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NORTH SOUTH UNIVERSITY

Department of Mathematics & Physics

Experimental Physics

PHY-108L.8

Name of the Experiment: **MAGNETICS FIELDS DUE TO A BAR MAGNET**

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(ii) Report Submitted: 28/08/2023

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EXPERIMENT 3: MAGNETICS FIELDS DUE TO A BAR MAGNET

1. **Objectives:**

   To draw and analyze the magnetic field lines of a bar magnet.

2. **Background:**

The magnetic field near a bar magnet can be represented by magnetic field lines. These field lines pass through the magnet and form closed loops around the magnet. The closed field lines enter one end of a magnet and exit the other end. The end of the magnet from which magnetic field lines emerge is called the north pole and the other end, where the field lines enter, is called the south pole.

Earth has a magnetic field that is produced in its core by still unknown mechanisms. On Earth's surface, the magnetic field can be detected with a compass which is essentially a slender bar magnet on a low friction pivot. The bar magnet or the magnetic needle turns because its north-pole end is attracted toward the south pole of the Earth's magnet located near the Arctic region of the Earth. Thus, the south pole of the Earth's magnetic field is located near the Northern Hemisphere, which is known as the *geomagnetic north pole*. In the Southern Hemisphere, the magnetic field lines point out of Earth and away from the Antarctic – that is away from Earth's *geomagnetic south pole*.

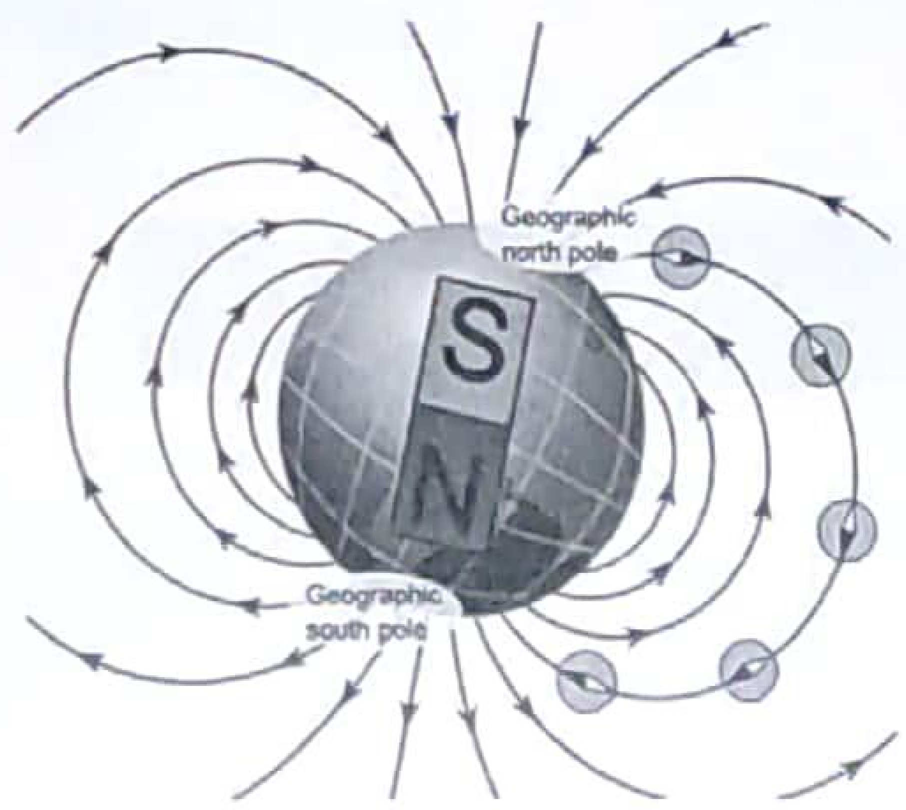

Figure 1: Magnetic field due to the Earth

3. **Required Materials:** Two bar magnets, One compass, A3 white paper

4. Procedures and Observations:

Part 1: Constructing Magnetic Field Lines of a Bar Magnet:

Use one of the compasses to determine the north pole and south pole of the magnet. The arrow on the compass is magnetic and will experience a torque so that the north pole of the compass will point towards the south pole of the bar magnet or away from the north pole. **Prior to starting the experiment, make sure that the compass poles are properly marked by placing it close to the north/south pole of a bar magnet**

Follow the following steps to complete each part of the experiment:

a. Collect an A3 white paper and tape it on the table.
b. Make sure there are no iron objects/magnets in the vicinity of the experimental area.
c. Place a bar magnet in the middle of the paper.
d. Draw an outline of the magnet on the paper and mark the poles as "N" for North and "S" for South.

