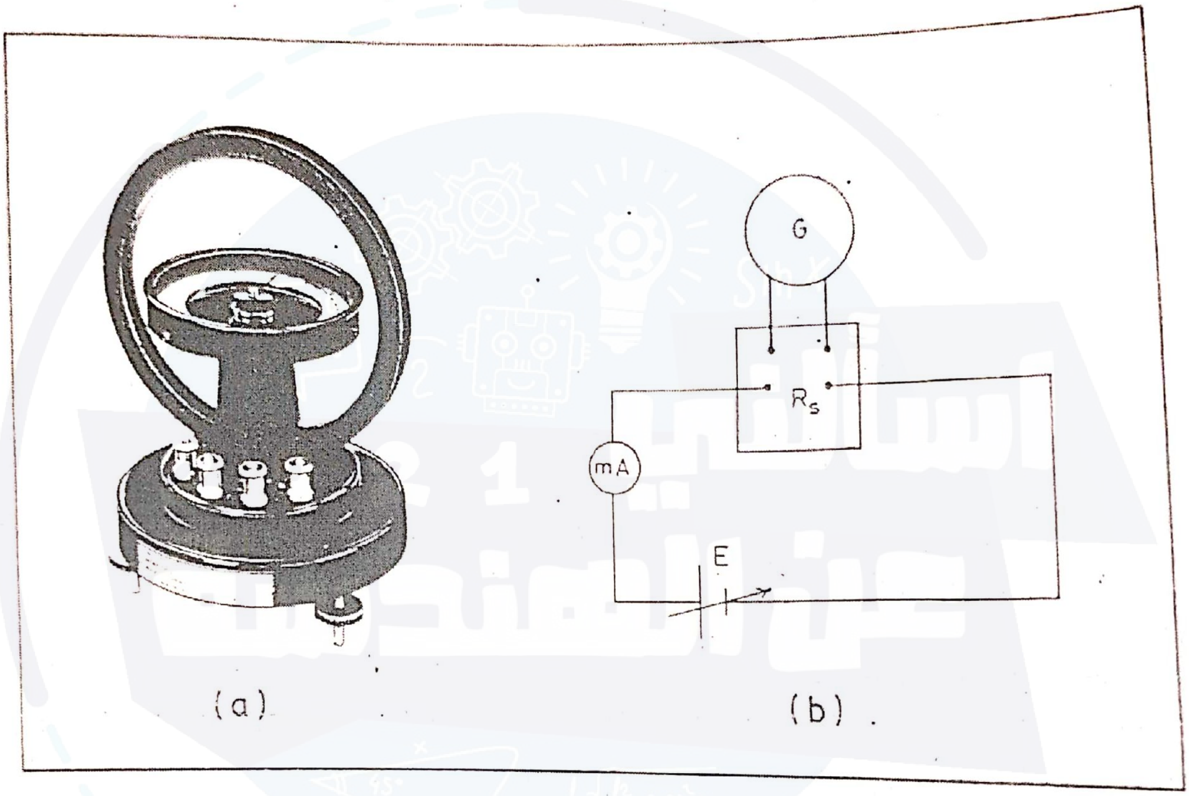


Fig. 8.2

2- With no current flowing in the the circuit, rotate the galvanometer until the **plane of the coil is aligned along the axis of the magnetic needle.** **Note that the magnetic needle is fixed at right angles to the compass pointer which is a long thin rod.** Now **rotate** the compass box until the ends of the **pointer** coincide with the **zero** marks of the scale of the scale (see Fig 8.3).

