1 Overview

A *homopolar motor* is the simplest electric motor to construct. The term *homopolar* here refers to the fact that neither the electric polarity nor the magnetic field polarity changes during operation of the motor. A schematic is shown in figure 1.

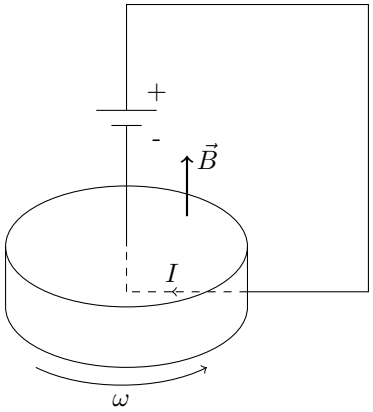

Figure 1: Schematic of a homopolar motor: the disk represents a magnet, which current travels through. The magnetic field exerts a force on the moving charges, causing the magnet to spin. The direction of rotation will depend on the direction of the current and magnetic field.

In this lab you will be constructing a variety of homopolar motors using a metal screw, batteries, and a disk magnet. Clamp the battery (or batteries) to a support stand, and suspend the screw below it using a magnet (or multiple magnets). Then use a wire to make a complete circuit from the magnet through the battery.

2 Tools

You will use a piece of paper to make a flag that attaches to your magnet, then use a photogate to collect data. There are some handy functions in LoggerPro that tell us the time interval that the gate is blocked or unblocked.

If there is only one flag sticking out from your motor, you know the motor makes one revolution (or 2π radians) in the time that the gate is unblocked. The LoggerPro function `BlockedToBlocked` returns the amount of time that the gate is unblocked—this gives you the period of rotation.

3 Tasks

3.1 Basic operation of the motor

Determine the following:

1. Does the wire need to be connected to the side, or the bottom, of the magnet? Does it matter either way? Why?

2. What does the direction of rotation tell you about the magnet's polarity (which side is the North side)?

3. What happens when you flip either the magnet or the battery? What happens if you flip both?

3.2 Changing the motor

You have a total of two batteries and two magnets. Each battery and each magnet should be roughly the same (though you can measure properties of each). Determine the following:

1. For a constant magnetic field, what effect did increasing the voltage have on the rotational speed? Was the effect different depending on the number of magnets?

2. For a constant voltage, what effect did doubling the number of magnets have on the rotational speed? Was the effect different depending on the number of batteries?

4 Lab report

All investigations above should be clearly described in your lab report. This may necessitate multiple diagrams and procedure outlines. The discussion and conclusion sections should cover the lab as a whole.