PEARSON EDEXCEL GCSE PHYSICS (HIGHER) · 1PH0

PHYSICS



MARK SCHEME

TOPIC 13: ELECTROMAGNETIC INDUCTION

SCORE	PERCENTAGE
/73	%

STEMUP

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Mark Scheme

Q1.

Question Number:	Answer	Additional Guidance	Mark
(i)	an explanation linking: (p.d. / current is only induced by a) changing magnetic field (1) a changing current (is needed to create a changing magnetic field) (1)	 alternating magnetic field the voltage/current (as shown) is not changing	**(2)** AO 1 1

Question Number:	Answer	Additional Guidance	Mark
(ii)	substitution into $\frac{V_p}{V_s}=\frac{N_p}{N_s}$ (1) $\frac{25}{V_s}=\frac{30}{150}$ rearrangement (1) $V_s = \frac{25\times150}{30}$ evaluation (1) (V_s =) 130 (V)	substitution and rearrangement in either order $\frac{V_s}{25}=\frac{150}{30}$ allow 120 or 125 award full marks for correct answer without working	(3) AO 2 1

Q2.

Question number	Answer	Additional guidance	Mark
	selecting, rearranging and substituting (1) ($V_s = \frac{N_s}{N_p} \times V_p$) $= \frac{400}{700} \times 230$ selecting, rearranging and substituting (1) ($I_p = \frac{V_s}{V_p} \times I_s$) $= \frac{131(.429)}{230} \times 1.75$ evaluation (1) 1(.00) (A)	accept correct alternative calculation routes 1 mark for any voltage rounding to 130 V $\frac{130 \times 1.75}{230}$ 0.989 (A) using 130 award full marks for the correct answer without working	(3) **AO2.1**

Q3.

Question number	Answer	Additional guidance	Mark
	use of $\frac{V_P}{V_S} = \frac{N_P}{N_S}$ (1) transformation and evaluation (1) (N_s=) 25	award full marks for correct answer without working	**(2)**

Q4.

Question number	Answer	Additional guidance	Mark
	substitution into $\frac{Vp}{Vs} = \frac{Np}{Ns}$ (1) $\frac{230}{15} = \frac{600}{Ns}$ Rearrangement and evaluation (1) ($Ns =$) $\frac{600 \times 15}{230}$ = 39	allow substitution and rearrangement in either order accept values that round to 39 e.g. 39.13 award full marks for the correct answer without working. if no other marks scored then award 1 mark for answers of that round to 0.026 (eg 0.255) (substitution mark)	**(2)** **AO2**

Q5.

Question number	Answer	Additional guidance	Mark
(i)	{step up/increase}(output) voltage or {stepdown/ decrease}(output) current		(1)

Question number	Answer	Additional guidance	Mark
(ii)	substitution (1) $\frac{230}{V_s} = \frac{18}{26}$ rearrangement (1) $(V_s =) \frac{230 \times 26}{18}$ evaluation (1) 330(V)	substitution and re-arrangement in either order allow 332 (.2) (V) allow answers between322 (V) and 333 (V)where candidates have truncated an intermediate calculation 159.2 (V), 160 (V) gains 1 mark award full marks for the correct answer without working	(3)

Q6.

Question number	Answer	Mark
	D a microphone	(1)

Q7.

Question number	Answer	Mark
	B keep the magnet still and move the coil to the left	**(1)**

Q8.

Question Number	Answer	Additional guidance	Mark
(i)	A description that makes reference to an alternating /changing current (1) in the primary coil (1)	ignore references to voltage / potential difference AC accept switch on or off	**(2)**

Question Number	Answer	Additional guidance	Mark
(ii)	substitution into $\frac{Vp}{Np} = \frac{Vs}{Ns}$ (1) $\frac{230}{2000} = \frac{15}{Ns}$ rearrangement (1) $(N_S =) \frac{2000 \times 15}{230}$ evaluation (1) 130 (turns)	rearrangement and substitution can be in either order $\frac{230}{15} = \frac{2000}{Ns}$ using $\frac{Vp}{Vs} = \frac{Np}{Ns}$ accept answers that round to 130 or 131 (arising from rounding of intermediate evaluations) award full marks for the correct answer without working	(3)

Q9.

	Answer	Acceptable answers	Mark
	transformer	Step-up transformer Step-down transformer	(1)

Q10.

