

PHYSICS



EXAM QUESTION PACK

P4.1 MAGNETS AND MAGNETIC FIELDS

SCORE

/43

PERCENTAGE

%

STEMUP

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Gateway Physics A (9-1)

Magnets and magnetic fields

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:

Additional resources may be supplied with this paper.

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname								
Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **43**.
- The total number of marks may take into account some 'either/or' question choices.

1 Which of these pairs of objects will attract each other?

A   copper bar

B  

C  

D   aluminium bar

Your answer ☐

[1]

2 The strength of the magnetic effect of a solenoid can be changed.

Which of the following rows correctly describes what happens to the strength when the current and number of turns are increased?

	Increased current	Increased number of turns
A	increases	decreases
B	increases	increases
C	decreases	increases
D	decreases	decreases

Your answer ☐

[1]

3 Why is an unmagnetised iron object attracted to a magnet?

- A The iron has magnetism induced by the magnet.
- B The iron has charged particles which attract the protons in the magnet.
- C The iron has charged particles which attract the electrons in the magnet.
- D The iron is attracted by the Earth's magnetic field.

Your answer

[1]

4(a) Two students, **A** and **B**, use different methods to see magnetic field patterns.

(i) Describe how student **A** can use a compass to plot a magnetic field pattern.

You may draw a diagram to help you answer this question.

[3]

(ii) Student **B** uses iron filings to show a magnetic field pattern.

Describe how student **B** uses iron filings to show a magnetic field pattern.

You may draw a diagram to help you answer this question.

----- [2]

(b) Their teacher prefers students to use the method proposed by student A.

Suggest **one** reason why.

----- [1]

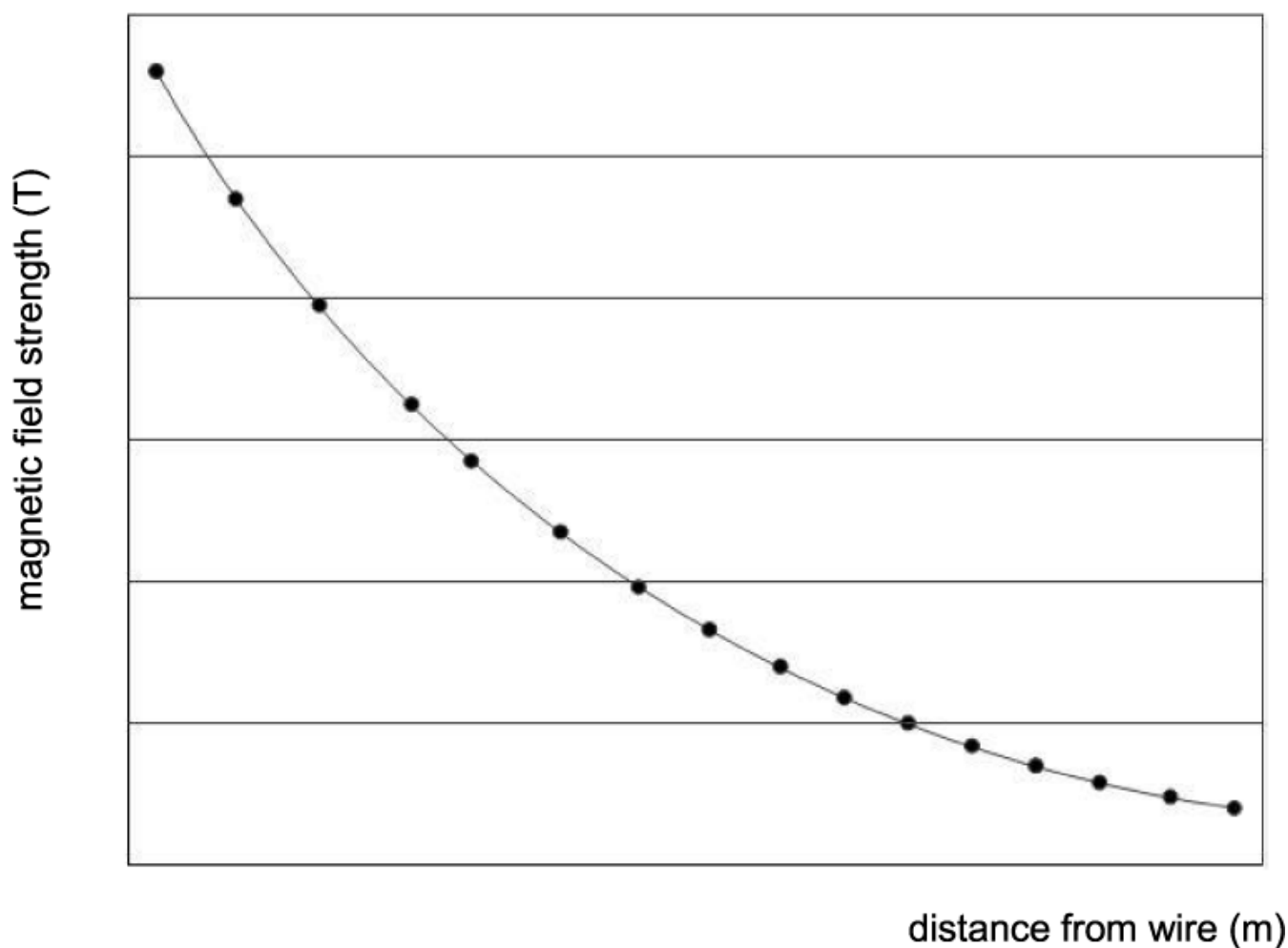
(c) Sketch the field pattern the students found around a bar magnet.