Magnetic Field Line # 1:

(a) Place a compass in one end of the magnet. Put dot marks at both ends of the needle.
(b) Move the compass such that the end of the needle next to the magnet is directly over the second dot and make a new dot on the other end.
(c) Continue doing it until you reach the other end of the magnet or goes outside the paper.
(d) Draw a line through the dots and indicate an arrowhead to show the direction in which the North end of the needle pointed, as shown in Figure 2.

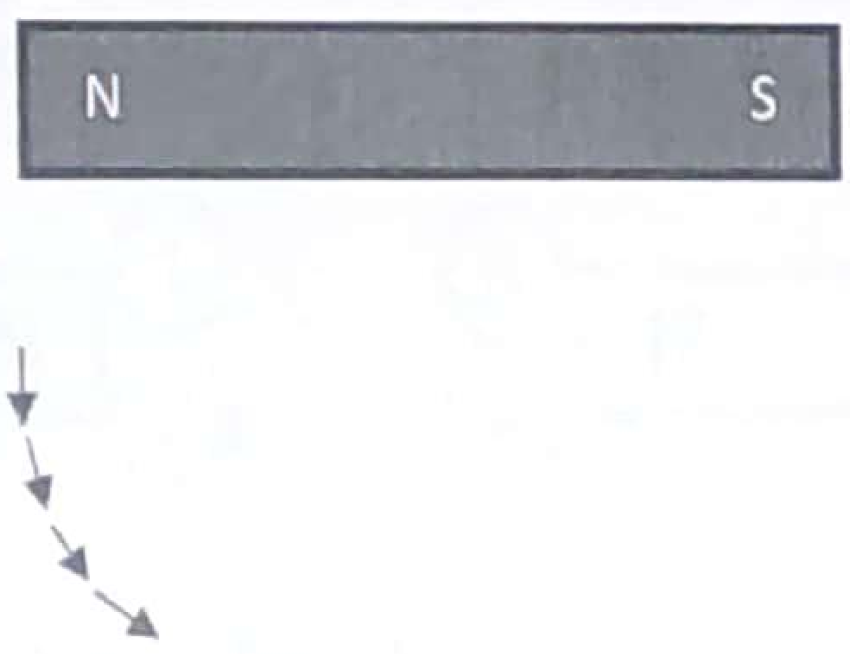

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Figure 2: Construction of magnetic field lines around a bar magnet

Magnetic Field Line #2: Repeat the process described for Line #1, but start from about 1 cm (½ inch) inside from the same end of the magnet.

In a similar way, draw two more magnetic field lines on the other side of the magnet. *Are the field lines symmetrical with respect to the magnet?*

Magnetic Field Line #3: This time start from 4 – 5 cm (approximately 1.5 – 2 inches) away from the same end and repeat the steps used for Field Line #1. Note that the center of the compass must be on the line if the outline of the magnet is extended to that direction. Repeat this same for other end of the N pole as well.

Repeat the procedure for the south side of the magnet.

Part #2: Constructing a Magnetic Field Diagram

Part 2 (I)

Get another piece of paper, if necessary, to do this part of the experiment, as shown in Figure 3. Arrange two magnets in such a way that three compasses can fit in between the magnets. Sketch the compass needles' directions as shown in the diagram below. Each position marked in the diagram is the starting point of a field line and mark the compass position a number of times for each starting point.

