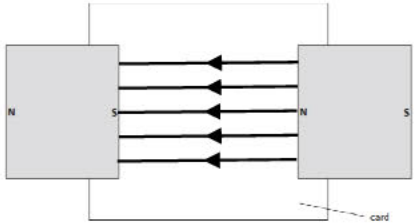
Question number	Answer	Notes	Marks
1 (a) (i)	Any two of: MP1. Idea of marking the line/points; MP2. Idea of moving the compass (to a new point along the line); MP3. Idea of starting a new line from a different place;	accept a labelled diagram allow use of iron filings use a compass allow • tapping paper to line up iron filings • multiple compasses	2
(ii)	Any two of: MP1. Correct shape **only;** MP2. lines not crossing each other; MP3. correct direction arrow shown on at least one line;	all field lines must be correct minimum of two curved lines of correct shape added anywhere in the field reject for MP3 any conflict of arrows	2
(b)	MP1 **all** field lines between the poles shown parallel and straight (by eye); MP2 minimum of 3 straight lines evenly spaced (by eye) between the poles; MP3 Opposite poles shown adjacent;	ignore arrows can only be given if minimum of 2 lines shown	3

Total 7 marks

Question number	Answer	Notes	Marks
2 (a) (i)	MP1. minimum of 3 straight lines evenly spaced (by eye); MP2. at least one arrow showing direction from N to S;	ignore field outside the rectangle defined by the magnets	2
(b) (i)	any sensible suggestion; e.g. otherwise large heat loss/overheating thin wire would melt to reduce the resistance so it does not sag/bend/eq		1
(ii)	any 3 of: MP1. magnetic field of wire/current; MP2. interacts with; MP3. magnetic field of (2) magnets; MP4. Fleming's left hand rule;	 For MP1 and MP3 must refer to what is causing the magnetic field	3
(iii)	MP1. reduce current; MP2. use less powerful magnets/greater separation of magnets;	ACCEPT Use thinner wire, switch off, reduce voltage not 'smaller' magnets allow rotate the wire so that the angle with the magnetic field is smaller	2

Total 8 marks

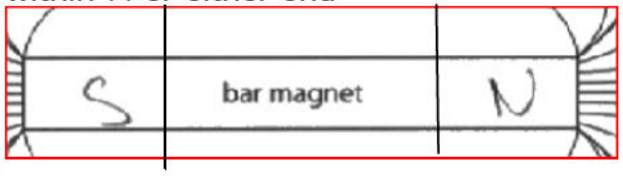
Question number	Answer	Notes	Marks
3 (a) (i)	1. at least one arrow showing direction from N to S (right to left); 2. one **horizontal** line between shaded faces; 3. minimum of 3 horizontal lines evenly spaced (by eye); **e.**  	Reject contradictory arrows For MP2,3 ignore any lines outside the rectangle between the shaded faces allow field lines that almost touch the faces	3
(ii)	1. a method **to show shape**; **e.** use compass(es) Use of iron **filings/ powder** 2. Use f (plotting) compass **to show direction**; 3. further **method detail**; **e.** mark card /move compass/multiple compasses idea of another line or lines added sprinkle (iron filings evenly on card) tap card (to distribute iron filings)	**Ignore** Position of card /Cling film **Ignore** pour/place/ drop /spill	3

Question number	Answer	Notes	Marks
(b)	any **two** of 1. (Fleming's) Left Hand (Motor) rule OR (current generates) magnetic field **around** the rod; 2. Idea that there is a force (on rod); 3. (translational) movement of rod; 4. Correct direction given, i.e. out of the paper;	allow LHM rule/LH rule/motor rule/ motor effect **Ignore** upwards rod is magnetic	2
		Total	**8**

