Student's Name: ______________________________ Student's Name: ______________________________

Lab day & time: ___________________ Date: __________________

Electromagnetic Induction (E6) - Data Sheets

Write all results on the data sheets in ink.

Activity 1: Voltage Induction Using a Magnet *(1.5 p.)*

1.2. Magnet inside the coil, but not moving (i.e., static magnetic field). Click on the Statistics tool  and select the mean value.

The average (mean) induced emf. $\mathcal{E}$= _____________ (   )

1.3. Move the magnet (once) in and out of the coil.

Measure the maximum value $\mathcal{E}_{max}$ of the induced <u>emf for quickly moving magnet</u>:

Click on the Statistics tool  and select the maximum value.

$\mathcal{E}_{max}$ = _____________ (   )

1.4. Measure the maximum value $\mathcal{E}_{max}$ of the induced <u>emf for slowly moving magnet</u>:

$\mathcal{E}_{max}$ = _____________ (   )

Compare this result with the result for *Activity 1.3*. <u>Explain</u> the difference (use Faraday's Law).

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1.5. Move the magnet (once) in and out of the coil (<u>magnet reversed</u>).

Describe the change in the induced voltage vs. time dependence after reversing the orientation of the magnet.

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Activity 2: Voltage Induction Using a Coil with Current *(2 p.)*

2.3. DC current in the primary coil.

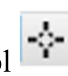
What is the average (mean) value of the induced emf in the secondary coil? Click on the Statistics tool  and select the mean value.

$\mathcal{E}_{\text{av}}$ = ______________ (   )

2.5. AC current, f = 200 Hz in the primary coil.

What is the maximum value of the induced emf in the secondary coil? Click on the Statistics tool  and select the maximum value. **Print** a copy of this graph.

$\mathcal{E}_{\text{max}}$ = ______________ (   )

Measure period and frequency of the induced emf. Use the "Coordinates" tool  and select "Multi-Coordinates" option.

f = ______________ (   )

What is this frequency relative to the frequency in the primary coil?

2.7. AC current, f = 100 Hz in the primary coil.

What is the maximum value of the induced emf in the secondary coil?

$\mathcal{E}_{\text{max}}$ = ______________ (   )

What is the frequency of the induced emf in the secondary coil?

f = ____________ (   )

What is this frequency of the induced voltage relative to the frequency in the primary coil? ____

2.8. How does the change in frequency change the amplitude of the induced emf? Please explain!

Hint: how does lowering the frequency affect the Δt in the formula $\mathcal{E}(t) = -\frac{\Delta\Phi_B}{\Delta t}$?

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2.9. AC current, f = 400 Hz in the primary coil.

What is the maximum value of the induced emf in the secondary coil?

$\mathcal{E}_{max}$ = ____________ (   )

Activity 3 : Transformers and Coils *(2 p.)*

3.2. What is the maximum value of the induced emf for the two 400-turn coils (>10 cm apart)?

Induced voltage (coils separated) $\mathcal{E}_{max}$ = ____________ (   )

3.3. What is the maximum value of the induced emf for the two 400-turn coils moved as close as possible together?

Induced voltage (coils together) $\mathcal{E}_{max}$ = ____________ (   )

How the mutual inductance M of these two coils has changed compared to 3.2? Check the *Theory* section.

Mutual Inductance M : *increased / decreased / remained the same* (circle one)

3.4. What happened to the induced emf when the magnetic steel frame was used? (i.e., did it increase or decrease)?

Induced voltage (with magnetic steel frame) $\mathcal{E}_{max}$ = ____________ (   )

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3.5. Exchange the #1 (the one connected to the OUTPUT terminals) 400-turn coil with the gray 800-turn coil. Keep the magnetic steel frame!

3.6. For the **800-turn primary** (#1) coil and the **400-turn secondary** (#2) coil:

#1 (primary) coil voltage = ______________________ (   )

#2 (secondary) coil voltage = ______________________ (   )

Calculate the ratio of secondary coil voltage to primary coil voltage according to the formula: $\frac{\#1\text{ voltage}}{\#1\text{ turns}} = \frac{\#2\text{ voltage}}{\#2\text{ turns}}$ for an ideal transformer?

$$\frac{secondary\ coil\ voltage}{primary\ coil\ voltage} = \_\_\_\_\_\_\_\_\_\_$$

For the 800-turn primary (#1) coil and the 400-turn secondary (#2) coil, <u>circle</u> the appropriate choice:

- The new induced emf is **HIGHER** or **LOWER** than the 400/400 arrangement.
- Is it a **STEP-UP** or **STEP-DOWN** transformer?

3.7. Connect the coil #2 to the OUTPUT terminals and the coil #1 to the Analog Channel A (i.e., swap the cables).

3.8. For the **400-turn primary** (#1) coil and the **800-turn secondary** (#2) coil:

#1 (primary) coil voltage = ___________________________ (   )

#2 (secondary) coil voltage = ___________________________ (   )

Calculate the ratio of secondary coil voltage to primary coil voltage according to the formula: $\frac{\#1\text{ voltage}}{\#1\text{ turns}} = \frac{\#2\text{ voltage}}{\#2\text{ turns}}$ for an ideal transformer?

$$\frac{secondary\ coil\ voltage}{primary\ coil\ voltage} = \_\_\_\_\_\_\_\_\_\_$$

For the 400-turn primary (#1) coil and the 800-turn secondary (#2) coil, circle the appropriate choice:

- The new induced emf is **HIGHER** or **LOWER** than the 400/400 arrangement.
- Is it a **STEP-UP** or **STEP-DOWN** transformer?

Complete the lab report and return it to the lab TA.