[2]

(d) The two students decide to investigate the magnetic effect of a current-carrying wire.

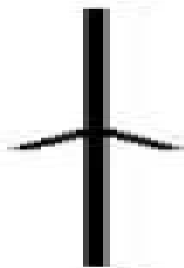
Look at the graph of their results.



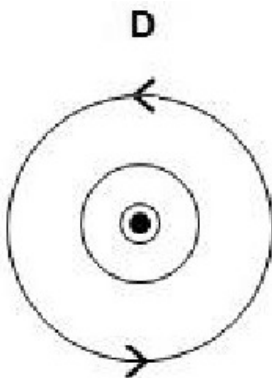
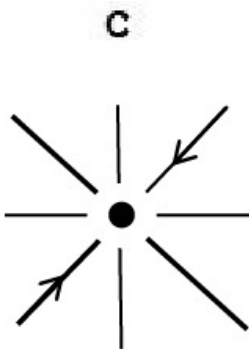
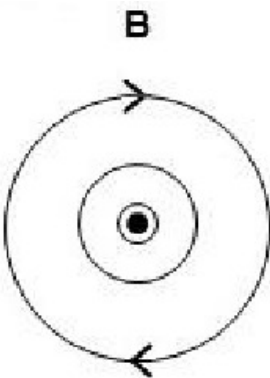
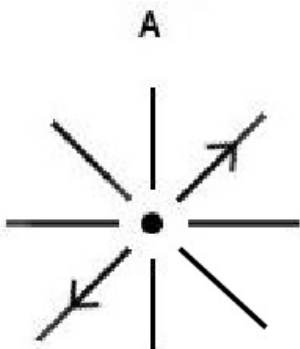
What trend does the graph show?

----- [2]

5 The diagram shows a wire carrying an electric current.



Which diagram shows the magnetic field viewed from above, with the current coming towards you?

