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WORKSHEETS
ATTEMPT | CHECK | CORRECT | IMPROVE

OCR A AS Resistivity 2 Practical worksheet

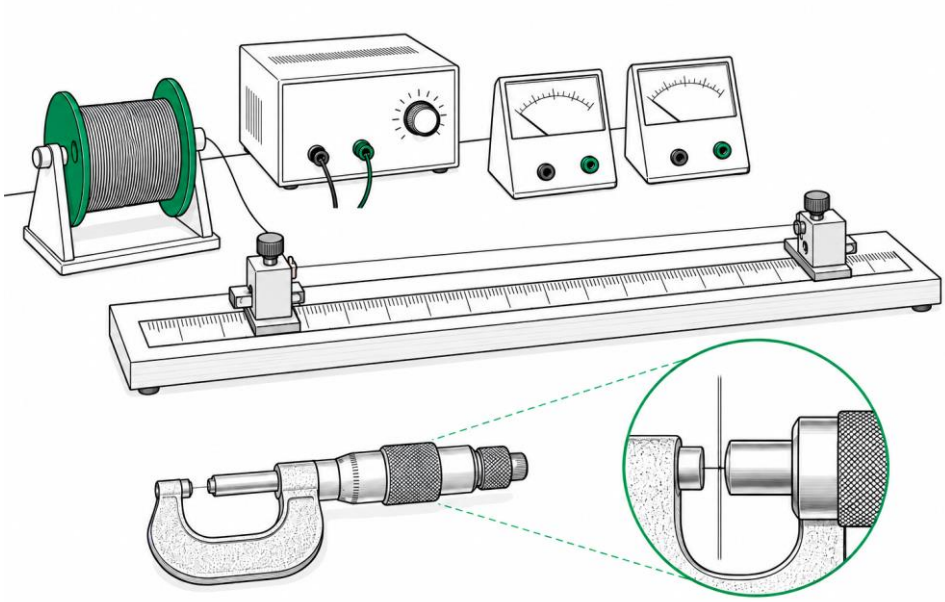
35–40 minutes independent practice + 15–20 minutes review | 43 marks

Specification points covered

- 4.2.4(a)(i) Define resistivity using R = ρL / A.
- 4.2.4(a)(ii) Use techniques and procedures to determine the resistivity of a metal.
- 1.1.3(d)(i) Selection and labelling of axes with appropriate scales, quantities and units.
- 1.1.3(d)(ii) Measurement of gradients and intercepts from experimental results.
- 1.1.4(d) Precision and accuracy of measurements and data, including margins of error, percentage errors and uncertainties in apparatus.
- 1.1.4(e) Refining experimental design by suggesting improvements to procedures and apparatus.

Northline precision-wire quality control

A manufacturer must verify the resistivity of a thin metal wire before it is used in low-temperature sensors. Your method must produce a gradient-based value and show how measurement quality is protected.



Context diagram: precision-wire test bench and micrometer measurement of diameter.

1. Planning the measurements and circuit

1. State the relation between resistance R, resistivity ρ, length L and cross-sectional area A. State the SI unit of ρ. [2 marks]

2. The factory varies the tested length of one wire. State the independent variable, the dependent variable and two quantities that should be controlled. [3 marks]

3. Draw a complete circuit for measuring the p.d. across and current through a chosen length of the test wire. Include a low-voltage d.c. supply, switch, ammeter, voltmeter and variable resistor. [3 marks]

2. Temperature, length and diameter

4. Explain how the variable resistor and switch help to keep the wire at an approximately constant temperature. [2 marks]

5. Describe how the separation of the electrical contact points should be measured accurately. [2 marks]

6. Describe how a micrometer should be used to obtain a reliable mean diameter for the wire. [2 marks]

3. Processing the measurements

7. The micrometer has resolution 0.001 mm. Use the table to identify the anomalous reading, calculate the mean diameter from the remaining readings, and calculate the cross-sectional area. [3 marks]

