PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

PHYSICS



MARK SCHEME

TOPIC 12: MAGNETISM AND THE MOTOR EFFECT (PAPER 2)

SCORE	PERCENTAGE
/134	%

STEMUP

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Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	S N	allow s or south north	(1)

Question number	Answer	Additional guidance	Mark
(ii)	an explanation linking two from (strength of magnetic) field /force (1) (depends on) distance from the magnet (1)	 (magnets) attract / repel force / field is weaker when further away (from magnet) or reverse argument lines of force are further apart	(2)

Question number	Answer	Additional guidance	Mark
(iii)	a description to include four from move brick towards the car (1) until car (just) starts to move (1) measure distance of brick from car/magnet (1) repeat with 2 magnets (1) compare distances (for one magnet and for two magnets) (1) detail about procedure (1) conclusion or prediction (1)	 change distance between car and brick measure how close car gets to the brick how to attach second magnet(s) how to measure distance where to measure take several readings and find average if distance is bigger then it works	(4)

(**Q03b 1SC0/2PF, Nov 2020**)

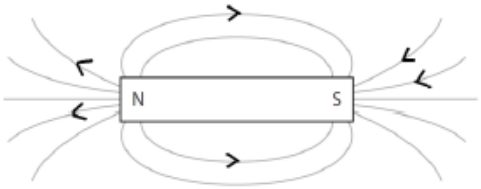
Q2.

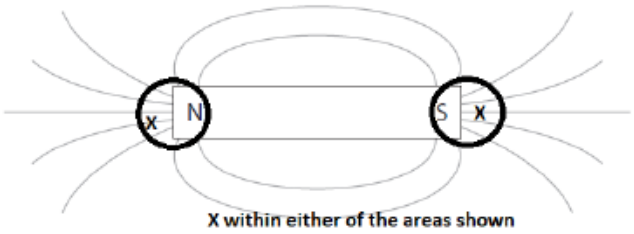
Question number	Answer	Additional guidance	Mark
(i)	the Earth/world/planet has a magnetic field / core(1)	Earth/world/planet has a north (and south) pole	**(1)** **AO3**

Question number	Answer	Additional guidance	Mark
(ii)	direction (of the field) has changed / rotated (1) (strength of the) field has **increased** (1)	(from 0 to) 36° from N to NE field is stronger (changed by) 16.52 (μT) numbers have increased (from 46.67 to 63.19)	**(2)** **AO3**

Question number	Answer	Additional guidance	Mark
(iii)	a description including **three** from use of equipment to measure distance (1) ruler / tape measure obtain a measurement (1) measure / record strength of the field (at a certain point) change the conditions (1) move the phone / magnet (to a different location) process the results (1) e.g. • draw a diagram • make a table • compare results/values • see when (field) stays constant	 measure the distance between phone and magnet rotate the phone/magnet	**(3)** **A03**

Q3.

Question number	Answer	Additional guidance	Mark
(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
(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
(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**

(**QU03a 1SC0/2PH, June 2022**)

Q4.

Question Number	Answer	Additional guidance	Mark
(i)	an explanation linking: (the compass needle) always points in the same direction (1) (because) the Earth's magnetic field exerts a force (on the needle) (1)	 accept points north / south ignore aligns with Earth's magnetic field do not accept (always) points towards core accept attracted to (magnetic) pole	**(2)** **AO2.2**

Question Number	Answer	Additional guidance	Mark
(ii)	any **one** from: motor/generator/ loudspeaker/ microphone / (plotting) compass	 accept any named device containing a permanent magnet e.g. door closer / fridge magnet / phone / any device with an electric motor / MRI ignore (bar) magnet	**(1)** **AO2.1**

(**QU03d 1SC0/2PF, June 2025**)

Q5.

Question Number:	Answer	Additional Guidance	Mark
(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
(ii)	select and substitute (1) (E =) ½ x 24 x 0.12^2 evaluation (1) (E =) 0.17 (J)	 ½ x 24 x 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

(**Q09 1SC0/2PH, June 2018**)

Q6.

