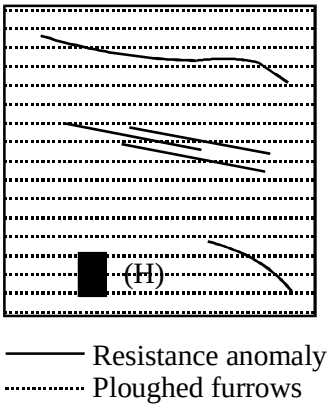
Resistivity and Potential Difference Questions

1. The diagram below shows the results of a resistivity survey carried out in a field at Abinger, Surrey in December 1995.



Define resistivity.

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(1)

The probes of a resistance meter are placed 1 m apart in the ground. They measure a resistance of 750 Ω. What approximate resistance would they measure if they were 0.5 m apart?

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(1)

The report on the geophysical survey from Abinger contains the following information:

"The diagram shows a rectangular high resistance anomaly (H) over the location of a mosaic floor excavated by the archaeologists."

Briefly explain what is meant by the term *high resistance anomaly*.

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(1)

Explain why the presence of the mosaic floor causes a high resistance anomaly.

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(1)

Low resistance anomalies are also detected. Suggest and explain a possible cause for a low resistance anomaly.

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(2)

Connections to the resistance meter are made using two long copper wires. Each wire has a cross-sectional area of 2.0×10^{-6} m^2 and a length of 5.0 m. Calculate the extra resistance that would be introduced into the circuit using these wires.

(Resistivity of copper = 1.7×10^{-8} Ω m)

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(3)

What percentage error would be introduced in a measurement of 750 Ω by ignoring the resistance of the wires? Comment on its significance.

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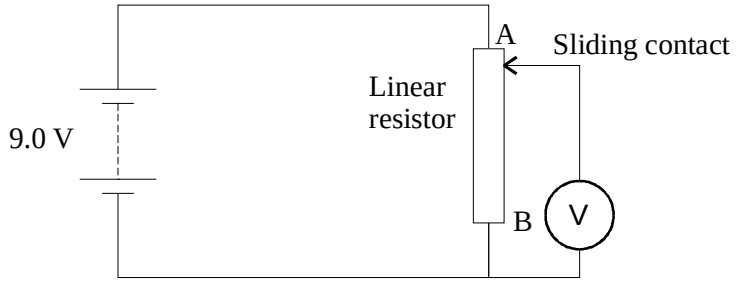
(2)
(Total 11 marks)

2. A student wants to provide lighting for a model house which she has made. She needs 3.0 V for her lamps but only has a 9.0 V battery, so uses a linear resistor AB in the circuit below. The linear resistor is made from a high resistance uniform conductor.



What is the name of the device AB when it is used in this manner?

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(1)

State the voltmeter reading when the sliding contact is at:

A ..... B .....

(2)

The student moves the sliding contact until the voltmeter reads 3.0 V.

Add an arrow labelled X to the diagram to show where the sliding contact must be placed.

(1)

The student replaces the voltmeter with a 3.0 V lamp but the lamp does not light. Explain why the lamp does not light.

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(3)
(Total *7* marks)

3. A physics teacher was driving to work when she heard the following report on the radio.

> "Scientists have been researching a method of judging people's opinions of politicians. They have found that the more strongly opposed people are to a politician's views, the more their hands sweat. This can be detected using a resistivity meter which has two probes resting on the palm of the hand."

Write down an equation to define resistivity, stating what each symbol represents.

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(3)

Why should the **resistivity meter** strictly be called a resistance meter?

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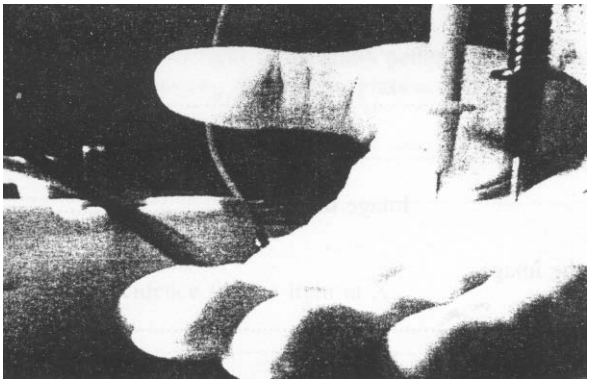
(2)

The teacher decided to see if this idea would work. She used a multimeter to measure the resistance across her palm as shown in the picture below.



