

Question number	Answer	Notes	Marks
1 (a) (i)	step-down (transformer);		1
(ii)	MP1. soft material loses magnetism quickly / easily; MP2. idea that magnetic field (in core) alternates / changes;	ignore unqualified references to losing magnetism	2
(b) (i)	$\frac{\text{input / primary voltage}}{\text{output / secondary voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$	allow <ul style="list-style-type: none"> • equation in words with turns ratio shown as a fraction • standard abbreviations :- s, p, in, out, 1, 2 • N or n for number of turns (condone T for number of turns) • "number of coils" for number of turns rearrangements also to include turns ratio as a fraction $(V_S/V_P) = (N_S/N_P)$ [equation inverted] $V_S = (V_P) (N_S/N_P)$ [V_S as subject] $V_P = (V_S) (N_P/N_S)$ [V_P as subject]	1
(ii)	substitution into a correct equation; evaluation (including rearrangement); e. $44 / V = 520 / 30$ $(V =) 2.5 (V)$	allow 3, 2.53, 2.54, 2.538	2



(c)	(i)	idea of a (frequency) limit / range to (human) hearing OR (frequency) is { too high / ultrasound}; mention of upper limit as 20 000 Hz;	ignore references to lower limit allow 20 kHz ignore references to lower limit	2
	(ii)	conversion of unit; substitution and evaluation; e. $t = 1.5 \text{ ms} = 0.0015 \text{ s}$ $(f =) 1/0.0015 = 670 \text{ (Hz)}$	allow 1000 or 0.001 in working, if no other mark can be given allow correct rounding only e.g. 700, 667, 666.7, 666.6 (recurring) 1 mark max for POT error e.g. 0.67, 6.7, 67 etc.	2

Total 10 marks



Question number	Answer	Notes	Marks	
2 (a)	i	Step down (transformer);	1	
	ii	$(V_P/V_S) = (N_P/N_S)$; $\frac{\text{input (primary) voltage}}{\text{output (secondary) voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$ $\frac{V_P}{V_S} = \frac{n_P}{n_S}$	Allow <ul style="list-style-type: none">equation in wordsstandard abbreviations :- s, p, in, out, 1, 2N, n or T for number of turnsRearrangements e.g. $(V_S/V_P) = (N_S/N_P)$ $V_S = (V_P) (N_S/N_P)$ $V_P = (V_S) (N_P/N_S)$	1
	iii	Substitution; (rearrangement and) evaluation; e.g. $\frac{230}{25} = \frac{\text{primary turns}}{100}$ 920 (Turns)	Do not credit the equation in words or symbols bald answer gains full marks	2

Question number	Answer	Notes	Marks
(b)	<p>Any 5 from</p> <p>MP1. it steps up or steps down the voltage;</p> <p>MP2. current in (primary) coil produces magnetic field;</p> <p>MP3. the current is changing /has frequency of 50 Hz;</p> <p>MP4. causing a (changing) magnetic field in the core;</p> <p>MP5. the core strengthens the magnetic field;</p> <p>MP6. field lines interact with (secondary) coil;</p> <p>MP7. which induces a voltage in the secondary coils;</p> <p>MP8. transformer won't work with (steady) d.c.</p>	<p>allow flux for magnetic field</p> <p>Allow increases or decreases voltage</p> <p>Allow concentrates for strengthens</p> <p>Allow flux changes in secondary coil</p> <p>Allow induces a current/eq</p> <p>NB do not credit repeat of stem</p>	5

(Total for Question 2= 9 marks)

Question number	Answer	Notes	Marks												
3 (a)	Any three of - MP1 use a stirrer / stir with thermometer; MP2 centralise / spread heat source; MP3 move thermistor and thermometer to same level; MP4 move thermistor and thermometer closer together; MP5 Use thermometer with finer scale / digital thermometer;	Ignore repeat readings	Max 3												
(b)	(milli)Ammeter;	Allow ammeter	1												
(c) (i)	Scale; (at least half the grid) Axes labelled including units; Plotting $\pm \frac{1}{2}$ small square;; Line of best fit;	Accept axes reversed -1 each plotting error, minimum 0 for plotting Curve through either (80, 0.2) or (100, 0.4) Allow line bisecting these two points	5												
		<table border="1"> <thead> <tr> <th>Temperature in °C</th> <th>Voltage in V</th> </tr> </thead> <tbody> <tr> <td>20</td> <td>6.0</td> </tr> <tr> <td>40</td> <td>2.2</td> </tr> <tr> <td>60</td> <td>1.1</td> </tr> <tr> <td>80</td> <td>0.2</td> </tr> <tr> <td>100</td> <td>.4</td> </tr> </tbody> </table>	Temperature in °C	Voltage in V	20	6.0	40	2.2	60	1.1	80	0.2	100	.4	
Temperature in °C	Voltage in V														
20	6.0														
40	2.2														
60	1.1														
80	0.2														
100	.4														
(c) (ii)	DOP (80, 0.2) circled (if supported by line of best fit)	Allow (100, 0.4) circled if supported by line of best fit	1												

