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EDEXCEL GCSE PHYSICS: QUESTIONS BY TOPIC

Magnetism and the Motor Effect (12)

GCSE Physics (Higher) Topic 12

7 questions · 66 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Physics 1PH0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION	SOURCE	MARKS	PAGE
1. Q5	Paper 2 June 2018	9	4
2. Q5	Paper 2 November 2020	9	7
3. Q5	Paper 2 November 2021	9	11
4. Q5	Paper 2 June 2023	9	14
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QUESTIONS

7 questions · 66 marks · lowest tariff first



9-MARK QUESTIONS

5 questions in this booklet



- 5** (a) A student has a bar magnet, a piece of iron the same size as the magnet, and some paper clips.

Describe how the student could use these items to demonstrate temporary induced magnetism.

(3)



(b) A student sets up the apparatus shown in Figure 9.

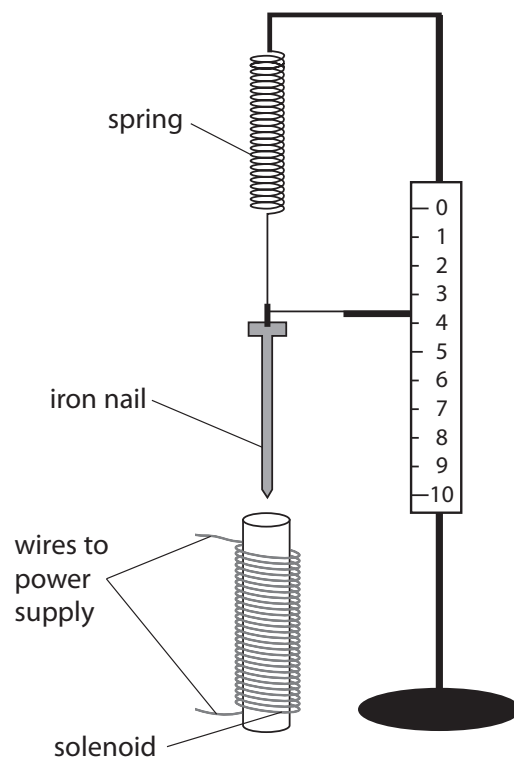


Figure 9

- (i) When the current in the solenoid is switched on, the solenoid attracts the iron nail.

Describe how the student could use this apparatus to investigate how the size of the current in the solenoid affects the force of attraction between the solenoid and the iron nail.

(4)

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(ii) The spring constant of a different spring is 24 N/m .

The spring is extended from its unstretched length by 12 cm .

Calculate the energy transferred in extending the spring by 12 cm .

Use an equation selected from the list of equations at the end of this paper.

(2)

energy transferred = ... J

(Total for Question 5 = 9 marks)



5 Figure 11 shows the magnetic field of a magnet.

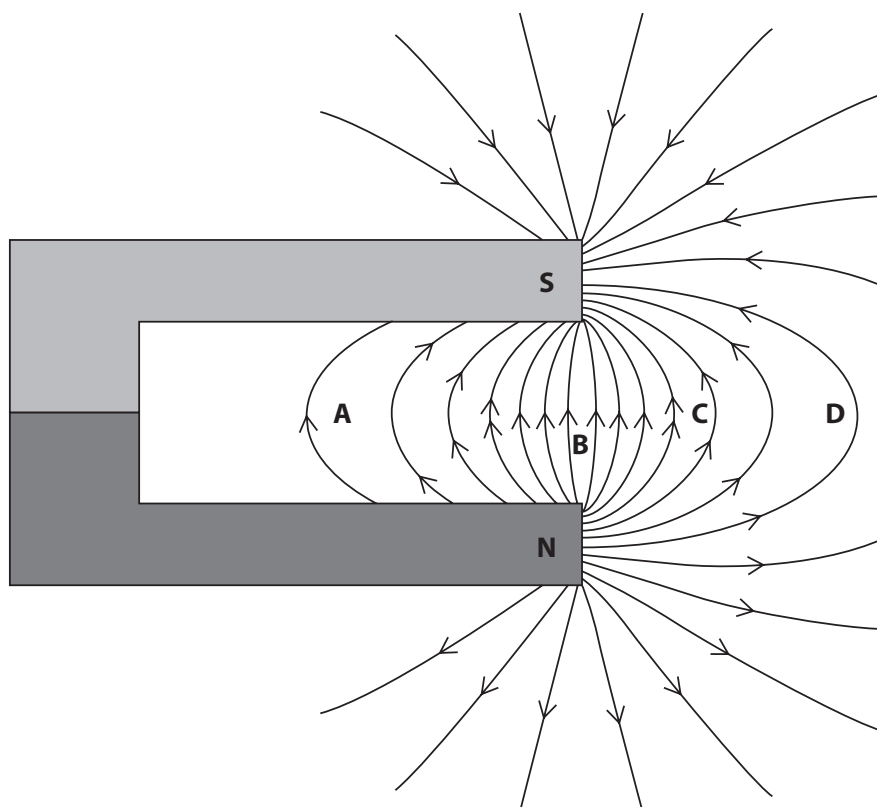


Figure 11

(a) At which point is the magnetic field strongest?

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(b) Figure 12 shows a wire carrying a current.

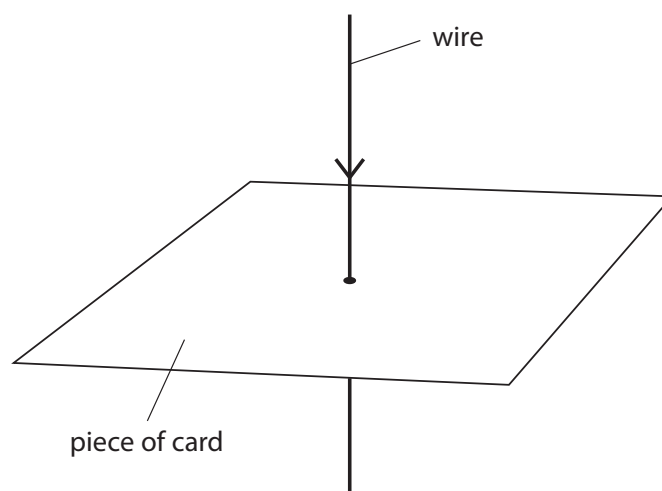


Figure 12

Draw, on the card in Figure 12, the magnetic field that is produced by the current.

