

IGCSE Physics - Section 2– Electricity – Mark scheme.

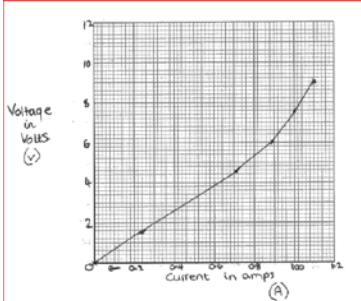
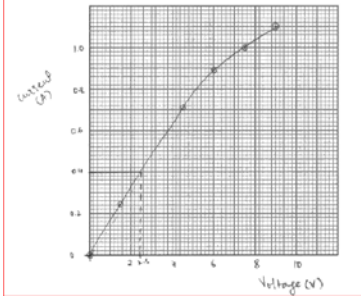
Q	Content	Marks
1	Mains electricity –three multiple-choice qs	3
2	Resistance of a wire – current and voltage	14
3	Electrostatics	5
4	Circuits, power	8
5	Electrical safety in the kitchen.	6
6	Thermistor investigation.	7
7	Kettle, power, fuses	11
8	Electrostatics – roll of sticky tape	5
9	Circuits, power, fuses.	15
10	Circuits, current, voltage and resistance.	13
11	Investigating a thermistor	12
		99

Question 1.

Question number	Answer	Notes	Marks
1 (a)	B (no earth connection);		1
(b)	C (the circuit cannot overheat if there is a fault);		1
(c)	A (in parallel);		1

Total 3 marks

Question 2.

Question number	Answer	Notes	Marks														
10(a)	<p>any 3 mistakes identified from</p> <p>MP1. cells are connected with wrong polarity;</p> <p>MP2. ammeter is connected in parallel (with wire);</p> <p>MP3. voltmeter is connected in series (with wire);</p> <p>MP4. circuit has not got a switch;</p>	<p>allow RA for any MP</p> <p>allow idea that meters should be swapped for two marks (MP2 and MP3)</p>	3														
(b) (i)	<p>suitable scale chosen (> 50% of grid used);</p> <p>axes labelled with quantities and unit;</p> <p>plotting correct to nearest half square (minus one for each plotting error) ;;</p> <p>line of best fit through zero;</p> <div style="display: flex; align-items: center; margin-top: 10px;">  <div style="margin-left: 10px;">= 4 not curve mark</div> </div> <div style="display: flex; align-items: center; margin-top: 10px;">  <div style="margin-left: 10px;">= 5</div> </div>	<p>only scales in 1,2,5,10 or 8 acceptable</p> <p>orientation unimportant</p> <p>points must be shown clearly</p> <p>i.e. two plotting errors = no marks for plotting</p> <p>i.e. smooth curve</p> <table border="1" style="margin-top: 20px; width: 100px;"> <thead> <tr> <th>I</th> <th>V</th> </tr> </thead> <tbody> <tr><td>0.0</td><td>0.</td></tr> <tr><td>0.2</td><td>1.</td></tr> <tr><td>0.7</td><td>4.</td></tr> <tr><td>0.8</td><td>6.</td></tr> <tr><td>1.0</td><td>7.</td></tr> <tr><td>1.1</td><td>9.</td></tr> </tbody> </table>	I	V	0.0	0.	0.2	1.	0.7	4.	0.8	6.	1.0	7.	1.1	9.	5
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0.0	0.																
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1.0	7.																
1.1	9.																
(ii)	0.40 A	range 0.39 A to 0.41 A	1														
(iii)	<p>One of -</p> <p>MP1. Temperature (of wire) was not constant;</p> <p>MP2. Resistance (of wire) was not constant;</p>		1														

Question number	Answer	Notes	Marks
10 (b) (iv)	Any four of - MP1. instrument to measure temperature; MP2. means to maintain constant temperature (of wire); MP3. use of $V = IR$; MP4. idea of repeating / averaging (at same temperature); MP5. idea of additional (interpolated) points; MP6. use linear part of the graph; MP7. use of gradient;	ignore all details about the circuit already given e.g. water bath, switch off and allow wire to cool $V \propto I$ obtain a range of values (of V, I) Allow reference to candidate's graph, e.g. current below 0.6 A Orientation unimportant	4

Total 14 marks

Question 3.