	Answer	Acceptable answers	Mark
(i)	Substitution (1) 1.5 × 6 Evaluation (1)	Power of 10 error max 1 mark Give full marks for correct answer	(2)

	9 (W) Ignore any unit given by candidate.	with no working shown	
(ii)	• More turns on the coil (1) • More powerful/stronger magnet(s) (1)	Wrap coils on iron (core/former)/ more coils/twists/loops. Bigger coil is insufficient. More magnets. Bigger/larger magnet is insufficient. Ignore increase speed of rotation	**(2)**
(iii)	A description including • in one direction only for DC (1) • reversing direction for AC (1)	'DC goes straight' is insufficient AC switches/changes direction OR moves to and fro 'AC goes different ways' is insufficient. Diagram with labelled arrows could get 2 marks.	**(2)**

Q11.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	60 (kW h/ units) (1) 60 x 20 (= 1200) (p) (1)	15459 - 15399 £12 ecf Award full marks for correct answer with no working £12 scores 2 Power of Ten error scores maximum 1 60 in answer space with no working scores 1	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	60 / 15 (1) 4 (kW) (1)	Allow ecf from 6(a)(i) marking point 1 Award full marks for correct answer with no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation linking any two of: • increase voltage (1) • decrease current (1) • reduce {loss / waste} of {energy / heat} (1)	Increase efficiency (of energy transmission) Ignore "more efficient" by itself Accept power instead of energy Accept no energy loss	**(2)**

Question Number		Indicative content	Mark
QWC	*** (c)**	A description to include some of the following points • speed of movement • stronger / more powerful (ORA) magnet • more turns / coils (ORA) • iron core • reversing movement • turning the magnet round • effect of any / each change • more conducting / less resistant wire • allow stronger current • allow ammeter reading / recording / voltage for current • allow moving coil Correct ideas but using inaccurate scientific terminology • larger / bigger magnet • more / longer movement Ignore • irrelevant information • speeds up current or more electricity	**(6)**
Level	**0**	no rewardable material	
1	**1-2**	• a limited description of any one change e.g. use more coils **OR** a stronger magnet. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3-4**	• a simple description of any two different changes **OR** one change and its effect e.g. use more coils and a weaker magnet **OR** more coils more current • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description of a change linked to its effect and a second different change e.g. using more turns of wire makes a bigger current. Moving the magnet out. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q12.

Question Number		Indicative Content	Mark
QWC	*	An explanation including some of the following points • a current/voltage/emf is induced when there is relative movement between a magnet and a coil of wire • the current is bigger when the movement is faster • the current is alternating/regularly changing direction • the current is zero when the magnet is not moving • points P and R on the graph correspond to the fastest movement of the magnet • the magnet is changing direction at points O, Q, S on the graph (quoting positive and negative current values from graph is sufficient to indicate a change in direction of current on graph) • the magnet is at the top/bottom of its movement at points O, Q, S on the graph • the magnet is not moving at points O, Q, S on the graph IGNORE references to number of turns or stronger magnet	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a limited explanation linking induced current to idea of movement of magnet OR limited reference linking graph to type of current with no link to model e.g. magnet moving in coil (induces a current) / (magnetic) field lines cut coil OR (the graph shows) an alternating current • spelling, punctuation and grammar are used with limited accuracy • the answer communicates ideas using simple language and uses limited scientific terminology
2	**3 - 4**	• a simple explanation linking the motion of the magnet to the size/direction of the induced current OR {a limited explanation linking induced current to idea of movement of magnet AND limited reference linking graph to type of current with no link to model} e.g. Magnet moving in the coil induces a current. The faster it moves the bigger the induced current. OR Magnet moving in the coil induces a current. When the magnet changes direction, the current changes direction. OR Magnet moving in the coil induces a current. The graphs shows an alternating current. OR Magnet moving in the coil induces a current. The current is positive at P and negative at R. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately

3	**5 - 6**	• a detailed explanation linking the motion of the magnet to the size/direction of the induced current AND reference to graph for one factor e.g. Magnet moving in the coil induces a current. The faster it moves the bigger the induced current. The magnet is moving fastest at point P on the graph. OR Magnet moving in the coil induces a current. When the magnet changes direction the current changes direction. At P and R the magnet is moving in opposite directions. OR Magnet moving in the coil induces a current. The current is positive at P and negative at R. The magnet is moving up at P and down at R. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q13.