Question number		Answer	Notes	Marks
4 (a)		any three of MP1 idea that there is **current** (in the wire/coil); MP2 idea that (the coil has) a **magnetic field**; MP3 idea that coil's magnetic field **interacts** with field of permanent magnet; MP4 idea that there is a **force** on the coil/wire; MP5 Idea that current or force **reverses** every half turn;	 Allow ideas of electromagnetic field, electromagnet Allow - 'magnetic fields touch / overlap' Ignore - 'cutting of magnetic fields' Allow ideas of LHM rule, Fleming's LHR, catapult field, attraction, repulsion Allow action of a commutator described	3

(b)	(i)		any two of MP1 increase magnetic field(e.g. stronger magnets or magnets closer or magnets curved round coil); MP2 increase current OR voltage Or more cells; MP3 increase number of turns (on coil); MP4 a sensible alternative suggestion e.g. use two or more sets of coils at angles, lubricate axle;	 Allow “use thicker wire” Ignore “stronger battery” Allow idea of 3 phase supply, iron stator	2
	(ii)		Suggestion that clearly results in reversal of the current OR the cell connections OR the magnet’s field;		1
(c)			any two of MP1 Idea that force is increased (by stronger field); MP2 Idea of radial magnetic field (rather than a uniform one); MP3 Coil remains in the field for a longer time;	 Allow idea that iron is magnetised Allow idea that magnetic field acts “all the way around” Allow idea that force acts over a larger part of a cycle	2

Question number	Answer	Notes	Marks
5 (a) i	there is a voltage; And one of (because there is a) change of flux OR field (lines) are cut; (which is) an induced voltage / emf;	 Allow induced current	2
ii	greater deflection/voltage; Idea that rate of change of flux (linkage) is greater; eg more magnetic field lines cutting coil (per second)	 ignore speed of magnet	2
(b) i	Idea that deflection is smaller;		1
ii	Idea that deflection is greater;		1
iii	Idea that deflection is in opposite direction;		1
		Total	**7**

Question number	Answer	Notes	Marks
6 (a)	Position of poles indicated correctly near end of magnet; S on L AND N on R ;	Allow at the end of the magnet within ¼ or either end 	2
(b)	Any suitable method, e.g. • Place plotting compass at side/end of magnet; • Mark position of end of compass; • Move end of compass needle to new mark (and repeat); OR o Place magnet under paper / plastic; o Sprinkle iron filings over; o Tap paper gently (to reveal pattern);	allow suitably clear diagram(s) reject for one mark 'charges' ignore comments about finding the direction of the field allow: steel dust for iron filings place for sprinkle	3

Total 5 marks

Question number	Answer	Notes	Marks
7 (a)	parallel field (DOP)	ACCEPT equally spaced and straight / equally spaced and do not change direction	2
(b)	two (permanent / bar) magnets	ACCEPT points made on an annotated diagram	3
	pole pieces arranged correctly e.g. North facing South	REJECT description of poles as positive / negative	
	idea of magnets being the correct distance apart	ACCEPT "close together", "not touching" ACCEPT idea that field is produced in the space between the N pole of one magnet and the S pole of the other REJECT answers that are clearly referring to electromagnets	

Question number	Answer	Notes	Marks
8 (a)	A carbon;		(1)
(b)	A negatively charged electrons;		(1)
(c)	D steel;		(1)
(d)	C 2 N poles facing;		(1)

Total for Question 8 = 4 marks

Question number	Answer	Notes	Marks
9 (a) (i)	any two ideas from:- MP1. voltage / current is <u>induced</u>; MP2. (because) field in coil is changing / field (lines) cut; MP3. current/voltage changes direction when magnet does; MP4. magnet slows down causing decrease in amplitude;	allow voltage for amplitude	2
(ii)	Either of - (voltage/current) changes direction; Positive <u>and</u> negative (voltage/current);	Ignore "wave"	1
(iii)	any two of - MP1. direction of magnet changes; MP2. amount of field (lines) cut changes / rate of flux cutting; MP3. direction of flux cutting changes; MP4. speed of magnet changes / slows down; MP5. as movement diminishes, so does voltage;		2
(b)	Any three of - MP1. Alternating trace that diminishes; MP2. Amplitude is larger; MP3. Frequency is lower;		3

Total 8 marks