PHYS 230
LAB-1 REPORT

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Lab Number: 1
Lab Date: 01.20.2025

IMAGE

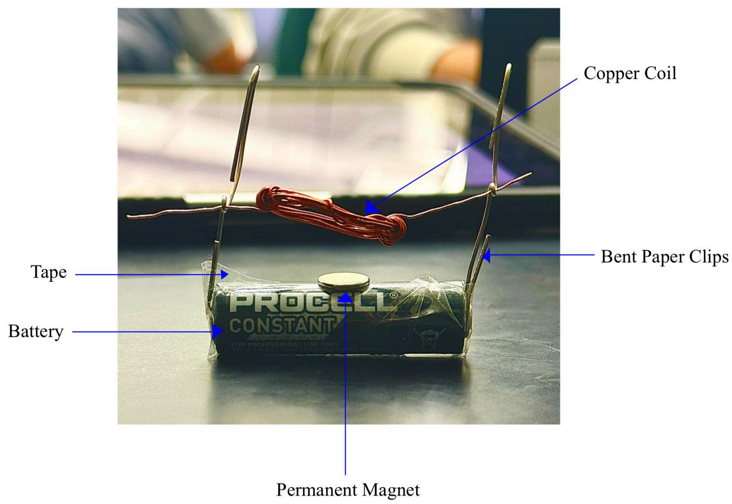

Fig 1.1: Labelled image of setup.

SUMMARY

In this experiment, we built a simple DC motor using copper wire, an AA battery, a permanent magnet, tape, and some paper clips. The motor operates by generating a temporary magnetic field in the coil when current flows through it, which interacts with the permanent magnet's magnetic field to create torque and rotation. We tested different coil shapes (circular, square, rectangular) and used a phone's magnetometer on the Phyphox app to map the magnetic field around the motor. The motor spun when the setup was correct, with rotation direction determined by the right-hand rule.

SENSOR

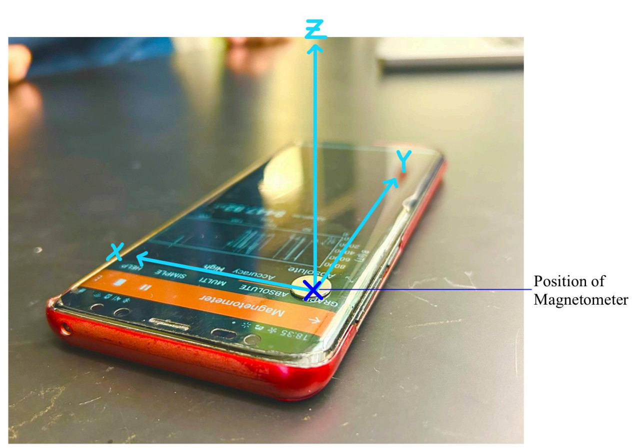

Fig 1.2: Labelled image of magnetometer on the phone relative to the x, y, and z axis.

