Lenz's Law

ELECTRICIAN

GRADES	LEARNING OBJECTIVE	CONCEPTS
• Physics 30 (Grade 12)	Students will gain an understanding of Lenz's law and its relation to the conservation of energy.	• Magnetism • Electricity • Gravity • Conservation of energy

Curriculum connections

PHYSICS 30

- GLO: Students will explain how the properties of electric and magnetic fields are applied in numerous devices.
- SO-STS: Explain that concepts, models, and theories are often used in interpreting and explaining observations and in predicting future observations (NS6a).
    - Discuss, qualitatively, Lenz's law in terms of conservation of energy. Provide examples of situations in which Lenz's law applies.

Description

Students will experiment with induced current as a magnet moves though a non-magnetic metal and observe how the direction of that current impacts the descent of the magnet.

Electricians need to understand Lenz's Law, as it applies to many aspects of their work, including running wires through aluminum conduits, handling bundled conductors, and working with generators, motors, inductors, and transformers. Real-world applications that utilize Lenz's Law include electromagnetic brakes, induction cooktops, eddy current balances and brakes, metal detectors, braking systems on trains, levitating trains (Maglev trains), card readers, and microphones. Electricians deal with many of these applications.

TIME

- 15–30 minutes

MATERIALS

- 1 magnet
- 3 aluminum pipes
- 2 copper pipes
- 1 PVC pipe
- 1 steel pipe
- 1 roll of electrical tape
- 1 stopwatch

Procedure

PREPARATION

- Lay materials out on a table or desk to ensure all materials are accounted for. Run the task prior to instruction. This lesson can be delivered as a demonstration, or students can self-discover individually or in groups.

STEPS

- Introduce students to the different materials by putting them on display. Tell students what each item is and how electricians use these materials in their work. Introduce or restate Lenz's law, which states that an induced electric current flows in a direction such that the current opposes the change that induced it (Britannica, 2023).
- Ask students what will happen if they drop the magnet 2 feet from the ground. What non-contact force will be acting on the magnet? Drop the magnet onto the cloth. Students will see that the magnet falls unimpeded onto the cloth.
- Ask students what will happen if they drop the magnet through the narrow 2-foot PVC pipe. What non-contact force will be acting on the magnet? Drop the magnet through the PVC pipe. Students will see that the magnet drops through the pipe at around the same speed as it did while free-falling.

- Ask students what will happen if they drop the magnet through the narrow 2-foot steel pipe. What non-contact force will be acting on the magnet? Drop the magnet. Students will see that the magnet will not fall. Ask students why the magnet did not fall. Explain that when a magnet is dropped in a steel tube, it's affected by both magnetism and gravity. However, because the magnetic force is stronger than the force of gravity, the magnet sticks to the pipe.
- Ask students what will happen if they drop the magnet through the narrow 2-foot copper pipe. What non-contact force will be acting on the magnet? Drop the magnet through the copper pipe. Note that the magnet will move through the copper pipe at a slower rate than the free fall and PVC pipe, but that it will not stick to the side of the pipe. This is Lenz's law at work.
- Ask students what will happen if they drop the magnet through the narrow 2-foot aluminum pipe. What non-contact force will be acting on the magnet? Drop the magnet through the aluminum pipe. Note that the magnet will move through the aluminum pipe at a slower rate than it did during the free fall and through the PVC pipe, but that the magnet will fall at about the same rate as it did through the copper pipe and will not stick to the side of the pipe. Why is this? Proceed to discuss Lenz's law and how it relates to the conservation of energy.

Assessment suggestions

WRITTEN

Students can explain Lenz's law in their own words, referencing the activity.

DISCUSSION

Discuss Lenz's law as a class, in groups, or individually.

Contributors

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References

Britannica. (2023). *Lenz's law – physics*. https://www.britannica.com/science/Lenzs-law