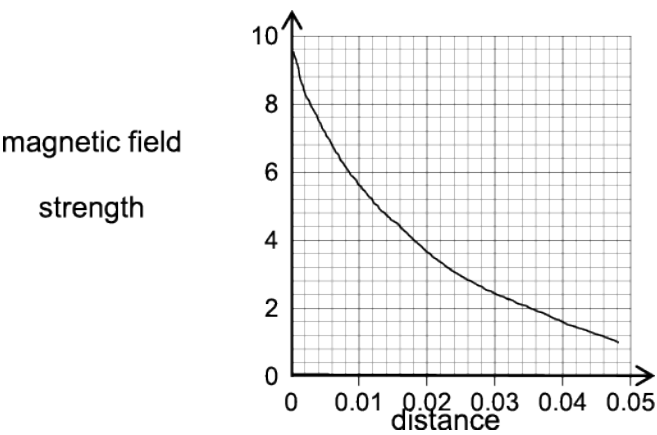


Your answer ☐

[1]

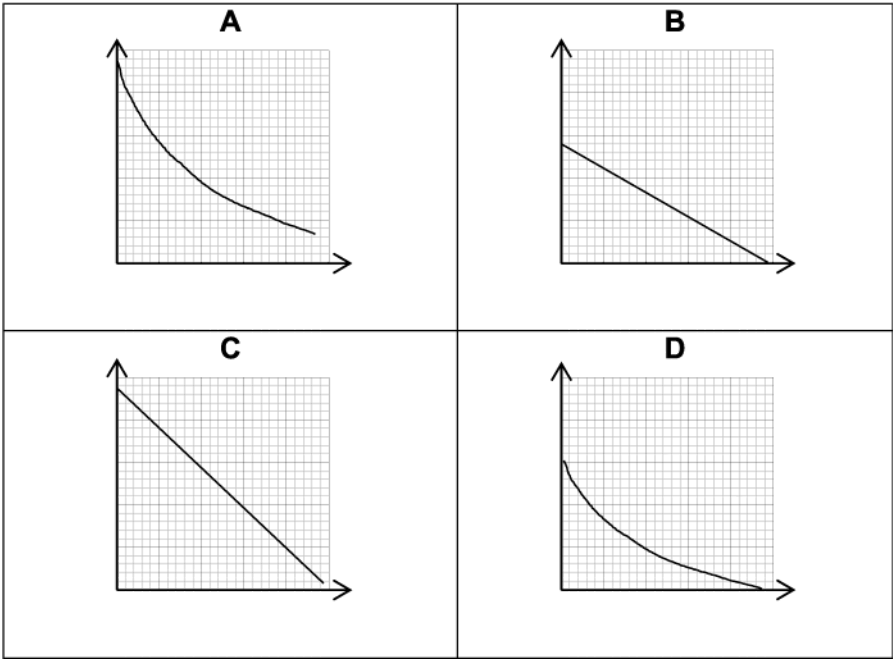
6 A student measures the magnetic field strength around a current carrying conductor at increasing distances from the conductor.

She plots her results.



The current in the conductor is decreased and a new graph plotted.

Which is the correct graph?



Your answer ☐

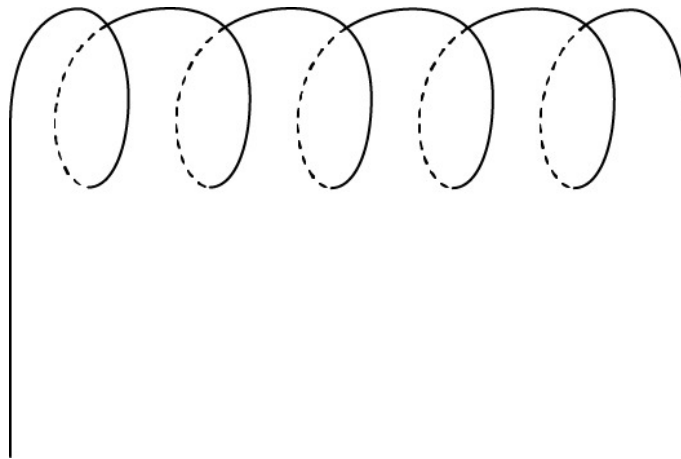
[1]

- (i) Mia investigates electricity and magnetism.

She connects a solenoid to a power supply.

The solenoid produces a magnetic field.

On the **diagram**, sketch the shape of the magnetic field produced.