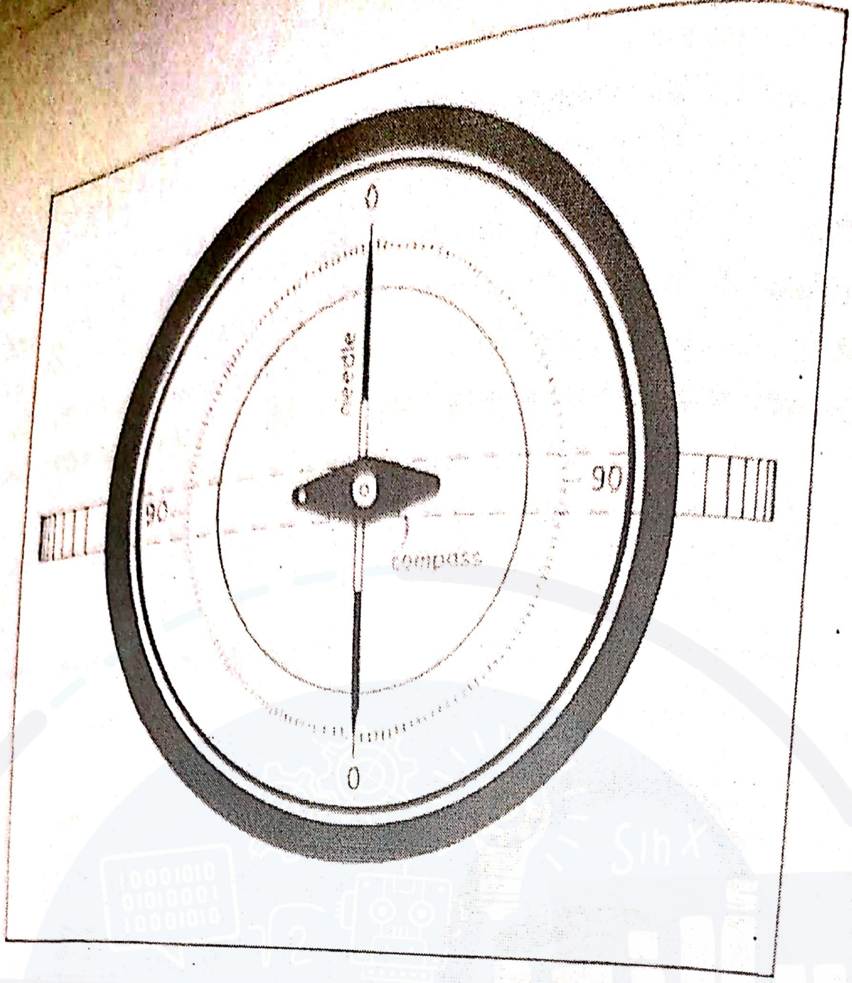


Fig 8.3

3- Now, start the current flowing in the circuit and adjust the rheostat to obtain a deflection of the pointer of the compass of about 30°.

4- Record the pointer readings at both ends θ_1 and θ_2 and the current **I** as indicated by the ammeter.

5- Now **reverse** the current by the reversing switch R_s and again record the deflection θ_3 and θ_4 for the same current I . The **average** $\bar{\theta}$ of the **four** readings is taken as the mean deflection corresponding to the current I . Becareful to **avoid parallax** errors by taking the pointer readings with the eye **vertically** over the top so that the **pointer and its mirror image underneath coincide.** Also **be sure** while taking your readings that the **compass needle is free to rotate.**(This can be checked by gently tapping the compass befor a reading is taken) .

6- Now increase the current and **repeat the above procedure**. Taking **8 sets** of readings covering the range from 30° to 60°. Enter your data in Table 8.1 below:

EXPERIMENT 8
THE MAMNETIC FIELD OF A CURRENT

- From the **Magnetic Field of a Curcent** experiment, the earth's magnetic field, H_E, will be determinned experimentally and compared to the accepted average field at the surface of earth (0.5×10^{-4} T = 0.5 G; 1.0 Tesla = 1.0×10^4 Gauss).

- This will be accomplished by measuring the deflection angle of a compass needle placed in an induced magnetic field, H_C.