She obtained the following readings with the probes 2 cm apart:

Radio Topic	Teacher's feelings	Approximate resistance/MΩ
Comedy	Very relaxed	3
Music	Relaxed	2
Politics	Annoyed	1

Do these results support the claims of the reporter? Give your reasoning.

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(3)
(Total 8 marks)

4. The table gives the resistivities of five different materials:

Material	Resistivity/ Ω m
Copper	1.8×10^{-8}
Iron	1.2×10^{-7}
Carbon	1.4×10^{-5}
Silicon	2.3×10^{3}
Glass	1.0×10^{12}

Explain what type of scale you would need to use to plot these values of resistivity on a graph.

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(2)

A student needs to make a 0.12 Ω resistor. She has some copper wire of diameter 0.80 mm.

(i) Show that the cross-sectional area of the wire is about 5×10^{-7} m^2

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(2)

(ii) Calculate the length of wire she needs for the 0.12 Ω resistor.

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(3)

What would be the advantage of making the resistor from iron wire of the same diameter?

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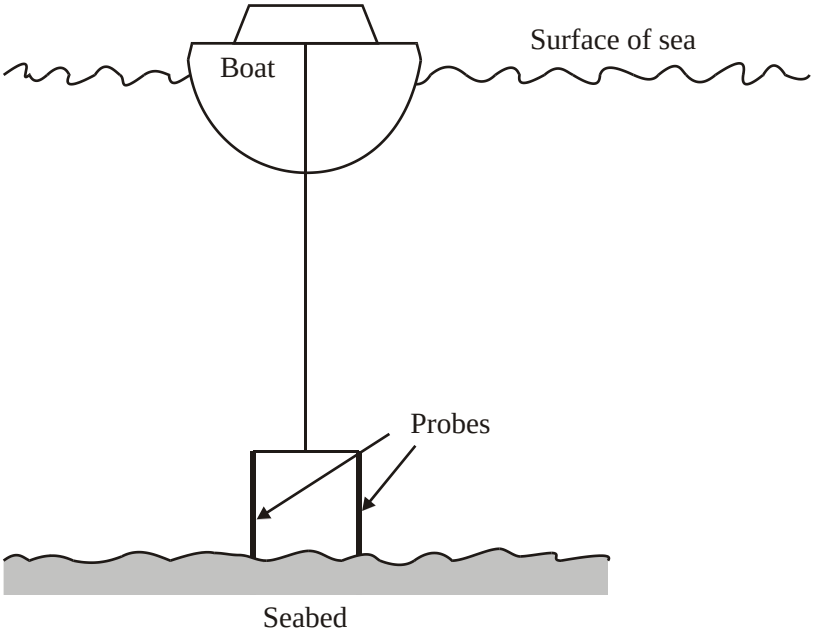
(1)
(Total 8 marks)

5. Resistivity measurements under the sea have been used to find new sources of fresh water.

Two probes are towed along the seabed behind a small boat.



Taking measurements using these probes, resistivity can be calculated at various depths below the seabed.

What measurements are needed to calculate resistivity?