Question number	Answer	Notes	Marks
3 (a)	MP1 Due to friction; MP2 Idea of <u>electron</u> transfer;	Allow idea of materials rubbing Ignore "charge" "static" Reject (for MP2 mark) idea of protons moving	2
(b) (i)	Idea of spark / ignition / fire / explosion	Ignore reference to shock and petrol fumes	1
(ii)	Idea of current (in the wire); OR Idea of charge moving (in the wire); Idea that this discharges tanker; OR No voltage/ p.d. remains;	ignore references to positive charges Allow: No charge is left No overall charge Charge is removed Tanker becomes neutral Ignore: "Electricity" further discussion of danger	2

Total 5 marks

Question 4.

Question number	Answer	Notes	Marks
3 (a) (i)	C – a fuse		1
(ii)	Idea of independent switching for lamps / rooms;	Allow idea of one bulb blowing but not affecting others idea that bulbs in parallel are bright(er than in series)	1
(b)	MP1. Idea of current changing direction ; MP2. Continuously;	vary is not enough Allow + and – current Can be shown as a diagram /graph (assume axes labels) Minimum requirement: MP1 shows both + and - (e.g. approximate sine curve) MP2 more than one cycle	2
(c) (i)	Conversion to seconds; Substitution in correct formula; Evaluation; e.g. $t = 7 \times 3600 (= 25200 \text{ s})$ $E = 0.12 \times 230 \times 7 \times 3600$ 700 000(J)	Allow 3600 or 25200 seen anywhere in working (695520) Correct answer without working scores full marks Accept alternative matching unit e.g. 696 kJ 11592 = 2 marks (time in mins) 193.2 = 2 marks (time in hours) Answer in Wh or Wmin with <u>matching</u> unit scores full marks.	3
(ii)	B - same as - less than		1

Total 8 marks

Question 5.

Question number	Answer	Notes	Marks
4	<p>Max of three electrical hazards identified;;;</p> <p>Max of three amplifying details relevant to the hazard(s) identified;;;</p> <p>MP1. Idea of water in contact with something electrical e.g. plugs/sockets/switches;</p> <p>MP2. Idea that an electrical device with a heating element reaches a high temperature;</p> <p>MP3. Idea that damaged equipment poses a hazard; e.g. microwave oven</p> <p>MP4. Idea overloaded cables or sockets;</p> <p>MP5. Idea of trip hazard from trailing cables;</p>	<p>Max of 2 amplifications for any one hazard. A repeated amplification can only be credited once e.g. shock, fire, provide plenty of sockets e.g. Idea that water conducts electricity;</p> <p>Idea that this can cause shock;</p> <p>(risk of) burns;</p> <p>idea that insulation can melt and cause a fire;</p> <p>Live parts should not be exposed; Idea that this can cause shock; leaky microwave radiation can cause cancer;</p> <p>circuits should have correct fuses; can cause a fire;</p> <p>don't use multiway socket extensions; provide sufficient sockets;</p> <p>Do not use extension cables; Provide sufficient sockets; Use short mains leads; NOTE</p>	6
	<p>MP6. Idea of misusing equipment e.g. sticking metal objects into a socket or exposed heating element;</p>	<p>Appropriate training/safety regime, e.g. use of 'blanks' to cover sockets that children can reach; Idea that this can cause shock; Use proper (insulated) tools;</p>	

Total 6 marks

Question 6.

