Energy and Voltage in circuits

Mark Scheme 4

Level	IGCSE(9-1)
Subject	Physics
Exam Board	Edexcel IGCSE
Module	Single Award (Paper 2P)
Topic	Electricity
Sub-Topic	Energy and Voltage in circuits
Booklet	Mark Scheme 4

Time Allowed: **69 minutes**

Score: **/57**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	775%	70%	60%	55%	50%	<50%

Question number	Answer	Notes	Marks
1 (a) (i)	step-down (transformer);		1
(ii)	MP1. soft material **loses** magnetism **quickly** / **easily**;	ignore unqualified references to losing magnetism	2
	MP2. idea that magnetic field (in core) alternates / changes;		

(b)	(i)	$\frac{\text{input / primary voltage}}{\text{output / secondary voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$	allow • equa ion in words with turns ratio shown as a fraction • sta dard abbreviations :- s, p, in, out, 1, 2 • N or n for number of turns (condone T for number of turns) • “numb r 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 ms = 0.0015 s (f =) 1/0.0015 = 670 (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

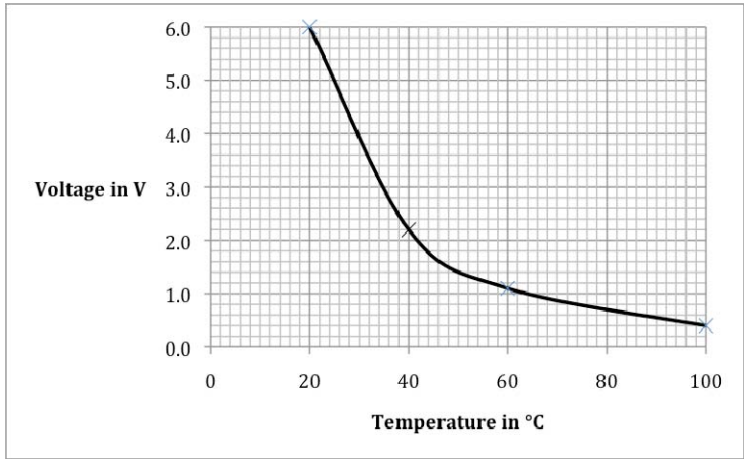
Total 10 marks

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 • equation in words • standard abbreviations :- s, p, in, out, 1, 2 • N, n or T for number of turns • Rearrangements 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)	Any 5 from MP1. it steps up or steps down the **voltage**; MP2. current in (primary) coil **produces** magnetic field; MP3. the current is changing /has frequency of 50 Hz; MP4. causing a (changing) magnetic field in the core; MP5. the core strengthens the magnetic field; MP6. field lines interact with (secondary) coil; MP7. which **induces** a voltage in the secondary coils; MP8. transformer won't work with (steady) d.c.	allow flux for magnetic field Allow increases or decreases voltage Allow concentrates for strengthens Allow flux changes in secondary coil Allow induces a current/eq NB do not credit repeat of stem	5

(Total for Question 2= 9 marks)

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>3 (a)</td><td>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;</td><td>Ignore repeat readings

Assume horizontal separation meant</td><td>Max 3</td></tr>
<tr><td>(b)</td><td>(milli)Ammeter;</td><td>Allow ampmeter</td><td>1</td></tr>
<tr><td>(c) (i)</td><td>Scale; (at least half the grid)
Axes labelled including units;
Plotting ±½ small square;;
Line of best fit;
 
</td><td>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
<table><tr><th>Temperature in °C</th><th>Voltage in V</th></tr><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></table></td><td>5</td></tr>
<tr><td>(c) (ii)</td><td>DOP (80, 0.2) circled (if supported by line of best fit)</td><td>Allow (100, 0.4) circled if supported by line of best fit</td><td>1</td></tr>
</table>

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 ÷ 680 = 0.00868 (A) = 8.7 (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 $I_pV_p = I_sV_s$; OR $I_{in}V_{in} = I_{out}V_{out}$;	A dimensionally correct power equation is required. Accept - Power in = Power out $I_1V_1 = I_2V_2$ **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 • 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

(ii)	Substitution into correctly rearranged equation; Calculation; e.g. $N_S = \frac{(110 \times 1200)}{230}$ 570	 Accept • 2 or more s.f. e.g. 574, 573.9 • Answers which round to 570	2
4 (c)	Any 5 from MP1. it steps up or steps down the voltage; MP2. current in (primary) coil produces magnetic field; MP3. the current is changing /has frequency of 50 Hz; MP4. causing a (changing) magnetic field in the core; MP5. the core strengthens the magnetic field; MP6. field lines interact with (secondary) coil; MP7. which induces a voltage in the secondary coils; MP8. transformer won't work with (steady) d.c.	allow flux for magnetic field Allow increases or decreases voltage Allow concentrates for strengthens Allow flux changes in secondary coil Allow induces a current/eq	5

(Total for Question 5 = 11 marks)

<table>
<tr><th colspan="3">Question number</th><th></th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>5</td><td>(a)</td><td>(i)</td><td></td><td>C (the same speed in free space)</td><td rowspan="2">Ignore a line through the voltmeter symbol</td><td>1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>B (there must be a current in the circuit)</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td></td><td>Voltmeter connected in parallel with any circuit component;
Component chosen is the LED;</td><td>voltage in V (or V/V) AND
all bars (or points) labelled
Ignore orientation
Allow non-zero origin</td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>Axes labelled- quantity and unit ;

Linear scale such that longest bar occupies at least half the grid;

Plotting---ignore order of bars
5 bars correctly plotted;;
If only 3 bars correctly plotted allow 1 mark for plotting

<table><tr><th>Colour of light from LED</th><th>Minimum voltage in V</th></tr><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></table></td><td>Bar length plotted to nearest ½ small square

ALL data plotted correctly as floating “x’s” gets only one mark for plotting

Reject both plotting marks if a line graph is drawn (only scale and axes marks are available in this case)</td><td>4</td></tr>
</table>

(iii)		Student is right/wrong – no mark Any two of MP1 idea that the visible spectrum is a sequence, with the end colours identified; MP2 Colour correctly related to wavelength (e.g. red has longest wavelength); MP3 Colour correctly related to voltage (e.g. blue needs highest voltage);	Red to blue (start either end) Allow ROYGBIV etc Wavelength (or frequency) correctly related to voltage = 2 marks, e.g. f increases with V λ increases with 1/V	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