

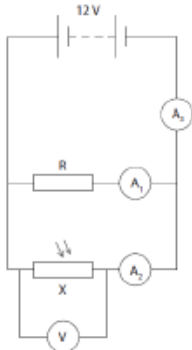
## Mark Scheme

Q1.

Question number	Answer	Notes	Marks
(a)	correct voltmeter symbol drawn in parallel with any component; component is the resistor, X;		2
(b)	use of $V = I \times R$ ; calculation of total R;  sum of resistances = total R; evaluation of resistance of X;  e.g. $9.0 = 0.012 \times R_T$ $R_T = 750 (\Omega)$ $750 = R_x + 250$ $(R_x =) 500 (\Omega)$	seen anywhere correct calculation of voltage of $250\Omega$ resistor evaluation of voltage of X  e.g. $V_{250} = 0.012 \times 250$ $V_{250} = 3.0 (V)$ $V_x = (9.0 - 3.0) = 6.0 (V)$ $(R_x =) 500 (\Omega)$	4
Total for question 7 = 6 marks			

Q2.

Question number	Answer	Mark
(a)(i)	An LDR (light-dependent resistor)	1

Question number	Answer	Mark
(a)(ii)	<ul style="list-style-type: none"> <li>correct symbol (1)</li> <li>correct position in parallel with X (1)</li> </ul> 	2

Question number	Answer	Additional guidance	Mark
(b)	rearrangement <ul style="list-style-type: none"> <li><math>I = V/R</math> (1)</li> </ul> substitution <ul style="list-style-type: none"> <li><math>I = 12/840 (= 0.014 \text{ (A)})</math> (1)</li> </ul>	0.01429 (A) some evidence of working required for two marks	2

Question number	Answer	Additional guidance	Mark
(c)(i)	correct addition of current in $A_1$ with current in $A_2$ $= 0.021 \text{ (A)}$ (1)	ecf from 3(b)  0.025 (A)  award full marks for correct numerical answer without working	1

Question number	Answer	Mark
(c)(ii)	An explanation that makes reference to the following points:  <ul style="list-style-type: none"> <li>resistance of LDR increases (1)</li> <li>hence current in <math>A_2/A_3</math> decreases (1)</li> </ul>	2

**(Total for question = 8 marks)**

Q3.

Question number	Answer	Mark
(a)	<ul style="list-style-type: none"> <li>Axes shown with either voltage or current against time AND more than one wavelength shown (1)</li> <li>Continuous curve drawn that alternates to + and -, and has approximately equal displacement on either side of x-axis (1)</li> </ul>	2

Question number	Answer	Additional guidance	Mark
(b)	A diode only allows current in one direction	allow answers which describe what would happen to a battery with a.c.	1

Question number	Answer	Additional guidance	Mark
(c)(i)	<ul style="list-style-type: none"> <li>All circuit symbols correct (1)</li> <li>Bulbs shown in series (1)</li> </ul>	allow cell for battery reject power supply symbol	2

Question number	Answer	Additional guidance	Mark
(c)(ii)	Power = current $\times$ voltage	allow rearrangement and correct symbols, e.g. $P = I \times V$	1

Question number	Answer	Additional guidance	Mark
(c)(iii)	Process includes: <ul style="list-style-type: none"> <li>rearrangement</li> <li>evaluation</li> </ul> e.g. $I = P/V$ (1) $= 0.33/6.0$ $= 0.055$ (A) (1)	1 mark max if incorrect $V$ is used	2

**(Total for question = 8 marks)**

Q4.

Question number	Answer	Additional guidance	Mark
(a)	In order to vary the current/voltage	allow because there is no variable voltage supply	1

Question number	Answer	Additional guidance	Mark
(b)(i)	A description that makes reference to the following three points: <ul style="list-style-type: none"> <li>a simple pattern statement e.g. as the voltage increases the current increases (1)</li> <li>a statement about linearity e.g. gradient decreases with voltage (1)</li> <li>reference to data from the graph e.g. at 0 V the current is 0 A, but at 10 V, the current is 0.16 A (1)</li> </ul>	allow alternative statements  the increase is greater at low voltages	3

Question number	Answer	Additional guidance	Mark
(b)(ii)	voltage = current × resistance	equation can be given in words or accepted symbols	1

Question number	Answer	Additional guidance	Mark
(b)(iii)	<ul style="list-style-type: none"> <li>• Rearrangement</li> <li>• Substitution</li> <li>• Evaluation</li> </ul> <p>e.g.  <math>R = V/I</math> (1)  <math>= 2.5/0.92</math> (1)  <math>2.7</math> (<math>\Omega</math>) (1)</p>	<p>seen anywhere</p> <p>allow a range of <math>\pm 0.02</math> A for the reading of current from graph</p> <p>max two marks if current incorrect</p>	3

Question number	Answer	Mark
(c)	Increases/equivalent	1

Q5.

Question number	Answer	Notes	Marks
(a)	A helium <b>nucleus</b> / 2 protons and 2 neutrons/ 4 nucleons, 2 protons;	Ignore chemical symbol	1
(b) (i)	Arrow labelled Y, through X away from nucleus;  Line of action of force would pass through centre of nucleus by eye;		2
(ii)	Arrow labelled Z, opposite direction to their answer from b) (i) by eye;  Same size as their answer from b) (i) by eye;	If no arrow Y, condone correct direction for arrow Z, i.e. force arrow pointing away from point X.	2
(iii)	MP1 Force on alpha is repulsive;  MP2 Alpha and nucleus must be same (type of) charge;  MP3 Alpha is positive <b>therefore</b> nucleus is positive;	Allow 'like charges repel' for MP1 and MP2	3
(c)	Selection of $F = ma$ ;  Substitution or re-arrangement;  Evaluation;  e.g. $a = 3.6 / 6.6 \times 10^{-27} = 5.5 \times 10^{26} \text{ m/s}^2$	Can be implied from working  -1 for PoT error  Allow $5.45 \times 10^{26}$ , $5.454 \times 10^{26}$ , $5.4545\dots \times 10^{26}$ etc Condone $5.4 \times 10^{26}$	3

Q6.