- This induced magnetic field at the center of the circular coil, H_C, results from the passage of a current in the coil and is given by the following equation:

$$H_C = \frac{2\pi N I}{10\, a}\ Gauss\text{, where}$$

  - I is the current flowing in the coil in amperes:
  - N is the number of turns (50 turns).
  - a (7.25 cm) is the redius of the coil.

- This deflection of the compass needle is a direct consequence of the resultant magnetic field aligning itself along the resultant field, H_{net}. Where H_{net} is composed of two perpindicular magnetic components. The first component is the induced magnic field, H_C, while the other component is the earth's magnetic field, H_E.

- In designing the experiment, we aligned the earth's magnetic field, H_E, parallel to the plane of the coil. This will ensure that H_E will be exactly perpendicular to the direction of the induced magnetic field H_C.

- Therefore, the resultant measured magnetic field will be given by:

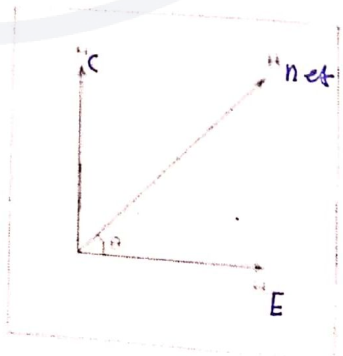
$$H_{Net} = \sqrt{H_C^{\,2} + H_E^{\,2}}\text{, Where}$$

$$I = K \tan\theta$$

$$\tan\theta = \frac{H_C}{H_E}$$

$$K = \frac{10\, a\, H_E}{2\pi N}$$

Where K is the **Reduction Factor** of the **Tangent Galvanometer**.



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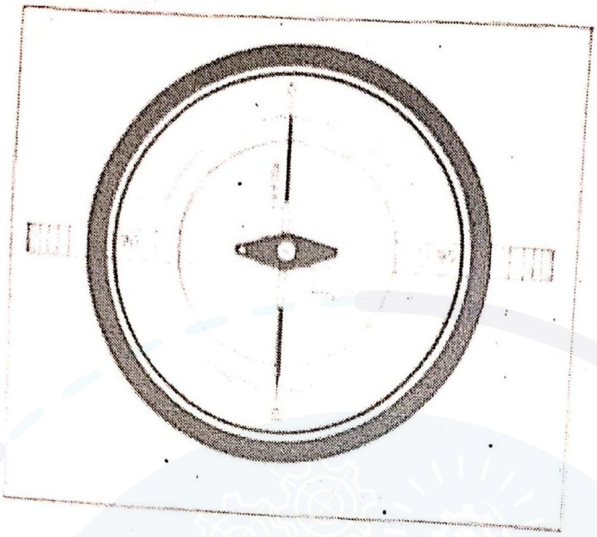
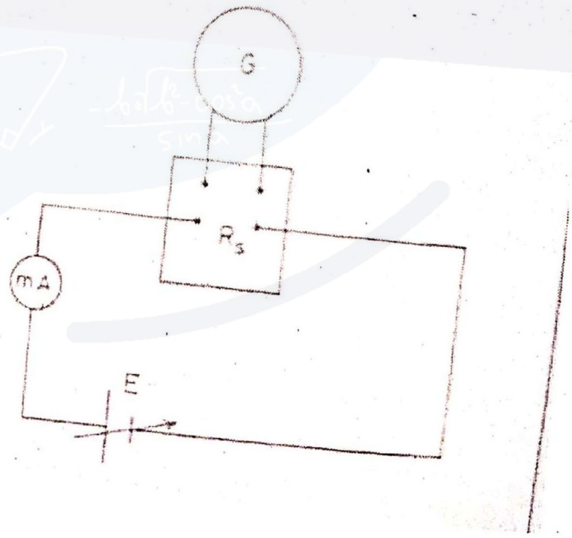
- **Tangent Galvanometer** consists of a magnetic compass situated horizontally at the center of a vertical circular coil.



Circuit Elements:

Tangant Galvanometer, Milli-Ammeter, Variable Power Supply, and Connecting Wires.



The Magnetic Field Of A Current