Electromagnetic Induction Lab

Lab Specifics

Learning Goals:

1. Construct a testing experiment to test a hypothesis
2. Collect and analyze graphical data carefully and recognize patterns
3. Use graphical data to test a hypothesis
4. Apply tested hypothesis to new situation

Available Equipment

- Bar Magnet
- Galvanometer
- Copper Coils (Different Loop numbers)
- Vernier Magnetic field Sensor
- Vernier Voltage Sensor
- Logger Pro

Part 1: Observation Experiment

Goal:

Your goal is to design as many experiments as you can to cause a current to run through the wire loop with the magnet (also called inducing a current). Come up with as many situation as you can that will induce a current in the wire loop.

a) First decide how you will set up the experiments to see if a current is actually induced in the wire (look at the equipment list).
b) For each experiment, explain what you did, draw a diagram, and make sure to specify if a current was induced.
c) Once you find a situation that works, look at the experiment and decide on the variables involved in inducing a current.
d) From this, come up with a relationship between the variables and the current induced in the coil.

Rubric:

Scientific Ability	**Missing(0)**	**Inadequate(1)**	**Needs Some Improvement(2)**	**Adequate(3)**
Is able to design a reliable experiment that investigates the phenomenon	The experiment does not investigate the phenomenon.	The experiment may not yield any interesting patterns.	Some important aspects of the phenomenon will not be observable.	The experiment might yield interesting patterns relevant to the investigation of the phenomenon.

Scientific Ability	Missing(0)	Inadequate(1)	Needs Some Improvement(2)	Adequate(3)
Is able to decide what parameters are to be measured and identify independent and dependent variables	The parameters are irrelevant.	Only some of parameters are relevant.	The parameters are relevant. However, independent and dependent variables are not identified.	The parameters are relevant and independent and dependent variables are identified.
Is able to identify a pattern in the data	No attempt is made to search for a pattern	The pattern described is irrelevant or inconsistent with the data	The pattern has minor errors or omissions	The patterns represents the relevant trend in the data
Is able to devise an explanation for an observed pattern	No attempt is made to explain the observed pattern.	An explanation is vague, not testable, or contradicts the pattern.	An explanation contradicts previous knowledge or the reasoning is flaw.	A reasonable explanation is made.
Is able to identify the assumptions made in devising the explanation	No attempt is made to identify any assumptions.	The assumptions are irrelevant or incorrect.	Some significant assumptions are not mentioned.	Most significant assumptions are correctly identified.

Part 2: Testing Experiment

Goal:

Your friend Mike, after conducting the above experiment decided that the induced EMF in a coil by a magnet can be given by the following equation:

$$|\varepsilon| = \left|\frac{\Delta\Phi_B}{\Delta t}\right|$$

Where $\Delta\Phi_B/\Delta t$ is the change in magnetic flux over time, where flux, as we learned, is given by:

$$\Phi_B = BA\cos(\theta)$$

Using the equipment available, conduct an experiment to test Mike's Hypothesis.

Rubric:

Scientific Ability	Missing(0)	Inadequate(1)	Needs Some Improvement(2)	Adequate(3)
Is able to design a reliable experiment that tests the hypothesis	The experiment does not test the hypothesis.	The experiment tests the hypothesis, but due to the nature of the design it is likely the data will lead to an incorrect judgment.	The experiment tests the hypothesis, but due to the nature of the design there is a moderate chance the data will lead to an inconclusive judgment.	The experiment tests the hypothesis and has a high likelihood of producing data that will lead to a conclusive judgment.
Is able to make a reasonable prediction based on a hypothesis	No attempt to make a prediction is made.	A prediction is made that is distinct from the hypothesis but is not based on it.	A prediction is made that follows from the hypothesis but does not incorporate assumptions	A correct prediction is made that follows from the hypothesis and incorporates assumptions.

Scientific Ability	Missing(0)	Inadequate(1)	Needs Some Improvement(2)	Adequate(3)
Is able to decide whether the prediction and the outcome agree/disagree	No mention of whether the prediction and outcome agree/disagree.	A decision about the agreement/disagreement is made but is not consistent with the outcome of the experiment.	A reasonable decision about the agreement/disagreement is made but experimental uncertainty is not taken into account.	A reasonable decision about the agreement/disagreement is made and experimental uncertainty is taken into account.
Is able to make a reasonable judgment about the hypothesis	No judgment is made about the hypothesis.	A judgment is made but is not consistent with the outcome of the experiment.	A judgment is made and is consistent with the outcome of the experiment but assumptions are not taken into account.	A reasonable judgment is made and assumptions are taken into account.
Is able to revise the hypothesis when necessary	A revision is necessary but none is made.	A revision is made but the new hypothesis is not consistent with the results of the experiment.	A revision is made and is consistent with the results of the experiment but other relevant evidence is not taken into account.	A revision is made and is consistent with all relevant evidence.

a) Think about what you are trying to do in this kind of experiment. Construct an experiment that will test the hypothesis. Make sure to include a verbal description of the experiment as well as a diagram showing your experimental setup.
b) How will you conduct the experiment?
c) Based on the hypothesis, what results do you predict?
d) What assumptions are you making in your prediction?
e) Do the experiment and record all data in a clear way(construct data tables, print out graphs, etc).
f) Do the results of the experiment match your prediction?What assumptions that you made might affect the results? What uncertainties are there in your experiment, are these significant enough to effect the results?
g) Make a judgment about your results.
h) If necessary, revise Mike's hypothesis.