Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• Reads current values at 3V for both components **(1)** • Current through fixed resistor R = 0.94 A **(1)**	Current values are 0.33 (A) and 0.61 (A) Allow tolerance of ± 0.01 A Allow tolerance of ± 0.02 A	**2**
(ii)	An explanation that makes reference to: • resistance of Y will be greater than resistance of parallel combination **(1)** • Y will have a greater share of the p.d **(1) OR** R will have a lower share of the p.d. **(1)** • so the reading on the voltmeter will increase. **(1)** **OR** • the current through R decreases **(1)** • as V = IR, the p.d. across R decreases**(1)** • so the p.d. across Y and the voltmeter reading will increase **(1)**	To score the final marking point candidates must score both MP1 and MP2	**3**

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Q2.

Question Number	Acceptable Answer		Additional Guidance	Mark
	• The measurement of resistance has an uncertainty of 0.6 %	(1)	MP1 accept use of 0.05 giving 0.3 % Example of calculation: Uncertainty in $R = \frac{0.1\Omega}{18.2\Omega} \times 100\% = 0.55\%$ Uncertainty in $L = \frac{0.05\,\text{m}}{1.25\,\text{m}} \times 100\% = 4.0\%$ Uncertainty in $d = \frac{0.01\,\text{m}}{0.27\,\text{m}} \times 100\% = 3.7\%$	
	• The measurement of the length has an uncertainty of 4 %	(1)		
	• The measurement of the diameter has an uncertainty of 4 %	(1)		
	• The % uncertainty in diameter is doubled giving the greatest amount of uncertainty into the value for the resistivity	(1)		4

Q3.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	• (Moving) electrons collide with lattice/ions	(1)		
	• Transfer of energy to (lattice) ions so they vibrate with larger amplitude/speed (and the temperature increases)	(1)		2
(ii)	• Electrons/ions in the tube collide with mercury/phosphor atoms and excite electrons (in the mercury/phosphor atoms)	(1)	Mention of work function scores 0 MP2 Allow de-excite for move back down	
	• Energy is released in the form of photons as the electrons move back down (to the ground state)	(1)		2

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Q4.

<table>
<tr><th>Question number</th><th>Acceptable answers</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td>*</td>
<td>This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.

Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.

The following table shows how the marks should be awarded for indicative content.

<table>
<tr><th>Number of indicative marking points seen in answer</th><th>Number of marks awarded for indicative marking points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5–4</td><td>3</td></tr>
<tr><td>3–2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
</td>
<td>Guidance on how the mark scheme should be applied:
The mark for indicative content should be added to the mark for lines of reasoning. For example, an answer with five indicative marking points which is partially structured with some linkages and lines of reasoning scores 4 marks (3 marks for indicative content and 1 mark for partial structure and some linkages and lines of reasoning).
If there are no linkages between points, the same five indicative marking points would yield an overall score of 3 marks (3 marks for indicative content and no marks for linkages).</td>
<td></td>
</tr>
</table>

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Question number	Acceptable answers	Additional guidance	Mark
* (continued)	The following table shows how the marks should be awarded for structure and lines of reasoning. **Number of marks awarded for structure of answer and sustained line of reasoning** Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout — 2 Answer is partially structured with some linkages and lines of reasoning — 1 Answer has no linkages between points and is unstructured — 0		

Question number	Acceptable answers	Additional guidance	Mark
* (continued)	**Indicative content** • The supply creates a changing magnetic field in the iron core • Rate of change of flux in toothbrush coil is equal to rate of change of flux in charger coil (for an ideal transformer) • The changing flux linkage in the coil of the toothbrush induces an e.m.f. according to Faraday's law • $E = -N \, d\phi/dt$ so to step down the e.m.f. there must be fewer turns in the toothbrush coil • The e.m.f. in the toothbrush coil must be larger than the toothbrush battery • Diode is included so battery is not discharged by the alternating e.m.f.	Allow provides dc to charge battery or similar.	**6**

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