



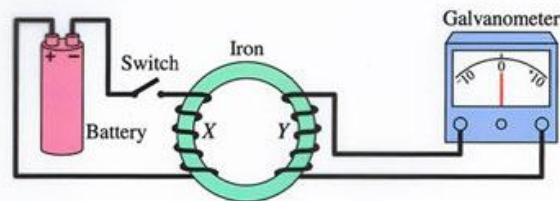
MND Physics

Electromagnetic Induction

Induced EMF is produced by a changing magnetic field.

KEYWORD: Changing!

It took Michael Faraday many years to discover this fact. He initially met with no success studying steady currents. Faraday used an apparatus much like this one:



It was through careful observation that he noticed a deflection in a galvanometer as he opened or closed the switch in the circuit. Faraday concluded that although a steady magnetic field produces no current, a **CHANGING** magnetic field can produce an electric current!

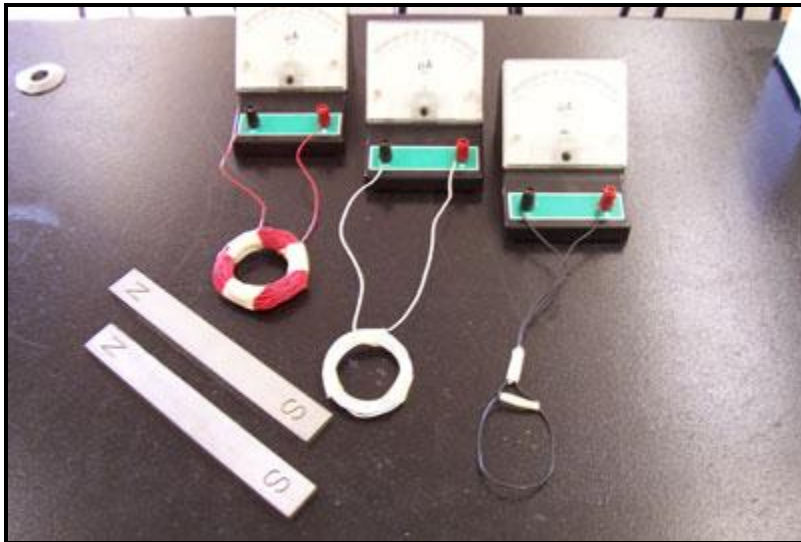
You are to create a lab for investigating how the three variables on the right hand side of the equation illustrated below effects the production of a potential difference represented by the left hand side of the equation (production of emf or potential difference gives rise to an electrical current). The magnetic field strength (B), the length of wire (l), and the rate of change of the magnetic field strength relative to the wire (v) are all variables you should have the student investigate:

$$emf = Blv$$

(In order to simplify our above equation (and investigation), we assume the magnetic field remains perpendicular to the wire loop)

AVAILABLE EQUIPMENT:

Galvanometers, 3 sizes of wire loops, 1 turn loop (black wire), 25 turn loop (white wire), 50 turn loop (red wire), 2 bar magnets.



PROCEDURE:

You have been given that $\text{emf} = Blv$ (for a perpendicular B field). Using the above equipment, have the student show experimentally that this relationship is, in fact, true.

Create a procedure for the lab student to investigate the relative effects of "B", "l", and "v" on emf production. You should be asking for **RELATIVE** changes and effects. Therefore, qualitative observations are acceptable; your students are not expected to perform quantitative calculations. Your lab, however, must be designed in such a way as to bring the lab student to a place where they can submit convincing evidence that $\text{emf} = Blv$.

EXPERIMENT GUIDELINES

1. It will help your student's investigation to recall that an increase/decrease in magnitude of any variable on the right hand side of the equation should increase/decrease the magnitude of the left hand side of the equation i.e. the emf.
2. Have your student keep 2 of the 3 variables constant while they investigate changes caused by changing the third variable.
3. There is actually a 4th variable in this investigation, the relative angle between the magnetic field and the wire loop! However, you can eliminate this variable if the magnetic field (the bar magnet) is always perpendicular to the wire loops.
4. Relative magnetic field strength (B) can be increased by adding a second magnet; make sure your students line up the poles so that they face the same direction! Otherwise you will cancel the effect of the B field.
5. Make sure your student's investigation includes an examination of the effects of all three variables, B, l, and v on emf strength.

DATA:

Create tables for the student to record lab data.

ANALYSIS:

Design an analysis section. Tell your student what you want analyzed.

QUESTIONS:

Create questions for your students to answer. Here is an example (do not use this one in your write-up):

1. Transformers are found everywhere: in TV sets, computers, i-pods, on utility poles to supply power to our homes, and many other applications. A transformer is a device for increasing or decreasing an AC voltage. Why does a transformer operate only for AC applications and not for DC applications? Be specific.