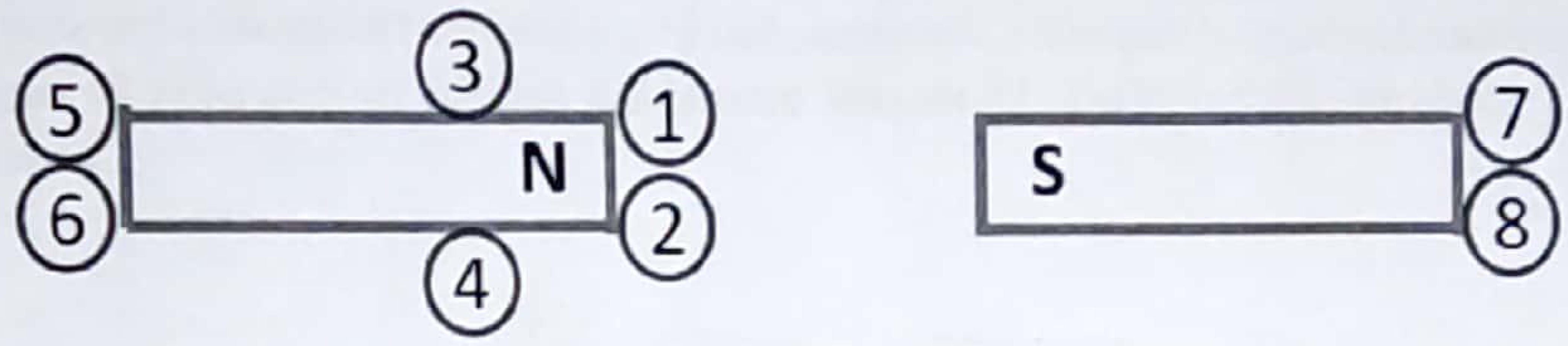


Figure 3: Two magnets with opposite poles facing each other

Part 2 (II)

Now reverse one magnet so that the two north poles face each other, as shown in figure 4. Follow the same procedure as above to draw some field lines from each starting point.

Figure 4: Two magnets with like poles facing each other

Part 3: Superposition of Magnetic Fields:

Place two bar magnets at right angles to each as illustrated in Figure 5. Let P be the point that lies along the centerlines of both magnets. Arrange the magnets so that their ends are equidistant from P (use ruler). Trace the outlines of the two magnets and label their poles.

Step 1: Place a compass on the dot, marked as **P**. Mark the needle position with two dots and draw an arrow indicating the needle's direction.

Step 2: Now remove the **Magnet #1** and indicate the compass needle's direction in the same manner as above. Then replace **Magnet #1** to its original position and remove **Magnet #2**. Again, indicate the needle's direction by drawing an arrow.