(2)

(c) Figure 13 shows two metal rods carrying a current.

A metal roller touches both rods and completes the circuit.
The roller is in the magnetic field produced by a magnet.

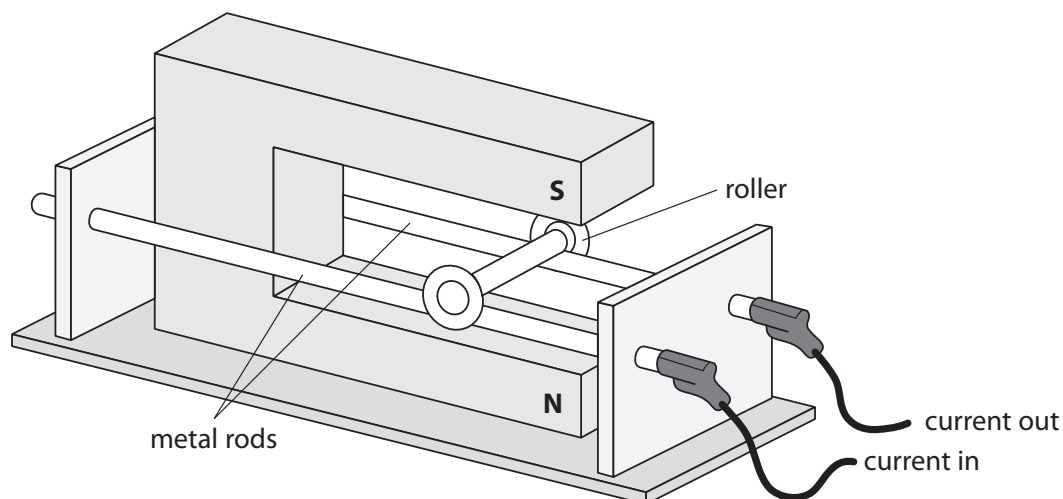


Figure 13

(i) The magnetic flux density of the magnetic field at the roller is 1.2 T.

The current in the roller is 2.5 A.

The length of the roller carrying the current is 0.060 m.

Calculate the force on the roller.

Use the equation

$$F = B \times I \times l$$

(2)

force on the roller = ... N

- (ii) Describe how Fleming's left-hand rule can be used to determine the direction of the force acting on the roller.

You may draw a diagram to help your answer.

(3)

- (iii) Draw an arrow on Figure 13 to show the direction of the force acting on the roller.

(1)

(Total for Question 5 = 9 marks)



- 5 (a) A student uses plotting compasses to investigate the magnetic field between the poles of two bar magnets.

Figure 12 shows **one** of the plotting compasses and **one** of the bar magnets.



Figure 12

The student places the two magnets on a piece of paper with a pole of one magnet a few centimetres away from a pole of the other magnet.

The student places 20 plotting compasses on the paper near the magnets.

Figure 13 shows the direction in which each of the plotting compasses points.

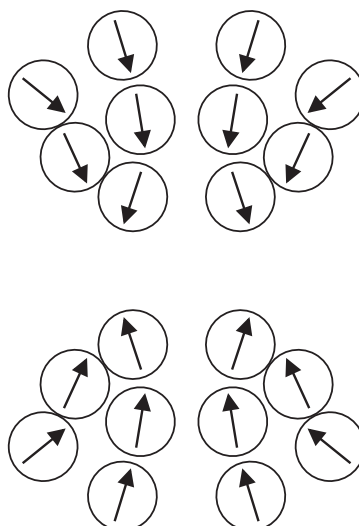


Figure 13

- (i) Draw two rectangles on Figure 13 to show the positions of the two bar magnets.

Label the N-pole and the S-pole of each magnet.

(2)

- (ii) The student wants to determine the shape of the magnetic field for a larger area around the magnets.

Describe how the student should continue the investigation using just one plotting compass.

(3)



- (b) Two long, thin magnets are held with their N-poles facing each other.
The force, F , between the magnets can be calculated using the equation

$$F = \frac{K}{d^2}$$

where

K is a constant value

d is the distance between the magnets.

- (i) The magnets are 4.0 cm apart.

The force between the magnets is 1.2 N.

Calculate the value of K .

State the unit.

(3)

$K =$ unit

- (ii) The magnets are held the same distance apart but with the N-pole of one magnet now facing the S-pole of the other magnet.

The value of K does not change.

State how the force would compare with the force in part (i).

(1)

(Total for Question 5 = 9 marks)



- 5 (a) Figure 8 shows two magnets with their N poles facing each other.



Figure 8

On Figure 8, draw the shape and direction of the magnetic field between the two magnets.

(2)

- (b) Figure 9 shows a toy that has a plastic cylinder, a plastic base and two similar magnets. Each of the two magnets is in the shape of a ring.

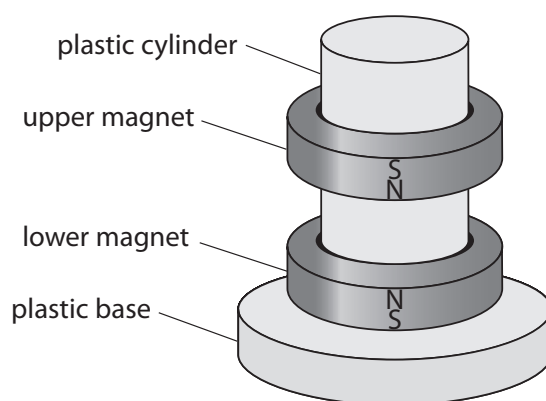


Figure 9

The upper magnet seems to float in the air above the lower magnet.

Describe the forces acting on the upper magnet.