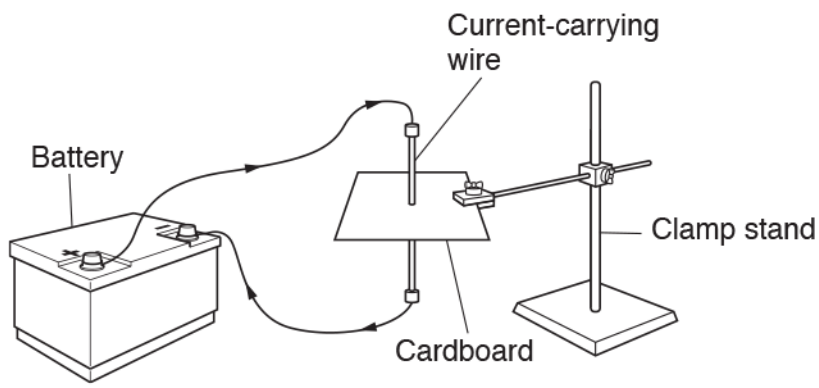
[2]

- (ii) Mia reverses the direction of the current through the solenoid.

Write down the effect this has on the magnetic field.

-----[1]

- 8(a) A student sets up an experiment to investigate the magnetic field around a current-carrying wire.



- (i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire.

[3]

- (ii) Draw the shape of the field which would be found around **this** wire.

[2]

(b) The behaviour of a magnetic compass is evidence that the core of the Earth is magnetic. Explain why.

[2]

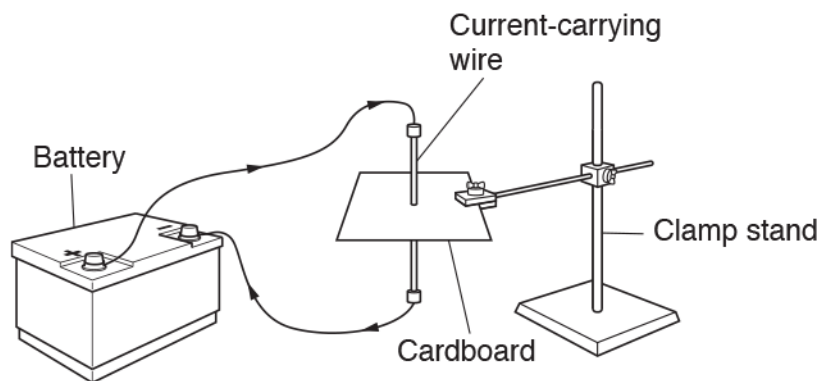
9 Which does **not** increase the magnetic effect of a solenoid?

- A Increasing the cross-sectional area of the solenoid
- B Increasing the current in the solenoid
- C Increasing the number of turns on the solenoid
- D Putting a soft iron core in the solenoid

Your answer ☐

[1]

10(a) A student sets up an experiment to investigate the magnetic field around a current-carrying wire.



(i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire.

[3]

(ii) Draw the shape of the field which would be found around **this** wire.

[2]

(b) The behaviour of a magnetic compass is evidence that the core of the Earth is magnetic. Explain why.

[2]

11 Which of these factors affects the strength of the magnetic field around a current-carrying wire?

- A Direction of the current only
- B Size of the current only
- C Distance from the wire only
- D Size of the current and distance from the wire

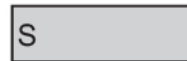
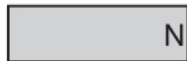
Your answer

[1]

12(a)

Draw the magnetic field pattern between the North and South poles of the magnets.

Include arrows on your field lines.



[3]

(b) Describe **one difference** between a permanent magnet and an induced magnet.

[1]

(c) A student investigates solenoids and writes the following:

Solenoids

Solenoids are coils of wire.

When a voltage flows through them a magnetic field is created.

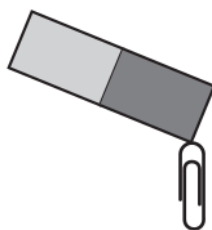
The magnetic field can be increased by decreasing the number of turns or by increasing the current.

The student makes **two** mistakes.

Put a **ring** around the **two** mistakes in the above box.

