Electro-magnetic Induction

Plan

During this investigation I shall be looking at electro -magnetic induction. Electro-magnetic induction happens when a magnet is moved in or near a coil. In order for a current to be induced, the coil has to be part of a complete circuit. Even without a complete circuit, a potential difference is still induced across either end of the coil. Moving a magnet into a coil causes a current to be induced in one direction and then moving it back out of the coil induces a current in the opposite direction.

A voltage can only be induced by the movement of the coil in the magnets magnetic field or the movement of a magnetic field round a coil. If there is no movement, then no voltage will be induced.

There are several different input variables that I could change for this experiment, each one having an effect on the induced voltage. These variables are:

- Strength of the magnet
- Speed the magnet is moving
- Number of turns in the coil
- Area of the cross-section of the coil

The output variable that I am going to measure for the experiment is the voltage that is induced by the input variable.

For this investigation I shall pose the question 'how does the amount of turns in a coil affect the voltage induced?' This means that the i nput variable I am going to change will be the number of turns in my coil and I shall measure the change by the voltage induced.

To make sure my experiment is a fair test, I shall keep the following variables the same:

- Strength of the magnet
- Speed the magnet is moving
- Area of the cross-section of the coil

These variables have to remain the same as, if any of them were changed then it would have an affect on the results I achieve.
In order to keep the strength of the magnet the same, I shall use the same magnet throughout the whole experiment, as I know its strength will not fluctuate. To keep the speed of the magnet the same I am going to drop it from the same height for each attempt, as this will ensure that its acceleration stays the same throughout. To make sure the area of the cross-section of the coil stays the same, I shall put my coils around pieces of cardboard tube which all have the same diameter.

I predict that more turns are in a coil, the higher the induced current will be. I think this because when a coil made up of one turn cuts through a magnetic field, a certain voltage is induced. If you were to double the number of turns in the coil, then the induced voltage would double. This leads me to predict that my results will give me a linear graph due to the linear relationship of my input and output variables.

Method

Apparatus

Retort stand
Magnet
2 leads
Ruler
Voltmeter
2 crocodile clips
5 coils (10, 20, 60, 90 and 20 turns)
Empty butter tub with foam in

Diagram

1. Secure coil in the clamp on the retort stand.
2. Measure distance from table to top of coil to ensure distance is 25cm.
3. Connect crocodile clips to either end of the coil.
4. Connect leads to crocodile clips.
5. Plug leads into voltmeter, creating complete circuit.
6. Place foam-filled tub underneath coil.
7. Place the 30cm ruler next to the coil, making sure that it is resting on the table.
8. Take magnet and hold at the top of the ruler with bottom of magnet in line with top of ruler.
9. Drop magnet through the coil.
10. Record the reading on the voltmeter.
11. Repeat five times with each different coil.

Results

I repeated the experiment five times for each different coil and took the average which gave me more accurate results than if I had only done it one for each. I took my results and plotted them on a graph.

Results table to show the voltage induced in a coil when the number of turns are altered

		Voltage (MV)	
Number of turns	Repeat	Voltage induced	Average
10	1	2.0	2.4
10	2	3.0	
10	3	2.0	
10	4	2.0	
10	5	3.0	
20	1	5.0	4.6
20	2	4.0	
20	3	4.0	
20	4	5.0	
20	5	5.0	
60	1	10.0	10.8
60	2	11.0	
60	3	11.0	
60	4	10.0	
60	5	12.0	
90	1	15.0	15.0
90	2	17.0	
90	3	16.0	
90	4	12.0	
90	5	15.0	
120	1	21.0	20.0
120	2	19.0	
120	3	19.0	
120	4	20.0	
120	5	21.0	

Conclusion

During this investigation I have been looking at how changing the number of turns in a coil affects the size of an induced voltage. I made the prediction that the more turns there are in a coil, the higher the induced voltage will be. I found that this was true. This means that the relationship between my two variables is that the higher the number of turns, the higher the voltage induced. This is shown by the fact that when I tested the coil with 10 turns I got an average voltage of 2.4MV and then when I tested the coil with 20 turns I got an a verage voltage of 4.6MV which is just about double that of 10 turns. This also proves that my second prediction, that my results would give me a linear graph, is true. This is also shown on the graph I constructed using my results. The line is almost perfectly straight. All of my points were close to the line of best fit.

Evaluation

In my opinion, my method for this investigation worked well, but I feel that there are a few areas that could have been improved.

The most difficult part of the investigation, I felt, to keep reliable was taking the reading on the voltmeter as the magnet passed through the coil. This is because it moved so fast that it was hard to keep track of with my eyes. This may have resulted in some readings being misread. One way of overcoming this problem would be to use a digital voltmeter that clocked the highest reading reached. Another problem with this investigation is dropping the magnet from the same height, as I tended to move the magnet up or down a little by accident and so th e magnet was not always dropped from exactly the same height.

Despite these problems I still think that my results are reliable as all my results are pretty similar. Also my results are pretty close to my line of best fit.