Use the idea of magnetic fields in your answer.

(3)

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(c) Figure 10 shows a current-carrying wire between the poles of a magnet.

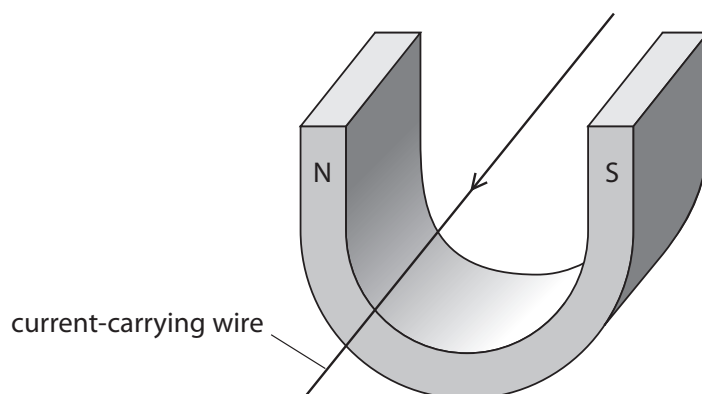


Figure 10

- (i) The magnet and the wire each experience a force when there is a current in the wire.

(2)

1 State the direction of the force on the wire.

2 State the direction of the force on the magnet.

- (ii) The force on the wire is 0.15 N.

The current in the wire is 2.7 A.

The magnet produces a field with a magnetic flux density of 0.50 T.

Calculate the length of the wire in the magnetic field.

Use an equation selected from the list of equations given at the end of the question paper.

(2)

length of the wire in the magnetic field = ... m

(Total for Question 5 = 9 marks)

5 (a) Figure 13 represents the Earth.

Figure 13 shows **two** magnetic compass needles placed near to the Earth's surface, at points Q and T.

Each magnetic compass needle can rotate about its central dot.

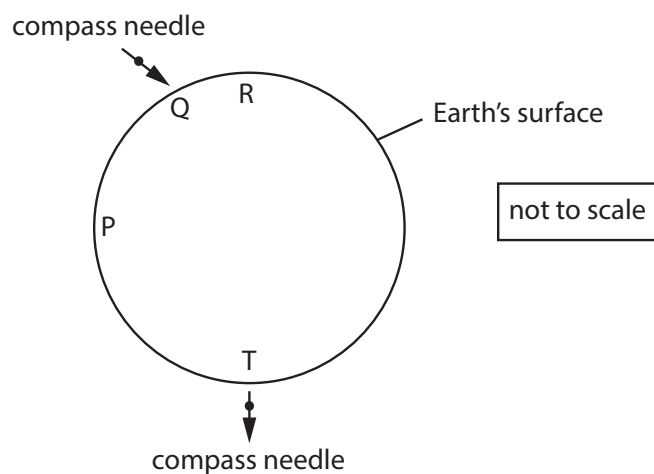


Figure 13

- (i) A compass needle is placed at point P and another at point R, near to the Earth's surface.

On Figure 13, draw an arrow at point P and an arrow at point R to show the direction of the compass needle at each point.

(2)

- (ii) Explain why the arrows point in the directions you have drawn in part (i).

You may draw on Figure 13 to help your answer.

(3)

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(b) Figure 14 shows a wire placed between the poles of a U-shaped magnet.

The wire is connected to a resistor and a battery.

The wire carries a current in the direction shown.

The wire is perpendicular to the magnetic field of the magnet.

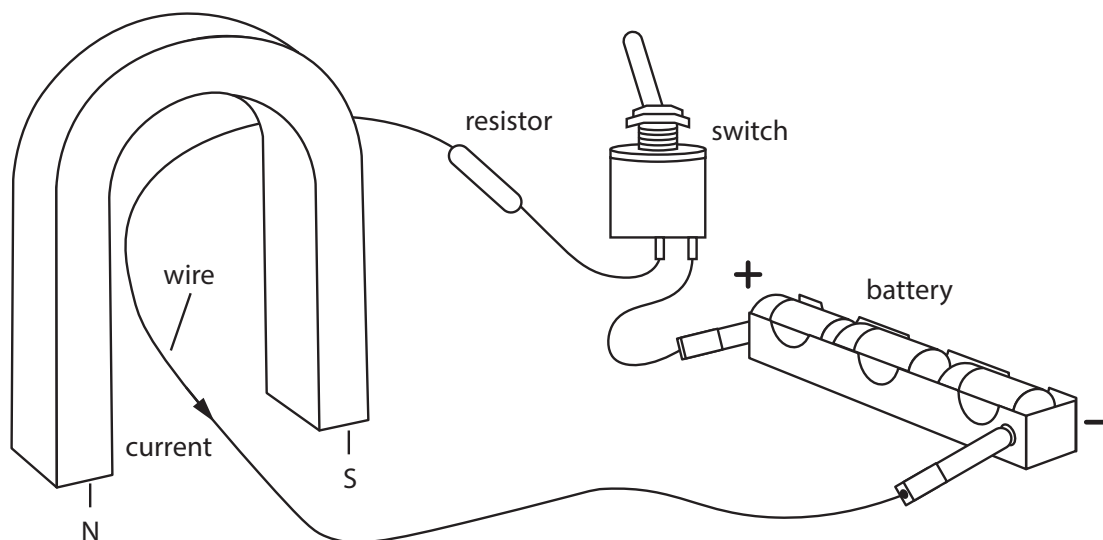


Figure 14

- (i) Draw an arrow on Figure 14 to show the direction of the force, F , acting on the wire.

Label this arrow 'F'.

(1)

- (ii) State **one** practical way of reversing the direction of force F .

(1)

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(iii) In Figure 14

- current in the wire = 3.2 A
- length of wire in the magnetic field = 0.042 m
- magnitude of the force on the wire = 0.078 N

Calculate the magnitude of the magnetic flux density between the two poles of the magnet.

(2)

magnetic flux density = ... T

(Total for Question 5 = 9 marks)



10-MARK QUESTIONS

1 question in this booklet



- 5 (a) Figure 11 shows the shape of the magnetic field near a bar magnet.

