1)

The copper cable connecting the starter motor to the battery has a length of 0.75m and cross-sectional area of $7.9 \times 10^{-5} m^2$. The resistance of the cable is $1.6 \times 10^{-3} \Omega$.

Calculate the resistivity of the copper giving an appropriate unit.

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answer .....

(3 marks)

2)

The critical temperature of tin is –269 °C. The resistivity of tin increases as its temperature rises from –269 °C.

(a) (i) Define resistivity.

[2 marks]

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(a) (ii) State the significance of the critical temperature of a material.

[2 marks]

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(b) A sample of tin in the form of a cylinder of diameter 1.0 mm and length 4.8 m has a resistance of 0.70 Ω.

Use these data to calculate a value of the resistivity of tin.
State an appropriate unit for your answer.

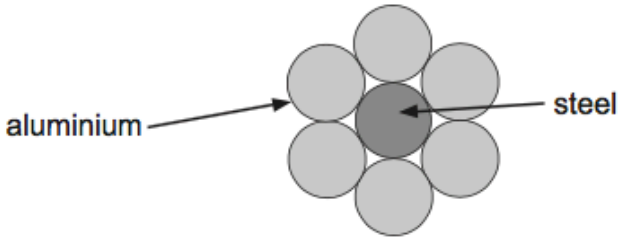
[4 marks]

resistivity ..... unit .....

3)

A cable used in high-voltage power transmission consists of six aluminium wires surrounding a steel wire. A cross-section is shown in **Figure 5**.

Figure 5



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.

[4 marks]

resistivity = ... unit .....

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

[3 marks]

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(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.

[3 marks]

Total power loss ..... W

4)

(a) A sample of conducting putty is rolled into a cylinder which is 6.0×10^{-2} m long and has a radius of 1.2×10^{-2} m.

resistivity of the putty = $4.0 \times 10^{-3}\,\Omega$m.

(a) (i) Calculate the resistance between the ends of the cylinder of conducting putty. Your answer should be given to an appropriate number of significant figures.

answer = ... Ω

(4 marks)

(a) (ii) The putty is now reshaped into a cylinder with half the radius and a length which is four times as great. Determine how many times greater the resistance now is.

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(2 marks)

(b) Given the original cylinder of the conducting putty described in part (a), describe how you would use a voltmeter, ammeter and other standard laboratory equipment to determine a value for the resistivity of the putty.

Your description should include

- a labelled circuit diagram,
- details of the measurements you would make,
- an account of how you would use your measurements to determine the result,
- details of how to improve the precision of your measurements.

The quality of your written communication will be assessed in this question.

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(8 marks)