

Drawing V-I graphs by hand

Every other page in this topic marks itself. This one does not, because the skill being practised is one only your own hand can learn: choosing a scale, plotting accurately and reading a value off a line you drew yourself. It is worth marks in the real test, and it is the part pupils most often lose them on.



graph paper



a ruler



a sharp pencil



a calculator

How to draw the graph

1 Put the right quantity on the right axis.

The quantity you changed goes across the bottom – here that is the **current**. The quantity you measured because of it goes up the side – the **voltage**.

2 Label both axes with the quantity *and* its unit.

current in R (A), not I and not amps. An unlabelled axis loses the mark every time.

3 Mark the origin 0.

Both axes start at zero for a V-I graph, because no current means no voltage.

4 Choose a scale that fills the paper.

Your points should spread over **more than half** the grid in both directions. Make each big square worth 1, 2, 5 or 10 – never 3, 7 or 15, because you will misread it.

5 Plot each point as a small neat cross.

A fat blob is worth about three squares of uncertainty.

6 Draw one best-fit line, not dot-to-dot.

A straight line if the points lie on one; a smooth curve if they clearly bend. Roughly as many points should sit above the line as below it.

7 Read your *line*, not your points, to get the resistance.

Pick a point that lies exactly on the line – ideally where it crosses a heavy grid line so both values are easy to read – and use $R = V \div I$. Read a point off the line even if none of your measured crosses sits there; that is what the line is for.

8 Steeper line, bigger resistance.

You will not be asked to *calculate* a gradient at National 5 in S3 – that comes in S4 – but you do need to say what a steeper line means: more volts are needed to push the same current through, so the resistance is larger.

What loses marks

- Axes swapped – voltage across the bottom. Read the question: it says plot voltage *against* current, and the first-named quantity goes up the side.
- A scale like 3 V per big square, so every reading is a guess.
- Points joined dot-to-dot in a zig-zag instead of one best-fit line.
- Using a measured cross that does not sit on the best-fit line. Read the line.
- Units left off the axes, or off the final answer.

The tasks

Task 1 – a resistor

A pupil measures the current in a resistor and the voltage across it, for six different settings of a variable resistor.

current in R (A)	0.02	0.04	0.06	0.08	0.10	0.12
voltage across R (V)	1.39	2.68	4.13	5.41	6.86	8.11

1. Plot a graph of **voltage across R** against **current in R**.
2. Draw the best-fit line.
3. Read a point that lies on your line and use $R = V \div I$ to determine the resistance of R.
Write down the point you used.
4. State one thing about the graph that tells you the resistor obeys Ohm's law.

Task 2 – a different resistor

The pupil repeats the experiment with a second resistor.

current in R (A)	0.05	0.10	0.15	0.20	0.25	0.30
voltage across R (V)	1.60	3.36	4.91	6.67	8.19	9.94

1. Plot this data on a **new** pair of axes and draw the best-fit line.
2. Read a point on your line and determine the resistance of this resistor.
3. Sketch, on one set of axes, how the two lines would compare. State whether the **steeper** line belongs to the **larger** or the smaller resistance, and say why.