Question number	Answer	Mark
	An answer that provides a description by making reference to: • (P) moves / spins (1) • (the two S-poles) repel / N(-pole) and S(-pole) attract (1)	**(2)**

(**Q01b 1SC0/2PF/S2, SAM**)

Q7.

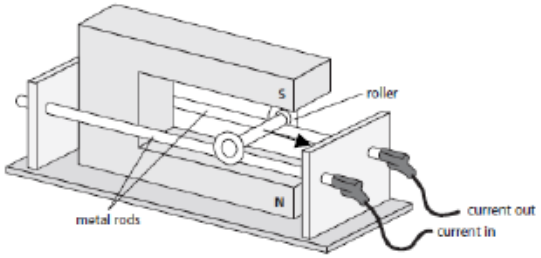
Question number	Answer	Additional guidance	Mark
(i)	substitution of values (1) $1.2 = \frac{K}{4(.0)^2}$ rearrangement and evaluation (1) (K=) 19 unit (1) N cm^2	allow rearrangment before substitution (K=) 1.2 x 4(.0)^2 19.2 0.00192 award full marks for the correct answer without working independent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

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

Q8.

Question number	Answer	Additional guidance	Mark
(i)	substitution (1) (F=) 1.2 x2.5 x0.06 evaluation (1) 0.18 (N)	award full marks for the correct answer without working	**(2)**

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

(**Q03c 1SC0/2PH, Nov 2020**)

Q9.

Question number	Answer	Additional guidance	Mark
	substitution and evaluation of K (1) (K = 650 x 3^2 =) 5.85 (x 10^3) substitution (1) B x 6^2 = 5.85 (x 10^3) rearrangement and evaluation (1) (B =) 160 (μT) **OR ALTERNATIVE METHOD** substitution (1) 650 x 3^2 = B x 6^2 rearrangement (1) (B=) $\frac{650 \times 3^2}{6^2}$ evaluation (1) (B =) 160 (μT)	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**

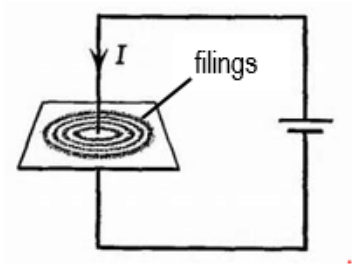
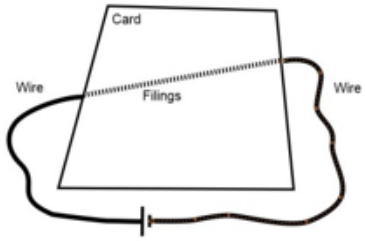
(**QU04c 1SC0/2PH, June 2025**)

Q10.

Question number	Answer	Additional guidance	Mark
	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) 2.0×10^{-4} (T)	0.0002 (T) accept any number that rounds to 2.0×10^{-4} (T) e.g. 1.989×10^{-4} (T) any number that rounds to 2.0×10^{-7} (T) e.g. 1.987×10^{-7} (T) is awarded 1 mark only award full marks for the correct answer without working	**(2)** **AO2.1**

(**QU03d 1SC0/2PH, June 2022**)

Q11.

Question Number	Answer	Additional guidance	Mark
	An answer that combines four of the following points. MP1: Put wire {through card / near card / under card / over card / round rolled up card} (1) MP2: Put iron filings on card / around wire (1) MP3: Connect wire to power pack One wire is acceptable (1) MP4: Switch on or reference to current / charges flowing (in wire) NOT in filings (1) MP5: Filings attracted / moving / see if wire attracts filings (1) MP6: Pattern seen in filings – circles / lines / onion (1)	IGNORE use of apparatus not specified in the list (Iron nails etc)   marking points can be scored from a diagram filings show shape of field	**(4)**

(**Q02b 1SC0/2PF, June 2019**)

Q12.