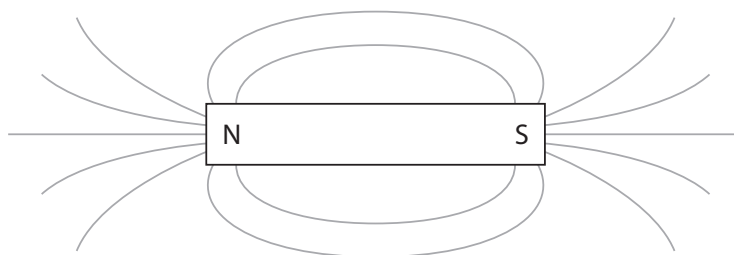


Figure 11

- (i) Draw arrows on the field lines in Figure 11 to show the direction of the magnetic field.

(1)

- (ii) Place a letter X on Figure 11 at a place where the magnetic field is strongest.

(1)

- (iii) Describe **two** differences between the magnetic field shown in Figure 11 and a uniform magnetic field.

(2)

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- (b) State how a uniform magnetic field may be obtained in a school laboratory.

(1)

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- (c) Figure 12 shows the directions of some plotting compass needles placed at different points near the Earth's surface.

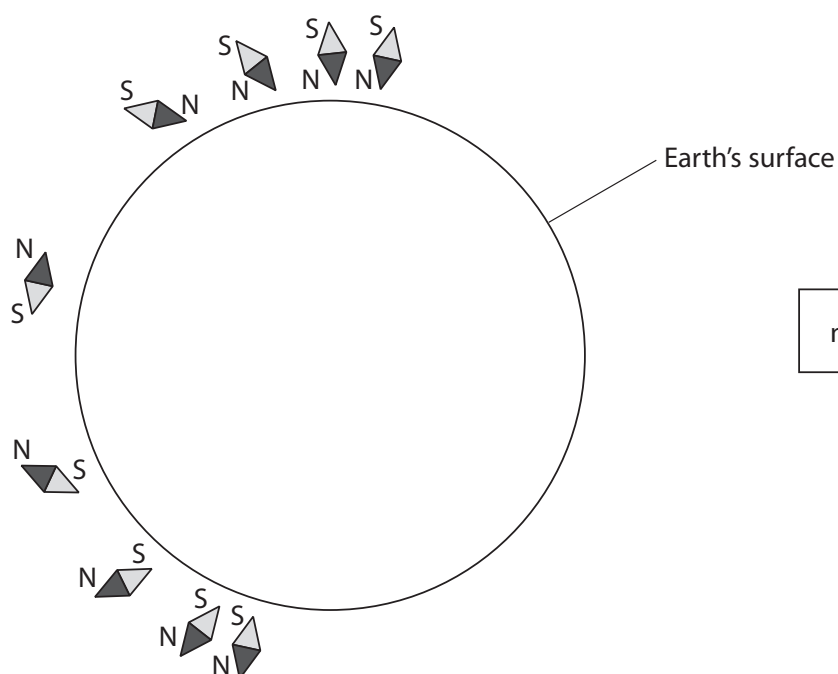


Figure 12

- (i) Sketch, on Figure 12, the Earth's magnetic field outside and inside the Earth.

(2)

- (ii) State which part of the Earth generates its magnetic field.

(1)

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.....

(d) A wire is placed at right angles to the Earth's magnetic field.

The wire is 0.600 m long and carries a current of 93.1 mA.

The force on the wire is 1.11×10^{-5} N.

Calculate the magnetic flux density of the Earth's magnetic field.

Use the equation

$$F = B \times I \times l$$

(2)

magnetic flux density = ... T

(Total for Question 5 = 10 marks)



11-MARK QUESTIONS

1 question in this booklet



- 7 (a) Figure 11 shows two nails, X and Y, hanging from a magnet.

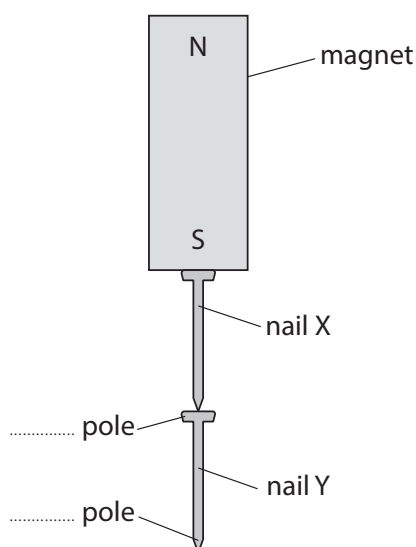


Figure 11

- (i) Complete the labels in Figure 11 to show the N and S poles of nail Y.

(1)

- (ii) Nail X is removed from the magnet and nail Y falls off nail X.

This shows that the magnet caused both nails to be

(1)

- ☐ A permanent magnets
- ☐ B temporarily charged
- ☐ C permanently charged
- ☐ D induced magnets

(b) A teacher has a pile of steel nails, a magnet and some plastic strips that are all the same size.

The teacher places a plastic strip under the magnet and picks up some nails from the pile, as shown in Figure 12.

