Topic 4.7 Magnetism Revision Booklet

ANSWERS AQA GCSE Physics 8463 · Foundation & Higher



Name _____ Class _____ Target grade _____

4.7
Magnetism

Work through a topic, then come back to it on the dates in your planner. Little and often beats one long cram.

Revise like a scientist

This booklet uses six revision techniques that research shows work best. Every activity is labelled with the technique it uses and the grade it targets.

Retrieval practice

Pulling ideas out of your memory makes them stick far better than re-reading. Brain dumps, quizzes and cover-and-recall tasks.

Spaced practice

Revisit each topic after 2 days, 1 week and 3 weeks. Forgetting a little, then remembering again, strengthens memory.

Interleaving

Mixed-topic questions train you to spot which idea a question needs, just like the real exam.

Dual coding

Words plus diagrams: graphs, ray diagrams and labelled apparatus give your memory two routes in.

Elaboration

Asking 'why?' and 'how?' and linking ideas together turns facts into understanding.

Worked examples

I do → We do → You do: study a full solution, finish a half-done one, then do one alone.

KEY

Grade pathways

GRADE 4

Secure the basics: recall definitions and units, pick the right equation from the equation sheet, and do one-step calculations.

GRADE 5

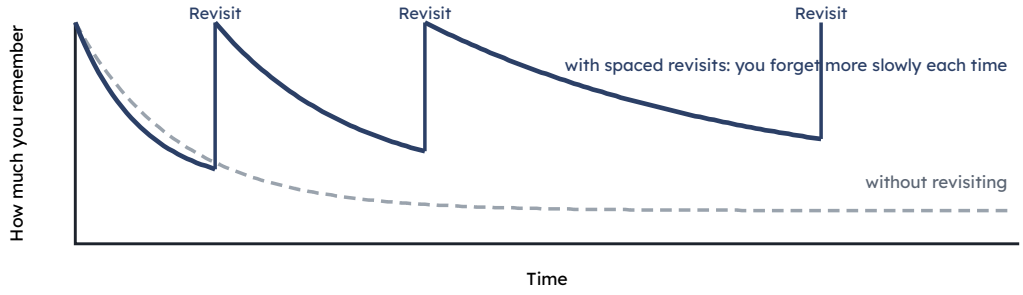
Rearrange equations, convert units, describe practicals and explain in two linked steps.

GRADE 7+

Multi-step calculations, evaluate methods and data, and write logical 6-mark answers.

SPACED PRACTICE DUAL CODING

Why spacing works



SPACED PRACTICE

My spaced revision planner

Write the date you'll do each session. Tick it off when it's done.

Topic	First go	+2 days	+1 week	+3 weeks	Before the mock
4.7 Magnetism					
Final review					

What's inside

Topic 7 · Magnetism (4.7)

7.1 Brain dump and checklist 4

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Final review

Final review: mixed questions 16

ROUTINE

The routine for every page

1. Try it cold. Answer from memory first, without notes. Struggling a bit is good: it's what makes learning stick.

2. Check and correct. Mark it with the answer booklet in a different colour pen. Fix every mistake.

3. Come back later. Redo anything you got wrong on your next spaced session.

ONLINE

Use it with mrsullyphysics.com

Flashcards for retrieval practice: cards you get wrong come back until you get them right.

Quizzes and Aim higher for extra Grade 5+ and 7+ questions with mark schemes.

Animations to see the physics move (dual coding).

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 Describe how to plot the magnetic field around a bar magnet using a small compass. [3]

Put the compass near one pole and mark the direction the needle points

Move the compass to the end of the needle and mark again; repeat

Join the dots to make a field line, then repeat from different starting points

2 Grade 7+ A 0.25 m wire in a 0.08 T field feels a force of 0.06 N. Calculate the current in the wire. [3]

F = BIl, so I = F ÷ (Bl)

I = 0.06 ÷ (0.08 × 0.25)

I = 3 A

3 Grade 5 Explain why a compass needle points north. [2]

The needle is a small magnet

It lines up with the Earth's magnetic field (evidence that the Earth's core is magnetic)

Brain dump and checklist

RETRIEVAL PRACTICE · GRADE 4 · GRADE 5 · GRADE 7

Brain dump

Set a timer for 5 minutes. Write or draw everything you remember about magnetism. No notes! Afterwards, add anything you missed in a different colour.

Prompts if you get stuck: poles? · field lines? · permanent vs induced? · compass? · solenoid? · electromagnet? · motor effect? · F = BIl? · generator effect? · transformers?