Question number	Answer	Additional guidance	Mark
i	D half the size of the voltage across the primary coil A and B are incorrect because the voltage will not necessarily be twice or half the value of the current C is incorrect because the voltage across secondary coil will be less than that across the primary coil		**(1)** **AO2**

Question number	Answer	Additional guidance	Mark
ii	an explanation linking **three** of magnetic field in primary / secondary coil / core (due to current) (1) magnetic field is alternating (1) (this magnetic) field cuts/links secondary coil (1) <u>induces</u> an alternating voltage (across secondary coil) (1)		**(3)** **AO1**

Q14.

Question number	Answer	Additional guidance	Mark
(b)	an explanation linking in a logical order any four of the following:- (alternating) current produces (changing) magnetic field (around coil)(1) the coil is in a magnetic field (of fixed magnets) (1) (varying current in magnetic field) produces a force (1) the force on the coil /cone (continuously) changes direction (1) the paper cone /coil vibrates/ moves to and fro (1)	 magnetic fields interact making the air molecules (in the cone) vibrate	**(4)**

Q15.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • the sequence of events is voltage change, conversion to direct current, followed by current limiting • the battery is the load in the secondary circuit, not a store of energy for the primary circuit • a transformer is needed to increase (or step up) the voltage • so a diode is needed to change a.c. to d.c. • the charging current can be limited to 15 A using a fuse (or circuit breaker) • a circuit breaker may be preferable to a fuse, since a fuse would need to be replaced after use • the transformer primary coil is connected between the live and neutral in the primary circuit • the diode is connected in the secondary circuit of the transformer • the battery(which is to be charged), diode, fuse and secondary coil should be connected in series in the secondary circuit	**(6)**

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q16.

SSQ NO:	CS NO:	Answer	Mark
*		Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 strand 1 (6 marks)** • Q is a step-up transformer • step up V causes I to be lower • voltage increases (25 kV to 400 kV) • R is a transmission line / (national) grid /cable • smaller currents in transmission lines • less energy lost though heating those wires • V = I x R • smaller voltage drop across the transmission line • S is a step-down transformer reducing voltage to 230V • ready for use in homes T • detail of transformers – iron core + coils • transformers are not 100% efficient • idea of power as V x I or P = I^2R	**(6)** **AO1.1**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which may be inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Summary for guidance

Level	**Mark**	**Additional Guidance**	**General additional guidance – the decision within levels** Eg - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance isolated ideas e.g. identifying two of Q, S and R	Possible candidate responses Q and S are transformers R is a wire / cable

Level 2	3–4	Additional guidance more detail about the process of what at least two of Q, R and S do / achieve	Possible candidate responses Q is a step-up transformer - voltage increases R is a high voltage transmission line / cable / part of the National Grid S is a step-down transformer → idea of reducing voltage to 230V
Level 3	5–6	Additional guidance understanding is detailed and fully developed. includes detail about functions and efficiency explanation	Possible candidate responses need for step up and step-down functions via transformers to transfer energy at high voltages (voltage may be specified e.g. 400kV) transformers are not 100% efficient smaller currents in transmission lines so less energy lost though heating those wires: makes system more efficient

Q17.

Question number	Answer	Additional guidance	Mark
	an explanation linking **three** from: needle oscillates (1) either side of (centre) zero (1) (in response to) pole entering and pole leaving (end of coil) (1) (producing) {p.d. / voltage / emf} induced (via changing magnetic field) (1) (producing) an alternating current (1)	 needle vibrates / moves side to side positive and negative accept N / north / S / south for pole do not accept magnet accept current produced / induced accept (induce) an alternating emf / voltage	**(3) AO1.2**

Q18.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • coil moving/cuts through magnetic field • coil experiences changing magnetic field • induces a voltage/current in the coil • size of voltage/current depends on rate of change of magnetic field • rate of change depends on angle between direction of movement and direction of field. • greatest (rate of) change when coil moving perpendicular to field. • maximum current at Q and S • coil is horizontal at Q and S • coil moving vertically up at Q and down at S • direction of current at Q opposite to S. • no change when coil moving parallel to field. • zero current at P, R and T • coil vertical at P, R, and T Credit can be given for correctly labelled diagrams	**(6)** **AO2 and AO3**