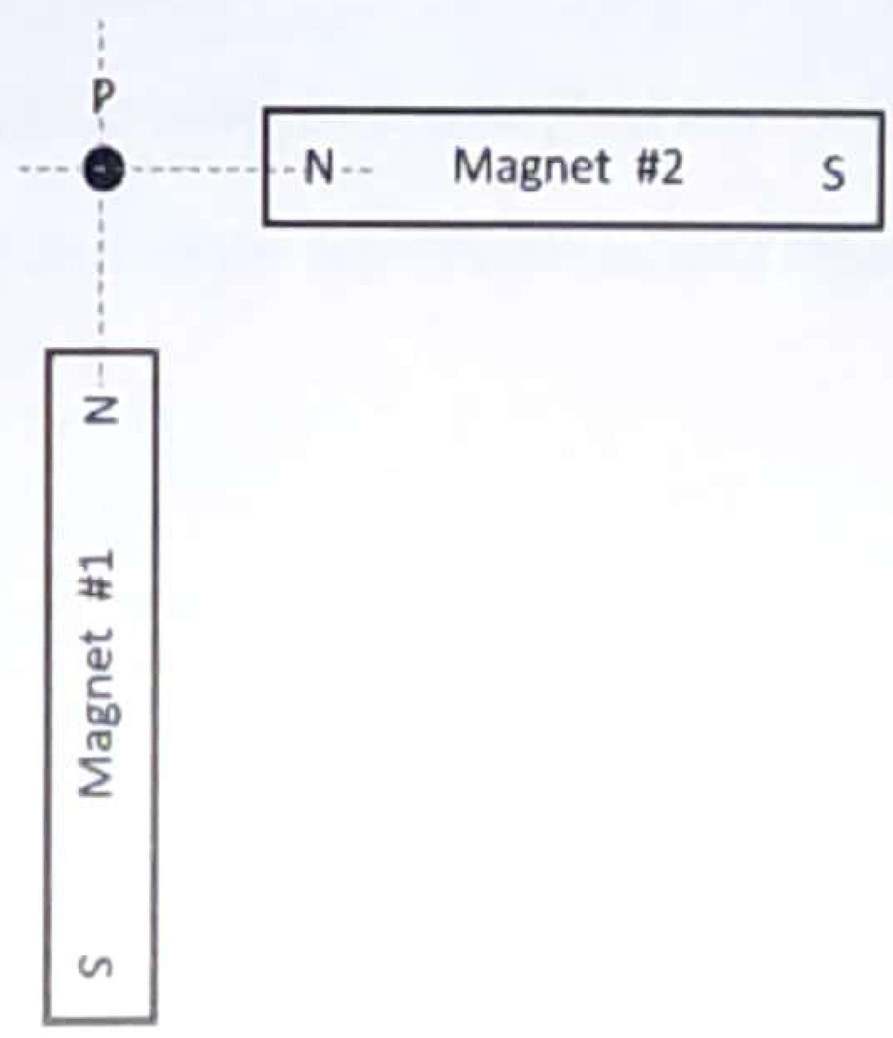


Figure 5: Two magnets at right angles to each other

Step 3: Now switch the position of the magnets (Magnet#1 replaced by Magnet#2 and Magnet #2 replaced by Magnet #1) and take note of the compass direction below. How does it differ from your observation in step 1.

Lab Report:

Date: 21.08.2023	
Name of the Students and IDs	(1) Shakil Ahmed 2221453042
	(2) Mortaza Morshed 2212697643
	(3) Safayat Ibrahim 2131174642

Tasks and Questions:

Note that all A3 papers used for drawing magnetic field lines must be attached with the report.

#1: Transfer the magnetic field from Part 1 of the experiment to your report.

#2: In Part 1 of the experiment, you have noticed that some of the magnetic field lines wander off and never come back to the bar magnet. Which part of your bar magnet do these lines come from? Why?