METACOGNITION

How confident am I?

Rate each statement now (before) by shading R, A or G. Rate again at the end of the topic (after).

I can...	Before			After		
	R	A	G	R	A	G
Describe attraction and repulsion between poles	○	○	○	○	○	○
Explain the difference between permanent and induced magnets	○	○	○	○	○	○
Draw magnetic field patterns and plot them with a compass	○	○	○	○	○	○
Explain how a compass shows that the Earth's core is magnetic	○	○	○	○	○	○
Describe the field around a wire and in a solenoid, and how to make an electromagnet stronger	○	○	○	○	○	○
Use Fleming's left-hand rule and F = BIl (Higher)	○	○	○	○	○	○
Explain how an electric motor works (Higher)	○	○	○	○	○	○
Explain how a loudspeaker works (Physics only, Higher)	○	○	○	○	○	○
Explain the generator effect, alternators, dynamos and microphones (Physics only, Higher)	○	○	○	○	○	○
Use the transformer equations (Physics only, Higher)	○	○	○	○	○	○

Extra practice

Retrieval · answers in the answer booklet

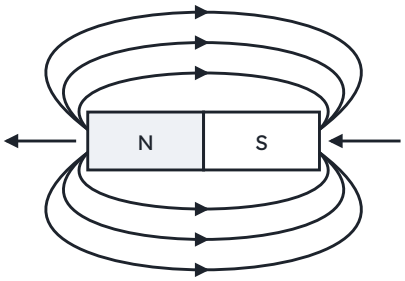
1 True or false? A compass points north because of the Earth's magnetic field. Explain. [2]

True. Evidence that the Earth's core is magnetic.

Knowledge organiser

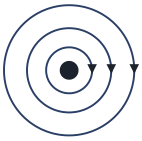
DUAL CODING | GRADE 4 | GRADE 5 | GRADE 7

MAGNETIC FIELDS AND ELECTROMAGNETISM

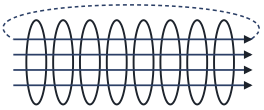


Field lines: N → S
closest at the poles,
where the field is strongest

Like poles repel,
unlike poles attract

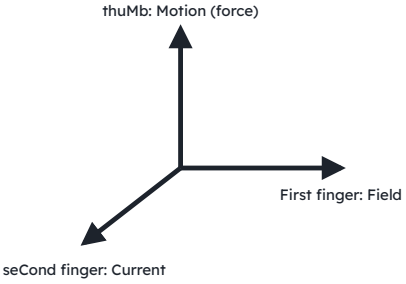


Wire (current into page):
circular field; stronger near the wire



Solenoid: strong, uniform field inside;
add an iron core → electromagnet

THE MOTOR EFFECT (HIGHER)



Fleming's left-hand rule (Higher)

F = B I l

F = force (N)
B = magnetic flux density (T)
I = current (A); l = length (m)

Reverse the current or the field
→ the force reverses

KEY EQUATIONS: ALL GIVEN ON THE PHYSICS EQUATIONS SHEET IN THE EXAM

Equation	Quantities and units	Watch out
F = B I l	force (N), magnetic flux density (T), current (A), length (m) (Higher)	Wire at right angles to the field
Vp ÷ Vs = np ÷ ns	p.d. (V) and number of turns on the primary and secondary coils (Physics only, Higher)	Same ratio both sides
Vs × Is = Vp × Ip	for a 100% efficient transformer: power in = power out (Physics only, Higher)	Step up p.d. → current down

GENERATOR EFFECT (PHYSICS ONLY, HIGHER)

A p.d. is induced when a wire moves relative to a magnetic field, or the field around it changes.
The induced current's field opposes the change that caused it.
Alternator → a.c.; **dynamo** → d.c.; **transformer** needs a.c.

TURN OVER

Key words, misconceptions, required practicals and Grade 7+ links are on the next page.

Knowledge organiser: key words, misconceptions, practicals

ELABORATION GRADE 4 GRADE 5 GRADE 7

KEY WORDS: LEARN THESE WORD FOR WORD (SAME AS SIDE 2 OF YOUR KNOWLEDGE ORGANISER)

Permanent magnet: produces its own magnetic field.
Induced magnet: becomes a magnet when placed in a magnetic field; induced magnetism always causes attraction.
Magnetic field: the region around a magnet where a force acts on another magnet or magnetic material.
Solenoid: a coil of wire; the field inside is strong and uniform. With an iron core: an electromagnet.
Motor effect (Higher): a force on a current-carrying conductor in a magnetic field.
Generator effect (PO, Higher): a p.d. is induced when a conductor moves relative to a magnetic field, or the field changes.
Magnetic flux density: the strength of a magnetic field, in tesla (T).