[2]

13 A magnet is used to pick up a paperclip.



Which statement explains why the paperclip is picked up?

- A The magnet is a permanent magnet and the opposite pole has been induced at the top of the paperclip.
- B The magnet is a permanent magnet and the same pole has been induced at the top of the paperclip.
- C The magnet is a temporary magnet and the opposite pole has been induced at the top of the paperclip.
- D The magnet is a temporary magnet and the same pole has been induced at the top of the paperclip.

Your answer

[1]

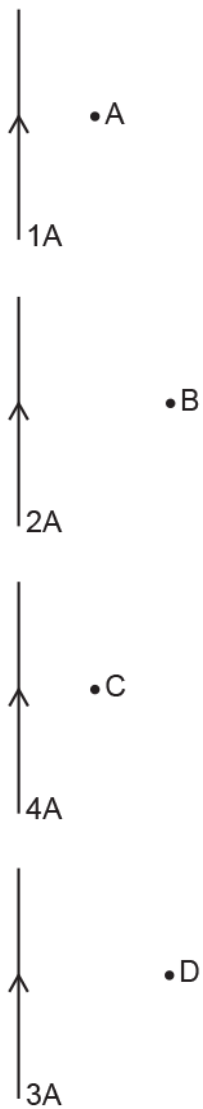
14 Which action **increases** the strength of an electromagnet?

- A Decreasing the current
- B Decreasing the number of turns of wire
- C Increasing the number of turns of wire
- D Using a copper core

Your answer

[1]

15 The different currents in four wires are shown below. The magnetic field is measured at positions A, B, C and D.



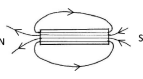
Which position will experience the strongest magnetic field?

Your answer

[1]

END OF QUESTION PAPER

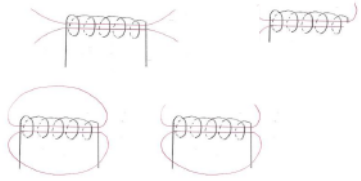
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			B	1	
			Total	1	
2			B	1	
			Total	1	
3			A	1	
			Total	1	
4	a	i	Any 3 from: Place magnet on a sheet of (plain) paper (1) Place the compass near the end of the magnet (1) Mark the position that the compass needle points to (1) Move the compass so the opposite end is at this position and mark the new position where the compass tip settles (1) Repeat above and below the magnet and then connect the marks together to construct a fieldline (1)	3	ALLOW full marks for a fully annotated diagram that demonstrates how the experiment would be undertaken
		ii	Place a clear / transparent / paper cover over the magnet (1) (Sprinkle) on iron filings (to show the field pattern) (1)	2	DO NOT ALLOW marks for diagram
	b		Any one from: Compass shows direction of field lines (1) Iron filings are easily spilt (1) Iron filings are difficult to remove from magnets (1) Iron filings carries a greater risk / AW (1) (Idea of) less accurate field pattern (1) Drawing provides a permanent record (1)	1	
	c		Correct field pattern drawn, (1)  e.g. Correct direction of arrow heads (1)	2	Minimum of 4 field lines No field lines crossing
	d		As the distance from the wire increases the strength of the magnetic field falls / AW (1) (idea of) the non-linear nature of the relationship (1)	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Total	10	
5			D	1	
			Total	1	
6			D	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
7		i	uniform field inside the (middle of) solenoid [1] correct outer shape [1]	2	Ignore arrows on field lines minimum of two 'straight and parallel' lines through solenoid minimum of one correctly drawn loop outside the solenoid OR a divergent field line outside the solenoid  [2] Examiner's Comments Drawing the magnetic field around a solenoid is something that has not been asked in this way previously. About a sixth of candidates omitted the question or failed to notice it was a question at all. The quality of the drawing was often unclear and marks were difficult to award for many answers due to this. Marks were available for a uniform field within the solenoid (two straight parallel lines) [1] and the correct outer shape (diverging field lines or a looped line outside the solenoid) [1]. The diagrams in the guidance in the mark scheme whilst not exhaustive, illustrates what was acceptable.
		ii	(same strength but) reverses direction / (same strength but) changes direction / AW [1]	1	Allow flips (direction) [1] Examiner's Comments This question asked what would happen if the current was reversed. Many wrote that this would increase the voltage rather than reverse it.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8	a	i	Any three from: place the compass onto the card or near to the wire (and turn on the current) ✓ plot / observe the direction of the compass / needle ✓ repeat idea of tip-to-tail / plotting onto the card ✓ repeat at different distances from the centre ✓	3 (AO3 × 1.2)	Examiner's Comments Q23 is an overlap question with J249/03. Identifying the command word 'describe' was key to candidates successfully answering this question. Those that did were able to apply their experience of practical activities supporting P4.1 and wrote down what they could do with a plotting compass in this experiment. Exemplar 14 (a) (i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire. If you place a compass on top of the wire it should in the north direction. ✗ [3] This candidate has not understood the question and is answering a different one about predicting how the compass will behave. Exemplar 15 (a) (i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire. The student will turn on the battery to activate the ~~the~~ circuit and with the cardboard use one hand to hold a compass on a point near the wire and let it draw the magnetic field of the cardboard. [3] The candidate has not thought out what they were going to say, so they have only made one relevant point before running out of space. Exemplar 16 (a) (i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire. Put the compass next to the wire and see where the arrow points. If it points to there is no magnetic field. If it points out there is a magnetic field. [3]

