ANSWER KEY.

Magnetic Fields

Physics | Answer Key

Part A: Poles and Domains

Answer each question in a sentence or two.

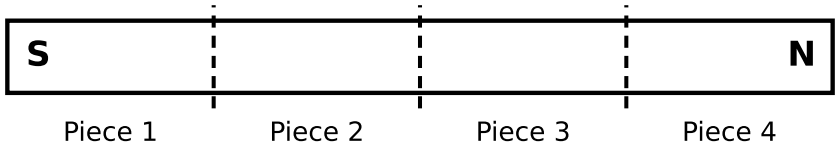
1. Two bar magnets are placed end to end, as shown in each pair. For each pair, do the magnets attract or repel? Name the two poles that face each other.

a. The N pole of the left magnet faces the S pole of the right magnet. Opposite poles: **attract**.

b. S faces S. Like poles: **repel**.

c. N faces N. Like poles: **repel**.

2. Maya cuts a long bar magnet into four equal pieces, as shown. How many S poles are there after the cuts? Which pole is on the right end of piece 2? If Maya slides piece 2 back toward piece 3 without turning either one, do they attract or repel? Explain.



Poles come in pairs: each piece becomes a complete magnet with its own N and S, pointing the same way as the original (S on the left, N on the right).

Count: 4 pieces, so **4 S poles** (and 4 N poles).

Right end of piece 2: an **N pole**.

Pieces 2 and 3: the N on the right of piece 2 faces the S on the left of piece 3. Opposite poles, so they **attract**.

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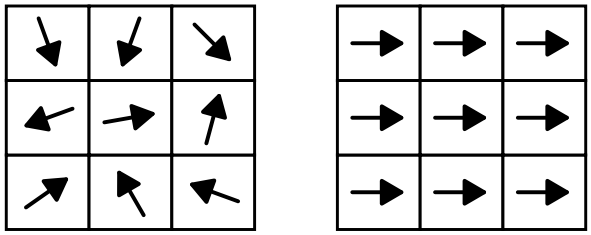
3. The arrows show the magnetic domains in two iron samples. Which sample is a magnet? Explain using the word *domains*, and describe one way to turn the other sample into a magnet.



Sample X **Sample Y**

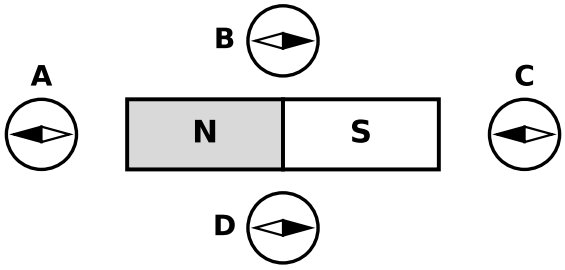
Sample Y is a magnet. Its domains are all lined up, so their tiny fields add together.

In Sample X the domains point in random directions, so their fields cancel and it is not a magnet.

To magnetize X, rub it with a magnet (in one direction) or place it in a strong magnetic field, which lines up its domains.

Part B: Mapping the Field

4. Four compasses, A through D, are placed around a bar magnet. Draw the needle in each compass as an arrow that points the way the compass's N end points. Then explain how you decided for compass B.



Outside a magnet the field points away from N and toward S, and a compass's N end points along the field. In the key, the black half of each needle is its N end.

A (left of the N end): points **left**, away from the N pole.

B (above the middle): points **right**, toward the S pole, as the field arcs from N to S.

C (right of the S end): points **left**, toward the S pole.

D (below the middle): points **right**, toward the S pole.

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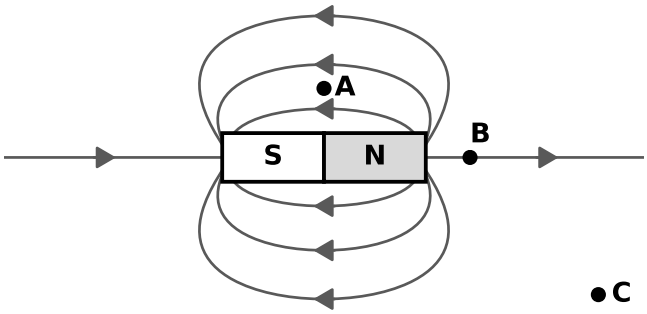
5. The drawing shows the field lines around a bar magnet.



a. Rank the strength of the field at points A, B, and C, strongest to weakest. Explain using the field lines.

b. Which way does the field point at point A?

c. Why can field lines never cross each other?

a. B > A > C. B is right at the N pole, where the lines are most crowded. A is above the middle, where the lines are more spread out. C is far away, where the lines are very spread out.

b. Left, toward the S pole. Outside the magnet the lines arc from N (right) back to S (left).

c. The field can only point one way at each spot. If two lines crossed, the field would point two different ways at the same point.

6. Diego's compass needle points toward Earth's geographic North Pole.

a. What kind of magnetic pole (N or S) is located up near the geographic North Pole? Explain.

b. Near which geographic pole do Earth's field lines come out of the ground?

a. A **magnetic S pole**. The compass's N end is attracted to it, and opposite poles attract.

b. Near the **geographic South Pole**. Field lines leave a magnet's N pole, and Earth's magnetic N pole is down near the geographic South Pole. The lines then enter near the geographic North Pole.

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