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

(**QU03b 1SC0/2PH, June 2023**)

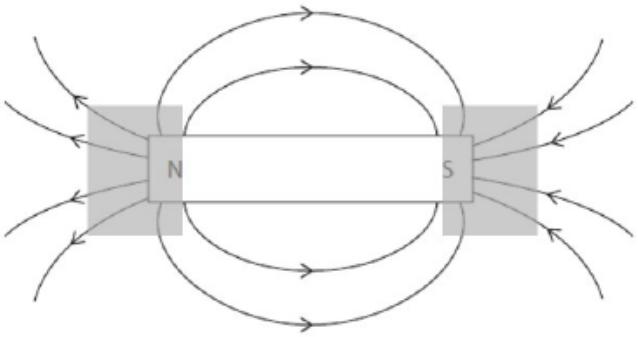
Q13.

Question number	Answer	Additional guidance	Mark
i	circle shown around wire (1)	allow tolerance for translation of 3D to 2D ignore any multiplicity of those circles	**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
ii	arrow indicating a clockwise direction (for magnetic field line drawn for i) (1)		**(1)** **AO1**

(**Q02b 1SC0/2PF, Nov 2021**)

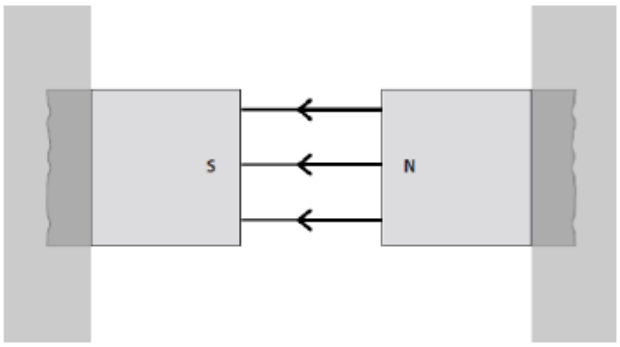
Q14.

Question Number	Answer	Additional guidance	Mark
(i)	X drawn in either of the shaded regions (1) 		**(1)** **AO1.1**

Question Number	Answer	Additional guidance	Mark
(ii)	the (magnetic) **field** is strongest (1) (because the field) lines are close(r) together (1)	accept strongest (magnetic) **force** allow more lines	**(2)** **AO3.2a/2b**

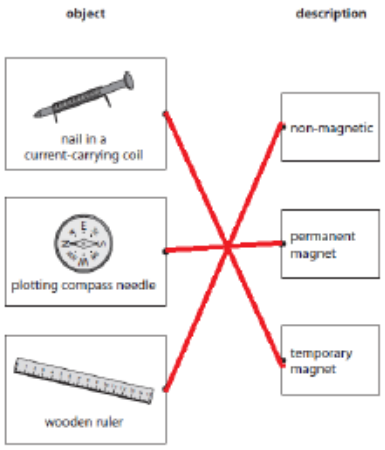
(**QU03c 1SC0/2PF, June 2025**)

Q15.

Question Number	Answer	Additional guidance	Mark
	 at least three straight lines between N and S poles (equally spaced) (1) **all** drawn arrows on lines are from N to S (1)	Ignore drawn lines which start inside the shaded regions judge by eye lines do not have to touch magnets ignore lines drawn above or below magnets / edge effects for this mark	**(2)** **AO2.2**

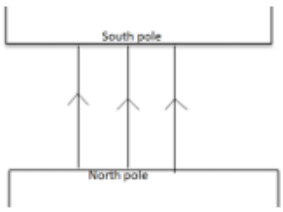
(**QU03b 1SC0/2PF, June 2025**)

Q16.