Question number	Answer	Notes	Marks
3 (d) (i)	voltage = current x resistance;	Accept rearrangements and symbols e.g. current = voltage ÷ resistance, $V=IR$, $R=V/I$	1
(ii)	Substitution into correctly rearranged equation; Conversion between amps and milliamps; Calculation yielding value correct to at least 2 s.f.; e. $I = 5.9 \div 680$ $= 0.00868 \text{ (A)}$ $= 8.7 \text{ (mA)}$	Accept x 1000 in calculation Allow 1 mark max if response is only a successful reverse argument leading to 5.8 V or 5.78 V	3

Total 14 marks



Question Number	Answer	Notes	Marks
4 (a) (i)	input power = output power; OR $I_p V_p = I_s V_s$; OR $I_{in} V_{in} = I_{out} V_{out}$;	A dimensionally correct power equation is required. Accept - Power in = Power out $I_1 V_1 = I_2 V_2$ input power = output power $V_P I_P = V_S I_S$	1
(ii)	Substitution in correctly rearranged equation; Calculation; e.g. $I_s = \frac{(2 \times 230)}{110}$ 4 (A)	Full marks for bald correct answer Accept more s.f. e.g. 4.2, 4.18, 4.1818	2
(b) (i)	$(V_p/V_s) = (N_p/N_s)$; $\frac{\text{input (primary) voltage}}{\text{output (secondary) voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$ $\frac{V_p}{V_s} = \frac{n_p}{n_s}$	Allow <ul style="list-style-type: none"> equation in words with turns ratio shown as a fraction standard abbreviations :- s, p, in, out, 1, 2 N, n or T for number of turns “number of coils” for number of turns Rearrangements also to include turns ratio as a fraction $(V_s/V_p) = (N_s/N_p)$ [equation inverted] $V_s = (V_p) (N_s/N_p)$ [V_s as subject] $V_p = (V_s) (N_p/N_s)$ [V_p as subject]	1

	<p>(ii) Substitution into correctly rearranged equation; Calculation; e.g. $N_s = \frac{(110 \times 1200)}{230}$ 570</p>	<p>Accept</p> <ul style="list-style-type: none"> • 2 or more s.f. e.g. 574, 573.9 • Answers which round to 570 	2
4 (c)	<p>Any 5 from</p> <p>MP1. it steps up or steps down the voltage;</p> <p>MP2. current in (primary) coil produces magnetic field;</p> <p>MP3. the current is changing /has frequency of 50 Hz;</p> <p>MP4. causing a (changing) magnetic field in the core;</p> <p>MP5. the core strengthens the magnetic field;</p> <p>MP6. field lines interact with (secondary) coil;</p> <p>MP7. which induces a voltage in the secondary coils;</p> <p>MP8. transformer won't work with (steady) d.c.</p>	<p>allow flux for magnetic field</p> <p>Allow increases or decreases voltage</p> <p>Allow concentrates for strengthens</p> <p>Allow flux changes in secondary coil</p> <p>Allow induces a current/eq</p>	5

(Total for Question 5 = 11 marks)

Question number		Answer	Notes	Marks												
5	(a)	(i)	C (the same speed in free space)	1												
		(ii)	B (there must be a current in the circuit)	1												
	(b)	(i)	Voltmeter connected in parallel with any circuit component; Component chosen is the LED;	Ignore a line through the voltmeter symbol	2											
		(ii)	<p>Axes labelled- quantity and unit ;</p> <p>Linear scale such that longest bar occupies at least half the grid;</p> <p>Plotting---ignore order of bars 5 bars correctly plotted;; If only 3 bars correctly plotted allow 1 mark for plotting</p> <table border="1" data-bbox="474 799 1065 1038"> <thead> <tr> <th>Colour of light from LED</th> <th>Minimum voltage in V</th> </tr> </thead> <tbody> <tr> <td>Red</td> <td>1.7</td> </tr> <tr> <td>Blue</td> <td>3.6</td> </tr> <tr> <td>Yellow</td> <td>2.1</td> </tr> <tr> <td>Orange</td> <td>2.0</td> </tr> <tr> <td>Green</td> <td>3.0</td> </tr> </tbody> </table>	Colour of light from LED	Minimum voltage in V	Red	1.7	Blue	3.6	Yellow	2.1	Orange	2.0	Green	3.0	<p>voltage in V (or V/V) AND all bars (or points) labelled Ignore orientation Allow non-zero origin</p> <p>Bar length plotted to nearest ½ small square</p> <p>ALL data plotted correctly as floating "x's" gets only one mark for plotting</p> <p>Reject both plotting marks if a line graph is drawn (only scale and axes marks are available in this case)</p>
	Colour of light from LED	Minimum voltage in V														
Red	1.7															
Blue	3.6															
Yellow	2.1															
Orange	2.0															
Green	3.0															
(iii)	<p>Student is right/wrong - no mark</p> <p>Any two of MP1 idea that the visible spectrum is a sequence, with the end colours identified;</p> <p>MP2 Colour correctly related to wavelength (e.g. red has longest wavelength);</p> <p>MP3 Colour correctly related to voltage (e.g. blue needs highest voltage);</p>	<p>Red to blue (start either end) Allow ROYGBIV etc</p> <p>Wavelength (or frequency) correctly related to voltage = 2 marks, e.g. f increases with V λ increases with 1/V</p>	2													
Total for question 6 = 10 marks																

Question number	Answer	Notes	Marks
6 (a)	C (132 000 V);		1
(b)	B (efficiency of transmission);		1
(c)	C (transformer);		1

Total 3 marks