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Level	**Mark**	**Additional Guidance**	**General additional guidance – the decision within levels** e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance isolated facts about interaction of electric current and magnetic fields **or** one salient feature of the graph	Possible candidate responses the coil experiences a changing magnetic field as it rotates. Size of the (induced) current varies.
Level 2	3–4	Additional guidance simple description of why current changes (either in direction or magnitude) **and** reference to at least one relevant point on the graph.	Possible candidate responses at position R the (plane of the) coil is parallel to the field and there is no current **Or** at position Q the coil is moving quickly through the field and the current is large.
Level 3	5–6	Additional guidance Full description of why current changes in magnitude or direction **and** reference to at least two relevant points on the graph	Possible candidate responses At Q, the coil is horizontal and moving most quickly across the field so the current is at its greatest. At R the coils is vertical and moving parallel to the field so there is no current.

Q19.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	<table><tr><th>component</th><th>☐</th></tr><tr><td>ammeter</td><td></td></tr><tr><td>coil of wire</td><td>☐</td></tr><tr><td>battery</td><td></td></tr><tr><td>magnet</td><td>☐</td></tr><tr><td>voltmeter</td><td></td></tr></table>	one mark for each correct tick deduct 1 mark for each extra tick	**(2)**

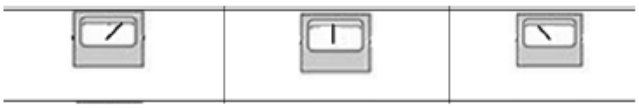
Question Number	Answer	Acceptable answers	Mark
(a)(ii)	Explanation linking any two of • wind (speed) is not constant (1) • voltage depends on wind speed (1)	need idea of varying wind {electrical energy / electricity} depends on wind speed higher wind speed gives {higher voltage/more electrical energy/more electricity} = 2 marks voltage is alternating = 2 marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	(saving) = 2 × 3 × 15 (1) 90 (p) (1)	award full marks for correct answer with no working 2 × 3 × 0.15 (£) 0.90	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	power = 2500 (W) (1) (current) = $\frac{2500}{230}$ (1) **ecf** 11 (A) (1)	award full marks for correct answer with no working [2.5/230 is 1 mark for these 2] 10.9 / 10.8... **accept** {0.01... / 0.11... / 1.1...} for 2 marks	**(3)**

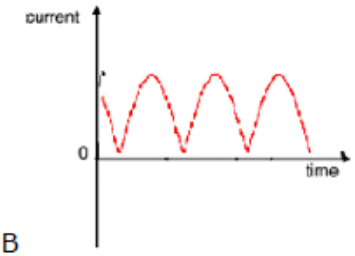
Question Number	Answer	Acceptable answers	Mark
(c)	EITHER sometimes no / very little wind (1) OR some appliances rated above 2 kW (1)	need wind vague references to weather are insufficient may use more than one appliance at once **or** house needs more (than 2kW) power not enough power for kettle **ignore** references to electrical energy / electricity	**(1)**

Q20.

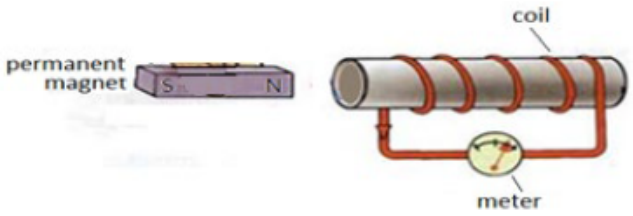
Question number	Answer	Mark
(i)	C  A and B are incorrect because there is no current when the magnet is station in the coil. D is incorrect because there is always a current when the magnet is moving in th coil	**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	any two from moving the magnet faster (1) using a stronger magnet (1) more turns/rotations on the coil (1)	 do not allow increase size of coil	**(2)**

Q21.

Question Number:	Answer	Mark
	 B **The only correct answer is B** ***A*** *is incorrect because it shows an alternating current which is produced by an alternator and not by a dynamo* ***C*** *is incorrect because it shows a square waveform which is not produced by a dynamo* ***D*** *is incorrect because it shows current linearly increasing with time and this is not produced by a dynamo*	**(1)** AO 3 2b

Q22.