Question number	Answer	Additional guidance	Mark
		three links correct (2) one link correct (1)	(2) AO1

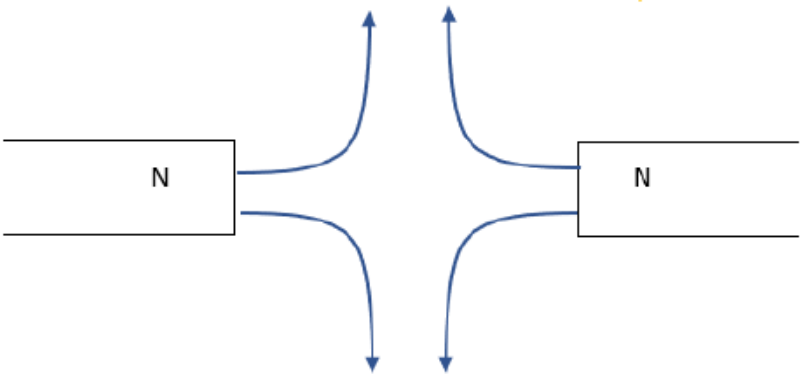
(**Q02a 1SC0/2PF, Nov 2021**)

Q17.

Question Number	Answer	Additional guidance	Mark
	 MP1: any (vertical) line from pole to pole (1) MP2: at least two further equidistant straight, (vertical) lines from pole to pole (1) MP3: arrow on any line, north to south (1)	ignore lines outside of the magnets for MP1 and MP2 judge by eye any arrow south to north, no mark awarded for MP3	(3)

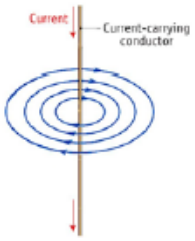
(**Q02c 1SC0/2PF, June 2019**)

Q18.

Question number	Answer	Additional guidance	Mark
	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**

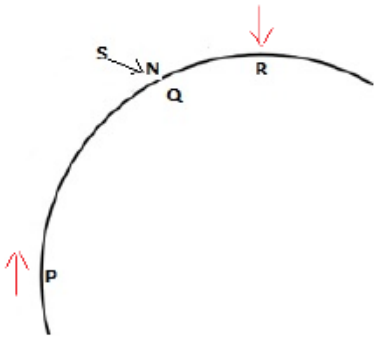
(**QU03a 1SC0/2PH, June 2023**)

Q19.

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

(**Q03b 1SC0/2PH, Nov 2020**)

Q20.

Question number	Answer	Additional guidance	Mark
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
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) south pole / T is at (magnetic) north pole (1)	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 RA	**(3)** **AO3.1**

(**QU03a 1SC0/2PH, June 2024**)

Q21.

Question number	Answer	Additional guidance	Mark
	an explanation linking any **two** of steel is magnetic (material) (1) aluminium is non-magnetic (material) (1) steel falls into container A / aluminium falls into container B (1)	 steel attracted / sticks to / carried round by magnet/roller) is not attracted / does not stick (to magnet roller) steel cans are carried further round than aluminium and fall into A steel hangs on for longer / aluminium falls quicker	**(2)**

(**Q03a 1SC0/2PF, Nov 2020**)

Q22.

Question	Answer	Mark
(i)	**B** iron ***A,C and D*** *are not magnetic materials*	**(1)** **AO1.1**

Question	Answer	Additional guidance	Mark
(ii)	A description to include: method (1) put magnet near paper clips outcome (1) (picks up/attracts) more paper clips OR (has the) longest chain OR (picks up/attracts from a) greater distance	method can be included with the outcome in one sentence for two marks e.g. see which magnet attracts the most paper clips	**(2)** **AO1.2**

(QU02c 1SC0/2PF, June 2024)

Q23.

