Electromagnetic induction GCSE AQA Higher Physics Past Papers Answers

01.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	move a (magnetic/plotting) compass around the wire the changing direction of the compass needle shows a magnetic field has been produced **OR** sprinkle iron filings onto the card (1) tapping the card will move the filings to show the magnetic field (pattern) (1)		1 1	AO1/2 4.7.2.1
2	**Level 2:** A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that explain how the ignition circuit works. — 3–4 **Level 1:** Simple statements are made. The response may fail to make logical links between the points raised. — 1–2 No relevant content — 0 **Indicative content** • closing the (ignition) switch causes a current to pass through the electromagnet • the iron core (of the electromagnet) becomes magnetised • the electromagnet/iron core attracts the (short side of the) iron arm • the iron arm pushes the contacts (inside the electromagnetic switch) together • the starter motor circuit is complete • a current flows through the starter motor (which then turns)		4	AO2/1 4.7.2.1
Total			**6**	

02.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	It is easily magnetised.		1	AO1/1 4.7.3.3
2	p.d. across the secondary coil is smaller (than p.d. across the primary coil)		1	AO3/2a 4.7.3.3 WS3.5
3	ratio $\frac{V_p}{V_s} = \frac{6}{12}$ $\frac{6}{12} = \frac{50}{N_p}$ $N_p = 100$	accept any other correct ratio taken from the graph use of the correct turns ratio and substitution or correct transformation and substitution allow 100 with no working shown for **3** marks	1 1 1	AO2/1 4.7.3.3
Total			**5**	

03.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	in a longitudinal wave the oscillations/vibrations are parallel to the direction of energy transfer. in a transverse wave the oscillations/vibrations are perpendicular to the direction of energy transfer.	accept wave travel for energy transfer throughout	1 1	AO1/1 4.6.1.1 AO1/1 4.6.1.1
2	accept any sensible suggestion eg. a vibrating drum skin does not move the air away to create a vacuum (around the drum)		1	AO1/2 4.6.1.1
3	**Level 3:** A detailed explanation linking variations in current to the pressure variations of a sound wave, with a logical sequence.	5-6	6	AO1/2 4.6.1.1 4.7.2.4
	Level 2: A number of relevant points made, but not precisely. A link between the loudspeaker and a sound wave is made.	3–4		
	Level 1: Some relevant points but fragmented with no logical structure.	1–2		
	No relevant content	0		
	Indicative content the current in the electrical circuit is varying the current passes through the coil the coil experiences a force (inwards or outwards) reversing the current reverses the force the size of the current affects the size of the force the varying current causes the coil to vibrate the (vibrating) coil causes the cone to vibrate the vibrating cone causes the air molecules to move the movement of the air molecules produces the pressure variations in the air needed for a sound wave the air molecules bunch together forming compressions and spread apart forming rarefactions			
Total			**9**	

04.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	motor effect		1	AO1/1 4.7.2.2
2	increase the strength of the magnet **or** increase the current		1	AO2/1 4.7.2.2
3	$4.8 \times 10^{-4} = F \times 8 \times 10^{-2}$ $F = 6 \times 10^{-3}$ (N) $6 \times 10^{-3} = B \times 1.5 \times 5 \times 10^{-2}$ $B = \frac{6 \times 10^{-3}}{7.5 \times 10^{-2}}$ $B = 8 \times 10^{-2}$ or 0.08	allow 8×10^{-2} **or** 0.08 with no working shown for **5** marks a correct method with correct calculation using an incorrect value of F gains **3** marks	1 1 1 1 1	AO2/1 4.7.2.2 4.5.4
	Tesla	accept T do not accept t	1	AO1/1 4.7.2.2
Total			**8**	

05.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	magnetic field around the coil changes **or** the magnetic field (lines) cut by the coil	allow the generator effect	1	4.7.3.1 AO2
	because the magnet changes direction		1	4.7.3.1 AO2
	stationary		1	4.7.3.1 AO2
	any **two** from: • stronger magnetic field • more turns on the coil • turns pushed closer together • spring with a lower spring constant	 allow stronger magnet allow heavier magnet bigger magnet is insufficient bigger coil is insufficient do **not** accept more coils of wire allow less stiff spring allow weaker spring do **not** accept add an iron core	2	4.7.3.1 AO2
Total			**13**	