MISCONCEPTIONS: SPOT THE MISTAKE

× Common mistake	✓ What's actually true
× All metals are magnetic.	✓ Only iron, steel, cobalt and nickel.
× Field lines can cross.	✓ Field lines never cross.
× Transformers work with d.c.	✓ They need a changing (a.c.) field to induce a p.d.

AIM FOR GRADE 7+

- Rearrange F = BIl; convert cm to m.
- Two-step transformer questions: p.d. from turns ratio, then current from power in = power out.
- Explain motors, loudspeakers and microphones as chains of cause and effect.

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ Explain how an electric bell works. [4]

When the switch is closed, current flows through the electromagnet, which becomes magnetised

It attracts the iron armature, so the hammer strikes the bell

Moving the armature breaks the circuit, so the electromagnet switches off

A spring pulls the armature back, completing the circuit again, so the cycle repeats

2 Grade 7+ Explain how a simple electric motor works. [4]

Current flows through a coil in a magnetic field

Each side of the coil feels a force (motor effect)

The forces on the two sides act in opposite directions, so the coil turns

A split-ring commutator reverses the current every half turn so it keeps rotating the same way

3 Grade 5 Name two magnetic materials. [2]

Any two from: iron, steel, cobalt, nickel

(Two correct for 2 marks)

RETRIEVAL PRACTICE | SPACED PRACTICE | GRADE 4 | GRADE 5

Equation sheet skills: which equation, which unit?

Every equation is on the Physics Equations Sheet, but it won't tell you which one a question needs or what unit the answer has. Cover the knowledge organiser and fill in the table. Redo it on another day.

Situation	Which equation?	Unit of the answer	Redo 1 ✓/×	Redo 2 ✓/×
Force on a wire carrying current in a magnetic field (Higher)	F = B I l	N		
Flux density from force, current and length (Higher)	B = F ÷ (I l)	T		
Secondary p.d. of a step-down transformer (Physics only)	Vp ÷ Vs = np ÷ ns	V		
Current in a transformer's primary coil (100% efficient)	Vp Ip = Vs Is	A		
Length of wire from force, field and current (Higher)	l = F ÷ (B I)	m		
Number of turns on the secondary coil	ns = np × Vs ÷ Vp	no unit		

RETRIEVAL PRACTICE | GRADE 4 | GRADE 5

Fill the gaps

Use the AQA key words. No word bank: that's the point.

1. Like magnetic poles **repel** each other.
2. Magnetic field lines go from the north pole to the **south** pole.
3. A magnet that produces its own magnetic field is a **permanent** magnet.
4. A solenoid with an iron core is called an **electromagnet** .
5. Moving a magnet into a coil induces a **potential difference** across the coil. (Physics only)

ELABORATION | GRADE 5

Odd one out

Circle the odd one out in each row and explain why.

1. iron · steel · nickel · copper

Copper: it isn't magnetic.

2. motor · loudspeaker · generator · electric bell

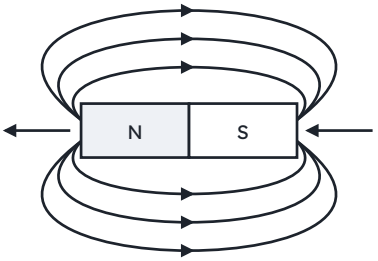
Generator: it uses the generator effect; the others use the motor effect (or electromagnets).

3. tesla · newton · ampere · metre per second

Metre per second: it isn't in F = B I l.

DUAL CODING GRADE 4 GRADE 5

Magnetic fields



Field lines: N → S
closest at the poles,
where the field is strongest

Like poles repel,
unlike poles attract

a Where is the magnetic field strongest? [1]

At the poles

b How does a plotting compass show the direction of a field? [2]

The needle points along the field line,

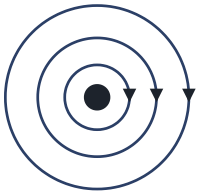
towards the south pole (in the direction of the field).

c Why does a compass point north when no magnet is near? [1]

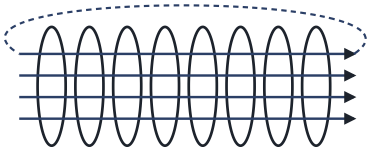
It lines up with the Earth's magnetic field (the Earth's core is magnetic).

