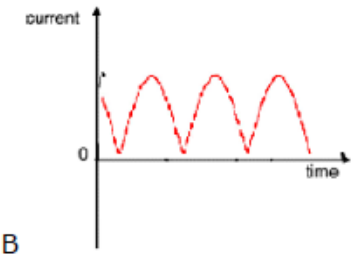
Mark Scheme

Q1.

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

Q2.

Question Number:	Answer	Additional Guidance	Mark
	substitution (1) $(I_s) = \frac{230 \times 0.02}{5.0}$ evaluation (1) 0.9(A)	 accept 0.92 (A) award full marks for the correct answer without working	**(2)** AO 2 1

Q3.

Question Number:	Answer	Mark
(i)	a power station	**(1)** AO 1 1

Question Number:	Answer	Mark
(ii)	the national grid	(1) AO 1 1

Question Number:	Answer	Mark
(iii)	heat loss is reduced	(1) AO 1 1

Q4.

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

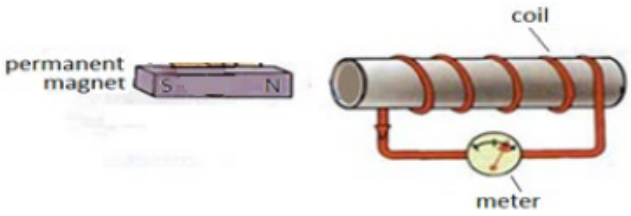
Question Number:	Answer	Additional Guidance	Mark
(ii)	substitution into $\frac{V_p}{V_s}=\frac{N_p}{N_s}$ (1) $\frac{25}{V_s}=\frac{30}{150}$ rearrangement (1) $V_s = \frac{25\times150}{30}$ evaluation (1) (V_s =) 130 (V)	substitution and rearrangement in either order $\frac{V_s}{25}=\frac{150}{30}$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

Q5.

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)

Q6.

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)

Q7.

	Answer	Acceptable answers	Mark
(i)	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)
(ii)	• More turns on the coil (1)	Wrap coils on iron (core/former)/	(2)

	• More powerful/stronger magnet(s) (1)	more coils/twists/loops. Bigger coil is insufficient. More magnets. Bigger/larger magnet is insufficient. Ignore increase speed of rotation	
(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)**

Q8.

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

Q9.

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)

Q10.

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)**

Q11.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	**component** ☐ ammeter coil of wire ☐ battery magnet ☐ voltmeter	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)**

Q12.

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)**

Q13.

	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

Q14.

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	