Question number	Answer	Notes	Marks
14 (a) (i)	<p>Voltmeter connected in parallel with any circuit component; Component chosen is the thermistor;</p>	Ignore a line through the voltmeter symbol	2
	(ii)	(because voltage is) a controlled variable;	1
	(iii)	Any one of - MP1. Idea of adjustment (of current or circuit resistance); MP2. To control the current;	1
(b)	<p>Any three of -</p> <p>references to the data: MP1. (yes it works) when the temps are high, the current almost matches the temperature; MP2. (no it's not OK) when the temps are lower, the current value does not match the temperature; MP3. It is only right at 10 (and 100);</p> <p>Practicality ideas: MP4. The current cannot be negative when the temperature is negative; MP5. Idea that Voltage will not be constant/ voltage has to be adjusted to keep it constant;</p> <p>line ideas MP6. Line/ graph is curved /eq;</p> <p>MP7. Line/ graph does not pass through the origin;</p>	<p>however expressed</p> <p>e.g. About the same from 80 °C to 100 °C; e.g. not equal at 20mA 20 °C</p> <p>allow (graph shows that) current not directly proportional to temperature allow 0,0</p>	3

Total 7 marks

Question 7.

Question number	Answer	Notes	Marks
2 (a) (i)	B - 960 joules per second;		1
(ii)	power = current x voltage;	allow equation as correct symbols and/or rearrangement e.g. $I = P \div V$	1
(iii)	appropriate calculation (including substitution OR rearrangement); answer to at least 2 sf seen anywhere; e.g. $960 = I \times 230$ (I =) 4.2 (A)	using 4 (A) to calculate power (920 W) or voltage (240 V) scores 1 mark max. (4.17391) allow 4.1 (A)	2
(b) (i)	any 3 of: MP1. large current to earth / in earth wire; MP2. fuse blows / melts / breaks; MP3. idea that circuit is broken; MP4. idea that the risk of shock is reduced / prevented;	ignore references to electricity or charge allow 'current surge' for large current 'ground' for earth ignore references to fire	3
(ii)	D - 13 A;		1
(c)	MP1. a way of measuring current e.g. ammeter; MP2. a method to vary current in fuse; MP3. a method of identifying that the fuse has broken e.g. lamp goes out, idea that current falls to zero etc.;	accept any points seen in diagram allow data logger allow variable power supply, variable resistor	3

Total 11 marks

Question 8.

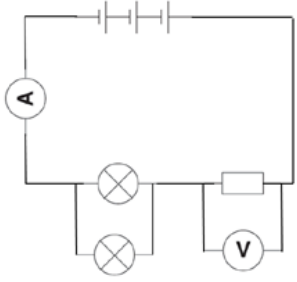
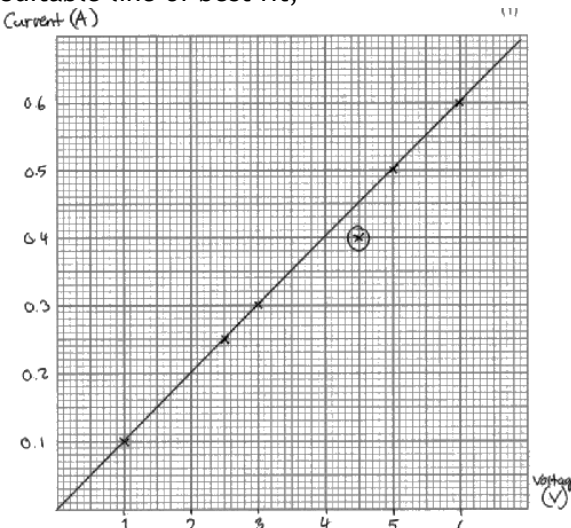
Question number	Answer	Notes	Marks
6 (a)	<p>any 3 of:</p> <p>MP1. idea of {rubbing / tearing} of {materials / surfaces};</p> <p>MP2. idea of movement / transfer of electrons;</p> <p>MP3. electrons have negative charge;</p> <p>MP4. (object becomes) negatively charged by gaining electrons OR positively charged by losing electrons;</p> <p>MP5. need for insulating material(s);</p>	<p>movement of positive {charge / electrons} can only score MP1 and MP5 ignore 'friction'</p>	3
(b)	<p>any 2 of:</p> <p>MP1. idea of opposite charges OR positive and negative charges;</p> <p>MP2. idea of attraction;</p> <p>MP3. idea of an (attractive) force larger than the weight of the loose end of tape;</p>	<p>reject if mentions positive electrons ignore 'different' condone 'unlike'</p>	2

