SCIENCE FOUNDATIONS

Electromagnetic induction

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how almost all the electricity in your home is made, since spinning magnets inside a power station generator create the voltage that reaches your outlets. A wind turbine spins its magnets with the wind, and a hydro dam spins them with falling water. The charger that powers your phone without a plug uses the same idea on a small scale. Knowing induction tells you how movement becomes electricity, and why a generator has to keep spinning to keep your lights on.



Rule

Electromagnetic induction: a voltage is induced in a coil only when the magnetic field through it is changing.

A faster change, a stronger magnet, or more turns in the coil gives a bigger voltage, and a still magnet induces no voltage at all.

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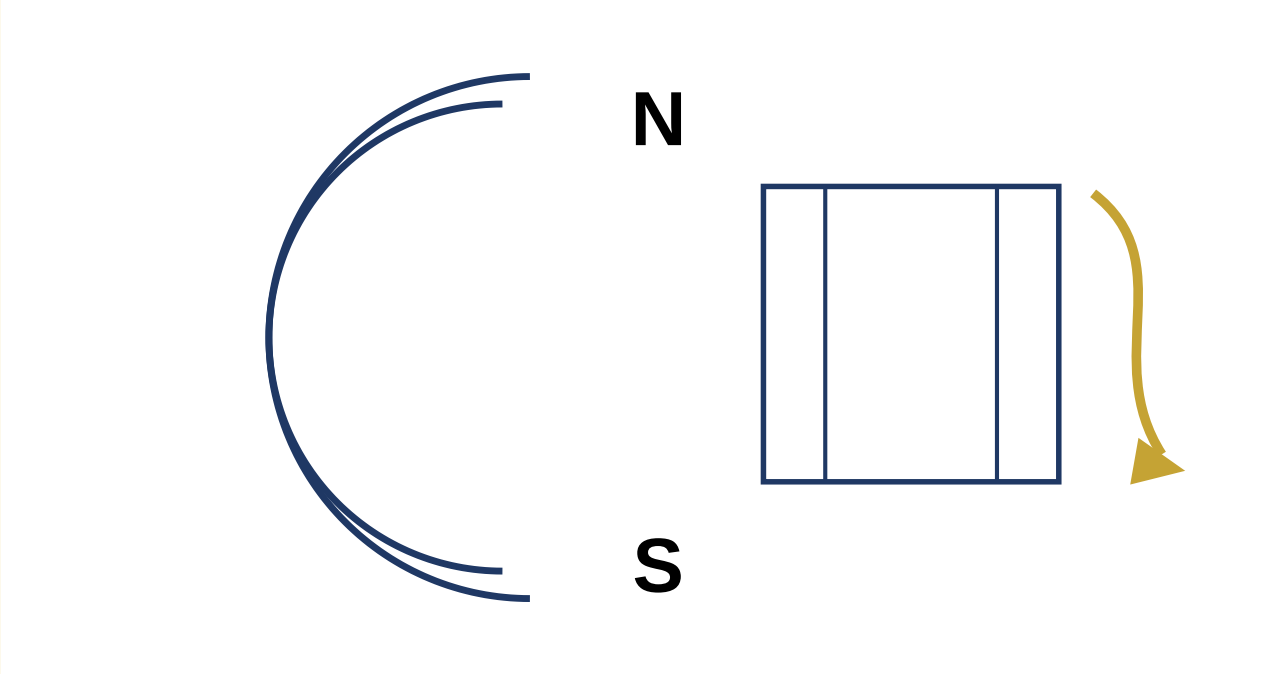
Worked examples

EXAMPLE 1

Q How can you increase the voltage from a generator coil?



SOLUTION

Recall what creates voltage: a changing magnetic field.

Speed up the change: spin the coil faster.

Or add more turns to the coil.

The result is spin faster, or use more turns.

