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| |  |  |  | | --- | --- | --- | | **Lab on Faraday and Lenz’s Law** | **Name** |  | |  |  |  | |  | **Date** |  | |
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| |  |  |  | | --- | --- | --- | |  | **Partner #1** |  | |  |  |  | |  | **Partner #2** |  | |
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| **Faraday and Lenz’s Laws Lab Handout/Worksheet** |
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| This lab provides you with an opportunity to study electromagnetic induction up close. Take advantage of this opportunity to try things with the equipment. If you are unsure if you will damage something, ask the instructor. Read the tasks below and perform these exercises, provide the input (directions and other simple words) asked for, and answer the questions as completely as possible. |
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| Please note that the compass needles in the lab are sometimes flipped. The bar magnets are sometimes flipped or fractured (more than one north or south pole along the length of the bar magnet. Before using the compass, verify that it does point north. Go out in to the hallway. With the lab room on your left, North should lie between the window, by the stairs right there on your left, and the main Physics Department office, on your right. Note which end of the compass is pointing that way. That is the north pole of the compass needle. |
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| Once you have determined which end of the needle is the north pole for the compass, check the poles of the bar magnet. The north pole of the bar magnet should cause the north pole of the compass needle to point away from it. The south pole of the bar magnet should cause the north pole of the compass needle to point towards it. Verify your magnets have the poles properly labelled. |
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| If either the compass or the bar magnet is not properly marked, just remember that as you do the experiment. Please **do not add** tape or other permanent or even temporary markings by ink or pencil, etc. to the compass or the magnet. |
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| **Experiment #1 Determining Magnetic Properties of a coil carrying a current** |
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| With the compass on the left side of the larger square coil and the coil set up as shown with the current flowing through it, note which way the compass North needle points to left of compass or to right. Remember means current is coming out of the paper and means current is going into paper. |
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| |  |  |  |  | | --- | --- | --- | --- | | **Place N or S** |  | **Place N or S** |  | | **N** |  | **S** |  | |  |  |  |  | |  |  |  |  | |
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| **Experiment #2 Comparing a bar magnet to a coil with a current flowing in it** |
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| Wire up the large square coil paying careful attention to which way the current will flow at the top and bottom of the coil as identified in the diagram below. Determine which way the current must go to create the magnetic fields indicated. Use the compass to verify the resulting magnetic field directions. |
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| In the diagrams below correctly identify which way the current is going in the coil which you should consider is oriented similar to this |
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| The represent the place where the current is either going into the plane of the paper or coming out of the plane of the paper. In the diagram below mark for the coils whether the current is going into the paper at that point or coming out of the paper by typing in the words, “in” or “out” For the bar magnets below type an N or an S to represent whether the poles are north or south. |
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| **Experiment #3 Inducing a current with a magnet** |
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| Connect the two terminals of the large square coil to the galvanometer directly, (no power supply should be connected!).Move a bar magnet in the region around and near the coil. Experiment a little by changing which pole is near the coil or in the coil, how fast you are moving the magnet, etc. Observe how the galvanometer behaves. |
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| By looking at the galvanometer needle, you can determine the direction the current is flowing in the coil using the following rule. If the galvanometer needle swings to the left, the current is entering from the left terminal. If the galvanometer needle swings to the right, the current is entering from the right terminal. This is illustrated below. |
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| To find the current direction in the coil, note that you have to examine the way the wire is wound onto the coil. |
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| For each situation below write whether the current is coming out of the paper or going into the paper for both the top of the coil and the bottom of the coil as you did in experiment #2. |
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| **Experiment #4 Explaining Induced Current Using Lenz’s Law** |
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| For the four situations pictured in Experiment #3, you are going to provide rationale for why the current was induced in the direction it was. Note: you may not say, cause we saw it that way in the lab! |
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| I have provided an example for the first one. I mention the important things that you should mention similarly for the remaining three! As shown, you do not have to write on all four lines. |
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| |  |  |  |  | | --- | --- | --- | --- | | **Out** |  |  | 1.As the magnet approaches the coil a strong B field points to the left increasing in the coil. | |  |  | 2.To oppose the change, an induced B field must point to the right in the coil. | | **In** |  | 3.To create a B field pointing to the right the induced current in the coil must come out the top of the coil and go in at the bottom. | |  |  |  | 4. | |
| |  |  |  |  | | --- | --- | --- | --- | |  |  |  | 1. | |  |  | 2. | |  |  |  | |  |  | 3. | |  |  |  | 4. | |  |  |  | 1. | |  |  | 2. | |  |  | 3. | |  |  |  | 4. | |  |  |  | 1. | |  |  | 2. | |  |  | 3. | |  |  |  | 4. | |
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| **Experiment #5 Inducing current from one coil to another (Transformers)** |
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| Wire up the inner coil to the power supply as shown. Leave the iron core in the coil to increase the magnetic field that results from this. Wire the galvanometer to the outer coil as shown. |
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| As indicated in the diagram, if the inner coil is wired to the power supply as shown the inner core should act as if a North Pole is on the right and the B field created should point to the right. If you are in lab verify this with a compass. Experiment with moving the inner coil near and into the outer coil. Check the galvanometer. Is the outer coil’s induced current behaving the way it should? For the cases below, indicate whether the outer coil has induced current in the orientation of A or B as shown here |
| |  |  | | --- | --- | |  |  | | **A** | **B** | |
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| Case #1 |
| |  |  |  | | --- | --- | --- | | Action | Primary coil | Secondary coil | | Move coils together (primary on) | A |  | | Move coils apart (primary on) | A |  | | With the Primary Coil inserted into the Secondary Coil Switch off primary | A |  | | With the Primary Coil inserted into the Secondary Coil Switch on primary | A |  | |
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| To do the next set of cases rewire the inner coil so that you are in configuration B like so |
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| Then repeat the actions now that the inner coil is of the opposite polarity and note what the induced current is in the secondary. |
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| Case #2 |
| |  |  |  | | --- | --- | --- | | Action | Primary coil | Secondary coil | | Move coils together (primary on) | B |  | | Move coils apart (primary on) | B |  | | With the Primary Coil inserted into the Secondary Coil Switch off primary | B |  | | With the Primary Coil inserted into the Secondary Coil Switch on primary | B |  | |
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