Question Number	Answer	Additional guidance	Mark
(i)	a diagram that has the meter connected across the ends of a coil and a magnet orientated parallel to the axis of the coil; for example 	poles need not be labelled	**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking move magnet towards coil and then away from coil (1) with note change in 'direction' of **meter** (1) move magnet quickly then slowly (1) with larger / smaller **meter** reading (1)	 change poles of magnet allow use of ± in digital meters change speed of movement of magnet or changes to the number of turns ignore changes to size/strength of magnet	**(4)**

Q23.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	D the spring has more elastic potential energy than the weight has kinetic energy		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	A description including three from MP1 Elastic potential energy /EPE (in stretched spring) (1) MP2 (EPE is) transferred to KE (initially) (1) MP3 change from KE to GPE or vice versa(1) MP4 (correct idea of) energy changes continuing MP5 {total mechanical energy /kinetic +potential energy} decreases (continuously) (1) MP6 (Eventually all is transferred to) {thermal/heat} (energy) (1)	care should be taken not to award marks for contradictory examples Starting point for description does not matter Ignore sound energy EPE becomes/goes to KE (initially) condone amplitude decreases to zero KE or PE 'lost' to surroundings	**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	B increase the efficiency of the motorcycle		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	MP1 (bump produces) relative motion (1) MP2 (motion between magnet and coil) {induces / generates} voltage (1)	coil moves round magnet/magnet moves {into/out of} coil / coil {cuts / moves across} magnetic field ignore magnets slide inside a coil (see stem) electromagnetic induction condone {induces / generates } {current/electricity} ignore (see stem) electrical energy provides / produces	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)(iii)	An explanation linking MP1 {more/frequent} bumps (1) (idea of shorter time / increased frequency) MP2 (bigger bumps produce) bigger amplitude / move more up and down (idea of bigger size) (1) MP3 (so) {induced voltage /voltage generated} is larger (1)	 idea of up and down for bump (coil / magnets) move up and down {faster / more often} (coil/magnets) move {further/higher/bigger distance} (up and down) {induced current/current generated} is larger electromagnetic induction gives more voltage/current condone more electricity/electrical energy is {induced / generated} allow once for MP1 (if MP1 or MP2 is not scored): 'bumpier' 'go in and out more'	**(3)**

Q24.

	Answer	**Acceptable answers**	**Mark**
(ai)	Substitution (1) 1.5 × 6 Evaluation (1) 9 (W) Ignore any unit given by candidate.	Power of 10 error max 1 mark Give full marks for correct answer with no working shown	**(2)**
(aii)	• More turns on the coil (1) • More powerful/stronger magnet(s) (1)	Wrap coils on iron (core/former)/ more coils/twists/loops. Bigger coil is insufficient. More magnets. Bigger/larger magnet is insufficient. Ignore increase speed of rotation	**(2)**
(aiii)	A description including • in one direction only for DC (1) • reversing direction for AC (1)	 'DC goes straight' is insufficient AC switches/changes direction OR moves to and fro 'AC goes different ways' is insufficient.	**(2)**

		Diagram with labelled arrows could get 2 marks.	

		Indicative Content	
QWC	***(b)**	A comparison including some of the following ideas • Transformers can be used or {voltages/curren {changed/transformed} • AC (can transmit) at lower current/high(er) vol • National Grid is (usually) over ground (DC cabl underground) • Less energy lost in transmission • National Grid system can supply to customers • Possible to create a grid linking power stations • More flexibility in voltage for consumer • Consumer can draw large(r) current • More flexibility in power drawn • Great(er) range of devices can be powered Ignore methods of electric	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited (maybe implied) comparison giving one fact e.g: AC can be at high(er) voltage OR the National Grid can supply houses not close to a power station/ further (away/than the New York system.) • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple comparison including two ideas which may be linked or not eg Nat. Grid can supply whole country and can be used for more appliances (than just lighting). e.g: AC can be transmitted further (than DC) (because it) wastes less energy • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• A detailed comparison including at least three ideas, with at least one direct link between two of them. • e.g. AC can be transmitted further (than DC) because AC can be transformed to {lower current/high(er) voltages}. OR AC can be transformed to {lower current/high(er) voltages}. Greater range of devices used. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Total for Question = 12 mark

Q25.

Question Number	Answer	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1(6 marks) Understanding of physics • (long) transmission wires have resistance • reduced p.d. at the destination • (thermal) energy is dissipated in the transmission wires • this creates a power loss (refers to $P=I^2R$) • transformers are used to step up to a high voltage for transmission • this means a low current (refers to $V_PI_P=V_SI_S$) • so power loss is small(er) • transformers used to step down to a safer voltage for consumers • consumer wires are shorter and so power loss is less of an issue	**(6)** AO 1 1

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• An explanation that demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents an explanation that is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	• An explanation that demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents an explanation of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	• An explanation that demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q26.

