

# Magnets, fields and electromagnets

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

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

These problems train you to predict how magnets act, to read and draw field lines, to explain how a compass works and to analyse how an electromagnet changes with turns, current and core. They start with poles and finish with design and data problems.

They suit Grade 8, Year 9 and Class 8 students, in line with middle school physical science (NGSS MS-PS2-3 and MS-PS2-5) and KS3 courses.

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

### Problem 1 Attract or repel? (easy)

Wanjiru in Nairobi plays with two bar magnets.

1. State what happens when two north poles are brought together.
2. State what happens when a north pole is brought near a south pole.
3. State what happens when two south poles are brought together.

### Problem 2 Magnetic or not? (easy)

Kofi in Accra tests six objects with a magnet: an iron nail, a copper coin, a steel paper clip, a piece of aluminium foil, a nickel pin and a plastic ruler.

1. List the objects the magnet attracts.
2. State which two metals in the list are not attracted.

### Problem 3 Pairs of magnets (easy)

Mei in Singapore sets up two pairs of magnets.



*Two pairs of magnets with a small gap between them.*

1. State whether pair P attracts or repels.
2. State whether pair Q attracts or repels.
3. Explain your answer for pair Q.

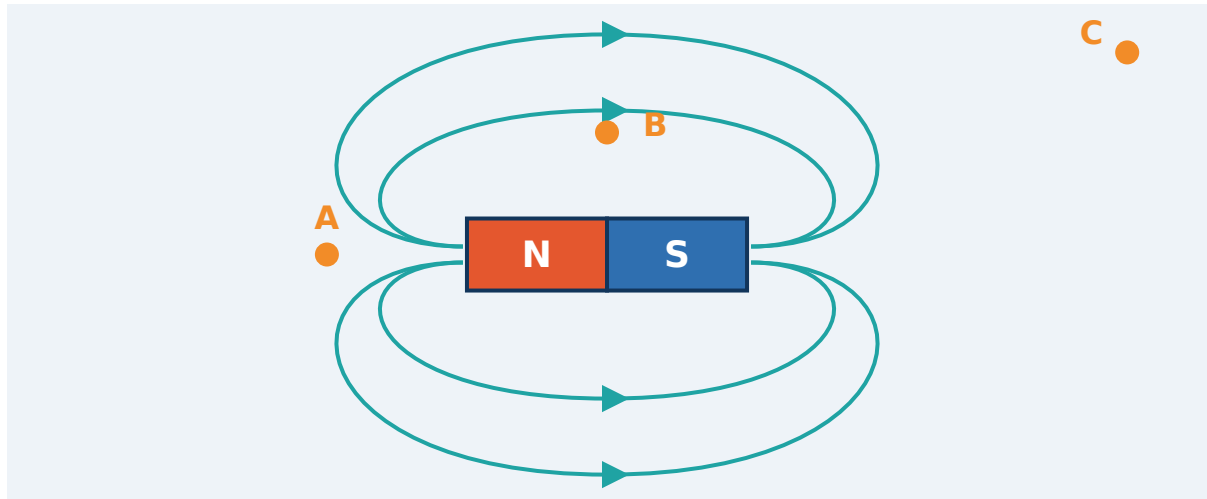
### Problem 4 Direction of field lines (easy)

A student draws field lines around a bar magnet.

1. State where field lines leave the magnet and where they enter it.
2. State what it means when field lines are close together.
3. State what the lines never do.

### Problem 5 Strong or weak? (easy)

Look at the three points near the magnet.



Points A, B and C near a bar magnet.

1. State which point has the strongest field.
2. Give a reason using the field lines.
3. State which point has the weakest field.

### Problem 6 Parts of an electromagnet (easy)

Diego in Texas builds an electromagnet.

1. Name the three parts needed to build a simple electromagnet.
2. State what happens to the magnetism when the switch is opened.

### Problem 7 Permanent and electro (medium)

Compare a permanent bar magnet with an electromagnet.

1. State two differences.
2. Give one use where the electromagnet is better.

### Problem 8 Turns and paper clips (medium)

Aarav in Pune winds different numbers of turns on an iron nail and counts the paper clips lifted:

15 turns: 4 clips; 30 turns: 8 clips; 45 turns: 12 clips; 60 turns: 16 clips.

1. Describe the pattern.

- Predict the clips lifted by 75 turns.
- Predict the clips lifted by 90 turns.

### Problem 9 More cells (medium)

Bilal in Lahore lifts paper clips with an electromagnet powered by 1, 2 and 4 cells in series. It lifts 6, 12 and 24 clips.

- State how the strength changes as cells are added.
- Calculate the percentage increase from 1 cell to 4 cells.