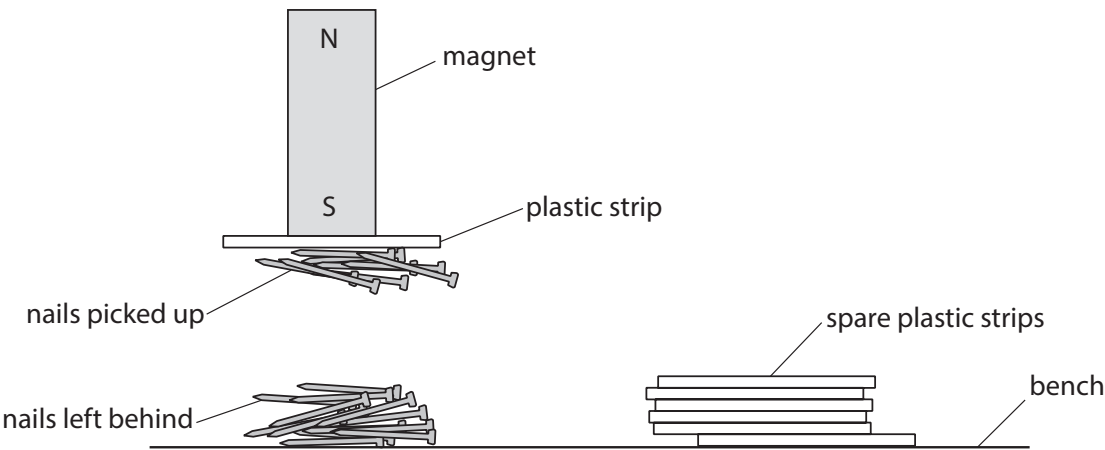


Figure 12

Some nails are not picked up and are left behind on the bench.

The teacher investigates how the number of nails that can be picked up changes when the number of plastic strips under the magnet is increased.

The results are shown in Figure 13.

	number of nails picked up				
number of plastic strips	1st trial	2nd trial	3rd trial	4th trial	mean
1	12	13	12	13	12.5
2	11		12	12	12.0
3	10	12	11	12	11.25
4	7	9	8	12	9.0
5	6	6	8	7	6.75
6	3	5	4	6	4.5
7	1	2	3	2	2.0

Figure 13

(i) Complete Figure 13 to show the missing value.

(1)

(ii) Use the data in Figure 13 to complete the bar chart in Figure 14.

(1)

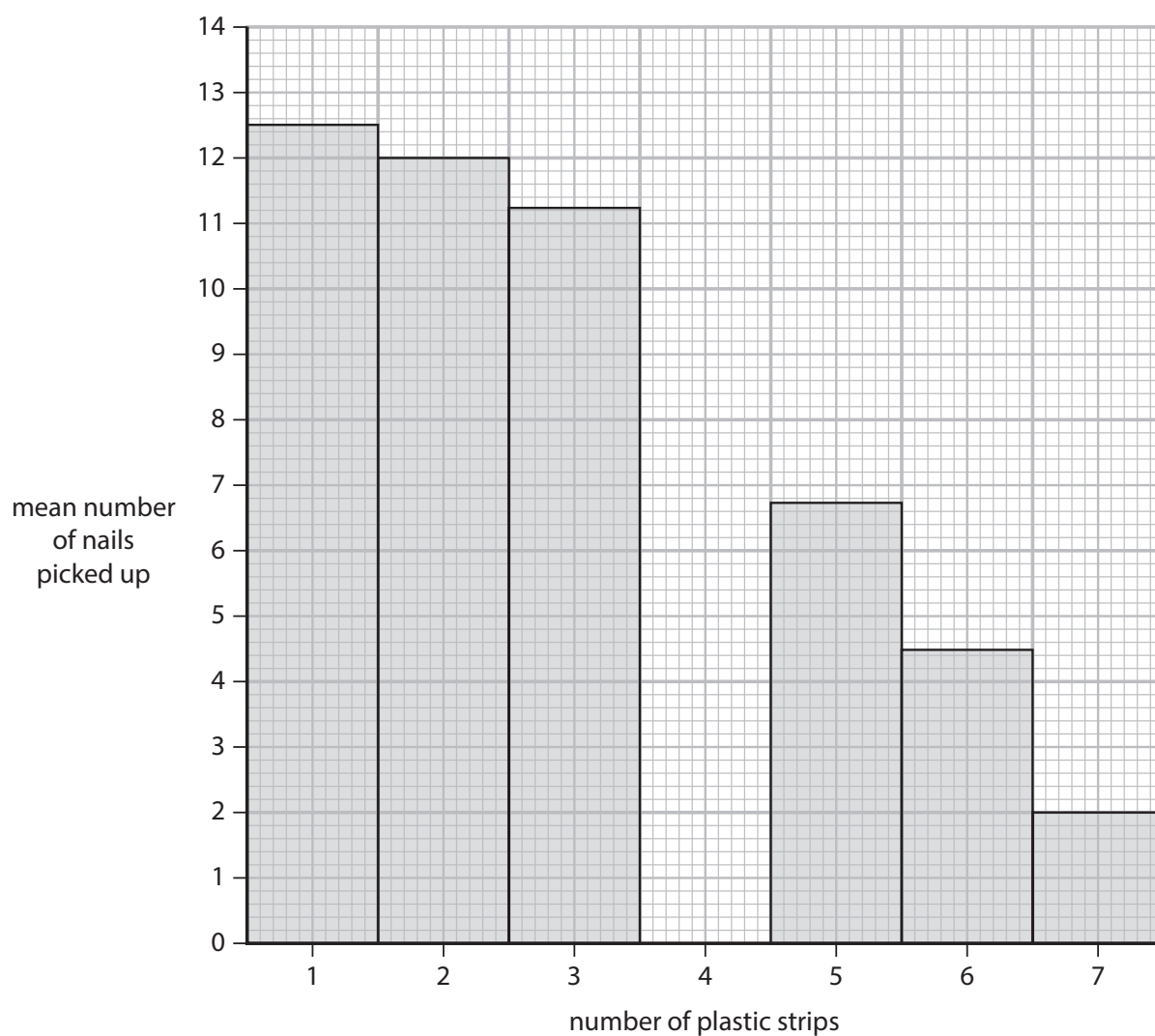


Figure 14

(iii) Use Figure 14 to describe the relationship between the number of plastic strips and the mean number of nails picked up.

(2)

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- (iv) A student thinks that none of the nails used in the investigation become permanently magnetised.

Suggest how the student could test this hypothesis.

(2)

- (c) The magnetic flux density, B , is a measure of the strength of the magnetic field of a magnet.

B varies with the distance, d , from a magnetic pole of a magnet as given by the equation

$$B \times d^2 = K$$

where K is a constant for the magnet.

At a distance of 3 mm from the pole of a magnet, $B = 650 \mu\text{T}$.