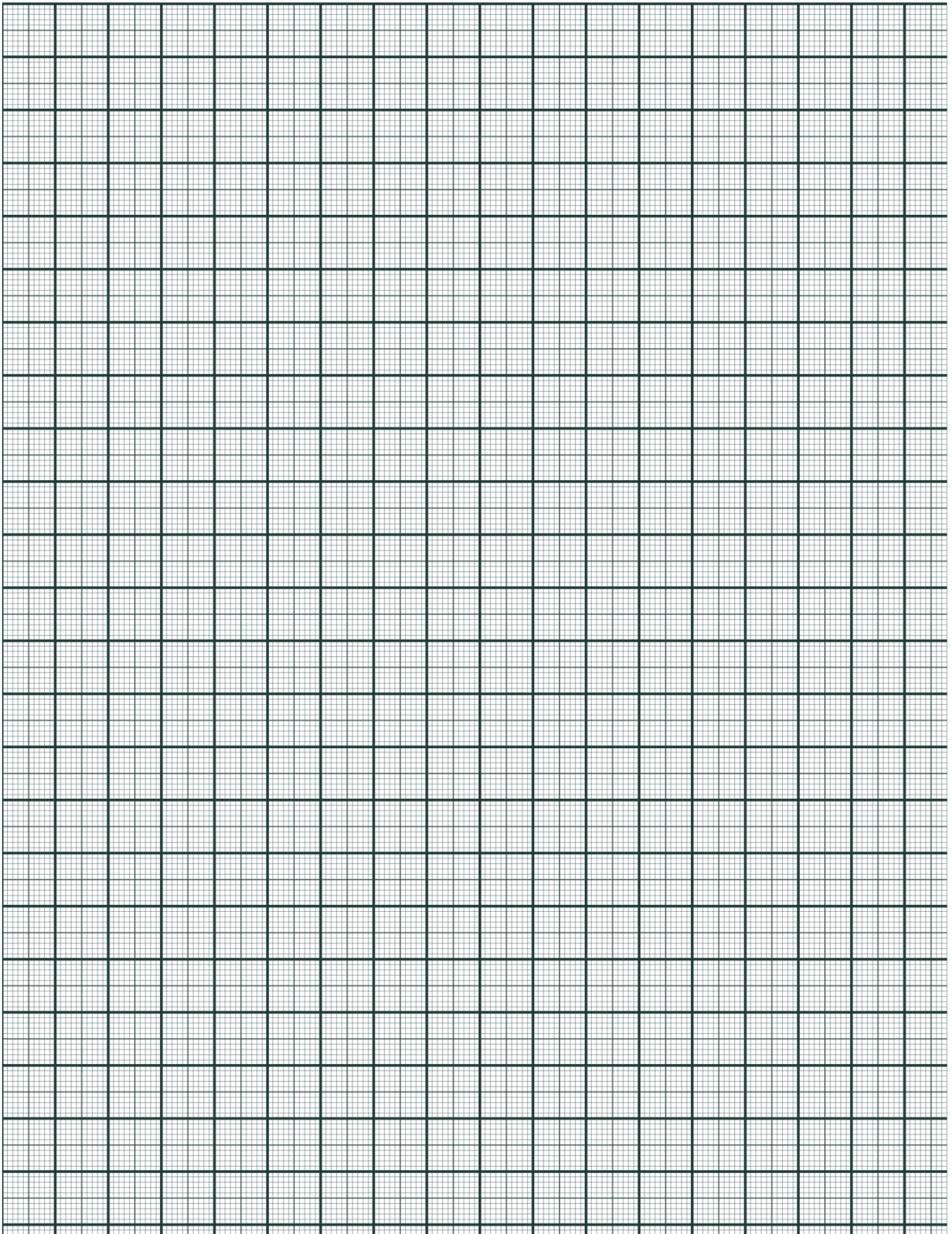
Task 3 – a filament lamp

The pupil now replaces the resistor with a filament lamp and repeats the experiment again.

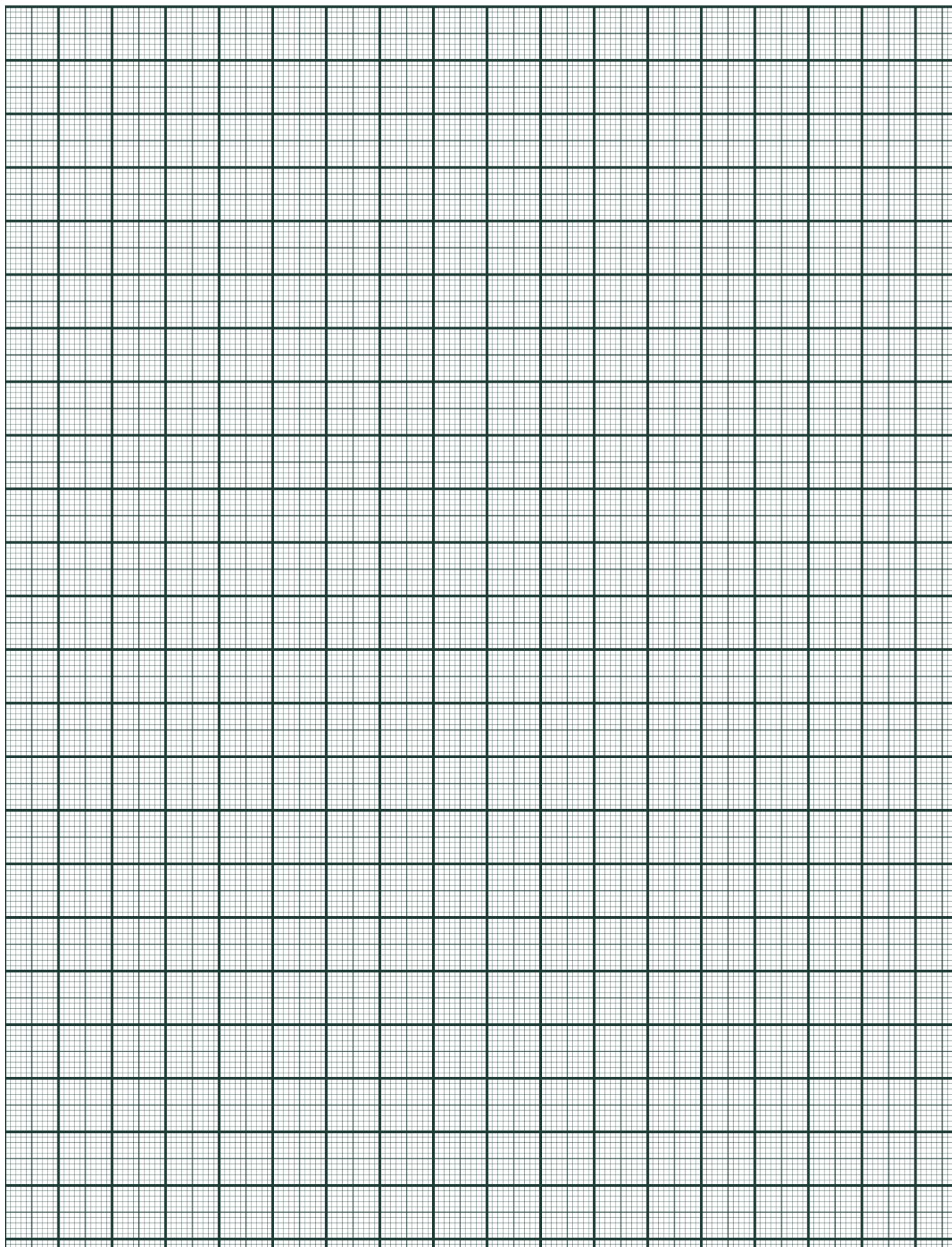
current in the lamp (A)	0.10	0.20	0.30	0.40	0.50	0.60
voltage across the lamp (V)	0.35	0.95	1.75	2.75	3.95	5.35