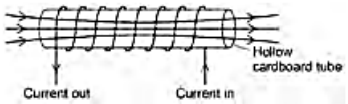
06.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	any **one** from: • too few turns / coils on the secondary • p.d. across the primary was reduced	allow number of turns / coils on the primary was increased ignore human error	1	AO3 4.7.3.4
2	the p.d. (across the secondary) goes above 2V	allow p.d. across secondary is higher than p.d. across primary after 20 turns	1	AO3 4.7.3.4
3	it increases (until the nails reach a constant temperature)		1	AO1 4.6.3.1
4		an answer of 1.2 (A) scores **5** marks		AO2 4.7.3.4
	$\frac{640}{4} = \frac{V_p}{1.75}$		1	
	$V_p = \frac{640 \times 1.75}{4}$		1	
	$V_p = 280$ (V)		1	
	$280 \times I_p = 336$	allow their calculated $V_p \times I_p = 336$	1	
	$I_p = 1.2$ (A)	allow an answer that is consistent with their calculated value of V_p	1	
	or			
	$336 = I_s \times 1.75$ (1)			
	$I_s = \frac{336}{1.75}$ (1)			
	$I_s = 192$ (A) (1)			
	$I_p = 192 \times \frac{4}{640}$ (1)	allow I_p = their calculated $I_s \times \frac{4}{640}$		
	$I_p = 1.2$ (A) (1)	allow an answer that is consistent with their calculated value of I_s		
Total			**8**	

07.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	at least three circles drawn clockwise arrows on circles	 allow **1** mark for one or two circles with clockwise arrows	1 1	AO1 4.7.2.1
2	4×10^{-6}		1	AO1 4.7.2.1
3	the sides of the coil (parallel to the magnet) experience a force (in opposite directions)	allow the current creates a magnetic field ignore Fleming's Left Hand Rule	1	AO1 4.7.2.3
	the forces cause moments that act in the same (clockwise / anticlockwise) direction **or** the moments cause the coil to rotate (clockwise / anticlockwise)	allow the magnetic fields interact to create a pair of forces (acting in opposite directions) **or** allow the magnetic fields interact causing the coil to rotate	1	
	(each half-revolution) the two halves of the (rotating) commutator swap from one (carbon) brush to the other		1	
	(each half-revolution) the commutator reverses the current (in the coil) **or** keeping the forces in the same direction (keeping the coil rotating)	allow keeps the current in the same direction relative to the (permanent) magnetic field	1	
Total			**7**	

08.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	field lines going in, (through) and out of the solenoid	 allow field lines only visible outside the cardboard tube allow a bar magnet shaped field with lines above and below the solenoid	1	AO1/1 4.7.2.1
	arrow(s) in correct direction		1	
2	the rods become (induced) magnets	allow the rods are (temporarily) magnetised ignore rods repel do not accept rods become charged	1	AO1/1 4.7.1.1
	with the same polarity (at each end)		1	
3	changed two (independent) variables (at the same time)	allow need to keep current or number of turns constant allow should only change one variable (at a time) allow current and number of turns both changed ignore fair test	1	AO3/1b 4.7.2.1 WS2.7
	so it is not possible to know the effect of one (independent) variable or the other		1	
4	(increasing the current) increases the strength until the strength reaches a maximum value	allow weight (held) for strength of electromagnet ignore a given current value for when maximum strength happens	1	AO3/2b 4.7.2.1 WS3.5
5	increasing the number of turns from 10 to 20 increases the strength more than increasing from 20 to 30	a general trend is required	1	AO3/2b 4.7.2.1 WS3.5
Total			**8**	

09.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
☐	to convert (the pressure variations in) sound (waves) into variations in current / p.d	allow electrical signal for variations in current / p.d. do not accept amplifies sound	1	AO1/1 4.7.3.3

10.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
☐	sound (waves) cause the diaphragm to vibrate	diaphragm moves is insufficient	1	AO1/1 4.7.3.3
	the diaphragm causes the coil / wire to vibrate	do not accept moves the coil / wire up and down if m.p.1 and m.p.2 do not score, allow sound (waves) cause the coil / wire to vibrate for **1** mark	1	
	the coil / wire moves through the magnetic field **or** the coil / wire cuts magnetic field lines		1	
	a potential difference is <u>induced</u> (across the ends of the coil / wire)	allow <u>induced</u> current for <u>induced</u> p.d.	1	

