

Exercise walk-through

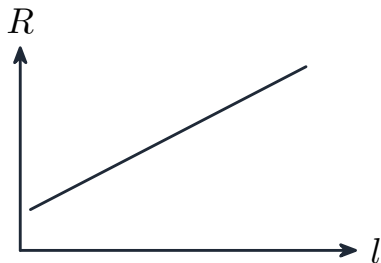
3.3

Graphs, processing and justified conclusions

Pearson Edexcel · International A-Level · Physics

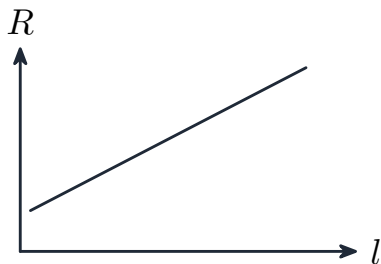
Exercise 2.1

2.1 A fitted graph of resistance against length is straight with a positive intercept. Explain why this is not proof of direct proportionality and suggest the physical origin of the intercept. [3]



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2.1 Direct proportionality requires a straight line through the origin. A positive intercept gives non-zero extrapolated resistance at zero measured wire length. Fixed contact/lead resistance is a possible cause.

Exercises 2.2·2.3

2.2 A best-fit resistance–length line passes through (0.20 m, 1.30 Ω) and (1.00 m, 4.50 Ω). Find gradient and intercept. Wire area is $1.2 \times 10^{-7} \text{ m}^2$. Find resistivity. [4]

best-fit line points
(0.20 m, 1.30 Ω)
(1.00 m, 4.50 Ω)
wire area $1.2 \times 10^{-7} \text{ m}^2$

2.3 A measured value is 8.90 g cm^{-3} with 0.9% uncertainty. Determine its interval and deduce whether it is consistent with 8.94 g cm^{-3} . [3]

measured density
 8.90 g cm^{-3}
uncertainty 0.9%

proposed value
 8.94 g cm^{-3}

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2.2 $m = \Delta R / \Delta l = (4.50 - 1.30) / (1.00 - 0.20) = 4.00 \text{ } \Omega \text{ m}^{-1}$. $c = R - ml = 1.30 - 4.00 \times 0.20 = 0.50 \text{ } \Omega$. $\rho = mA = 4.00 \times 1.2 \times 10^{-7} = 4.8 \times 10^{-7} \text{ } \Omega \text{ m}$.

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 8.90 g cm^{-3}
uncertainty 0.9%

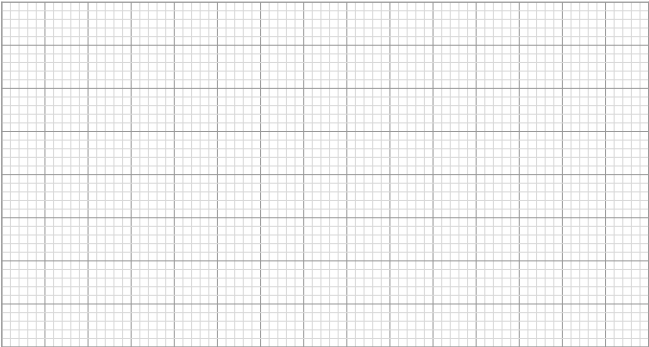
proposed value
 8.94 g cm^{-3}

2.3 $\Delta\rho = (0.9/100) \times 8.90 = 0.0801 \text{ g cm}^{-3}$. Interval about 8.82 to 8.98 g cm^{-3} . 8.94 is inside, so the measurement is consistent with it; this does not uniquely prove composition.