Question number	Answer	Notes	Marks
(a)	A (current); B is incorrect because power is the rate of energy transferred C is incorrect because resistance is the ratio of voltage and current D is incorrect because voltage is the energy transferred per unit charge passed		1
(b)	D (voltage); A is incorrect because current is the rate of flow of charge B is incorrect because power is the rate of energy transferred C is incorrect because resistance is the ratio of voltage and current		1
(c) (i)	correct voltmeter symbol used; voltmeter drawn in parallel with S;	condone drawn in parallel with R or the battery	2
(ii)	0.20 (A); 0.60 (A);	this order only allow 0.2 (A) this order only allow 0.6 (A)	2
(iii)	voltage = current $\times$ resistance;  substitution; evaluation;  e.g. $V = I \times R$ $(V =) 0.40 \times 11$ $(V =) 4.4 (V)$	formula should be seen or implied by calculation allow standard symbols and rearrangements ignore C, c for current	3
(iv)	idea that voltage across battery is the same as voltage across R;  (because) battery and R are connected in parallel / no other resistive components on loop with battery and R;	allow numerical value given e.g. 'voltage of battery = 4.4V'	2

(d)	idea that resistance (of thermistor) changes; when temperature increases, resistance decreases; (therefore) current increases when temperature increases;	allow even if relationship is the wrong way round ORA  ORA	3
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Q8.

Question number	Answer	Additional guidance	Mark
(a)	Idea of friction (between particles)	allow rubbing	<b>1</b>

Question number	Answer	Additional guidance	Mark
(b)	An explanation linking: <ul style="list-style-type: none"> <li>electrons in the ground (1)</li> <li>are repelled from the surface layers (1)</li> </ul>	reject for one mark movement of positive charges	2

Question number	Answer	Additional guidance	Mark
(c)(i)	To remove (or add) electrons from the outer shells/levels of an atom	allow turning (atoms) into ions	1

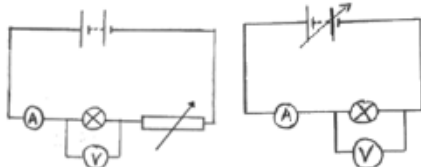
Question number	Answer	Additional guidance	Mark
(c)(ii)	Charge = current × time	allow in words or any rearranged form e.g. $Q = I \times t$	1

Question number	Answer	Additional guidance	Mark
(c)(iii)	<ul style="list-style-type: none"> <li>Rearrangement</li> <li>Substitution and evaluation</li> </ul> $t = Q/I \text{ (1)}$ $= 15/32\ 000$ $= 0.00047 \text{ (s) (1)}$	POT error = -1  award full marks for correct numerical answer without working	2

Question number	Answer	Additional guidance	Mark
(c)(iv)	Process includes: <ul style="list-style-type: none"> <li>substitution of <math>V (= IR)</math> into energy equation</li> <li>substitution</li> <li>rearrangement</li> <li>evaluation</li> </ul> $E = QIR \text{ (1)}$ $510 \times 10^6 = 15 \times 32 \times 10^3 \times R \text{ (1)}$ $R = \frac{510 \times 10^6}{15 \times 32 \times 10^3} \text{ (1)}$ $1060 \text{ (}\Omega\text{) (1)}$	allow calculation of V from $E = QV$ or $E = VIt$  allow substitution into $V = IR$ allow rearrangement of $V = IR$  1062.5 must see answer to at least 2 significant figures in order to determine that evaluation is correct  some supporting working must be seen with correct answer to receive full marks	4

(Total for question = 11 marks)

Q9.

Question number	Answer	Notes	Marks
(a) (i)	<p>circuit with symbols for ammeter, voltmeter, lamp, any power supply all correct;</p> <p>voltmeter in parallel with lamp; ammeter in series with lamp;</p> <p>correct means of varying voltage of lamp i.e. variable power supply/rheostat/potentiometer;</p> <p>e.g.</p> 	<p>variable power supplies or variable number of cells can be shown using labelled standard symbols</p> <p>if no lamp in circuit, allow ammeter drawn in series with power supply allow variable resistor in series with lamp</p>	4
(ii)	<p>any four from:</p> <p>MP1. record ammeter and voltmeter reading;</p> <p>MP2. repeat readings (for each voltage) and find average;</p> <p>MP3. idea of changing the voltage / current;</p> <p>MP4. plot a graph of voltage and current;</p> <p>MP5. switch off current/circuit between readings;</p>	<p>allow 'measure voltage and current'</p> <p>allow repeating experiment to find average</p> <p>allow described method that would change voltage or current e.g. adding more cells, changing circuit resistance etc.</p> <p>ignore "let lamp cool between readings"</p>	4
(b) (i)	ampere / amp / A / mA;	reject I	1
(ii)	<p>correctly evaluated energy; given to 2 significant figures;</p> <p>e.g. 162 (J) gets 1 mark 160 (J) gets 2 marks</p>	DOP	2
(iii)	red or orange;		1

