Period 17 Activity Sheet: Induction Motors and Transformers

Activity 17.1: What Is Induced Current?

a) Inducing Current
   1) Connect a solenoid to the large galvanometer that measures electric current. Move a magnet near and into the solenoid. Describe what happens.

   2) Hold the magnet still and move the solenoid wire. Describe what happens.

   3) What happens if neither the magnet nor the solenoid wire is moving?

   4) Connect one hand-cranked generator to a second hand-cranked generator and make the second generator spin. How is this activity similar to a generating plant? How is it similar to a motor?

b) Direct Current and Alternating Current
   1) Move a magnet into and out of the small coil of wire with red and green bulbs attached. How must you move the magnet so that the red bulbs light and then the green bulbs light?

   2) Is the current that you induce as you move the magnet direct current (DC) or alternating current (AC)? ________ How do you know?

   3) Connect the hand-cranked generator to the coil with read and green bulbs and turn the crank. Is the current you that induce DC or AC? ________ How do you know?
Activity 17.2: What Is Induced Magnetism?

a) Your instructor will demonstrate a large solenoid, which is connected to a variable current source.

1) What happens when a small light bulb is placed near the solenoid?

2) What happens when a disc and a shield are held near the solenoid?

3) What happens when a solid ring is placed over the solenoid?

4) What happens when a ring with a slit is placed over the solenoid?

5) Move a solid ring and a slit ring over the end of a large U-shaped magnet. What do you feel when you move the rings?

6) Why is there a difference between the solid ring and the slit ring?

b) Your instructor will demonstrate a pendulum, which swings between the poles of a large magnet. On the end of the pendulum are discs of various shapes.

1) Which shape of disc causes the pendulum to stop abruptly?

2) Which shape of disc permits the pendulum to swing freely?

c) Hold the long aluminum tube upright with a foam pad on the floor beneath it. Drop one blue slug down the tube. Now drop the other blue slug down the tube.

1) What is the difference between the two blue slugs?

2) Explain what you observed using the principles of induced magnetism.
d) Your instructor will demonstrate several induction motors.

1) Examine the small black induction motor on your table. Why doesn't this motor need a permanent magnet?

2) Explain what causes the rotor in an induction motor to turn.

3) A watt hour meter is an example of an induction motor. How is the watt hour meter similar to the spinning disc your instructor held near the large solenoid?

**Activity 17.3: How Do Transformers Work?**

a) **Make a transformer** with the large coil of wire. Connect the coil to the power strip. Loop a piece of wire through the center of the coil several times. Attach the ends of the wire to a 4 bulb tray.

1) Note the brightness of the bulbs.

2) Wrap more turns of wire around the coil. What happens to the bulb brightness?

3) What happens to the bulbs when you use fewer turns of wire? ________________

4) How many turns of wire are in the large coil? Loop the wire through the coil several times and attach the ends of the wire to a digital multimeter. Set the meter to AC voltage and read the output voltage, $V_s$. Assume that the input voltage, $V_p$, is 120 volts. Calculate the number of turns of wire in the large coil. __________

5) How does a current in one coil of wire in a transformer induce a current in a second coil of wire?

6) How is a transformer like a simple machine?
7) Your instructor will demonstrate large transformers and the high voltage they can produce with a “Jacob’s ladder.” What evidence do you see that a large voltage exists between the two “ladders”?

**Activity 17.4: Superconductivity and Induced Magnetism**

1) Your instructor will give you a small magnet and a cup with a piece of superconducting material attached to the bottom. Very carefully pour small amounts of liquid nitrogen on the superconductor to cool it. (Caution: Liquid nitrogen can quickly freeze your skin.) Hold the small magnet above the cold disc with tweezers and release the magnet. What happens?

2) What force holds the small magnet above the superconducting disc?

3) How does the magnet induce a current in the superconducting disc?

4) Why is a superconductor needed for this activity?