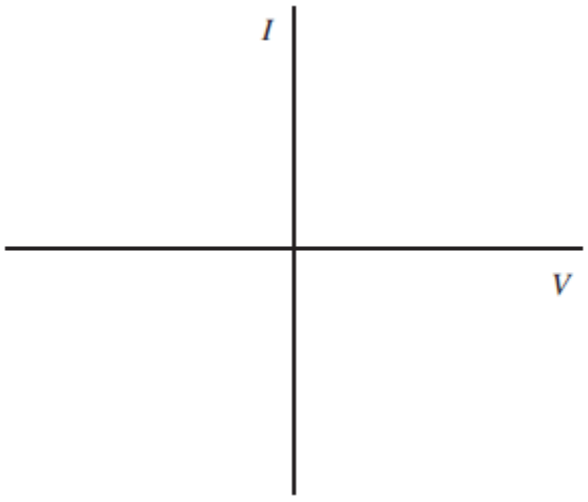
Q1.(a) Sketch, on **Figure 1**, the current−voltage (IV) characteristic for a filament lamp for currents up to its working power.

Figure 1



(2)

(b) (i) State what happens to the resistance of the filament lamp as the current increases.

.....

(1)

(ii) State and explain whether a filament lamp is an ohmic or non−ohmic conductor up to its working power.

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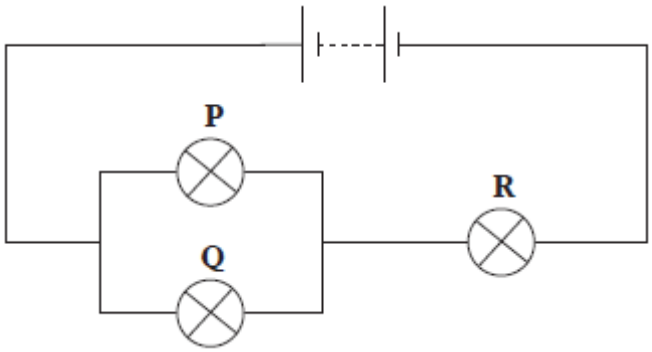
(1)

(c) Three identical filament lamps, **P**, **Q** and **R** are connected in the circuit shown in **Figure 2**.

Figure 2.



The filament in lamp **Q** melts so that it no longer conducts. Explain why lamp **P** becomes brighter and lamp **R** becomes dimmer.

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(2)

(d) A filament lamp, **X**, is rated at 60 W 230 V. Another type of lamp, **Y**, described as 'energy saving' has the same light intensity output but is rated at 11 W 230 V.

(i) Calculate the electrical energy converted by each lamp if both are on for 4 hours a day for a period of 30 days.

electrical energy converted by **X** = ... J

electrical energy converted by **Y** = ... J

(2)

(ii) Suggest why the two lamps can have different power ratings but have the same light intensity output.

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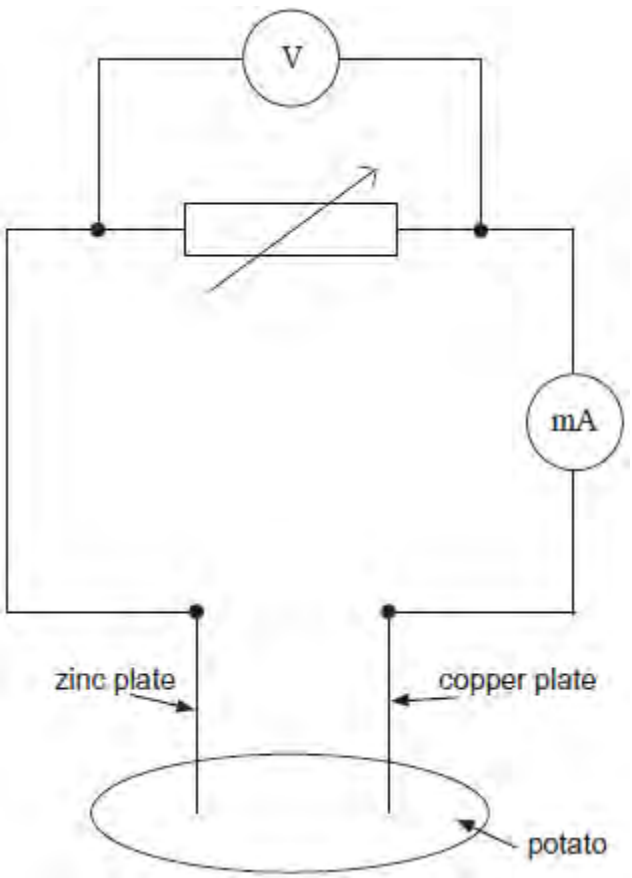
(2)
(Total 10 marks)

Q2. A 'potato cell' is formed by inserting a copper plate and a zinc plate into a potato. The circuit shown in **Figure 1** is used in an investigation to determine the electromotive force and internal resistance of the potato cell.

Figure 1



(a) State what is meant by electromotive force.