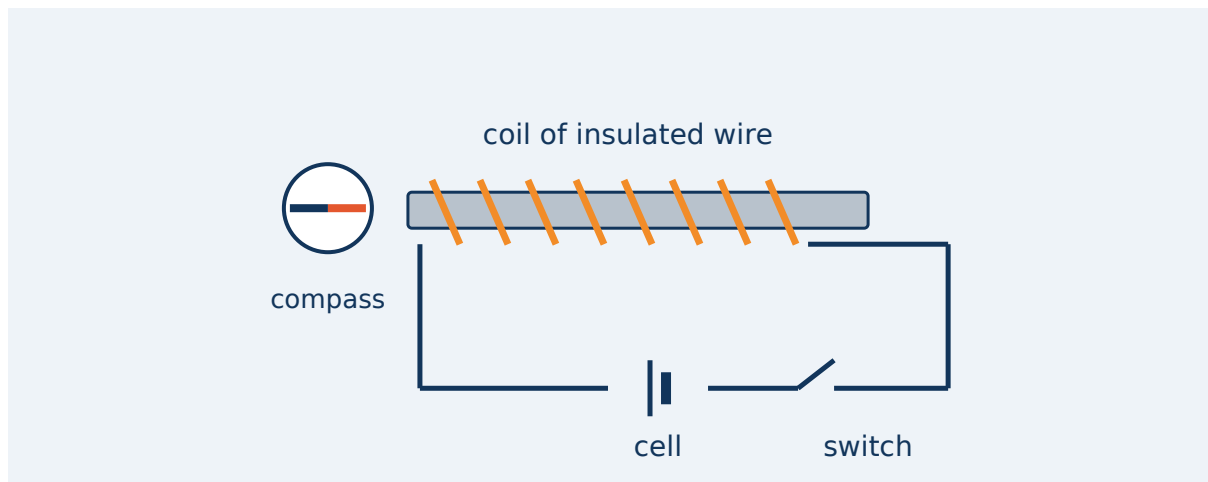
### Problem 10 Which core? (medium)

Emma in Leeds wraps the same coil on four different rods and measures the number of pins lifted: iron nail 9, steel screw 6, plastic rod 1, no rod 1.

- State which rod gives the strongest electromagnet.
- Calculate how many times more pins the iron nail lifts than the plastic rod.
- Suggest why the plastic rod gives the same result as no rod.

### Problem 11 Which end is which? (medium)

Chiamaka in Lagos places a compass beside the left end of her electromagnet. The N end of the needle points towards the coil.



*Compass beside the left end of an electromagnet while the current flows.*

- State the pole at the left end of the coil.
- Give the reason.
- She reverses the cell. State what the needle does and the new pole at the left end.

### Problem 12 Why a compass points north (medium)

A hiker in Nairobi uses a compass.

- Explain why the needle points north.
- Explain why the reading is wrong if the compass is beside a steel water tank.

**Problem 13 Cutting a magnet** (medium)

Mei cuts a magnetised steel needle into two equal pieces.

1. State how many poles each piece has.
2. State which poles the ends at the cut have.
3. Explain why a single pole cannot be obtained.

**Problem 14 Distance and force** (medium)

Kofi measures the pull of a magnet on an iron ball at several distances:

1.0 cm: 4.0 N; 2.0 cm: 1.0 N; 3.0 cm: 0.44 N; 4.0 cm: 0.25 N.

1. Describe how the force changes as the distance grows.
2. Calculate the percentage decrease from 1.0 cm to 2.0 cm.
3. Explain this using field lines.

**Problem 15 Plotting a field** (medium)

Aarav wants to map the field of a bar magnet using a plotting compass on paper.

1. List the steps in order.
2. Explain how he shows the direction of the field.

**Problem 16 Scrapyard crane** (hard)

A scrapyard crane uses an electromagnet with a soft iron core to lift cars.

1. Explain why it is better to use an electromagnet than a permanent magnet.
2. Explain why the core is soft iron rather than steel.
3. State two ways to make it lift a heavier car.

**Problem 17 Two variables** (hard)

Diego tests turns and cells in an electromagnet:

| Turns | Cells | Clips lifted |
|-------|-------|--------------|
| 20    | 1     | 5            |
| 40    | 1     | 10           |
| 20    | 2     | 10           |
| 40    | 2     | 20           |

1. State the effect of doubling the turns.
2. State the effect of doubling the cells.
3. Predict the clips lifted with 60 turns and 3 cells.

**Problem 18 Plan an investigation** (hard)

Bilal in Lahore wants to find out whether the number of cells changes the strength of an electromagnet.

1. Name the independent variable and the dependent variable.
2. List three variables he must keep the same.
3. Suggest how he can stop the coil from heating up during the test.
4. Describe how he should show his results.

**Problem 19 Spot the errors** (hard)

A student writes three statements.

(A) Field lines cross where the field is strongest.

(B) A coil with no core is not magnetic when a current flows.

(C) Cutting a magnet gives one piece that is only N and one that is only S.

1. Correct statement (A).
2. Correct statement (B).
3. Correct statement (C).

**Problem 20 Floating magnets** (hard)

A model train of mass 120 g floats above a track using repelling magnets. Each pair of magnets gives an upward force of 0.50 N. Use  $g = 9.8 \text{ N/kg}$ .

1. Calculate the weight of the train.
2. Calculate how many pairs are needed.
3. Explain why the magnets must be placed with like poles facing.