DUAL CODING GRADE 4 GRADE 5

Electromagnets



Wire (current into page):
circular field; stronger near the wire



Solenoid: strong, uniform field inside;
add an iron core → electromagnet

a Describe the field inside a solenoid. [2]

Strong and uniform:

parallel, equally spaced field lines.

b Give three ways to make the electromagnet stronger. [3]

More turns on the coil

more current

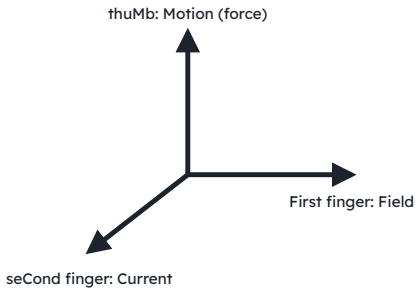
add an iron core

c Why is an electromagnet useful in a scrapyard crane? [1]

It can be switched off to drop the metal.

DUAL CODING GRADE 5 GRADE 7

Fleming's left-hand rule (Higher)



Fleming's left-hand rule (Higher)

F = B I l

F = force (N)
B = magnetic flux density (T)
I = current (A); l = length (m)

Reverse the current or the field
→ the force reverses

a What do the thumb, first finger and second finger represent? [3]

Thumb: motion (force)

First finger: field

Second finger: current

b Give two ways to reverse the force on a wire. [2]

Reverse the current

reverse the magnetic field

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 Describe one difference between a permanent magnet and an induced magnet. [2]

A permanent magnet produces its own magnetic field

An induced magnet only becomes magnetic when placed in a magnetic field (and loses most of it when removed)

2 Grade 7+ Explain how a moving-coil microphone converts sound into an electrical signal. [4]

Sound waves make the diaphragm vibrate

The attached coil moves in the magnetic field of a permanent magnet

A potential difference is induced across the coil (generator effect)

The p.d. varies in the same pattern as the sound wave

3 Grade 5 Explain the difference between a permanent magnet and an induced magnet. [2]

A permanent magnet produces its own magnetic field

An induced magnet only becomes a magnet when placed in a magnetic field, and loses most of its magnetism when removed

I do, we do, you do

WORKED EXAMPLES | GRADE 4 | GRADE 5

F = B I l (Higher)

I do (worked example)

B = 0.2 T, I = 5 A, l = 0.3 m. Calculate F.

1. F = B I l
2. F = 0.2 × 5 × 0.3
3. **F = 0.3 N**

We do (finish it)

B = 0.05 T, I = 2 A, l = 0.6 m.

1. F = 0.05 × 2 × ___ **0.6**
2. F = ___ N **0.06**

You do

F = 0.48 N, I = 4 A, l = 0.4 m. Calculate B.

B = F ÷ (I l)

= 0.48 ÷ 1.6

= 0.3 T

WORKED EXAMPLES | GRADE 5 | GRADE 7

Transformers (Physics only)

I do (worked example)

Primary 400 turns at 240 V. Secondary 50 turns. Calculate Vs.

1. Vs = Vp × ns ÷ np
2. = 240 × 50 ÷ 400
3. **Vs = 30 V**

Step-down

We do (finish it)

Vp = 230 V, Ip = 0.5 A, Vs = 23 V. Calculate Is.

1. Vp Ip = Vs Is
2. 230 × 0.5 = 23 × ___ **Is**
3. Is = ___ A **5**

You do

np = 100, ns = 2000, Vp = 12 V.

Vs = 12 × 2000 ÷ 100

= 240 V

step-up

ELABORATION | GRADE 5 | GRADE 7

Spot the mistake

Each student has made one mistake. Find it and correct it.

1 Tia: "F = B I l = 0.1 × 3 × 20 = 6 N for a 20 cm wire." [2]

Use metres: 0.1 × 3 × 0.2 = 0.06 N.

2 Uma: "A transformer works with a steady d.c. supply." [1]

It needs a.c.: a changing field is needed to induce a p.d.

3 Vic: "Magnetic field lines can cross." [1]

They never cross.

Extra practice

Retrieval · answers in the answer booklet

1 Define **permanent magnet**. [1]

Produces its own magnetic field.

Why? How? Explaining magnetism

ELABORATION GRADE 4 GRADE 5 GRADE 7

Build an explanation

Answer each question in two steps. Use the starter, then push yourself with the Grade 7+ extension.

