A-Level Physics: **w25 11**

Question 33 (Answer: **A**)

- A filament lamp heats up as the current rises, so its resistance grows and the graph bends towards the voltage axis – symmetrically about the origin.
- A diode conducts one way only: flat for reverse voltage, rising sharply past a forward threshold.
- So take the symmetric S-shape for the lamp and the one-sided curve for the diode.

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Question 33 (Answer: **B**)

- $R = \rho L/A$ for X, and Y must give the same R with length $2L$.
- So $\rho_Y(2L)/A_Y = \rho L/A$, which means $\rho_Y/A_Y = \rho/2A$.
- Halving the resistivity while keeping the same area does exactly that.

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Question 32 (Answer: **A**)

- As the current rises the filament heats up, so its resistance increases.
- The graph therefore bends towards the voltage axis instead of staying straight.
- It is still symmetric about the origin, which rules out a diode; a fixed resistor would give a straight line.

Question 34 (Answer: **D**)

- Halving the diameter quarters the cross-sectional area, so that metre has four times the resistance.
- The two lengths are in series, so exactly the same current flows in both.
- $P = I^2R$, so the thinner metre dissipates $4P$.

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5(a)(i)	potential difference per unit current
5(a)(ii)	resistor connected to cell in a closed loop **and** correct circuit symbols used for all components
	ammeter connected in series with resistor **and** voltmeter connected in parallel with resistor
5(b)(i)	(resistance) = 1.38 / 0.276 = 5.00 (Ω)
5(b)(ii)	$\rho = RA / L$
	$\rho = 5.00 \times \pi \times (0.496 \times 10^{-3})^2 / (4 \times 0.864)$
	$= 1.12 \times 10^{-6}\ \Omega\,m$
5(b)(iii)	calculation of a fractional or percentage uncertainty in one quantity 0.001 / 0.864 **or** 0.002 / 0.496 **or** 0.02 / 1.38 **or** 0.001 / 0.276
	percentage uncertainty = $[(0.001 / 0.864) + (2 \times 0.002 / 0.496) + (0.02 / 1.38) + (0.001 / 0.276)] \times 100$ $= 2.7\%$
5(b)(iv)	$\Delta\rho = 0.03 \times 1.12 \times 10^{-6}$ $= 3 \times 10^{-8}\ \Omega\,m$

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Question 32 (Answer: **C**)

- Resistance is defined as potential difference divided by current, $R = V/I$.
- A is the reciprocal of that, and B has the units of power.
- D is only part of the resistivity formula, which also needs the cross-sectional area.

Question 33 (Answer: **D**)

- A diode conducts in one direction only.
- So the graph stays flat for reverse voltage and rises steeply past a forward threshold.
- That asymmetry about the origin is the giveaway; a resistor gives a straight line and a filament lamp a symmetric curve.

Question 35 (Answer: **A**)

- In series the current is the same in both components, and their p.d.s must add to 12 V.
- So look along the graph for the current at which the thermistor's voltage plus the resistor's voltage is 12 V.
- That happens at 0.36 mA – neither component is ohmic, so you cannot simply use V/R.

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Question 33 (Answer: **D**)

- Ohm's law requires the current to be *proportional* to the p.d. – a straight line through the origin.
- Only the first graph is such a line.
- A curve, or a straight line that misses the origin, is not ohmic.

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Question 34 (Answer: **D**)

- $R = V/I = 1.50/4.90 = 0.306\ \Omega$.
- $A = \rho L/R = (6.90 \times 10^{-7})(2.20)/0.306 = 4.96 \times 10^{-6}\ m^2$.
- $d = \sqrt{4A/\pi} = 2.5 \times 10^{-3}$ m; C is the radius, from dropping the factor of 4.

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7(a)	$R = \rho L / A$
	$= (1.12 \times 10^{-6} \times 1.5) / 2.45 \times 10^{-7}$
	$= 6.86\ \Omega$
7(b)(i)	(A method where the) reading (on the galvanometer) is zero.
7(b)(ii)	e.m.f. / 1.2 = 64 / 150
	e.m.f. $= (64 / 150) \times 1.2$ $= 0.51$ V
7(b)(iii)	(the internal resistance will cause a) drop in p.d. across the wire / the terminal p.d. is lower
	So the null point will move to the right

5(a)(i)	temperature decreases, resistance decreases
5(a)(ii)	line from origin with decreasing gradient drawn in first quadrant or line from origin with decreasing gradient drawn in third quadrant
	line drawn in the third or first quadrant of similar composition (straight line from origin followed by correct curve) and similar size as compared by eye to the first line
5(b)(i)	$E = P / I$ $= 18 / 1.5$
	$= 12\ \text{V}$
5(b)(ii)	$I = 3.3 - 1.5$ $= 1.8$
	$I = Anvq$ $1.8 = 1.4 \times 10^{-9} \times 3.4 \times 10^{28} \times v \times 1.6 \times 10^{-19}$
	$v = 0.24\ \text{m s}^{-1}$