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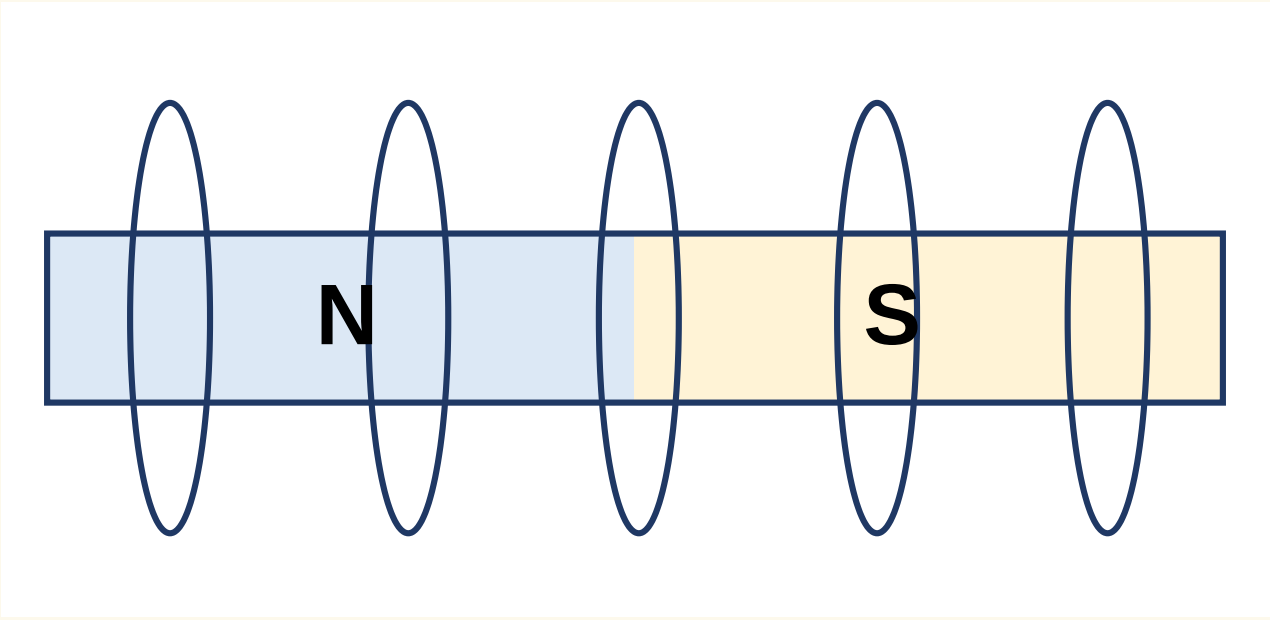
EXAMPLE 2

Q A magnet is held still inside a coil. Voltage?



SOLUTION

Ask if the field is changing: the magnet is still, so it is not.

No change means no induced voltage.

State the voltage.

The result is 0 V.

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Practice questions

1

A generator coil is spun twice as fast. What happens to the voltage?

A It becomes smaller

B It becomes larger

C It stays the same

D It becomes zero

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2

A generator produces a small voltage. Name two ways to make the voltage larger.

A. Spin the coil slower and use fewer turns

B. Use a weaker magnet and fewer turns

C. Spin the coil faster and use more turns on the coil

D. Hold the magnet still inside the coil

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3

A magnet is pushed into a coil, then held still inside the coil. Is a voltage induced while the magnet is held still?

- A Yes, a large voltage
- B Yes, a small voltage
- C No, because the field is not changing
- D Yes, but only while the coil is still

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4

Moving a magnet into a coil: is a voltage induced?

- A No, no voltage is induced
- B Yes, but only if the coil is still
- C No, a magnet must be still to induce a voltage
- D Yes, a voltage is induced

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5 What creates an induced voltage?

- A A still magnet
- B A changing magnetic field
- C A bigger coil
- D A longer wire

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6 A generator's magnet is replaced with a stronger magnet, and the coil is spun at the same speed. What happens to the voltage?

- A It becomes smaller
- B It becomes larger
- C It stays the same
- D It becomes zero

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7 More coil turns: voltage becomes?

A Smaller

B Zero

C The same

D Larger

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8 Generator: motion to what?

A Motion

B Electricity

C Heat

D Magnetism

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9

Motor: electricity to what?

A Electricity

B Heat

C Motion

D Light

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10

A generator coil is rewound with fewer turns, and spun at the same speed. What happens to the voltage?

A It becomes larger

B It becomes smaller

C It stays the same

D It becomes zero

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ANSWER KEY

1. It becomes larger

2. Spin the coil faster and use more turns on the coil

3. No, because the field is not changing

4. Yes, a voltage is induced

5. A changing magnetic field

6. It becomes larger

7. Larger

8. Electricity

9. Motion

10. It becomes smaller

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