Question Number	Answer	Additional guidance	Mark
(i)	**The only correct answer is B:** up **A is incorrect** because it does not follow the "Left Hand Rule" **C is incorrect** because it is not perpendicular to the direction of the magnetic field. **D is incorrect** because it is not perpendicular to the direction of the magnetic field.		**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	A description that includes: (forces are) equal (in size) **and** opposite (in direction)	 accept (in this context) forces balance	**(1)**

Question Number	Answer	Additional guidance	Mark
(iii)	substitution into $F = B \times I \times l$ (1) $0.045 = 0.72 \times I \times 30\ (\times 10^{-3})$ rearrangement (1) $(I =) \frac{F}{B \times l}$ OR $\frac{0.045}{0.72 \times 30\ (\times 10^{-3})}$ evaluation (1) 2.1 (A)	rearrangement and substitution can be in either order $(I =) \frac{45}{21.6}$ accept answers that round to 2.1 (A) accept final value rounded down to 2 leave POT until final evaluation award full marks for the correct answer without working	**(3)**

(**Q03b 1SC0/2PH, June 2019**)

Q24.

Question Number	Answer	Mark
	C cobalt **C** is the only correct answer. **A** is incorrect because aluminium is not magnetic. **B** is incorrect because carbon is not magnetic. **D** is incorrect because copper is not magnetic.	**(1)**

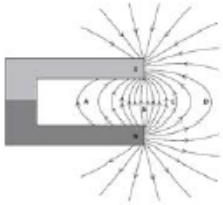
(**Q02a 1SC0/2PF, June 2019**)

Q25.

Question Number	Answer	Mark
	C steel **A, B** and **D** are incorrect because they are non-magnetic	**(1)** **AO1.1**

(**QU03a 1SC0/2PF, June 2025**)

Q26.

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

(**Q03a 1SC0/2PH, Nov 2020**)

Q27.

Question Number	Answer	Mark
(i)	**The only correct answer is A**  **B is incorrect** because it is not tangential to the (circular) magnetic field lines produced by the current **C is incorrect** because it is not tangential to the (circular) magnetic field lines produced by the current **D is incorrect** because it is not tangential to the (circular) magnetic field lines produced by the current	**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	A description of the method that includes: **EITHER** (using single compass) record field at one location (1) find how field continues (1) connect the dots (to reveal overall shape of field / line) (1) **OR** arrange multiple compasses (1) over all of the card (1) direction of (all of) the compass needles indicates shape of field (1) **OR** sprinkle iron filings on card (before current is switched on) (1) switch on current/ tap card (1) pattern produced indicates shape of field (1)	Marking points may be awarded from a diagram. mark where compass points **or** put dots at each end of needle / arrow move compass to new position / until needle over previous dot start from different position and repeat (idea of obtaining concentric circles) all the way round the wire allow iron filings to arrange themselves	**(3)**

(**Q03a 1SC0/2PH, June 2019**)

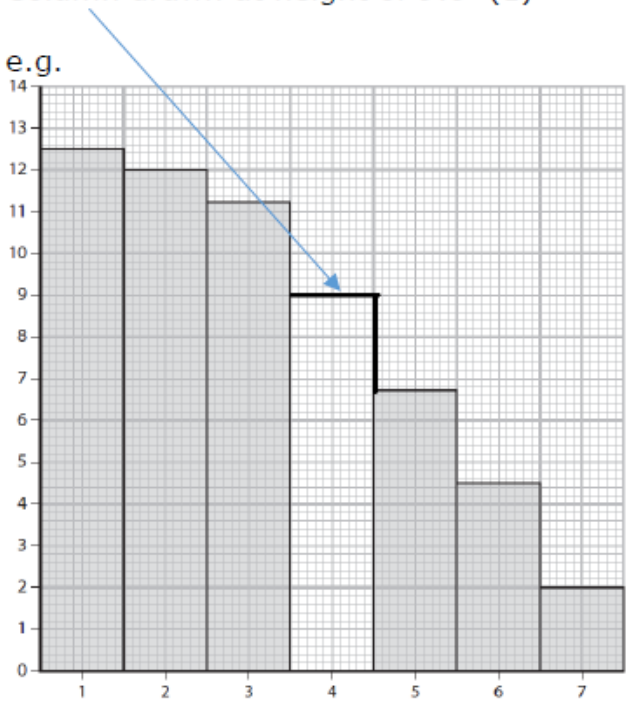
Q28.