1. Plot the data and draw a **smooth best-fit curve**. Do not force a straight line through these points.
2. Determine the resistance of the lamp when the current in it is 0.20 A.
3. Determine the resistance of the lamp when the current in it is 0.60 A.
4. State what happens to the resistance of the lamp as the current increases, and explain why.

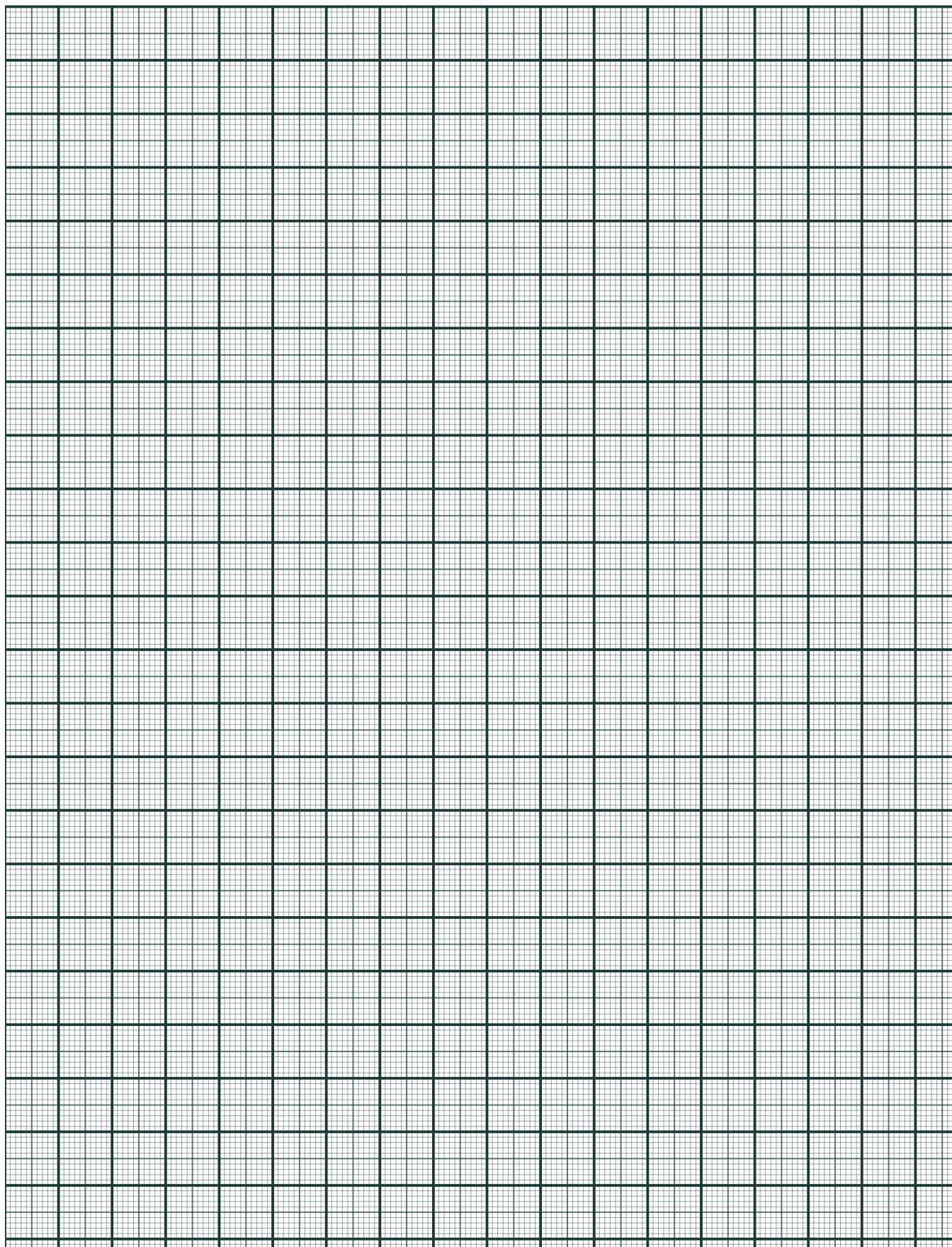
Task 1 – a resistor – graph paper



Task 2 – a different resistor – graph paper



Task 3 – a filament lamp – graph paper



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