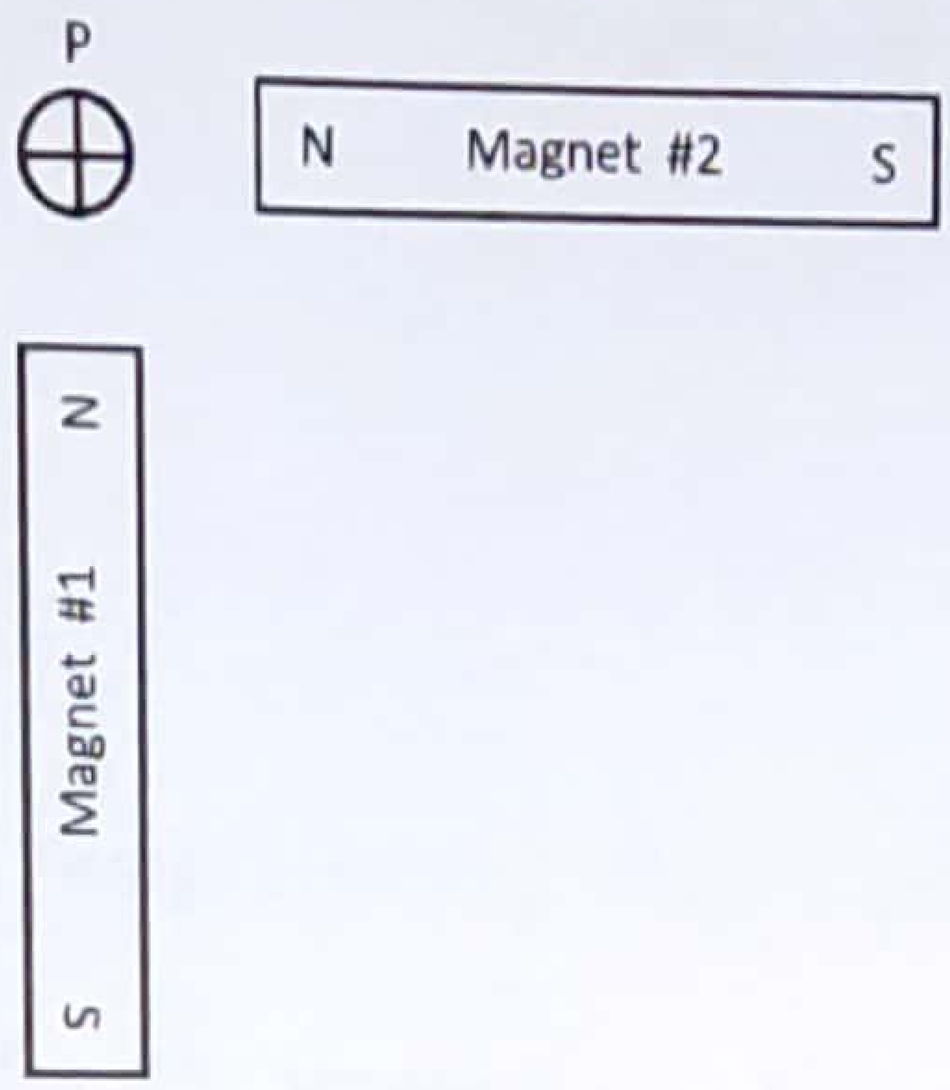
Magnetic field lines always form closed loops, flowing from North pole of the magnet to the South pole. When we see some of the magnetic field lines wander off and never come back to the bar magnet. Its because those lines are emerging from the north pole and extending outward into space, since these lines don't loop back to the magnet itself, they appear to be travel off in a direction away from the magnet. This behavior is a fundamental property of magnetic fields, where field lines indicate the direction and strength of the magnetic force at diffrent points in space.

#3: Transfer the field lines you have drawn on the A3 paper from Part 2 (I)of this experiment to the figure below.

#4: Transfer the field lines you have drawn on the A3 paper from Part 2(II) of this experiment to the figure below. (Also attach the paper) Is there any place in the diagram where the magnitude of the magnetic field is equal to zero? Where?

two magnets are placed in opposite directions, there is a point in between them where ~~a~~ magnitude of the magnitude field becomes zero. This point is called the "neutral point" or "zero field point. It is located along the line that connects the two opposite poles of the magnets. At this neutral point, the magnetic field vectors from both magnets cancel each other out, resulting in an net magnetic field strength of zero.

#5: Two bar magnets are placed at right angles to one another. A compass is placed at point P in Figure 4. In what direction does the needle point? Why?



compass alligns itself along the ~~di~~ resultant direction of the combined magnetics fields produced by the two magnets. As Magnet #2 is stronger than Magnet #1 needle points closer to Magnet #1

#6: Are both the magnets of the same strength? Use your experimental data to justify your answer.

THe compass needle aligns itself with the direction of the magnetic field and the angle between the compass needle and the direation of the magnetic field indicates the strength of the field. From the experiment we see that compass points (31°) from magnet 1 compared to the angle (39°) from magnet2. It explains that magnet#2 is stronger than the magnetic field produced by magnet #1. It demonstrates that both the magnets are not of the same strength.

Results:

Discussion:

In the conducted experiment, the primary objective was to explore the behavior of magnetic fields surrounding a bar magnet The experiment involved placing a compass at various points around magnets to observe the orientation of the compass needle. The experiment demonstrated construction of magnetic field diagram between two magnets with opposite poles facing each other. This part demonstrated how magnetic field interections between different poles influence the resulting field patterns. Part 3 explains the superposition of magnetic field by placing two bar magnets at rigth angles to each other. This showcased the complexity of magnetic interection, and how their combination influences the resultant field direction. This experiment has practical applications in understanding magnetic phenomena, which are crucial in various scientific and engineering fields.