Question number	Answer	Mark
	B copper	**(1)**

(**Q01a 1SC0/2PF/S2, SAM**)

Q29.

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

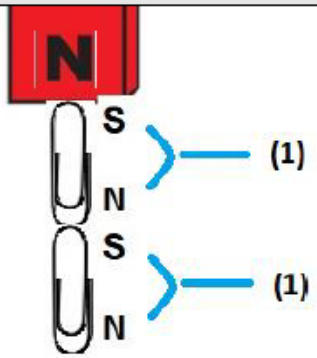
Question number	Answer	Additional guidance	Mark
(ii)	Column drawn at height of 9.0 (1) e.g.  	Allow ½ square tolerance must have horizontal and vertical lines drawn ignore shading / fill	**(1)** **AO2**

Question number	Answer	Additional guidance	Mark
(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
(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**

(**QU04b 1SC0/2PH, June 2025**)

Q30.

Question number	Answer	Additional guidance	Mark
(i)		both poles needed for each mark (either side of paper clip, right or left) allow just S at the top of the pair and N at the bottom of the pair for 1 mark ignore the third paper clip after these two (given in question)	**(2)** **AO1**

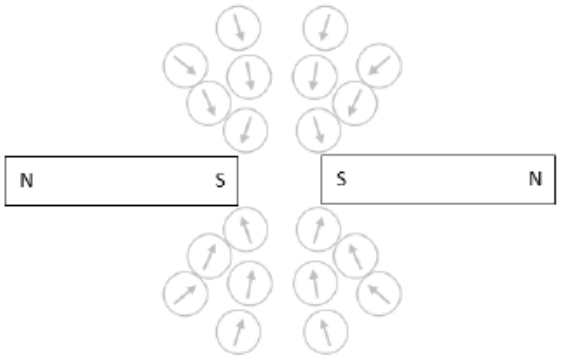
Question number	Answer	Additional guidance	Mark
(ii)	induced (1)		**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
(iii)	iron / steel / nickel / cobalt (1)	ignore 'metal' do not allow any other named metal	**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
(iv)	description including **two** from use a (plotting) compass (1) (plotting compass) shows a change in direction / needle moves OR bring the paper clips together (1) seeing if they attract / repel (1) OR use of iron filings (around the paperclips) (1) see a pattern (1)	sees repulsion / repelling bring the paper clips near to a magnetic material ignore 'magnet' for this marking point do not accept 'attracts to a magnet' accept for two marks bring a magnet close to a paper clip to test for repulsion	**(2)** **AO1**

(**QU02a 1SC0/2PF, June 2023**)

Q31.

Question number	Answer	Additional guidance	Mark
(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
(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

(**Q03a 1SC0/2PH, Nov 2021**)

Q32.

Question Number:	Answer	Mark
	B | small | large **The only correct answer is B** ***A*** *is not correct because the current is small* ***C*** *is not correct because the distance from the wire is large* ***D*** *is not correct because the distance from the wire is large*	**(1)** AO 1 1

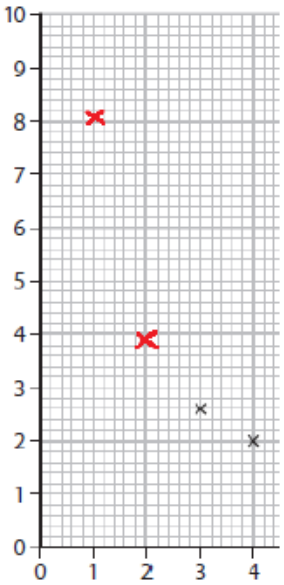
(**Q04 1SC0/2PF, June 2018**)

Q33.