Total 5 marks

Question 9.

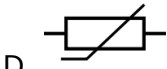
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2 (a)	any 2 of: MP1. so that lamps work independently; MP2. so that they all get mains/same voltage/230V; MP3. so that different areas/rooms can have different brightness/power/light intensities of lamps;	so that can light some rooms without all being on or off/each lamp has its own switch/if 1 lamp blows the others will still work allow no reduction in light output for main voltage allow different currents	2															
(b)	D 1.38 A;		1															
(c)	any 3 of: MP1. current increases over max value of fuse; MP2. fuse wire melts; MP3. cuts off current; MP4. prevents wire(s) in circuit from overheating;	allow current gets too high blows/breaks breaks circuit ignore 'stops electricity' ignore electric shocks	3															
(d) (i)	power = voltage x current	allow in standard symbols or in words	1															
(ii)	substitution into correct equation; evaluation; e.g. 0.26 X 230 60 (W)	allow 240 V for mains but not incorrect current (62.4 W) allow 59.8 (W) condone 317(.4) (W) for 1 mark	2															
(iii)	answer from (d)(ii) x 180 ; evaluation; unit; e.g. 60 X 180 11000 joules/J	accept correct use of $E = V \times I \times t$ allow ecf from (d)(ii) mark independently allow 10800, 10764	3															
2 (e) (i)	<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">S₁ position</th> <th style="padding: 5px;">S₂ position</th> <th style="padding: 5px;">lamp is lit</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">W</td> <td style="padding: 5px;">X</td> <td style="padding: 5px;">(yes)✓</td> </tr> <tr> <td style="padding: 5px;">W</td> <td style="padding: 5px;">Y</td> <td style="padding: 5px;">(no) ×</td> </tr> <tr> <td style="padding: 5px;">Z</td> <td style="padding: 5px;">X</td> <td style="padding: 5px;">(no) ×</td> </tr> <tr> <td style="padding: 5px;">Z</td> <td style="padding: 5px;">Y</td> <td style="padding: 5px;">(yes)✓</td> </tr> </tbody> </table> <p style="margin-left: 20px;">any three correct; all 4 correct;;</p>	S ₁ position	S ₂ position	lamp is lit	W	X	(yes)✓	W	Y	(no) ×	Z	X	(no) ×	Z	Y	(yes)✓	allow 1 mark when middle two rows blank, but otherwise correct allow 1 mark when top and bottom rows blank but otherwise correct	2
S ₁ position	S ₂ position	lamp is lit																
W	X	(yes)✓																
W	Y	(no) ×																
Z	X	(no) ×																
Z	Y	(yes)✓																
(ii)	any sensible suggestion of 2 way switching; e.g. on a corridor on stairs basement/cellar	allow clear description of 2 switches controlling the same light	1															

Question 10.

