**Faraday’s**

**Electromagnetic Induction**

Electricity and Light

Unit 5

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This lab uses the **Remote lab** platform from PhET Interactive Simulations at University of Colorado Boulder, under the CC-BY 4.0 license.

Download the simulation from: <https://phet.colorado.edu/en/simulation/faraday>

If you cannot open the application, you might need to install Java first <https://www.java.com/en/download/windows-64bit.jsp>

Learning Goals:

* + Identify the dipole nature of magnets
  + Understand the principle of induction.
  + Explain how to use a magnet to light a bulb
  + Explain the process of mutual induction

Pre lab Questions (10 points)

Type Your Answers in Blue

Students are asked to refer to the course book for required Theory to complete the pre lab and the rest of the labs.

1. **What is electromagnetic induction? (1)**

A current is created by voltage production (also known as electromotive force) as a result of a shifting magnetic field.

1. **What is the unit for Electromotive force (emf)? (1)**

Students typically regard emf as a force and specify its unit in Newton (N). But because emf is a potential difference caused by a changing magnetic field rather than a force, its unit is the volt (V).

1. **What is Faraday’s Law? What two things does it relate?** (3)

Faraday law states that a voltage is induced in a circuit whenever relative motion exists between a conductor and a magnetic field and that the magnitude of this voltage is proportional to the rate of change of the magnetic flux. So Faraday law gives a relation between induced voltage and changing magnetic flux.

1. **What is Lenz’s Law? What does it conserve? (2)**

Lenz's law states that when an emf is produced by a change in magnetic flux according to Faraday's Law, the polarity of the induced emf is such, that it produces a current which tries to opposes the change which produces it.Lenz law conserves total energy.

**5. In the early 1830’s physicist Michael Faraday discovered magnetic induction. In his experiment, emf was induced in a coil of wire by a bar magnet. What did Faraday observe when the magnet is at rest and when it is moving? (3)**

Faraday noted that no emf is produced in the coil while the magnet is at rest. However, when a magnet moves, a coil generates an emf whose polarity relies on the magnet's direction of motion and whose amplitude depends on the rate of motion.

1. **Bar Magnet**

A screenshot of a computer

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Q1.1 Describe how does the compass interact with the bar magnet

The north needle of the compass is always pointing towards the south bar of magnet

Q1.2 If we say the magnetic field lines are pointing from North to South outside of the magnet, what happens to it when it’s inside the magnet?

If it was inside the magnet then , magnetic fiels goes from south pole to north pole

1. **Pickup Coil**

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Q2.1 When you move the magnet towards the coil (as in the diagram), describe what happens inside the coil.

Current is Induced, directed upward(i.e, electrons flow downward)

Q2.2 When you move the coil towards the magnet, describe what happens inside the coil. Did the direction of the moving charges change?

Current is Induced, Direction is same as the magnet moving to the right

Q2.3 When you move the magnet away the coil, describe what happens inside the coil. Did the direction of the moving charges change?

Electrons flow upward

Q2.4 Suggest how you can make the lamp brighter.

1. Moving the magnet faster
2. Increase the number of loops
3. Increase the strength of Magnet

Q2.5 Change the bar magnet strength to 20%. How did the brightness of the lightbulb change? Why?

Less Bright

1. **Electromagnet**

A screenshot of a computer

Description automatically generated

Q3.1 Suggest two ways of how you can make the induced magnetic field strength weaker.

1. Lower Voltage
2. Less number of coils

Q3.2 What happens when you reverse the direction of the battery?

Reverse the direction of the B-field

Q3.3 What happens when you change the current source to AC?

The B-filed direction changes periodically

1. **Generator**

A screenshot of a cell phone

Description automatically generated

Q4.1 Open the water tap. You should see the lamp is on continuously. Explain why.

The water keeps turning the wheel and magnet continuously.Hence there is always a change of magnetic field strength experienced by the coil.According to Faraday Law, whenever there is a change of magnetic fluxlinkage, there is an induced emf.Since the circuit is completed with the lamp, a current will be induced and flow through the lamp, so the lamp is on continuously

Q4.2 Suggest FOUR ways to obtain a brighter lamp

* More number of loops
* Greater flow of water
* Greater loop Area
* Greater Magnetic field

1. **Transformer**

A screenshot of a computer

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Q5.1 Move the battery and coil towards the right quickly and stop. Describe what happens to the lamp.

When move towards the right the lamp was lit and then went off

Q5.2 Suggest TWO ways of how you can keep the lamp on forever using the battery coil. (Do not change to AC)

1. Moving the coil with lamp back and forth
2. Changing the voltage of the battery periodically

Q5.3 Change the current source to AC. You should see the lamp go shining continuously. This is process is called MUTUAL INDUCTION. Explain why this happened step by step.

So since alternating current would induce B-field with alternating direction in the coil, there will be a constant change of magnetic flux linkage experienced by the lamp coil and According to Faradays Law there would be changing emf and hence changing current across the lamp coil

Q5.4 Suggest SIX ways to increase the brightness of the lamp when AC is used:

1. Increase AC frequency
2. Increase the number of lops of the AC supply coil
3. Increase the AC current amplitude
4. Increase the number of lops of the lamp coils
5. Reduce the separation between the two coils
6. Increase the loops area of the lamp coil