Magnetic Field Line #1;#2; and

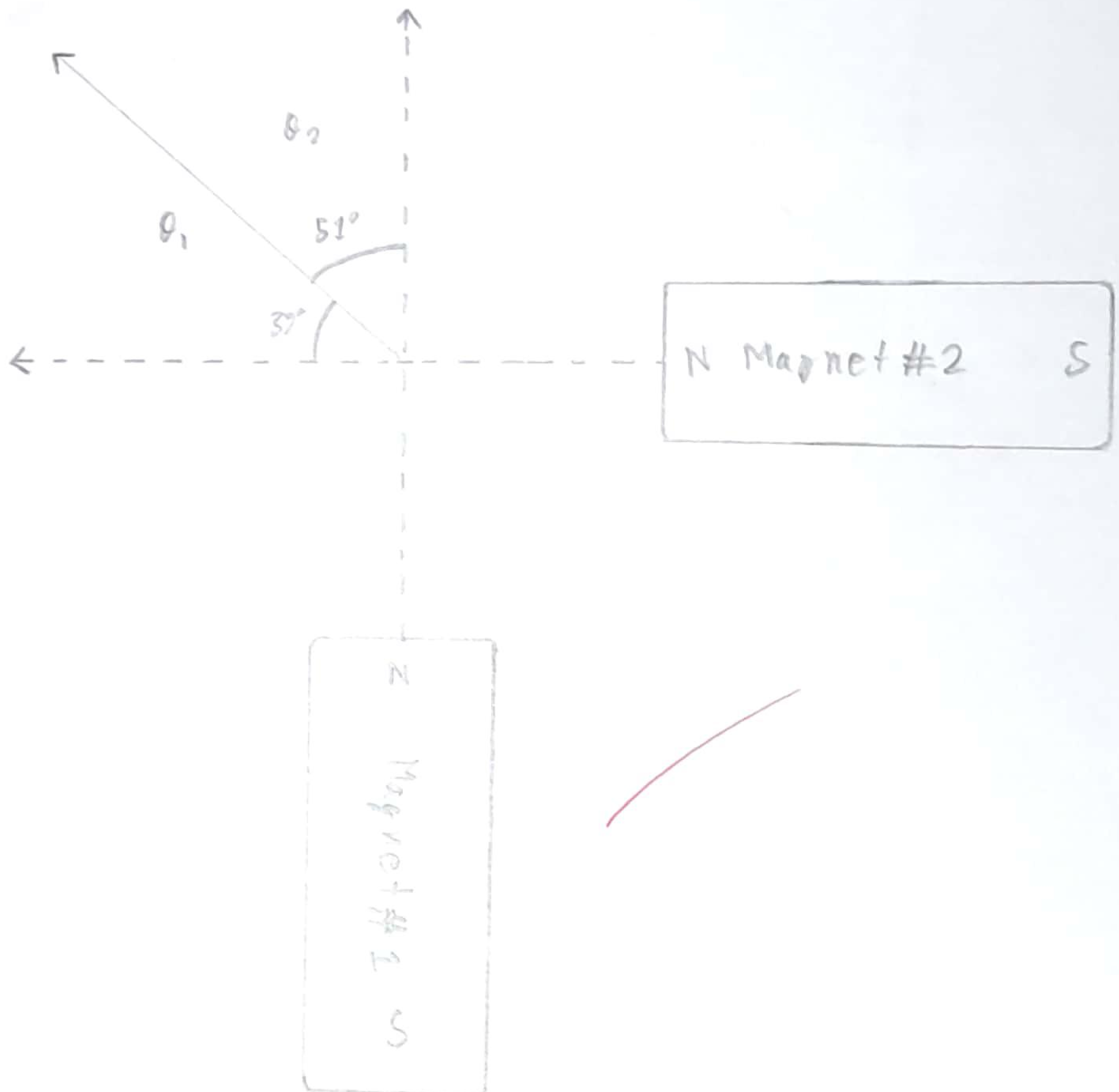
Part 2 (1)

#3


(11)
4
S
N
P
N
S

As, $\theta_2 > \theta_1$

Magnet #2 is stronger than Magnet #1



Part : 1

Mahadul.

