**Magnetic Field Mapping and Induction Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Course:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Time:\_\_\_\_\_\_\_\_\_\_    Partner(s):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**A. Magnetic Field Mapping**

Map the magnetic field lines for a bar magnet and a horse-shoe magnet and attach your mappings to this report.

**B. Electromagnetic Induction**

**Purpose:** Investigate the electromotive force (emf) induced in a solenoid by a moving magnet.

**Apparatus:** PC w/interface, voltage sensor, solenoid, magnets (bar and horse-shoe), and soft-box (to catch the magnet).

**Theory:**

When a magnet is passed through a coil there is a changing magnetic flux through the coil which induces an electromotive force, emf. According to Faraday's law of induction the induced emf, *ξ* is given by; where *B*┴ is the magnetic field perpendicular to the area *A* and *N* is the number of turns in the coil.



In this activity, a plot of the emf *versus* time is made and the area under the curve represents the magnetic flux.

**Procedure:**

1.  Connect the voltage sensor to analog channel A.

2. Plug in the red and black leads from the voltage sensor to the solenoid and place the solenoid vertically on the lab table.

3. Open DataStudio, select Open Activity, select Library, select Physics Labs, select P30 Induction, and select the Voltage Graph display.

4. Place one side of the horse-shoe magnet inside the solenoid.

5. Click Start and remove the horse-shoe magnet. If nothing is displayed, place the other side of the magnet and try Procedure (5) again.

6. Measure the peak value of the induced emf using the Smart Tool and the magnetic flux (area under the V vs. t graph) using the Statistics (Σ) menu. (First high-light the peak and then click on "area" under "Statistics")

7. Repeat procedures 4-6, for removing the magnet quicker, and complete the data table for the horse-shoe magnet.

8. Remove the horse-shoe magnet data and obtain a blank display.

9. Place the soft-box on the floor close to the edge of the table and hold the solenoid vertically above it.

10. Click Start and drop the bar magnet, N-pole down, through the solenoid.

11. The data collection will stop automatically. You should see two peaks.

12. Magnetic flux is obtained by finding the area under the V vs. t graph. (First high-light the peak and then click on "area" under "Statistics")

DATA

a. Horse-shoe magnet

|  |  |  |
| --- | --- | --- |
|  | Slow removal | Quick removal |
| Peak value of the induced emf |  |  |
| Magnetic flux (Area under the V vs. t graph) |  |  |

Q1. Why the magnitude of the peak value of the induced emf is higher for the quick removal?

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Q2. Is the magnitude of the magnetic flux equal for the two peaks?

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b. Bar magnet:

|  |  |  |
| --- | --- | --- |
|  | First Peak | Second Peak |
| Peak value of the induced emf |  |  |
| Magnetic flux (Area under the V vs. t graph) |  |  |

Q1. Is the magnitude of the magnetic flux equal for the two peaks?

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Q2. Why the magnitude of the peak value of the induced emf is higher for the second peak?  
  
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Q3. Describe how the display will change if the S-pole is down when the bar magnet is dropped.

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Q4. Click Start again and drop the bar magnet, this time S-pole down, through the solenoid. Describe and explain what you see. Does this support your prediction in Q3?  
  
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Write a conclusion for B on a separate last page.