

Magnets, fields and electromagnets

Grade 8 science (Year 9 · Class 8) · Worksheet answers

Each answer gives the reasoning as well as the result. Where a problem needs an explanation, use the key terms in the answers: poles, field lines, current, turns and core. Compare your wording with the model answers and fill any gaps.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS2-3, MS-PS2-5

Problem 1 Attract or repel?

1. They **repel**.
2. They **attract**.
3. They **repel**.

Problem 2 Magnetic or not?

1. **Iron nail, steel paper clip and nickel pin.**
2. **Copper and aluminium.**

Problem 3 Pairs of magnets

1. In pair P the facing poles are S and S, so the magnets **repel**.
2. In pair Q the facing poles are S and N, so the magnets **attract**.
3. Unlike poles attract, and the right end of the first magnet (S) faces the left end of the second (N).

Problem 4 Direction of field lines

1. Lines **leave the north pole and enter the south pole**.
2. The field is **strong** there.
3. They **never cross**.

Problem 5 Strong or weak?

1. Point **A**.
2. The field lines are closest together near the pole.
3. Point **C**, which is far from the magnet and has no lines near it.

Problem 6 Parts of an electromagnet

1. A **coil of insulated wire, an iron core and a power supply (cell)**.
2. The magnetism **almost disappears**, because the current stops.

Problem 7 Permanent and electro

1. A permanent magnet is always magnetic and has fixed strength. An electromagnet **can be switched on and off and its strength changed**.
2. For example **lifting scrap metal in a scrapyard**, because the crane can drop the load by switching off.

Problem 8 Turns and paper clips

1. Doubling the turns **doubles the clips**; the clips are proportional to the turns (4 clips for every 15 turns).
2. 75 turns = 5×15 , so $5 \times 4 =$ **20 clips**.
3. 90 turns = 6×15 , so $6 \times 4 =$ **24 clips**.

Problem 9 More cells

1. More cells give a bigger current, so the electromagnet gets **stronger**.
2. Increase = $24 - 6 = 18$. $18 \div 6 \times 100 =$ **300 %**.

Problem 10 Which core?

1. The **iron nail**.
2. $9 \div 1 =$ **9 times**.
3. Plastic is not a magnetic material, so it cannot become magnetised and adds nothing to the field.

Problem 11 Which end is which?

1. A **south pole**.
2. Unlike poles attract, so the needle's N end points to a south pole.
3. The needle **turns round** because the poles swap; the left end becomes a **north pole**.

Problem 12 Why a compass points north

1. The needle is a small magnet that lines up with the Earth's magnetic field, which behaves like a giant bar magnet, so its N end points to the north.
2. The steel tank becomes magnetised and has its own field, which can be stronger than the Earth's field, so the needle **points towards the tank**.

Problem 13 Cutting a magnet

1. **Two poles**: each piece has N and S.
2. The cut ends become **opposite poles**; one is N and the other S, and they are attracted together.
3. Each tiny part of a magnet is itself a small magnet, so every piece always has a north and

a south end.

Problem 14 Distance and force

1. The force **decreases quickly** as the distance grows.
2. Decrease = $4.0 - 1.0 = 3.0 \text{ N}$. $3.0 \div 4.0 \times 100 = \mathbf{75 \%}$.
3. The field lines spread out and get further apart away from the magnet, so the field is weaker there.

Problem 15 Plotting a field

1. Place the magnet on the paper and draw round it. Put the compass near one pole and mark both ends of the needle. Move the compass so its tail is at the last point, mark again, and repeat until you reach the other pole. Join the dots with a smooth line, then start again at a new position.
2. The compass needle's N end points along the field, so the arrow goes **from the N end of the needle to the other pole's S end**, in the direction of N to S.

Problem 16 Scrapyard crane

1. The current can be switched off to drop the car where it is wanted; a permanent magnet would hold it forever.
2. Soft iron loses its magnetism almost at once when the current stops, so the load drops. Steel would stay magnetised.
3. **More turns of wire and a bigger current** (or a bigger core).

Problem 17 Two variables

1. Doubling the turns **doubles** the clips (5 to 10).
2. Doubling the cells **doubles** the clips (5 to 10).
3. 60 turns is 3 times 20 and 3 cells is 3 times 1, so clips = $5 \times 3 \times 3 = \mathbf{45 \text{ clips}}$.

Problem 18 Plan an investigation

1. Independent: **number of cells**. Dependent: **number of paper clips lifted**.
2. Number of turns, the same iron core, the same type of paper clip (also the same wire).
3. Close the switch only for a few seconds for each reading and let the coil cool between readings.
4. Draw a table of cells against clips (with repeats and a mean), then plot a graph of mean clips against cells.

Problem 19 Spot the errors

1. Field lines **never cross**. They are closest together where the field is strongest.
2. A coil **is magnetic** while current flows, but weaker than with an iron core.

3. Each piece has **both N and S** poles.

Problem 20 Floating magnets

1. $0.120 \text{ kg} \times 9.8 \text{ N/kg} = \mathbf{1.18 \text{ N}}$.
2. $1.18 \div 0.50 = 2.35$, so **3 pairs** (rounding up).
3. Like poles repel, which pushes the train up. Unlike poles would attract and pull the train down onto the track.