Crank to Click

Trace how motion, electricity, and magnetism work together.

PHY.5.1 "Analyze and explain electricity and the relationship between electricity and magnetism."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline what causes voltage in the generator, circle what creates the buzzer's magnetic field, and number the steps that make the strip vibrate. Use your marks to trace the link between electricity and magnetism in both parts of the device.

A Warning Device You Can Crank

1. At a bike repair shop, a student builds a hand-cranked warning device. Turning a handle spins a magnet beside a coil of wire in its generator. As the magnet turns, the magnetic field through the coil changes. That change produces an induced voltage across the coil. When the circuit is closed, current flows from the coil through the warning device and back. If the handle stops, the magnet no longer changes the field through the coil, so the generator stops supplying voltage. The device does not create electrical energy from nothing; the student's turning supplies it.

2. The warning device includes a buzzer with a second coil wrapped around an iron core. Current from the generator flows through this coil when a metal contact is closed. The current produces a magnetic field, turning the core into an electromagnet. The core attracts a springy iron strip, which pulls away from the contact and breaks the circuit. With no current, the core loses most of its magnetism, and the strip springs back to close the contact. Repeated opening and closing makes the strip vibrate and produces a buzzing sound.

3. The student tests the device by turning the handle at different speeds. A faster turn changes the magnetic field through the generator coil more rapidly, so the induced voltage can increase. If the buzzer is connected, the larger voltage can drive more current, though the circuit's resistance also matters. At the same speed, running the buzzer requires more force at the handle than spinning the generator with its circuit open, because electrical energy is being delivered. This is a two-way link: a changing magnetic field can drive electric current in the generator, while electric current creates the magnetic field that moves the buzzer's strip.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why does the generator stop supplying voltage when the handle stops?

2. How does current from the generator cause the buzzer's strip to vibrate?

3. If the student cranks faster, what changes in the generator, and how could that affect the current in the connected buzzer?

4. At the same cranking speed, why does running the buzzer take more force than spinning the generator with its circuit open?

3 YOUR TURN

Your own words

Design a hand-cranked paper clip picker using a generator coil and a separate coil wrapped around an iron core. In four sentences, explain how it picks up clips, what happens when you stop cranking, and why powering it takes more force than spinning an open-circuit generator at the same speed.

Crank to Click

PART 1 · READ AND MARK

Underline what causes voltage in the generator, circle what creates the buzzer's magnetic field, and number the steps that make the strip vibrate. Use your marks to trace the link between electricity and magnetism in both parts of the device. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why does the generator stop supplying voltage when the handle stops?	**The magnet stops turning, so the magnetic field through the generator coil no longer changes and no voltage is induced.**
2	How does current from the generator cause the buzzer's strip to vibrate?	**Current makes the buzzer's coil an electromagnet that attracts the strip. The strip breaks the contact, stopping the current. It then springs back and closes the contact, repeating the cycle.**
3	If the student cranks faster, what changes in the generator, and how could that affect the current in the connected buzzer?	**The magnetic field through the generator coil changes more rapidly, which can increase the induced voltage and drive more current through the buzzer.**
4	At the same cranking speed, why does running the buzzer take more force than spinning the generator with its circuit open?	**Running the buzzer delivers electrical energy to it. The student must supply that energy by doing more work at the handle.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Turning the crank spins a magnet near the generator coil, changing the magnetic field through that coil and inducing a voltage. In a closed circuit, that voltage drives current through the separate coil, making its iron core magnetic enough to attract paper clips. When I stop cranking, the induced voltage disappears and the core loses most of its magnetic pull. At the same speed, powering the picker requires more force than spinning an open-circuit generator because my work supplies the electrical energy.

Accept explanations that connect a changing magnetic field to induced voltage, and current in the separate coil to the core's magnetic pull. Students should attribute the extra cranking force to energy delivered to the powered circuit, not simply to the weight of the clips.