Calculate the value of B at a distance of 6 mm from the pole of the magnet.

(3)

B at 6 mm = ... μT

(Total for Question 7 = 11 marks)



MARK SCHEMES

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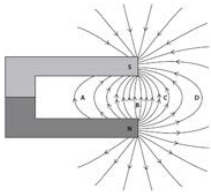
Question Number:	Answer	Additional Guidance	Mark
5(a)	a description to include: method of producing temporary induced magnetism (1) method of demonstrating the magnetic properties of the temporary magnet (1) method of demonstrating magnetic effect is temporary (1)	place iron near / in contact with magnet / in magnetic field OR use magnet to pick up one paper clip OR use magnet to make iron a temporary magnet paper clip(s) attracted to iron OR use first paper clip to pick up another paper clip remove magnet and paper clips no longer attracted / fall off OR wait some / short time and iron bar no longer picks up / attracts paper clips	(3) AO 1 2

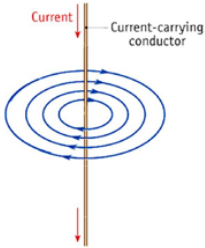
Question Number:	Answer	Additional Guidance	Mark
5(b)(i)	a description to include 4 of the following: • note position of pointer before current is switched on (1) • measure position of pointer when current in coil (1) • (use an ammeter to) measure current (1) • calculate the extension / stretch of the spring (1) • use force (of attraction) is proportional to extension / stretch (of spring) (1) • repeat with different currents (1)	measure length of spring before current is switched on how far nail moves calculate force from spring constant and extension calibrate spring increase the current calculate the extension of the spring using new position of pointer minus starting position of pointer is worth 3 marks	(4) AO 2 2

Question Number:	Answer	Additional Guidance	Mark
5(b)(ii)	select and substitute (1) (E =) $\frac{1}{2} \times 24 \times 0.12^2$ evaluation (1) (E =) 0.17 (J)	$\frac{1}{2} \times 24 \times 12^2$ max 1 mark accept answers that round down to 0.17 e.g. 0.1728 POT error (e.g. 1728) max 1 mark award full marks for correct answer without working	(2) AO 2 1

(Total for Question 5 = 9 marks)

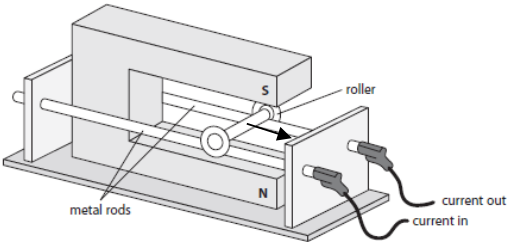


Question number	Answer	Mark
5(a)(i)	B  A, C and D are in the areas where the field lines are further apart and the field is weaker	(1)

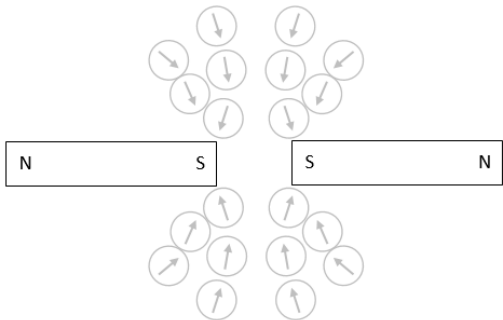
Question number	Answer	Additional guidance	Mark
5 (b)	 at least two concentric circles (1) arrows correct (1)	separation of the circles is increasing	(2)

Question number	Answer	Additional guidance	Mark
5 ci	substitution (1) ($F =$) $1.2 \times 2.5 \times 0.06$ evaluation (1) 0.18 (N)	award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
5(c)(ii)	a description to include first finger, second finger and thumb (of left-hand) held mutually perpendicular (1) first finger (is in the direction of) magnetic field OR second finger (is in the) direction of) current (1) thumb (is in the) direction of force / motion (1)	award 1 mark for attempt at mutually perpendicular shown in a diagram diagram relating thumb and fingers to correct quantities at right angle gains 3 marks	(3)

Question number	Answer	Additional guidance	Mark
5(c)(iii)	 arrow from roller towards contacts (1)		(1)

Total marks for question5 = 9

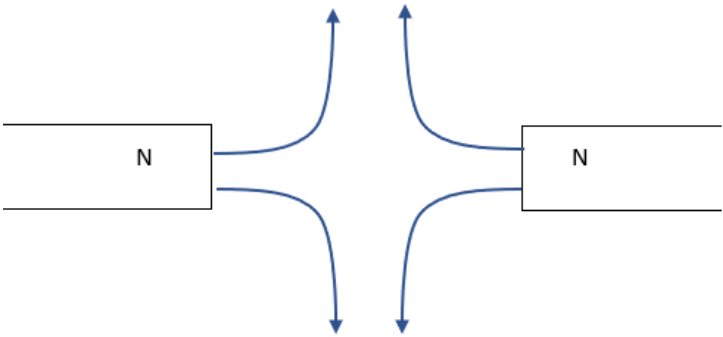
Question number	Answer	Additional guidance	Mark
5 (a)(i)	example:  rectangles in (approximately) correct position (1) all four poles correctly labelled (1)	judge by eye but do not allow rectangles in contact	(2) AO3

Question number	Answer	Additional guidance	Mark
5 (a)(ii)	a description to include place a (plotting) compass on the paper (near to the magnet(s)) and mark direction of the field (at that point) (1) determine how the field continues from that point (1) connect field lines to reveal overall shape(1)	place a (plotting) compass on the paper (near to the magnet(s)) and put a dot at each end of the needle move compass so that one end of the needle is over the mark (just made) join up the dots	(3) AO1

Question number	Answer	Additional guidance	Mark
5 (b) (i)	substitution of values (1) $1.2 = \frac{K}{4(.0)^2}$ rearrangement and evaluation (1) $(K =) 19$ unit (1) N cm^2	allow rearrangement before substitution $(K =) 1.2 \times 4(.0)^2$ 19.2 0.00192 award full marks for the correct answer without working independent mark N m^2	(3) AO2