Exercise 3.1

3.1 Plot resistance against length from the data below. Draw a best-fit straight line and use a large triangle to estimate its gradient. State suitable units and explain why the triangle should be large. [6]

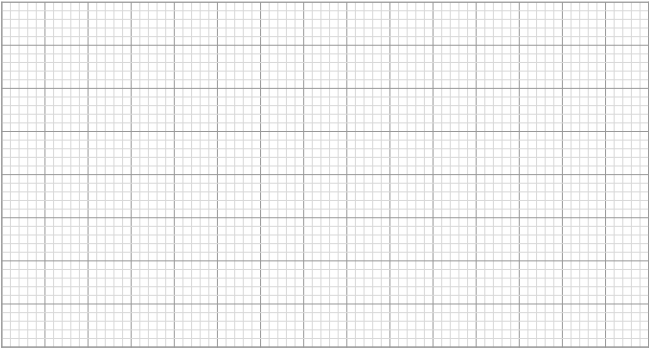
Length / m	Resistance / Ω
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0.40	2.08
0.60	2.92
0.80	3.67
1.00	4.51



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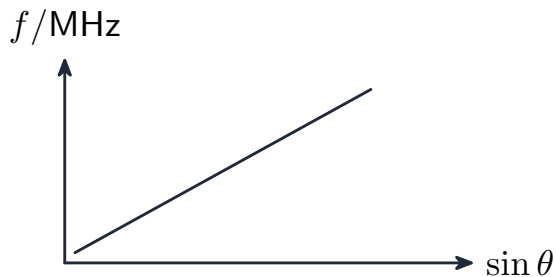
3.1 Correct orientation, quantity/unit labels and regular scales filling a useful part of the grid. All five points accurately plotted. Thin straight best-fit line balancing scatter. Large triangle using well-separated points on the fitted line. Gradient about $4.0 \Omega \text{ m}^{-1}$, accepting about 3.9–4.1 from a sensible fit. A larger triangle reduces percentage coordinate-reading uncertainty in the changes.

Full solution 3.1

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Exercise 3.2

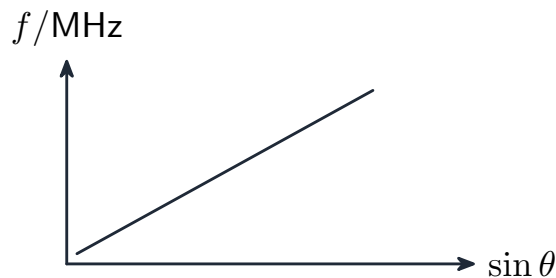
3.2 A supplied model is $f = (v/\lambda) \sin \theta$. A graph of f/MHz against $\sin \theta$ has gradient $2.30 \times 10^3 \text{ MHz}$. The light wavelength is 650 nm . Calculate v and explain the danger of ignoring the frequency-axis unit. [4]



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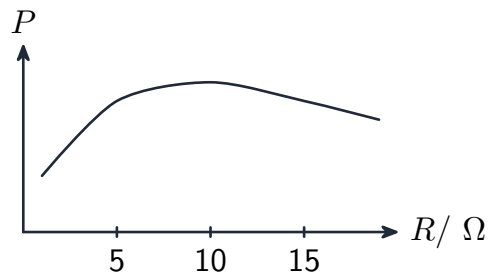


supplied gradient: $2.30 \times 10^3 \text{ MHz}$

3.2 The SI gradient is $2.30 \times 10^3 \times 10^6 = 2.30 \times 10^9 \text{ Hz}$. The model gives $v = \lambda \times \text{gradient}$.

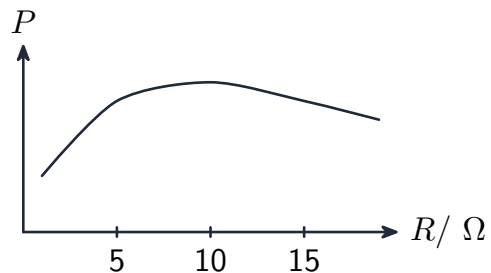
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3.3 A power–resistance graph suggests a maximum near $10\ \Omega$; current data use $5\ \Omega$ steps. Explain how to improve the maximum-location estimate. At the maximum, half the source power heats its internal resistance. Give one advantage and one disadvantage of this operating point for a transmitter. [5]



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3.3 Take additional readings at smaller resistance intervals around the indicated maximum. Keep source conditions steady, limiting current/heating and checking repeated readings for drift. Use the fitted curve/scatter rather than declaring one point exact. Advantage: maximum external power available for transmission. Disadvantage: large internal heating/only 50% source efficiency, wasting energy and needing cooling.