PEARSON EDEXCEL GCSE PHYSICS (HIGHER) · 1PH0

PHYSICS



MARK SCHEME

TOPIC 12: MAGNETISM AND THE MOTOR EFFECT

SCORE	PERCENTAGE
/111	%

STEMUP

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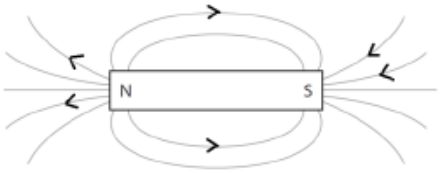
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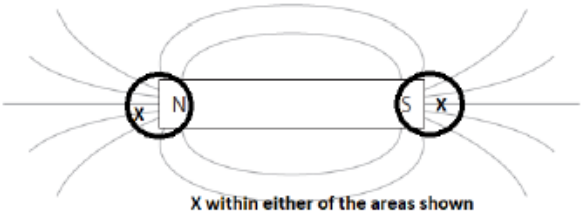
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Mark Scheme

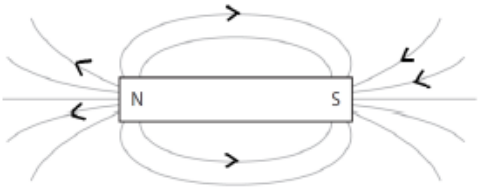
Q1.

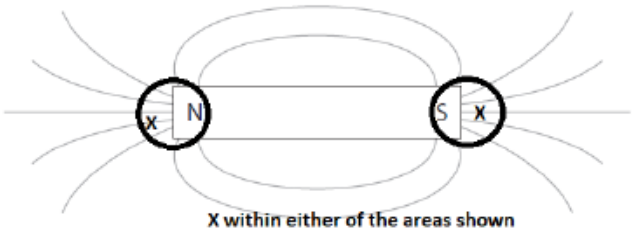
Question number	Answer	Additional guidance	Mark
(i)	consistent arrows showing magnetic field direction(s) (1)  	arrows showing direction out of N, towards and into S minimum of two arrows all arrows shown must be in the correct direction	**(1)** **AO1.2**

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**

Q2.

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**

Q3.

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

Q4.

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

Q5.

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**

Q6.

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**

Q7.

Question number	Answer	Additional guidance	Mark
	substitution into correctly rearranged equation (1) $I = \frac{F}{B} \times l$ $= \frac{0.089}{0.47} \times 0.713$ evaluation to 2 s.f. (1) current = 0.27 (A)	give full marks for correct numerical answer without working	 **(2)**

Q8.

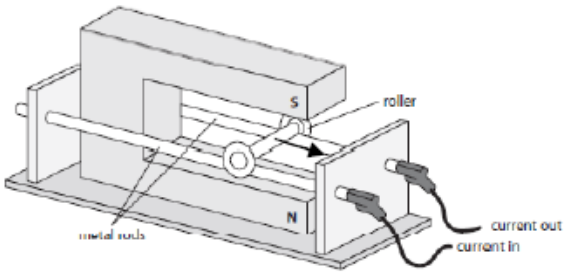
Question number	Answer	Additional guidance	Mark
a	recall and substitution (1) (force x 12.0 =) 0.050 x 8.4 rearrangement (1) (force =) $\frac{0.050 \times 8.4}{12.0}$ evaluation (1) (force =) 0.035 (N)	allow substitution and rearrangement in either order award full marks for the correct answer without working. if no other marks scored then award 1 mark for answers that round to 29 (eg 28.57) (substitution mark)	**(3)** **AO2**

Question number	Answer	Additional guidance	Mark
b	a description to include **four** of the following measure the value of current (1) measure force or distance(1) vary the current (1) restore equilibrium of system (1) calculate ratio between force and current or distance and current (1) if ratio is the same then they are proportional (1)	 accept calculate for measure increase weight or move (existing) weight to new position plot a graph of force / distance against current graph would be a straight line (through the origin)	**(4)** **AO3**

Q9.

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)

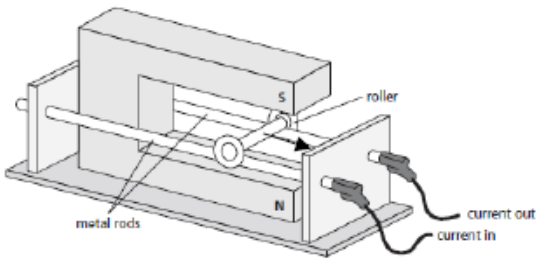
Question number	Answer	Additional guidance	Mark
(ii)	a description to include first finger, second finger and thumb (of left-hand) held mutually perpendicular (1) first finger (is in the direction of) magnetic field OR second finger (is in the) direction of) current (1) thumb (is in the) direction of 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)

Q10.

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)**

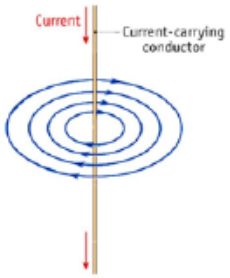
Q11.

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**

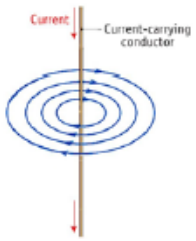
Q12.

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**

Q13.

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

Q14.

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

Q15.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks): • the transmission wire carries an alternating current (1) • the force is caused by this current which varies in size and direction (1) • the direction of this force depends on the direction of the current so the direction of the force also changes (1) • the magnitude of this force depends on the magnitude of the current so the magnitude of the force also changes (1)	allow responses that link the changes in the force to the interaction of the changing field around the wire with the constant field of the Earth	**(4)**

Q16.