Question Number:	Answer	Additional guidance	Mark
	a description to include: remove the magnet (from the paper clips)(1) paperclips no longer attracted to each other (1)	 accept no longer magnetic	**(2)** AO 3 1a AO 3 1b

(**Q06 1SC0/2PF, June 2018**)

Q34.

Question number	Answer	Additional guidance	Mark
i	 One mark for each point plotted correctly, to within ± 1 small square		(2) AO2

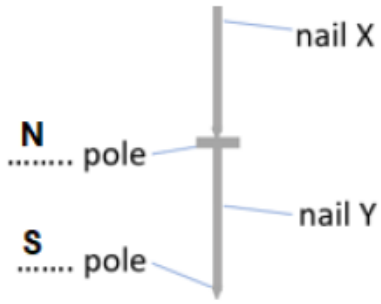
Question number	Answer	Additional guidance	Mark
ii	smooth curve drawn fitting the plotted points (1)	judge by eye	(1) AO2

Question number	Answer	Additional guidance	Mark
iii	substitution using an attempt at calculation – any subtraction seen (1) e.g. 2(.0) – 1(.0) evaluation (1) (-) 1(.0) (mT)	 accept any number that rounds to 1.0 award full marks for correct answer without working	(2) AO3

Question number	Answer	Mark
iv	(size of) current	(1) AO1

(**Q02c 1SC0/2PF, Nov 2021**)

Q35.

Question number	Answer	Additional guidance	Mark
(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
(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

(**QU04a 1SC0/2PH, June 2025**)

Q36.

Question number	Answer	Additional guidance	Mark
(i)	An answer that provides a description by making reference to: • concentration/density (of iron filings) (1) • greatest at strongest field (1)	(filings) close together / bunched up	(2)

Question number	Answer	Mark
(ii)	An answer that combines the following points to provide a logical description of the method: • use of (plotting) compass(es) (1) • (place) at various different points (around the magnet) (1) • the direction is the way the compass points (1)	(3)

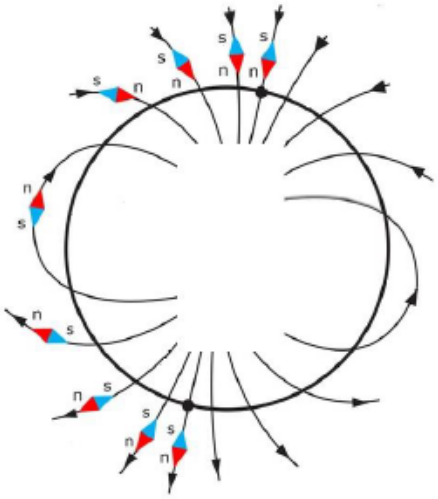
(**Q01c 1SC0/2PF/S2, SAM**)

Q37.

Question Number:	Answer	Additional guidance	Mark
	a description to include: use a compass (1) always points in the same direction / will point north (1)	 accept reasonable alternatives such as suspended magnet needles on cork in water	**(2)** AO 3 2a

(**Q07 1SC0/2PF, June 2018**)

Q38.

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

(**QU03c 1SC0/2PH, June 2022**)

Q39.

Question number	Answer	Additional guidance	Mark
(i)	(magnetic field) {lines / circles / pattern} closer (together at P) (1)	(magnetic field) lines more concentrated (at P) (magnetic field) lines further apart / less concentrated at Q ignore idea that P is closer (to the wire than Q)	**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
(ii)	a description to include as current increases magnetic field strength increases (1) linear/ increases in even steps / doubling idea / proportional (1)	allow positive correlation 'directly proportional' scores 2 marks	**(2)** **AO3**

(**QU02b 1SC0/2PF, June 2023**)

Q40.

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

Question number	Answer	Additional guidance	Mark
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
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**

(**QU03b 1SC0/2PH, June 2024**)