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					If the candidate had written their answer as bullet points it would have helped them to identify that after the first two clear descriptions they were no longer describing how to investigate a magnetic field. Exemplar 17 (a) (i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire. This candidate's response is a good example of the effective use of short clear instructions when describing experimental procedures . It is much easier to follow this type of scientific writing rather than continuous descriptive prose in longer sentences. AFL Give the students the instructions for a practical activity as a single descriptive paragraph and ask them to summarise the instructions a fixed number of short bullet points. Alternatively ask them to write down the procedure after they have completed the activity, but keeping to a word limit.
		ii	one or more circles around wire ✓ clockwise arrow(s) ✓	2 (AO2 × 2.2)	DO NOT ALLOW a spiral BUT ALLOW if clockwise direction shown by an arrow on the spiral then ✓ <u>Examiner's Comments</u> Some good answers were drawn by candidates. However, the annotated field direction on the drawings were not always correct. The question explicitly asks for the shape of the field around this wire. A common misconception was to draw the field around a bar magnet.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		always points to North / South ✓✓ OR Points to (magnetic) North / South ✓ line up with the magnetic field lines of the Earth ✓ OR Compass needle shows (an angle of) dip ✓ Dip (angle) changes (from equator) ✓	2 (AO2 ×1.1)	ALLOW Points North/South wherever you are ✓✓ <u>Examiner's Comments</u> This was a challenging question for candidates. This question asks about a quite separate behaviour of a magnetic compass in the Earth's magnetic field. Wherever you might happen to be on the surface of the Earth a magnetic (dipping) compass will always point north (or south). There were very few candidates who referred to the angle of dip in the direction of the north (or south) magnetic pole. Or that at the magnetic poles a dipping compass dips vertically downward towards the core of the Earth.
			Total	7	
9			A ✓	1 (AO1.2)	<u>Examiner's Comments</u> About two thirds of candidates gave the correct answer A.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10	a	i	Any three from: place the compass onto the card or near to the wire (and turn on the current) ✓ plot / observe the direction of the compass / needle ✓ repeat idea of tip-to-tail / plotting onto the card ✓ repeat at different distances from the centre ✓	3 (AO3 × 1.2)	<u>Examiner's Comments</u> Some candidate did not attempt to describe the experiment here. Most got the idea of placing the compass on the card or near the wire. Rather fewer described the plotting or observing using the compass. Fewer still suggested the idea of repeating at different distances or places. About a quarter of candidates gained all 3 marks here and about a quarter did not gain credit.
		ii	one or more circles around wire ✓ clockwise arrow(s) ✓	2 (AO2 × 2.2)	DO NOT ALLOW a spiral BUT ALLOW if clockwise direction shown by an arrow on the spiral <u>Examiner's Comments</u> This was well answered with about half of the candidates drawing a circular field [1] with arrows showing a clockwise direction [1]. Some candidates drew a circular field [1] but either got the direction wrong or did not indicate a direction at all. Some labelled it with both clockwise and anticlockwise arrows so the direction mark could not be given.
	b		always points to North / South ✓✓ OR Points to (magnetic) North / South ✓ line up with the magnetic field lines of the Earth ✓ OR Compass needle shows (an angle of) dip ✓ Dip (angle) changes (from equator) ✓	2 (AO2 × 1.1)	ALLOW Points North / South wherever you are ✓✓ <u>Examiner's Comments</u> Most candidates gained 1 mark for the idea of pointing north. Better answers (about a third) stated that the compass always pointed north and gained both marks. There were very few answers referring to the angle of dip.
			Total	7	