11.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
☐	Iron		1	AO1 4.7.2.1

12.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	there is a current in the solenoid / circuit	allow a charge flows through the solenoid / circuit	1	AO1 4.7.2.1
	creating a magnetic field	allow the solenoid / coil is magnetised	1	
	attracting the bolt		1	

13.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	1.50 cm = 0.015 m		1	AO2 4.5.3
	2.88 = k × 0.015	this mark may be awarded if distance is incorrectly/not converted	1	
	k = 2.88 / 0.015	this mark may be awarded if distance is incorrectly/not converted	1	
	k = 192 (N/m)	allow a correctly calculated answer using an incorrectly/not converted distance	1	

14.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	to vary the (output) potential difference so that you don't need a different generator for each type of device	allow different devices require different potential differences allow so that it is compatible with different devices do **not** allow answers in terms of power	1 1	AO3 4.7.3.4
2	$\frac{1.5}{5.0} = \frac{150}{N_s}$ $N_s = \frac{150}{0.3}$ $N_s = 500$		1 1 1	AO2 4.7.3.4
3	the coil moves through the magnetic field **or** the coil cuts magnetic field lines a potential difference is <u>induced</u> (across the coil) there is a complete circuit, so a current is induced (in the coil) every half turn the potential difference reverses direction so (every half turn) the current changes direction		1 1 1 1 1	AO1 4.7.3.1 4.7.3.2
4	provides a continuous / moveable contact / connection (between the coil and the transformer / contacts / brushes) **or** stops the wires from twisting together		1	AO3 4.7.3.2

5	(after disconnection) there is no induced current so no magnetic field (produced around / by the coil) to oppose the movement of the coil		1 1 1	AO1 4.7.3.1
Total			**14**	

15.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	motor (effect)		1	AO1 4.7.2.4
2	current creates a magnetic field (around the coil) (which) interacts with the permanent magnet field producing a (resultant) force causing the coil/cone to move (when the) direction of the current reverses, the direction of the (resultant) force reverses (producing a sound wave)	 allow coil/cone for force allow backwards for reverses	1 1 1 1	AO1 4.7.2.4
3	the student changed two variables at the same time (so) it is not possible to know the effect of each variable	allow only one variable should be changed at a time	1 1	AO3 4.6.1.2
Total			**7**	

16.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	**A** primary coil **and** **B** secondary coil		1	AO1 4.7.3.4
	C iron core		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	$\frac{230}{V_s} = \frac{200}{1200}$		1	AO2 4.7.3.4
	$V_s = \frac{1200 \times 230}{200}$		1	
	$V_s = 1380$ (V)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	(the alternating current causes) a changing magnetic field around the primary (coil)		1	AO2 4.7.3.4
	creates magnetic field that changes direction in the core	allow creates a changing magnetic field in the core	1	
	this induces an alternating potential difference across the secondary (coil causing an alternating current)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4	down		1	AO2 4.7.2.2

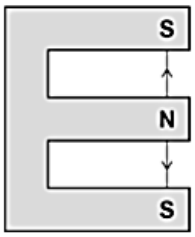
Question	Answers	Extra information	Mark	AO / Spec. Ref.
5	$B = 60 \times 10^{-6}$ (T)		1	AO2 4.7.2.2
	$0.045 = 60 \times 10^{-6} \times 50 \times l$	allow correct substitution of incorrectly / not converted value of B	1	
	$l = \dfrac{0.045}{60 \times 10^{-6} \times 50}$	allow correct rearrangement using an incorrectly / not converted value of B	1	
	$l = 15$ (m)	allow a correct calculation using an incorrectly / not converted value of B	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6	the wire / force is at right angles to the magnetic field	allow the current is constant allow the cable is straight allow the field is uniform allow the force is constant	1	AO3 4.7.2.2

Total Question		14

17.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	current **or** potential difference	allow charge flow	1	AO1 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2			1	AO1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	an induced magnet is a material that becomes a magnet when it is placed in a magnetic field **or** an induced magnet loses most / all of its magnetism (quickly) when removed from a magnetic field	allow 'when close to another magnet' for 'when it is placed in a magnetic field' allow 'no magnets are nearby' for 'removed from a magnetic field' 'temporary magnet' alone is insufficient	1	AO1 4.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4	motor effect		1	AO1 4.7.2.2 4.7.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5	16 mA = 0.016 A	allow 1.6×10^{-2} (A)	1	AO2 4.7.2.2
	$0.013 = B \times 0.016 \times 6.5$	allow correct substitution using incorrectly / not converted current	1	
	$B = \frac{0.013}{0.016 \times 6.5}$	allow correct re-arrangement using incorrectly / not converted current	1	
	$B = 0.125$ (T)	allow correct calculation using incorrectly / not converted current allow 0.13 (T)	1	