Question Number	Answer	Acceptable answers	Mark
(a)	An explanation linking two from MP1 (so that they) decrease the (high) voltages (1) MP2 high voltages used for efficiency/energy saving (1) MP3 (step-down transformers) used {near / for} {homes / factories/appliances} (1) MP4 (so that it is) safer (1)	**stepping down voltage reducing from {high/eg 200 000 V} to {low /e.g.230 V} voltage** **low current used for efficiency/ energy saving** less risk of electrocution high voltages are dangerous	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	one line / curve above **and** below x-axis (1) two complete cycles in the 1.0 s (1)	one complete cycle in 0.5 s	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	Transposition (1) $V_s = V_p \times n_s/n_p$ Substitution (1) (V_s =) $\frac{12 \times 100}{2400}$ Evaluation (1) 0.5 (V)	Substitution and transposition in either order i.e. if $\frac{12 \times 100}{2400}$ is seen this scores 2 If they sub Vp, Np and Ns correctly, ignore anything for Vs even a blank Calculation may be done using turns ratio Correct answer no working = full marks answer (no working) with POT error =2 (eg 5 or 0.05) Ignore powers of 10 until evaluation	**(3)**

Question Number	Answer	Acceptable answers	**Mark**
(d)	C		**(1)**

Q27.

	Answer	Acceptable answers	Mark
(a)	transformer	Step-up transformer Step-down transformer	**(1)**
(b)	A suggestion to include any 2 of the following • (LED) turns on and off • as voltage/current {changes direction/from +ve to –ve/ twice each second } (1) • (LED) on for (+ve) part of cycle (1) • (LED) off for (-ve) part of cycle (1)	Flash(es) / flicker(s) (on and off) current changes every 0.25 s /4 times each second Turns on twice each second = 2 marks Only on when voltage/current is +ve gains both marks	**(2)**
(c)	substitute (1) 3 = I × 12 transformation (1) I = 3 ÷ 12 evaluation (1) 0 .25 (A) Ignore any unit given by candidate	Subst. and transform. either order 1 mark only can be scored for correct substitution after incorrect transposition. Accept any number of sig. figs. that rounds to 0.25 (A) 250 mA gains 3 marks give full marks for correct answer, no working 2.5 × any other power of ten = 2 marks eg 25 (A) gains 2 marks	**(3)**

			Indicative Content	
QWC		***(d)**	A discussion including some of the following points • improved lighting levels for LEDs • energy savings per year for LEDs or calculatio time • calculation of energy savings over lifetime of L calculation of monetary savings by using LEDs • link to savings in fossil fuels for LEDs or link to LEDs and reduced global warming • comparison of lifetimes and maintenance cost	
Level	**0**	No rewardable content		
1	**1 - 2**	• a limited discussion of benefits using some pieces of the information provided, e.g. LEDs last 40 000 hours longer and the lighting levels are 200% brighter. • the answer communicates ideas using simple language and uses		

		limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple discussion of benefits using some pieces of the information and processing one of them OR 2 processed pieces of information. e.g. LEDs save 3000 kW h of energy each year and are much brighter. The money they save each year compared to fluorescents is £420. OR The payback time for the LEDs is about 5 years and in that time they would have to pay for the fluorescent lights to be replaced 5 times. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed discussion of benefits using processed information covering more than half of the data points in the table e.g. LEDs use less energy each year and this means that fossil fuel reserves are not used up as quickly. The LEDs save £420 each year and have a payback time of about 5 years. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q28.

Question number	Answer	Additional guidance	Mark
(i)	An explanation that combines identification via a judgment to reach a conclusion, via reasoning to include • the peaks get higher (1) • because (faster means) greater rate of change of magnetic field (1) • the width of the peaks gets less (1) • because (faster means) shorter times for magnet to travel through (coils) (1)	greater induced emf / voltage width of each wave gets less	**(4)**

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that combines identification, via a judgment, to reach a conclusion, via reasoning, linking one from: • time involved is very short (1) • 500 ms (0.5 s) shown on graph (1) with one from • the meter could not respond quickly enough (1) • human/person could not take/record the readings quickly enough (1)	 data loggers can take (lots of) readings quickly human reaction times insufficient	(2)