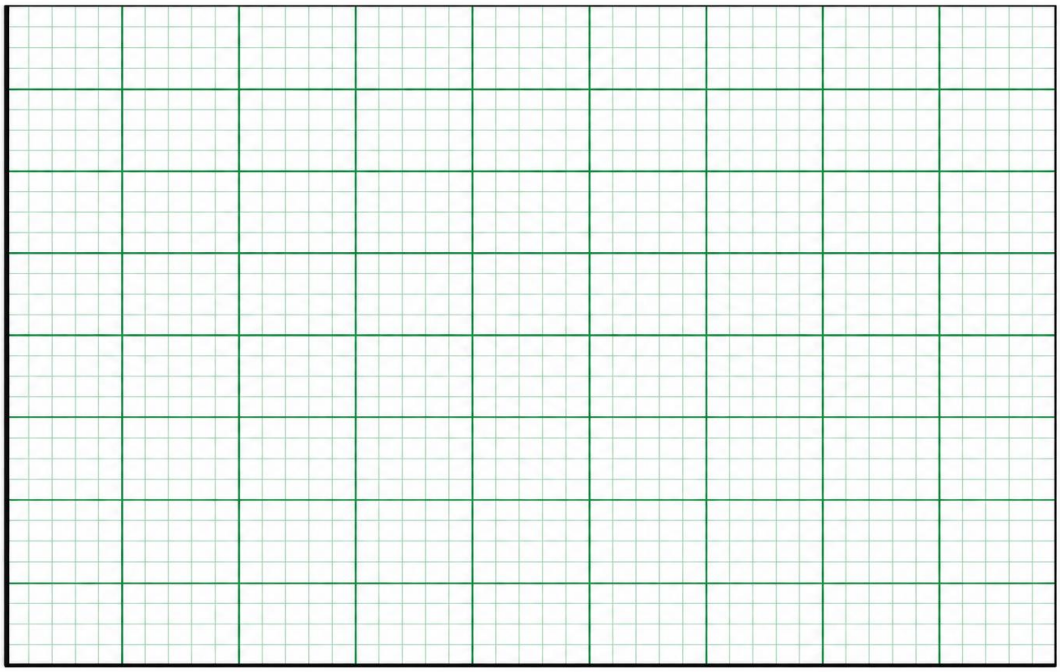
Position along wire / m	Diameter in direction 1 / mm	Diameter in direction 2 / mm
0.10	0.381	0.379
0.45	0.380	0.382
0.80	0.378	0.445

8. Use R = V/I to calculate the two missing resistance values in the results table. Give each to two decimal places. [3 marks]

Length L / m	p.d. V / V	Current I / A	Resistance R / Ω
0.20	0.212	0.200	1.06
0.30	0.297	0.198	—
0.40	0.392	0.202	1.94
0.50	0.476	0.200	2.38
0.60	0.557	0.197	2.83
0.70	0.647	0.198	—
0.80	0.734	0.198	3.71

4. Graph and gradient

9. On the graph grid, label the horizontal axis length L from 0.0 to 0.9 m and the vertical axis resistance R from 0.0 to 4.0 Ω. Plot all seven points and draw a straight line of best fit. [3 marks]



Graph grid: 0.0–0.9 m horizontally and 0.0–4.0 Ω vertically.

10. Use two well-separated points on your line of best fit to determine its gradient, including a unit. [2 marks]

5. Resistivity and uncertainty

11. Use your gradient and the mean area from Question 7 to determine the resistivity of the wire. [2 marks]

12. The line of best fit has a small positive intercept on the resistance axis. Explain one likely cause and why the gradient method still gives a valid wire resistivity. [2 marks]

13. Treat the uncertainty in mean diameter as ±0.001 mm. Calculate the percentage uncertainty in diameter and hence the approximate percentage uncertainty in cross-sectional area. [3 marks]

14. The gradient is 4.41 ± 0.10 Ω m^{-1}. Estimate the percentage uncertainty and absolute uncertainty in the final resistivity. Use your area uncertainty from Question 13. [2 marks]

6. Evaluation and complete method

15. Suggest three specific improvements that would increase the quality of the resistivity result. For each, state the problem it reduces. [3 marks]

16. Write a complete six-mark-style method for determining the resistivity of the wire. Use the prompts: circuit and controls; length and diameter measurements; repeated V and I readings; graph and gradient; calculation of ρ; uncertainty and evaluation. [6 marks]

Review and improve

□ I measure the length between electrical contacts and the diameter in several places and orientations.
□ I use a best-fit gradient rather than a single R/L value to determine resistivity.
□ I link each practical improvement to the uncertainty or systematic effect it reduces.