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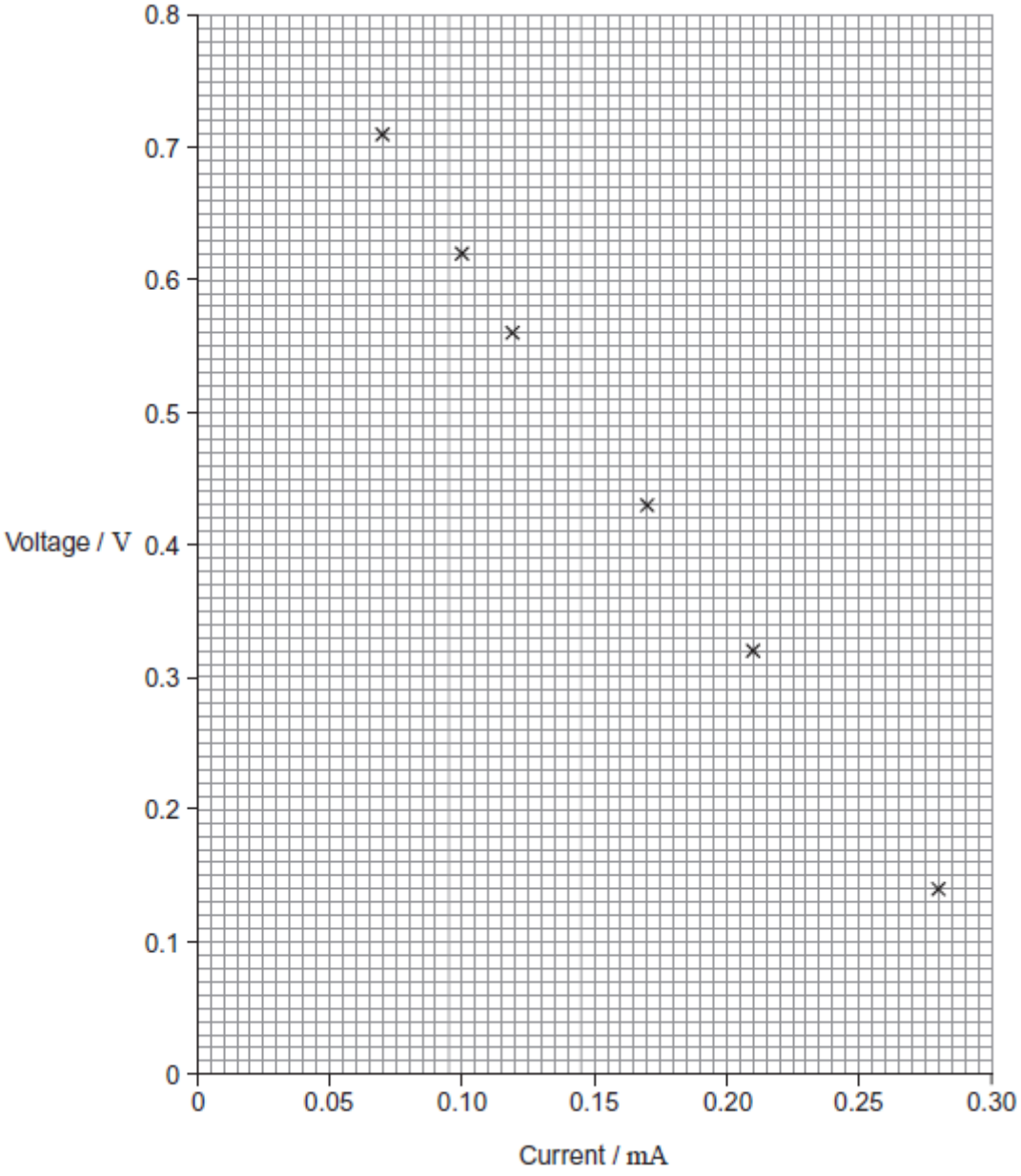
(2)

(b) The plotted points on **Figure 2** show the data for current and voltage that were obtained in the investigation.

Figure 2



(i) Suggest what was done to obtain the data for the plotted points.

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(1)

(ii) The electromotive force (emf) of the potato cell is 0.89 V. Explain why the voltages plotted on **Figure 2** are always less than this and why the difference between the emf and the plotted voltage becomes larger with increasing current.

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(3)

(iii) Use **Figure 2** to determine the internal resistance of the potato cell.

internal resistance = ... Ω

(3)

(c) A student decides to use two potato cells in series as a power supply for a light emitting diode (LED). In order for the LED to work as required, it needs a voltage of at least 1.6 V and a current of 20 mA.

Explain whether the LED will work as required.

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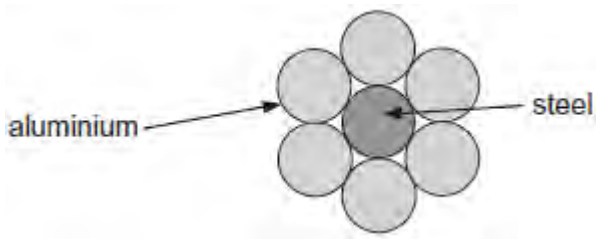
(2)
(Total 11 marks)

Q3. A cable used in high-voltage power transmission consists of six aluminium wires surrounding a steel wire. A cross-section is shown below.