Part : 2 (I)

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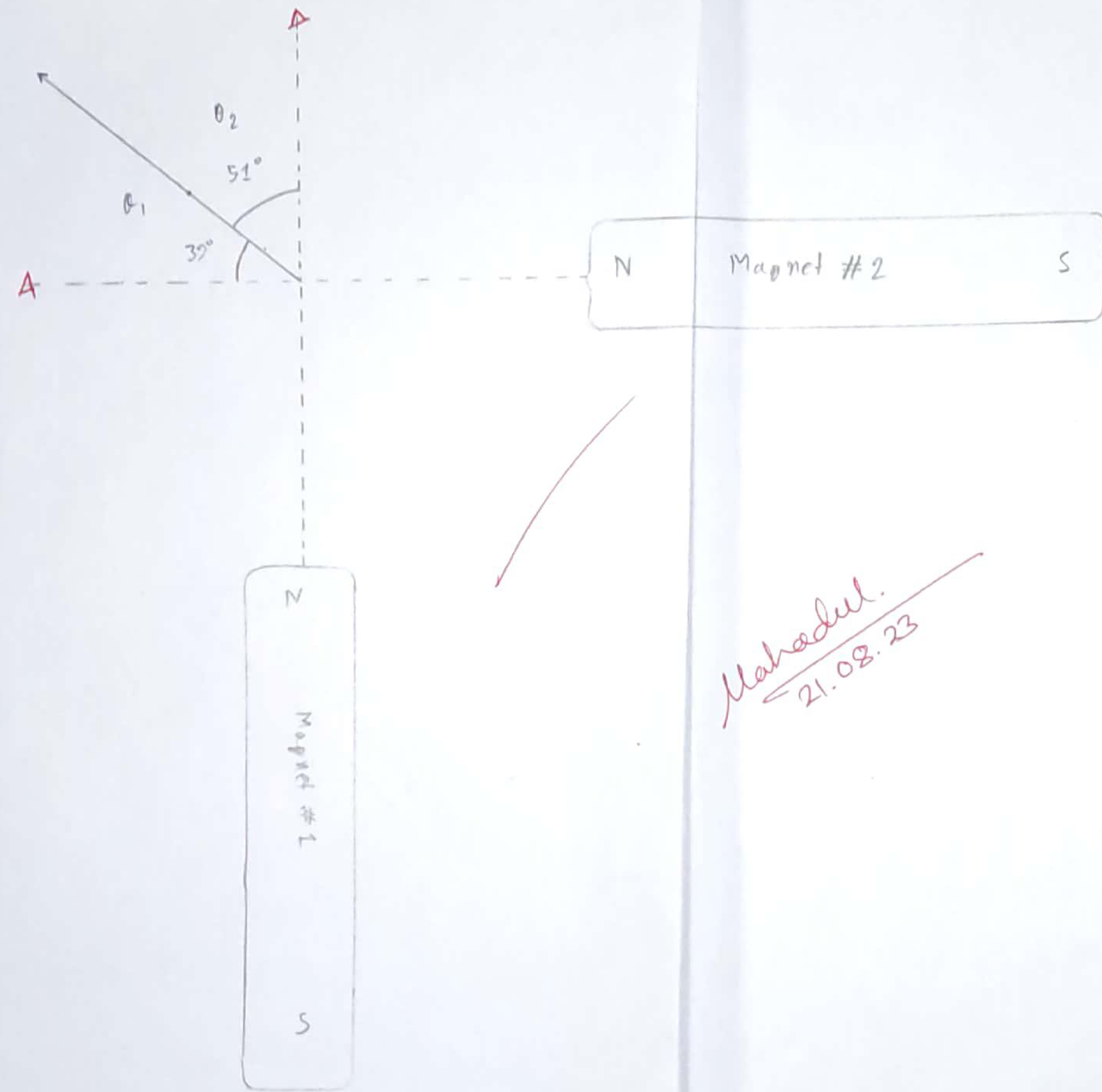
As $\theta_2 > \theta_1$
Magnet 2 is stronger than Magnet 1



Mahadul.
21.08.23


S
N
N
S