Question number	Answer	Additional guidance	Mark
5 (b) (ii)	same magnitude and opposite direction (1)	allow (now) attraction for opposite direction	(1) AO1

Question 5 total 9 marks

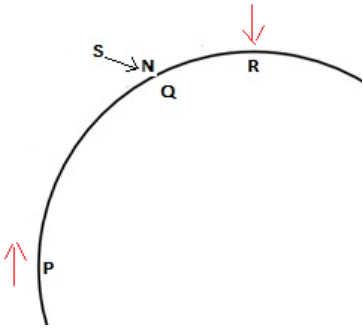
Question number	Answer	Additional guidance	Mark
5 (a)	at least four lines as shown (1) at least two arrows directed away from N poles (1) 	lines must not intersect (cross over) ignore continuation of lines to S of a magnet independent mark do not award if one or more arrows shown pointing towards N pole	(2) AO1

Question number	Answer	Additional guidance	Mark
5 (b)	any three from magnetic fields interact (1) (force due to) repulsion (between magnets) (1) (repulsion) force upwards (on upper magnet) (1) weight / gravitational force (downwards on upper magnet) (1) forces equal size / in equilibrium (1)	marks can be awarded from a correctly labelled diagram magnets are in each other's magnetic field repel / push away accept gravity (acts downwards) forces are balanced ignore references to charge	(3) AO1

Question number	Answer	Additional guidance	Mark
5 (c) (i)	1 up(wards) (1) 2 down(wards) (1)	independent marks accept out(wards from the magnet) accept in(wards) / into (magnet) allow 1 mark for 1 down / in(wards) AND 2 up / out(wards)	(2) AO1

Question number	Answer	Additional guidance	Mark
5 (c) (ii)	substitution (1) $0.15 = 0.5(0) \times 2.7 \times L(\text{length})$ rearrangement and evaluation (1) (length =) 0.11 (m)	alternative method re-arrangement (1) (length =) $\frac{F}{B \times I}$ Or (length =) $\frac{0.15}{0.5(0) \times 2.7}$ (substitution and) evaluation (1) (length =) 0.11 (m) allow any values that round to 0.11 e.g 0.111 accept 0.1 or 0.1 (m) allow 1 mark for answer of 9 (with or without working) award full marks for correct answer without working.	(2) AO2

Total 9 marks

Question number	Answer	Additional guidance	Mark
5 (a) i	arrow pointing up the page at P (1) arrow pointing down the page at R (1)	 judge directions by eye – within 10° acceptable as a guide allow arrows inside or outside the circle	(2) AO3.1

Question number	Answer	Additional guidance	Mark
5 (a) ii	an explanation linking any three from: Earth has a magnetic field (1) (magnetic compass) needle/arrow points in the direction of the field (1) (Earth's magnetic) field goes into Earth at Q and/or R / comes out of Earth at T (1) (Earth's magnetic) field runs parallel to Earth's surface at P (1) Q and/or R are at (magnetic)	credit answers shown in Figure 13 the core is magnetic / (it is as if there were a) magnet inside the Earth (north pole of compass) needle/arrow points to south pole of magnet magnetic field lines go from north to south poles of magnet magnetic south pole of Earth is at (geographic) north pole or	(3) AO3.1

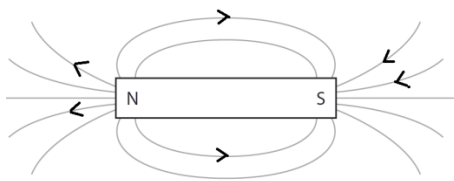
Question number	Answer	Additional guidance	Mark
5 (b) i	arrow pointing vertically up (1)	seen anywhere judge direction by eye	(1) AO2.1

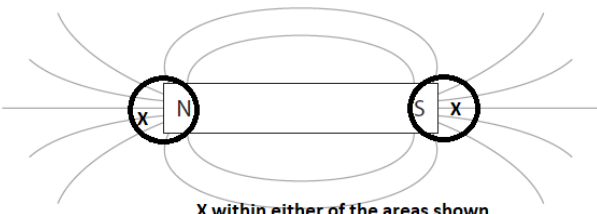
Question number	Answer	Additional guidance	Mark
5 (b) ii	statement (1) accept any clear action that will reverse the current OR accept any clear action that will reverse the poles	swap the battery connections around turn the magnet around	(1) AO2.2

Question number	Answer	Additional guidance	Mark
5 (b)iii	rearrangement and substitution (1) (B =) $\frac{0.078}{3.2 \times 0.042}$ evaluation (1) 0.58 (T)	(B =) $\frac{0.078}{0.1344}$ any number rounding to 0.6 (T) award full marks for the correct answer without working	(2) AO2.1

Total for Question 5 = 9 marks

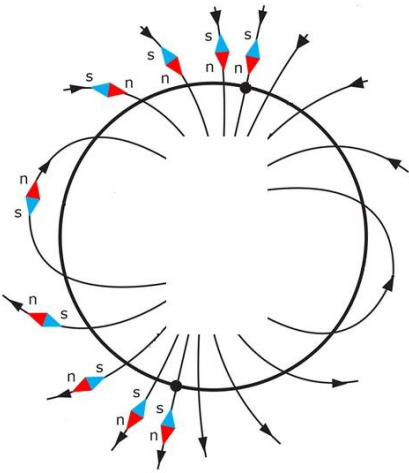


Question number	Answer	Additional guidance	Mark
5 (a) (i)	consistent arrows showing magnetic field direction(s) (1) 	arrows showing direction out of N, towards and into S minimum of two arrows all arrows shown must be in the correct direction	(1) AO1.2

Question number	Answer	Additional guidance	Mark
5 (a) (ii)	'X' placed just/immediately to the left of the N pole or just/immediately to the right of S pole (1)  X within either of the areas shown	allow on the letters N or S do not allow further inside the magnet	(1) AO1.1

