Name _____ Section _____

Period 17 Activity Sheet: Induction Motors and Transformers

Activity 17.1: How Can Current Be Induced in a Closed Circuit?

a) Connect the tan coil of wire to the large galvanometer that measures electric current. Move a magnet near and into the wire coil. Describe what happens.

b) Hold the magnet still and move the coil of wire. Describe what happens.

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

Activity 17.2: How Do Generators Work?

a) Attach a hand-cranked generator to a small motor and turn the crank. Explain what happens inside the generator when the crank turns to create an electric current.

b) List the energy conversions that take place when you crank the generator and make the motor's shaft turn.

c) 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?

Activity 17.3: Is Induced Current Alternating or Direct Current?

a) 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?

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

c) Connect the hand-cranked generator to the coil with red and green bulbs and turn the crank. How must you turn the crank to generate AC current?

Activity 17.4: What Is Induced Magnetism?

a) 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?

b) 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?

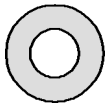
2) Explain what you observed using the principles of induced magnetism.

c) Using your observations from parts a) and b), what can you conclude about the force between the induced magnetism and the magnet that induces it?

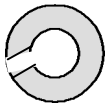
d) Your instructor will demonstrate a **large solenoid,** which is connected to a variable current source.

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

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



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



4) 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?

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

Name _____ **Section** _____

Activity 17.5: What Is an Induction Motor?

Your instructor will demonstrate several induction motors.

a) What happens when your instructor holds a disc and a shield near the large solenoid?

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

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

d) 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 17.6: How Do Transformers Work?

a) Your instructor will discuss transformers and the relationship between the number of turns of wire and the voltage of a transformer's secondary coil

Describe the relationship between the number of turns of wire and the voltage in the transformer coil.

b) **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. (**Caution:** Do not let the ends of the wire you loop touch one another.) 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) Wrap double the number of loops of wire around the coil that you used in activity 4) above. How does the output voltage change? Make a prediction and then measure the voltage V_s using a multimeter.

Prediction: _____ **Measurement:** _____

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

7) How is a transformer like a simple machine?

c) 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 17.7: Superconductivity and Induced Magnetism

1) Your instructor will give you a small magnet and a piece of superconducting material attached to an inverted cup. 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?