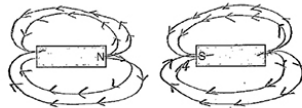
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
11			D ✓	1 (AO1.1)	<u>Examiner's Comments</u> The majority of the candidates scored this mark. Some candidates chose response B. It is important that candidates read all the responses in these types of multiple-choice questions. A good technique is to eliminate responses first perhaps by placing a small cross next to (in this case A). Since both the size of the current and the distance from the wire are correct, then response D is selected.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12	a		One straight line between the middle of the two poles ✓ At least 2 correctly curved lines between the edges of the poles, one above and one below ✓ Arrows on field lines going N to S ✓	3 (AO1.2) (AO1.2) (AO1.2)	Ignore any field lines not between the labelled poles Allow dotted lines. Straight line by eye (rulers not used) Concave smooth curves Any wrong arrow loses this mark <u>Examiner's Comments</u> The question required candidates to sketch of the magnetic field 'between the North and South poles' and this was emphasised in the diagram by only labelling a single N and S. The three marks were given for: symmetrical(ish) convex cured lines joining the top and bottom of the adjacent poles, a straight line from the centre of the N to the centre of the S, and arrows on the lines going from N to S.  Misconception A common misconception is for candidates to see one familiar thing in the stem of a question and assume that is what they are being asked to do. A number of candidates drew the 'standard' magnetic field around a bar magnet. Exemplar 4 is a response where the candidate has not understood the question. However, because they drew the field directions correctly they gained a consolation mark.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					Exemplar 4 20 (a) Draw the magnetic field pattern between the North and South poles of the magnets. Include arrows on your field lines.  [3]
	b		Any one from: Induced magnets lose their magnetism (when away from a magnetic field)/AW OR A ✓ Permanent magnets retain their magnetism (when away from a magnetic field)/AW ✓	1 (AO1.1)	Examiner's Comments Around half the candidates correctly identified that induced magnetism was temporary. A common misconception was to explain induced magnetism in terms of electromagnets.
	c		Mistakes: When a <u>voltage</u> flows through them a magnetic field is created. ✓ The magnetic field can be increased by <u>decreasing</u> the number of turns..... ✓	2 (AO3.1b) (AO3.1b)	Must circle 'voltage, or 'flows through', or whole sentence Should circle 'decreasing (the number of turns)' but NOT the increasing current bit. If a candidate circles 'magnetic field can be increased' and then circles all or part of the increasing current bit, award 1 mark only for this sentence. Examiner's Comments Most candidates identified one error (for example voltage or decreasing), and some two. A number tried to ring entire sentences without identifying the individual errors in the sentences. This approach was an allowed approach for the second sentence (where the two errors are unambiguous), but not for the third sentence where if one statement is correct the other will be incorrect. The magnetic field will only increase if the number of turns increases, or if the number of turns is decreased then the magnetic field will decrease.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
13			A	1 (AO1.1)	
			Total	1	
14			C	1 (AO1.1)	
			Total	1	
15			C	1 (AO2.2)	
			Total	1	