Question number	Answer	Additional guidance	Mark
5 (a) (iii)	A description to include any two from: (in comparison with bar magnet's field shown the uniform field has:) 1. only one direction (1) 2. straight lines (1) 3. parallel lines (1) 4. equidistant lines (1) 5. same strength of field everywhere (1)	(in comparison with uniform field the bar magnet's field lines:) vary in direction curved lines converge / diverge vary in distance(s) apart / gap vary in strength of field if no other mark is awarded, credit any diagram showing a uniform magnetic field for 1 mark	(2) AO3.2

Question number	Answer	Additional guidance	Mark
5 (b)	(inside) a solenoid / long coil (with a current / power supply) (1)	give credit for diagrams accept: horseshoe magnet (between / using) pair of Magnadur / flat magnets (between / using) Helmholtz coils (between / using) two bar magnets, with unlike poles facing each other	(1) AO1.2

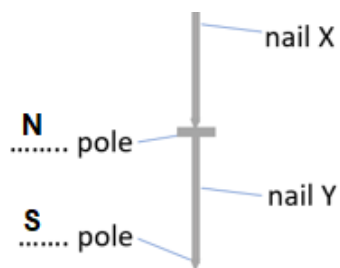
Question number	Answer	Additional guidance	Mark
5 (c) (i)	Sketch including any two from at least two field lines outside the Earth approximately aligning with compasses (1) at least two field lines continue inside the Earth towards imaginary poles (1) all arrows on lines drawn in the correct direction(s) outside the Earth (1) 	field lines need to have a gap inside the Earth ignore arrows on field lines inside the Earth	2 AO3.1

Question number	Answer	Additional guidance	Mark
5 (c) (ii)	(magnetic outer) core (1)	moving charges/ions	(1) AO1.1

Question number	Answer	Additional guidance	Mark
5(d)	rearrangement and substitution (1) $(B = \frac{F}{I \times l})$ $= \frac{1.11 \times 10^{-5}}{93(.1 \times 10^{-3}) \times 0.6(000)}$ evaluation (1) $2.0 \times 10^{-4} \text{ (T)}$	0.0002 (T) accept any number that rounds to $2.0 \times 10^{-4} \text{ (T)}$ e.g. $1.989 \times 10^{-4} \text{ (T)}$ any number that rounds to $2.0 \times 10^{-7} \text{ (T)}$ e.g. $1.987 \times 10^{-7} \text{ (T)}$ is awarded 1 mark only award full marks for the correct answer without working	(2) AO2.1

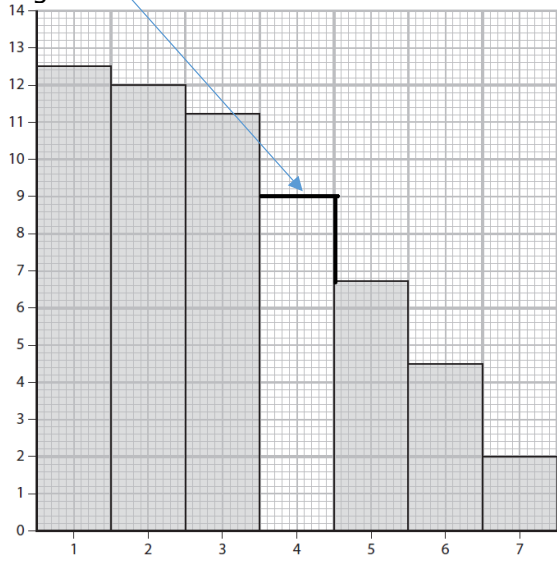
Total 10 marks

Question number	Answer	Additional guidance	Mark
7(a) (i)	both labels as shown (1)	accept North / north for N South / south for S accept labels at the side e.g.:	(1) AO1



Question number	Answer	Additional guidance	Mark
7(a) (ii)	D induced magnets B and C are incorrect because electric charge is not relevant in this context A is incorrect because permanent magnets would remain attracted		(1) AO1

Question number	Answer	Additional guidance	Mark
7(b) (i)	13		(1) AO2

Question number	Answer	Additional guidance	Mark
7(b) (ii)	Column drawn at height of 9.0 (1) e.g. 	Allow $\frac{1}{2}$ square tolerance must have horizontal and vertical lines drawn ignore shading / fill	(1) AO2

Question number	Answer	Additional guidance	Mark
7(b) (iii)	a description to include as number of strips increase, the number of nails (picked up) decreases (1) (relationship is) non-linear (1)	allow reverse argument allow negative correlation one goes up and one goes down allow description of non-linearity e.g. change is not in even steps / non-uniform ignore inversely proportional	(2) AO3

Question number	Answer	Additional guidance	Mark
7(b) (iv)	a suggestion to include suitable test (1) expected result (before and after) (1)	put near to a magnet / compass needle put near to (unmagnetised) iron (filings) put next to each other (same end of) nail attracted to both poles of magnet/ compass needle do not pick up (unmagnetised) iron (filings) are not attracted to each other accept reverse test result for magnetised nails	(2) AO3

Question number	Answer	Additional guidance	Mark
7(c)	substitution and evaluation of K (1) $(K = 650 \times 3^2 =) 5.85 \times 10^3$ substitution (1) $B \times 6^2 = 5.85 \times 10^3$ rearrangement and evaluation (1) $(B =) 160 \text{ (}\mu\text{T)}$ OR ALTERNATIVE METHOD substitution (1) $650 \times 3^2 = B \times 6^2$ rearrangement (1) $(B =) \frac{650 \times 3^2}{6^2}$ evaluation (1) $(B =) 160 \text{ (}\mu\text{T)}$	distance doubles e.g. $6/3 = 2$ B changes by factor of 4 e.g. $2^2 = 4$ accept values that round to 160 e.g. 162.5 or 163.89 $(B =) \frac{650}{4}$ accept values that round to 160 e.g. 162.5 or 163.89 award 2 marks for a value that rounds to 160 to any other power of ten award full marks for correct answer without working	(3) AO2

Total for Question 7 = 11 marks

