SCIENCE FOUNDATIONS

Magnetic fields

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how a compass points north on a hike, and how the magnets in a fridge door and an electric motor do their work without ever touching what they move. A hiker with a dead phone battery can still navigate with a compass because the Earth's field is always there. An electric motor spins because its magnetic fields push on each other. Knowing magnetic fields tells you how an invisible pull can move things at a distance, from a fridge magnet to the needle in a compass.



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Worked examples

EXAMPLE 1

Q Two north poles are brought together. What happens?



SOLUTION

Recall the pole rule: like poles repel.

Both poles are north, so they are like poles.

Conclude: they push apart.

The result is they repel.

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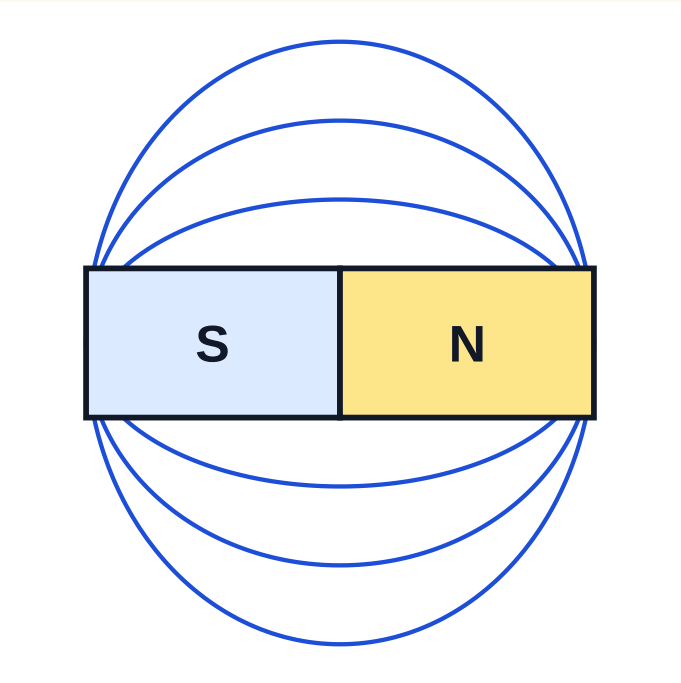
EXAMPLE 2

Q Draw the field around a bar magnet.



SOLUTION

Start lines at the north pole, going outward.

Curve them around to enter the south pole.

Draw lines closer together near the poles, where the field is stronger.

The result is lines north to south outside the magnet, closest at the poles.

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Practice questions

1 The north-seeking end of a compass needle is brought near the north pole of a bar magnet. What happens, and why?

- **A** They attract, because opposite poles attract
- **B** They repel, because like poles repel
- **C** Nothing happens, because a compass has no poles
- **D** They repel, because opposite poles repel

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2

A north pole and a south pole are brought together. What happens, and why?

- **A** They attract, because opposite poles attract
- **B** They repel, because like poles repel
- **C** They attract, because like poles attract
- **D** Nothing happens, because the poles cancel out

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3

Field lines around a bar magnet leave which pole, and where are they closest together?

A Leave the south pole, closest together near the middle

B Leave the north pole, closest together near the poles

C Leave the north pole, closest together near the middle

D Leave the south pole, closest together near the poles

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Where is the field around a bar magnet strongest, and how can you tell from the field lines?

A Near the middle, where the lines are farthest apart

B Near the poles, where the lines are farthest apart

C Near the poles, where the lines are closest together

D Near the middle, where the lines are closest together

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5 Field lines leave which pole and enter which pole?

- **A** Leave the south pole, enter the north pole
- **B** Leave the north pole, enter the south pole
- **C** Leave both poles and enter the middle
- **D** Enter both poles and leave the middle

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6 What do closer field lines mean?

- **A** A weaker field
- **B** A stronger field
- **C** No field at all
- **D** A field pointing south

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7 A compass needle points along what?

- A The electric field lines
- B The nearest pole
- C The magnetic field lines
- D The North Star

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8 Why does a compass point north?

- A The needle is pulled toward the Sun
- B Earth acts like a giant magnet, so the needle lines up with Earth's field
- C The needle points at the North Star
- D Air currents push the needle north

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Two south poles are brought together. What happens?

A They attract

B They stick together

C Nothing happens

D They repel

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10

Where is a bar magnet's field strongest, and where is it weakest?

A Strongest near the poles, weakest near the middle

B Strongest near the middle, weakest near the poles

C Strongest at the poles and the middle

D The same strength everywhere

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ANSWER KEY

1. They repel, because like poles repel

2. They attract, because opposite poles attract

3. Leave the north pole, closest together near the poles

4. Near the poles, where the lines are closest together

5. Leave the north pole, enter the south pole

6. A stronger field

7. The magnetic field lines

8. Earth acts like a giant magnet, so the needle lines up with Earth's field

9. They repel

10. Strongest near the poles, weakest near the middle

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