Question	Answers	Mark	AO / Spec. Ref.
6	**Level 2**: Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3-4	AO3 4.6.1.4
	Level 1: Relevant features are identified and differences noted.	1-2	
	No relevant content	0	
	Indicative content: • for all three people, the minimum sound level that can be heard increases as frequency increases **Age** • the minimum sound level that can be heard increases with age • between 2000 and 3000 Hz the minimum sound level that can be heard increases more in **B** compared to **C** • **C** has very little variation in the minimum sound level that can be heard at all frequencies **Working in a loud environment:** • increases the minimum sound level that can be heard at all frequencies above 2000 Hz compared to working in a quiet environment • the minimum sound level that can be heard increases more as frequency increases from 2000 to 4000 Hz compared to working in a quiet environment • doesn't affect the minimum sound level that can be heard at 2000 Hz to access **level 2** the answer must include at least **one** comparison for age **and one** comparison for working in a loud environment, using supporting data/information from the graph		

Total Question	**12**

18.

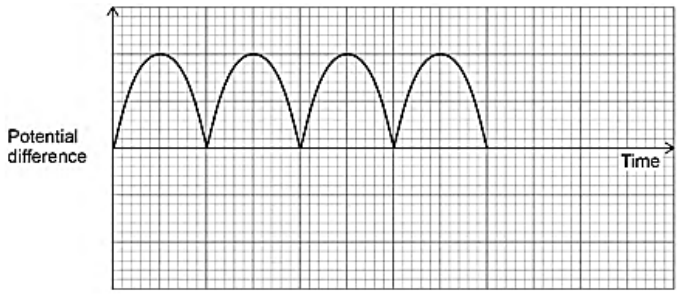
Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	iron	allow nickel / cobalt do not allow steel	1	AO1 4.7.3.4
	it is easily magnetised (and demagnetised)	allow it is a magnetic material MP 2 is dependent on MP 1	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	$\frac{230}{V_s} = \frac{2000}{40}$		1	AO2 4.7.3.4
	$V_s = \frac{40}{2000} \times 230$	subsequent marks can only be awarded if the first equation is correct and has been used	1	
	$V_s = 4.6$ (V)		1	
	$4.6 \times I_s = 6.9$	this mark may be awarded if the pd is incorrectly calculated	1	
	$I_s = 1.5$ A	allow a correctly calculated I_s using an incorrectly calculated pd	1	
	OR			
	$6.9 = I_p \times 230$ (1)			
	$I_p = \frac{6.9}{230}$ (1)	subsequent marks can only be awarded if the first equation is correct and has been used		
	$I_p = 0.03$ (A) (1)			
	$I_s = 0.03 \times \frac{2000}{40}$ (1)	this mark may be awarded if I_p is incorrectly calculated		
	$I_s = 1.5$ (A) (1)	allow a correctly calculated I_s using an incorrectly calculated I_p		

Total Question	7

19.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	the coil moves through the (magnetic) field **or** the coil cuts (magnetic) field lines		1	AO1 4.7.1.2 4.7.3.1 4.7.3.2
	a potential difference is induced (across the coil)		1	
	there is a complete circuit, so a current is induced (in the coil)		1	
	(because) each half-revolution, the two ends of the coil swap from one brush to the other **or** each half-revolution, (the two halves of) the commutator switch brushes / contacts	(because) the half of the coil connected to each brush always moves in the same direction	1	
	(so) the direction of the (induced) current / potential difference does not reverse every half rotation	allow the direction of the (induced) current / potential difference is the same every half rotation	1	

Question	Answers	Mark	AO / Spec. Ref.
2	 allow a correct graph showing a negative output potential difference only	1	AO1 4.7.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	(after disconnection) there is no (induced) current		1	AO1 4.7.3.1
	(so) no magnetic field (produced around / by the coil)		1	
	to oppose the movement of the coil	allow no force opposes the movement of the coil	1	

Total Question	9