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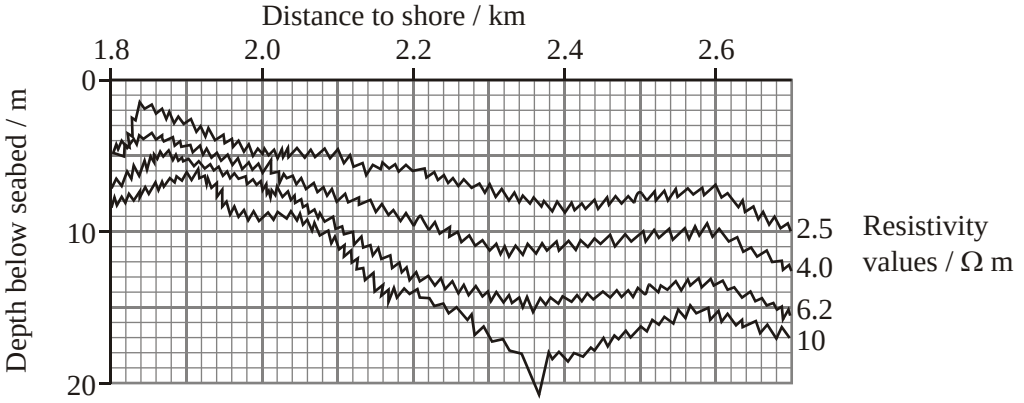
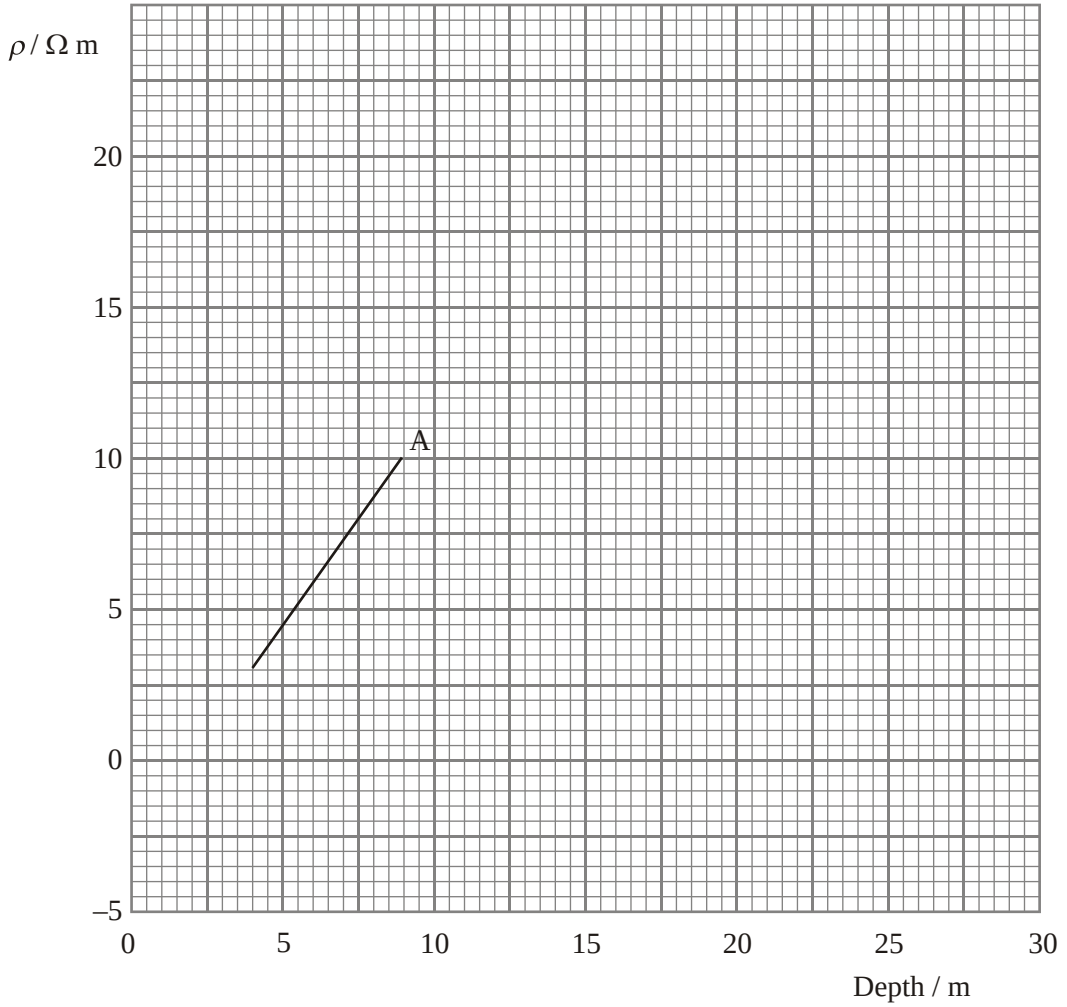
(3)

The diagram below displays the resistivities measured in a survey.



Line A below has been plotted using some of this data. It shows how resistivity ρ varies with depth below the seabed 2.0 km from the shore.



Make measurements from this graph to determine the equation of line A.

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(3)

Use the survey results to add another line to show how resistivity varies with depth 2.4 km from the shore.

(3)

The resistivity gradient (the variation of resistivity with depth) is greater in areas where there is fresh water below the seabed. Suggest the best distance from the shore to drill for fresh water.

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(1)

(Total 10 marks)