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)**

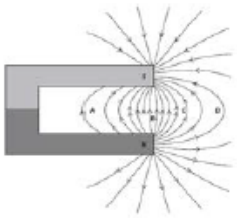
Q17.

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)**

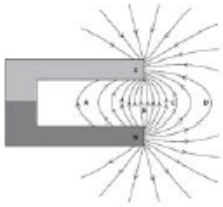
Question Number	Answer	Additional guidance	Mark
(ii)	A description that includes: (forces are) equal (in size) **and** opposite (in direction)	 accept (in this context) forces balance	**(1)**

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)**

Q18.

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)**

Q19.

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)

Q20.

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)**

Q21.

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)**

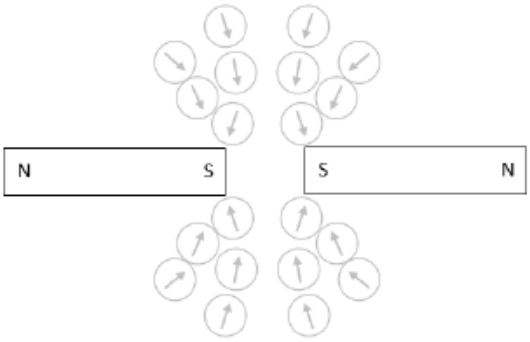
Question Number	Answer	Additional guidance	Mark
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	OR sprinkle iron filings on card (before current is switched on) (1) switch on current/ tap card (1) pattern produced indicates shape of field (1)	allow iron filings to arrange themselves	

Q22.

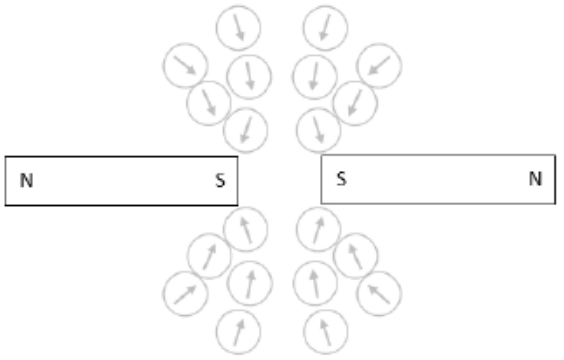
Question number	Answer	Additional guidance	Mark
	Any three from: • use a higher current as the force depends on the current (1) • use more/stronger/larger range of magnets (1) • use a force meter with smaller range, e.g. 0.00 to 0.01 (1) • use a longer distance from pivot to increase the moment of the force on the wire (1)	accept voltage for current add variable resistor (in series) with power supply accept use more sensitive force meter	**(3)**

Q23.

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**

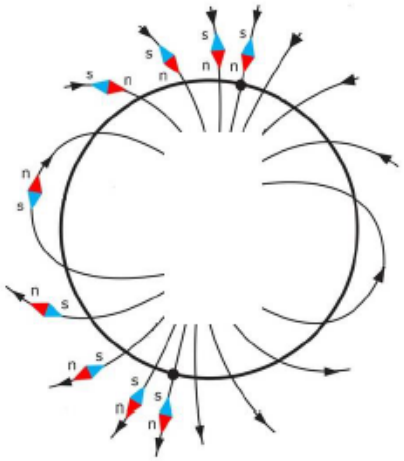
Question number	Answer	Additional guidance	Mark
(ii)	a description to include place a (plotting) compass on the paper (near to the magnet(s)) and mark direction of the field (at that point) (1) determine how the field continues from that point (1) connect field lines to reveal overall shape(1)	 place 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**

Q24.

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

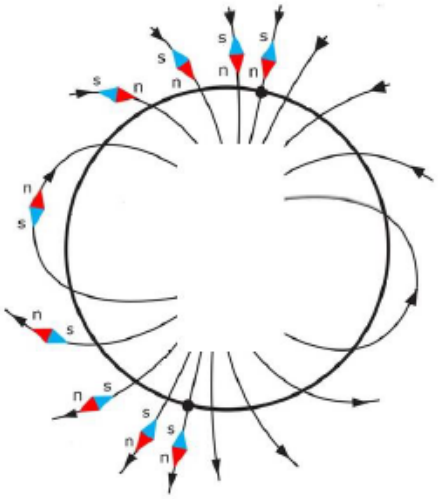
Question number	Answer	Additional guidance	Mark
(ii)	a description to include place a (plotting) compass on the paper (near to the magnet(s)) and mark direction of the field (at that point) (1) determine how the field continues from that point (1) connect field lines to reveal overall shape(1)	 place 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

Q25.

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**

Q26.

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**

Q27.

Question number	Answer	Additional guidance	Mark
	(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**

Q28.

Question number	Answer	Additional guidance	Mark
	(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**

Q29.

Question number	Answer	Additional guidance	Mark
	(sum of) the clockwise moments = (sum of) the anticlockwise moments	moment of magnet = moment of modelling clay moments are equal (size)	**(1)** **AO1**

Q30.

Question Number:	Answer	Additional Guidance	Mark
	a description to include:		**(3)** AO 1 2
	method of producing temporary induced magnetism (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	
	method of demonstrating the magnetic properties of the temporary magnet (1)	paper clip(s) attracted to iron OR use first paper clip to pick up another paper clip	
	method of demonstrating magnetic effect is temporary (1)	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	

Q31.

Question Number:	Answer	Additional Guidance	Mark
	a description to include:		**(3)** AO 1 2
	method of producing temporary induced magnetism (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	
	method of demonstrating the magnetic properties of the temporary magnet (1)	paper clip(s) attracted to iron OR use first paper clip to pick up another paper clip	
	method of demonstrating magnetic effect is temporary (1)	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	

Q32.

Question number	Answer	Mark
(a)	D	**(1)**

Question number	Answer	Mark
(b)	C	**(1)**