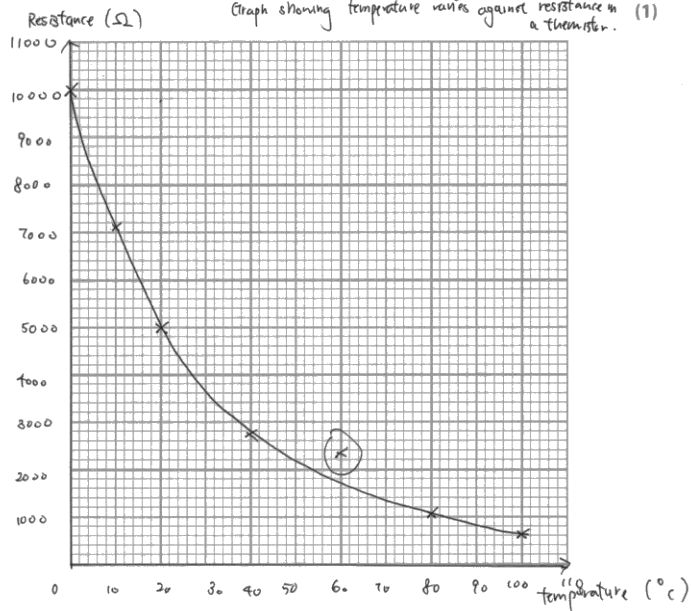
Question number	Answer	Notes	Marks														
6 (a)	<p>mark each of these independently:</p> <p>MP1. a resistor in series with the lamp only;</p> <p>MP2. a second lamp in parallel with the first lamp;</p> <p>MP3. a voltmeter that measures the voltage across the resistor;</p> <p>MP4. an ammeter that measures the total current in the circuit;</p>	<p>circuit symbols used must be correct (no square voltmeter/ammeter etc.)</p> 	4														
(b) (i)	<p>labels on axes including units;</p> <p>scales on axes;</p> <p>plotting;;</p>	<p>axes can be either way round</p> <p>must occupy >50% in each direction</p> <p>-1 for each error</p>	4														
(ii)	I = 0.4, V = 4.5 clearly indicated;		1														
(iii)	<p>Suitable line of best fit;</p> 	<table border="1"> <thead> <tr> <th>Voltage in V</th> <th>Current in A</th> </tr> </thead> <tbody> <tr> <td>1.0</td> <td>0.10</td> </tr> <tr> <td>2.5</td> <td>0.25</td> </tr> <tr> <td>3.0</td> <td>0.30</td> </tr> <tr> <td>4.5</td> <td>0.40</td> </tr> <tr> <td>5.0</td> <td>0.50</td> </tr> <tr> <td>6.0</td> <td>0.60</td> </tr> </tbody> </table>	Voltage in V	Current in A	1.0	0.10	2.5	0.25	3.0	0.30	4.5	0.40	5.0	0.50	6.0	0.60	1
Voltage in V	Current in A																
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6.0	0.60																
(iv)	voltage = current x resistance;	in words or standard symbols	1														
(v)	<p>substitution into correct equation using any suitable pair of values taken from the graph line or table;</p> <p>evaluation of R = 10 (Ω);</p>	allow (0.1,1), (0.6,6) etc	2														

Total 13 marks

Question 11.

Question number		Answer	Notes	Marks	
5	a	 D		1	
	b	i	Any two ideas from: MP1. it acts as water bath; MP2. gives more gradual heating or cooling OR gives (easier/better) control of temperature; MP3. protects the thermistor against direct heating/prevents intense heating;	allow water distributes temperature (more) evenly /RA for air very high temperature	2
		ii	B; in parallel across the thermistor in series with the thermistor		1
	c	i	ignore orientation of the graph suitable scales marked on both axes (> 50% of grid used); both axes labelled with quantity and unit; points within $\pm \frac{1}{2}$ small square;;		4
		ii	anomalous point at 60, 2350;		1
		iii	LOBF; should go through 60, 1750 approx no obvious abrupt changes of gradient		1

(iii) Draw a curve of best fit.



Temperature in °C	Resistance in Ω
0	10 000
10	7 060
20	5 000
40	2 670
60	2 350
80	1 080
100	609

d	i	water boils at 100°C/OWTTE;	1
	ii	any sensible method to get temp between 0 and 20; e.g. add ice to water use cold water from tap/fridge	1
			total = 12 marks