1 Explain why a current-carrying wire in a magnetic field experiences a force.

Grade 4–5 starter: "The current produces its own magnetic field, which…"

A current in the wire produces a magnetic field around it.

This field interacts with the field of the magnet,

Grade 7+ extension: "Link to the motor effect:…"

so the wire experiences a force (the motor effect).

The force is largest when the wire is at right angles to the field.

2 Explain how a moving-coil loudspeaker produces sound. (Physics only)

Grade 4–5 starter: "An alternating current in the coil…"

An alternating current flows in the coil, which sits in the field of a permanent magnet.

The coil experiences a force that keeps reversing (motor effect),

Grade 7+ extension: "Link to the cone and pressure variations:…"

so the coil and cone vibrate back and forth,

creating pressure variations in the air: a sound wave.

3 Explain why transformers help reduce the energy wasted in the National Grid. (Physics only)

Grade 4–5 starter: "Step-up transformers increase the p.d., so…"

Step-up transformers increase the p.d. for transmission.

For the same power, a higher p.d. means a lower current ($P = V I$).

Grade 7+ extension: "Link to current and heating:…"

A lower current means less energy is dissipated by heating the cables ($P = I^2 R$).

Step-down transformers then reduce the p.d. to a safe level for homes.

ELABORATION GRADE 5

True or false? Justify it.

Saying why is worth more marks than saying true or false.

4 "All metals are magnetic." [2]

False: only iron, steel, cobalt and nickel are magnetic;

copper and aluminium are not.

5 "An induced magnet keeps its magnetism when it's removed from the field." [1]

False: an induced magnet loses most or all of its magnetism quickly.

ELABORATION GRADE 5 GRADE 7

Practical skills: induced p.d. in a coil (Physics only)

A student moves a magnet into a coil connected to a sensitive voltmeter.

Change made	Voltmeter reading
Magnet pushed in slowly	0.2 V
Magnet pushed in quickly	0.8 V
Magnet held still inside the coil	**0 V**
Magnet pulled out quickly	**–0.8 V**
Coil with twice as many turns, magnet in quickly	**1.6 V**

a Complete the table with your predictions. [3]

0 V; –0.8 V (opposite direction); 1.6 V

b Why is there no reading when the magnet is held still? [2]

There is no change in the magnetic field in the coil,

so no p.d. is induced.

c Give two ways to increase the induced p.d. [2]

Move the magnet faster

use more turns / a stronger magnet

d Explain why a current is induced only if the coil is part of a complete circuit. [2]

A p.d. is induced either way,

but charge can only flow (current) if there is a complete circuit.

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ A 100% efficient transformer has a primary p.d. of 230 V and a primary current of 0.5 A. The secondary p.d. is 12 V. Calculate the secondary current. [3]

Vs × Is = Vp × Ip

12 × Is = 230 × 0.5 = 115

Is = 115 ÷ 12 = 9.6 A

2 Grade 5 Give three ways to make an electromagnet stronger. [3]

Increase the current

Add more turns to the coil

Put an iron core inside the coil

3 Define **evidence earth's core is magnetic**. [1]

A compass points north when away from other magnets.

Exam practice

GRADE RADE 4

Secure the basics

1 What is the unit of magnetic flux density? [1]

Tesla (T)

2 Name the two poles of a magnet. [2]

North

south

3 Which direction do field lines go? [1]

From north to south

4 Name a magnetic material. [1]

Iron / steel / cobalt / nickel

5 What is a solenoid? [1]

A coil of wire.

GRADE RADE 5

Apply and rearrange

6 Describe how to plot the field of a bar magnet using a compass. [3]

Place the magnet on paper and put a compass near one pole.

Mark where the needle points; move the compass to that mark and repeat.

Join the marks to make a field line; repeat from other starting points.

7 Explain the difference between a permanent magnet and an induced magnet. [2]

A permanent magnet produces its own magnetic field.

An induced magnet only becomes a magnet when placed in a magnetic field.

8 A 0.25 m wire carries 6 A at right angles to a 0.4 T field. Calculate the force. (Higher) [2]

F = 0.4 × 6 × 0.25

= 0.6 N

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 Give three ways to increase the strength of an electromagnet. [3]

Increase the current

Increase the number of turns on the coil

Add an iron core

2 Define **electromagnet uses**. [1]

Electric bells, relays, door locks and scrapyard cranes.

