

Magnet Power Patterns

Use data to predict electric and magnetic force effects.

GRADES 6-8 • MS-PS2-3

MS-PS2-3 "Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors..."

NAME _____

DATE _____

SPOT THE PROPORTIONAL PATTERN

When one factor changes while the battery, wire, and setup stay the same, data can show a proportional pattern. In a proportional pattern, multiplying the number of wire turns or equal magnets by a factor multiplies the force or motor speed by the same factor. Compare ratios to find missing values and notice data that breaks the pattern.

WORKED EXAMPLE

A coil with 9 wire turns has a strength of 27 force units. With the same battery and wire, predict the strength with 18 turns.

1. 18 turns is 2 times 9 turns.
2. Multiply 27 force units by 2.
3. $27 \times 2 = 54$ force units.

Answer: 54 force units

PRACTICE 6 problems

- 1** With the same battery and wire, an electromagnet with 4 turns has a strength of 12 force units. Predict its strength with 16 turns.

ANSWER _____

- 2** An electromagnet with 15 turns has a strength of 30 force units. If strength stays proportional, what is the strength with 25 turns?

ANSWER _____

- 3** In a motor test, 1 equal magnet produces 7 rotations per minute. If speed is proportional to the number of magnets, how many rotations per minute will 6 equal magnets produce?

ANSWER _____

- 4** In a proportional motor test, 8 equal magnets produce 56 rotations per minute. How many equal magnets are needed to produce 70 rotations per minute?

ANSWER _____

- 5** An electromagnet with 17 turns has a strength of 34 force units. If the number of turns doubles and all other conditions stay the same, what is the new strength?

ANSWER _____

- 6** Data show that 13 wire turns produce 39 force units. If the force is 78 force units under the same conditions, how many wire turns were used?

ANSWER _____

APPLY IT Show your work

- 1** At a school makerspace, a small electromagnet with 19 wire turns can hold 5 steel tokens. The group keeps the battery, wire type, and testing method the same. If the number of turns increases to 57 and the pattern stays proportional, how many steel tokens should the electromagnet hold?

WORK SPACE

ANSWER _____

- 2** A student tests a motor for a model car. With 4 equal magnets, the motor shaft turns 28 rotations per minute. If the student uses 20 equal magnets and the data pattern remains proportional, what speed should the shaft have?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A class tests an electromagnet while keeping the battery and wire type the same. Their data are 10 turns, 20 force units; 20 turns, 40 force units; and 30 turns, 45 force units. In 2 sentences, identify the trial that does not fit the proportional pattern and write one question the class should ask about the data.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	With the same battery and wire, an electromagnet with 4 turns has a strength of 12 force units. Predict its strength with 16 turns.	48 force units
2	An electromagnet with 15 turns has a strength of 30 force units. If strength stays proportional, what is the strength with 25 turns?	50 force units
3	In a motor test, 1 equal magnet produces 7 rotations per minute. If speed is proportional to the number of magnets, how many rotations per minute will 6 equal magnets produce?	42 rotations per minute
4	In a proportional motor test, 8 equal magnets produce 56 rotations per minute. How many equal magnets are needed to produce 70 rotations per minute?	10 equal magnets
5	An electromagnet with 17 turns has a strength of 34 force units. If the number of turns doubles and all other conditions stay the same, what is the new strength?	68 force units
6	Data show that 13 wire turns produce 39 force units. If the force is 78 force units under the same conditions, how many wire turns were used?	26 wire turns

PART 2 • APPLY IT

- 15 steel tokens** 57 turns is 3 times 19 turns. Multiply 5 tokens by 3 to get 15 tokens.
- 140 rotations per minute** 20 magnets is 5 times 4 magnets. Multiply 28 rotations per minute by 5 to get 140 rotations per minute.

CHALLENGE

The 30-turn trial does not fit because 30 turns should give 60 force units if the pattern stayed proportional. Did the current from the battery stay the same during the 30-turn trial?

Accept equivalent proportional reasoning, including correct ratio tables or equations. For the challenge, accept any accurate identification of the 30-turn trial and any testable question about a controlled factor, such as battery current, wire type, or measurement method.