The resistance of a length of 1.0 km of the steel wire is 3.3 Ω. The resistance of a length of 1.0 km of **one** of the aluminium wires is 1.1 Ω.

(a) The steel wire has a diameter of 7.4 mm.
Calculate the resistivity of steel. State an appropriate unit.

resistivity = ... unit .....

(4)

(b) Explain why only a small percentage of the total current in the cable passes through the steel wire.

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(3)

(c) The potential difference across a length of 1.0 km of the cable is 75 V.

Calculate the total power loss for a 1.0 km length of cable.

Total power loss ..... W

(3)
(Total 10 marks)

Q4.(a) The power P dissipated in a resistor of resistance R is measured for a range of values of the potential difference V across it. The results are shown in the table below.

V / V	V^2 / V^2	P / W
1.00	1.0	0.21
1.71	2.9	0.58
2.25		1.01
2.67		1.43
3.00	9.0	1.80
3.27	10.7	2.18
3.50	12.3	2.43

(i) Complete the table above.

(1)

(ii) Complete the graph below by plotting the two remaining points and draw a best fit straight line.

(2)

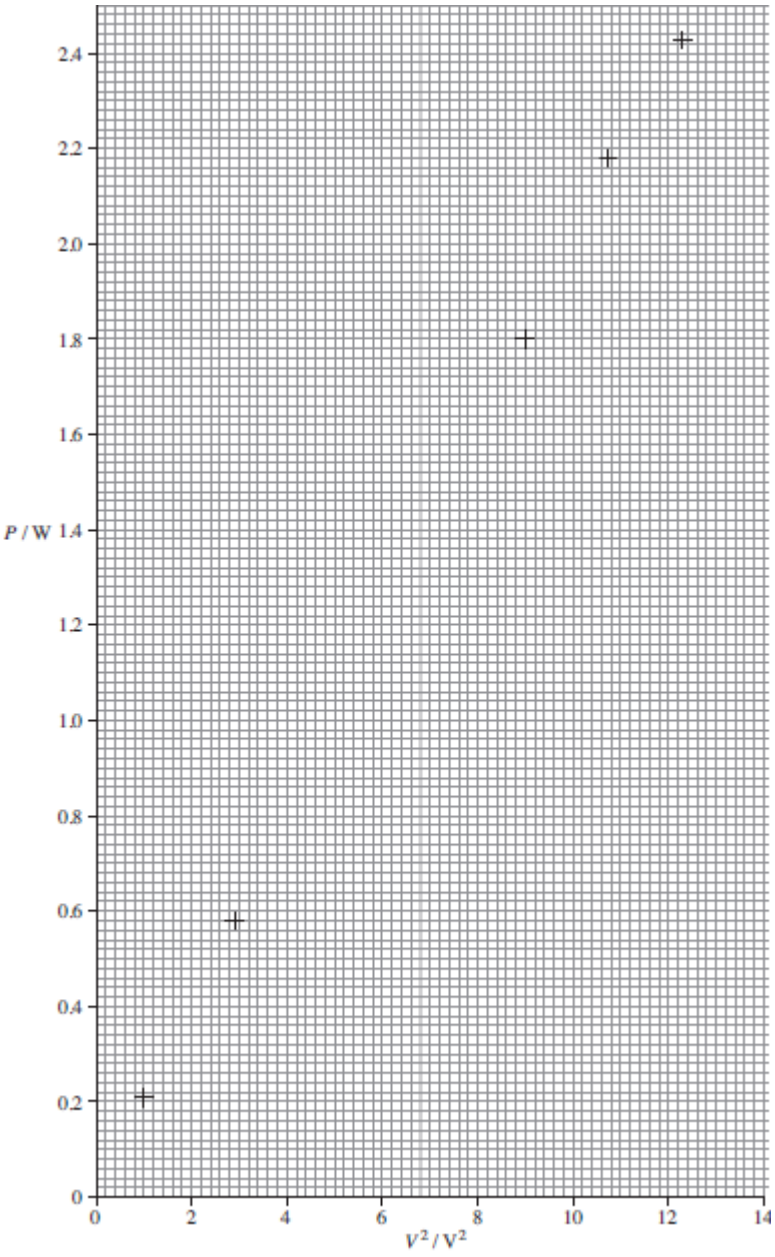
(iii) Determine the gradient of the graph.

gradient = ...

(3)

(iv) Use the gradient of the graph to obtain a value for R.

R = ...



(1)

(b) The following questions are based on the data in the table above.

(i) Determine the value of R when V = 3.50 V.

R = ... Ω

(1)

(ii) The uncertainty in V is ± 0.01 V. The uncertainty in P is ± 0.05 W.

Calculate the percentage uncertainty in the value of R calculated in part (1).

percentage uncertainty = ... %

(3)

(iii) Hence calculate the uncertainty in the value of R.

uncertainty = ...

(1)

(iv) State and explain whether the value of R you calculated in part (1) is consistent with the value of R you determined from the gradient in part (a)(iv).

(2)

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(Total 14 marks)