Exam practice (continued)

GRADE RADE 7+

Stretch

9 A transformer is 100% efficient. The primary coil has 1200 turns and a p.d. of 240 V; the secondary gives 12 V and 3 A. Calculate the turns on the secondary and the primary current. (Physics only) [4]

ns = np × Vs ÷ Vp = 1200 × 12 ÷ 240 = 60 turns

Vp Ip = Vs Is

240 × Ip = 12 × 3

Ip = 0.15 A

10 Describe how a simple a.c. generator (alternator) produces a p.d. (Physics only) [6]

A coil of wire is rotated in a magnetic field (or a magnet rotates in a coil).

The coil cuts the magnetic field lines, so the magnetic field through the coil changes,

which induces a p.d. across the ends of the coil (generator effect).

As the coil rotates, the direction of the induced p.d. reverses every half turn,

so the output is alternating; slip rings and brushes connect the coil to the circuit.

Faster rotation, more turns or a stronger field give a bigger p.d. and higher frequency.

Total: _____ / 23

RETRIEVAL PRACTICE SPACED PRACTICE GRADE 4

Quick-fire retrieval: Magnetism

Cover everything. Answer in under 3 minutes. Redo it on your next spaced session.

1 Unlike poles?

Attract

2 Rule for the motor effect?

Fleming's left-hand rule

3 Core of an electromagnet?

Iron

4 Step-up transformer: more turns on?

Secondary

5 What does a dynamo produce?

d.c.

6 Evidence the Earth's core is magnetic?

A compass points north

Extra practice

Retrieval · answers in the answer booklet

1 What is the unit of magnetic flux density? [1]

A Tesla (T) **B** Newton (N) **C** Weber **D** Ampere (A)

A: Tesla (T). B is measured in tesla.

Reflect and plan

METACOGNITION

Re-rate yourself

Go back to the checklist at the start of this topic and fill in the 'After' column.

METACOGNITION GRADE 4 GRADE 5 GRADE 7

Exam wrapper: why did I drop marks?

After marking the exam practice, write the question numbers you got wrong in the right row.

Reason I lost marks	Question numbers	What to do next
I didn't know or remember it (knowledge gap)		Flashcards and brain dumps
I knew it but misread the question or command word		Underline command words
Maths slip: units, rearranging, standard form		Redo the "we do / you do" pages
I ran out of time or didn't finish		Timed practice: 1 mark per minute

METACOGNITION

Two things I'm now confident about

METACOGNITION

One thing I still need to work on, and how I'll fix it

e.g. 'Rearranging equations → redo the Grade 7+ questions and use the website's Aim higher section.'

SPACED PRACTICE

Book my next spaced sessions

Write the dates in the planner at the front: +2 days, +1 week, +3 weeks.

Extra practice

Retrieval · answers in the answer booklet

1 Define **induced magnet**. [1]

Becomes a magnet only when it is in a magnetic field.

RETRIEVAL PRACTICE | SPACED PRACTICE | GRADE 4 | GRADE 5 | GRADE 7

Final review: test yourself on the whole topic

Do these without your notes, a week after finishing the booklet. Mark them with the answer booklet and add any you got wrong to your 'still to learn' list on the reflect page.

Each question shows its target grade. Aim to get every Grade 4 and 5 question right before moving on to Grade 7+.

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ A 0.08 m length of wire carries a current of 2.5 A at right angles to a magnetic field of flux density 0.4 T. Calculate the force on it. [3]

F = BIl

F = 0.4 × 2.5 × 0.08

F = 0.08 N

2 Grade 5 Describe the magnetic field pattern around a bar magnet. [3]

Field lines go from the north pole to the south pole

Lines are closest together at the poles, where the field is strongest

Field lines never cross

3 Grade 5 Explain why an electromagnet, rather than a permanent magnet, is used in a scrapyard crane. [2]

An electromagnet can be switched on and off

So it can pick up the scrap and then drop it in a new place

4 Grade 7+ A transformer steps 230 V down to 11.5 V. The primary coil has 2000 turns. Calculate the number of turns on the secondary coil. [3]

Vp ÷ Vs = np ÷ ns

230 ÷ 11.5 = 2000 ÷ ns

ns = 2000 × 11.5 ÷ 230 = 100 turns

5 Grade 5 Describe how you could show that a wire carrying a current produces a magnetic field. [3]

Place a plotting compass next to the wire

Switch the current on: the compass needle moves (deflects)

Reverse the current: the needle points the opposite way

6 Calculate the force on a 0.5 m wire carrying 2 A at right angles to a 0.1 T field. [2]

F = BIl = 0.1 × 2 × 0.5 = 0.1 N.