Hettie
Roebuck

Physics Investigation
Electromagnets

Aim

My aim for this experiment is to find out what kind of effect the strength of an electromagnet has if the number of turns on the coil and the current going through the coil are increased.

Background

Electromagnetic induction is the idea that magnetism can travel from one object to another even though they are insulated.

A greater number of coils in the solenoid around the core will increase the strength of the field produced by that electromagnet. This is because the amount of power given to the solenoid and core is increased so the core receives an increase in power, so the domains become aligned strongly, and more domains become aligned. In addition, with an increase in coils the coils cover a greater surface area of the core. This means the coil covers more domains and therefore more domains are influenced. Each turn has it's own field so more turns mean more fields. The greater amount of turns causes constructive interference, which increases the size and strength of the magnetic field.

The type of wire also affects the strength of the electromagnet. If a wire is thicker then current can flow more easily and the current will increase so the strength of the electromagnet will increase. In addition, the length of wire may also affect the strength of the electromagnet because as the wire becomes longer there is a greater amount of resistance so current may decrease.

Diagram

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Variables

- Voltage
- Current
- Number of coils around the core
- Size of wire used for coils
- Size of magnet

I chose to use the number of coils around the core as my variable. I decided this because I have access to accurate equipment to measure the current, when I change it. The other available variables will be kept constant throughout the experiments.

Prediction

I predict that if you increase the number of turns on the coil the electromagnet will be stronger. The electromagnet will be stronger if the number of turns on the coil is increased because there will be electrons travelling through the coil which will produce a magnetic field. If you increase the number of coils, you create a stronger magnetic field, which means a stronger magnet. Therefore I predict that as the number of turns on the coil increases the greater the induced voltage will be. This is shown by the formula: voltage = current x resistance. This would mean there would be more resistance.

Fair and Safe Test

To make this test fair I am going to have just one variable, the number of coils around the core. I will also keep the same type of wire to keep the same amount of resistance. I

will use all other equipment the same for each experiment. I will do this to get accurate and fair results.

Safety

All the electric components should be handled carefully at all times. The iron nail and the core should be handled with great care because as electricity passes through them they become hotter, so electricity should always be turned off when they are not being used.

Diagram

Apparatus

- Magnet
- Tripod
- Bubble wrap
- Voltmeter
- 2 leads

Preliminary

I did a preliminary experiment with the same apparatus that I will use in my main experiment. I did a preliminary so I could work out an appropriate method for my main experiment. I also did it to find and effective distance to drop the magnet from and also so I could decide a possible range of how many coils to do the experiment for.
From this experiment I found that my initial idea of having the magnet at 50cm was too difficult to aim. But I found

that a more reasonable height was 20cms as this was not a problem at that height.

Method

The apparatus was set up as shown in the diagram. It was then measured 20cms above the coil with 60 turns. The magnet was then dropped through the coil and the voltmeter was checked and the number of volts induced was recorded. This method was then repeated three times and tried with different numbers of coils.

Results

No. Of Coils	*(in volts)* 1	*(in volts)* 2	*(in volts)* 3	*(in volts)* Average
60	0.2	0.3	0.1	0.2
120	0.2	0.2	0.3	0.233333
240	0.6	0.5	0.4	0.5
300	0.5	0.6	0.7	0.6
400	0.7	1	0.9	0.866667
600	0.8	1.2	1	1
1200	2.3	2.2	2.8	2.433333
3600	6	4.6	5	5.2

Analysis

From the graph, it can be seen that as the number of turns increased, the voltage induced increased. This proves my prediction was correct. My prediction was correct because as I increased the number of turns, the magnetic field increased. This meant that it increased the magnetic force. This made the magnetic field stronger too. From the graph I have plotted the average from my results and I have also plotted a line of best fit. I found that my prediction was correct because the graph clearly shows the increase. The induced voltage seemed to greatly increase this looked

worrying at first however this was because in my experiment the number of coils greatly increased in uneven amounts which meant it was difficult to draw a completely accurate conclusion however the basic prediction still was correct.

Evaluation

I think that my results were quite accurate. I think to improve my experiment further, I would take the results several more times in order to prove that the values are completely accurate. I could also investigate a higher number of coils and have a range of coils with turns going up by the same each time, as this would show the results more accurately. This was because in my experiment the number of coils greatly increased which meant it was difficult to draw a completely accurate conclusion however the basic prediction still was correct. I think this was quite a fair test because I was able to keep the other variables constant. I also took an average this would mean that I was able to get a more accurate range. My measurements were made as accurate as possible by carrying out all the things as mentioned in fair test and by producing replications of the same experiment. If I were to do the experiment again I would I would carry out an experiment when there were no coils wrapped around it so this can be taken into account in my analysis. I feel that this experiment could be improved by having a digital voltmeter, as it was difficult to read the results exactly to get a more accurate result