GRAPH

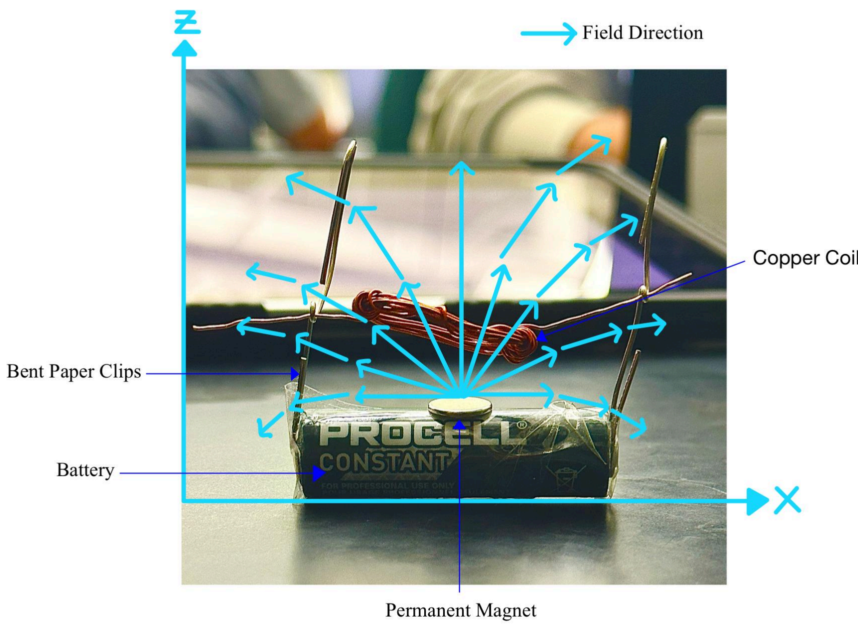

Fig 1.3: Labelled 2D graph showing the magnetic field direction relative to the position of the motor in the xz-plane.

SHAPE

The circular coil performed the best during testing, followed by the oval, rectangular, and square coils. The circular shape likely allowed for smoother rotation due to better symmetry and weight distribution, while the other shapes faced more resistance. However, since the coils were shaped by hand, uneven weight distribution and imperfections likely influenced the results, making it difficult to draw definitive conclusions. To better understand the impact of coil shape, more precise construction would be needed.

COIL

Increasing the number of loops generally made the motor faster, as more loops created a stronger magnetic field. However, beyond a certain point, the added weight of extra loops began to outweigh the benefit of the increased magnetic force. The odd or even number of loops did not appear to have any noticeable effect on the motor's speed.

RPM

To measure the DC motor's speed in RPM, I recorded a slow-motion video of the motor in action. By counting the number of rotations within a specific time frame and dividing it by the duration of the video, I calculated the number of turns per second, which I then multiplied by 60 to convert to RPM. The result came out to be 147.3 rpm.

The current design of the motor doesn't generate enough torque to lift objects, but it could be used to power small, low-resistance devices, such as turning a light load or driving a simple mechanical system. The motor's limited power makes it more suited for tasks that require minimal force.

IMPROVE

To improve the DC motor, we could use a stronger magnet for more torque, more conductive wire to reduce resistance, and increase the current for more power. Adding more coils would also boost performance.

MAGNET

A stronger magnet would increase the force exerted on the coil, which would result in more torque and faster rotation. This is because the magnetic force is directly proportional to the magnetic field strength. Using the equation

$$F = IBhz$$

we see that increasing B (the magnetic field strength) directly increases the force (F) on the coil.

CURRENT

Reversing the direction of the current will cause the coil to spin in the opposite direction, as the magnetic force on the coil changes direction according to the right-hand rule. Increasing the current will make the coil spin faster, as the force exerted on the coil is directly proportional to the current. This can be seen in the equation

$$F = IBhz$$

By increasing current (I), the force (F) on the coil increases, resulting in a higher torque and faster rotation of the motor.

FIELD

The magnetic fields are not always perfectly perpendicular to the coil, which means the motor’s efficiency is reduced. When the magnetic field is at an angle to the coil, not all of the magnetic force contributes to generating torque, leading to less efficient conversion of electrical energy into mechanical energy. Ideally, the field should be perpendicular to the coil to maximize the torque and efficiency.

ERROR

Some of the main sources of error in this experiment include inconsistencies in the coil's shape, which can affect the uniformity of the magnetic field and the torque produced. The quality of the materials, such as the wire and magnet, may also vary, influencing the motor's performance. Additionally, inaccuracies in measuring the magnetic field or the motor's speed, as well as the potential for friction or misalignment in the motor setup, could lead to errors in the results.

REFERENCES

1. *PHYS 230 Lab Manual 1*,University of Alberta, 2025. [Online]. Available: eClass. [Accessed: Jan. 25, 2025].

ACKNOWLEDGEMENTS

I would like to thank my lab TA, Joshua Peltonen, for guiding me throughout the lab and explaining the concepts behind the experiment. It was also great to learn that he's a fellow HunterxHunter fan! I would also like to thank my lab partners, Muhammad Abdurrab Siddiqui, Muhammad Ayaan Hafeez, and Eduard Tailibayev, for helping me set up the experiment and for keeping the lab environment enjoyable.