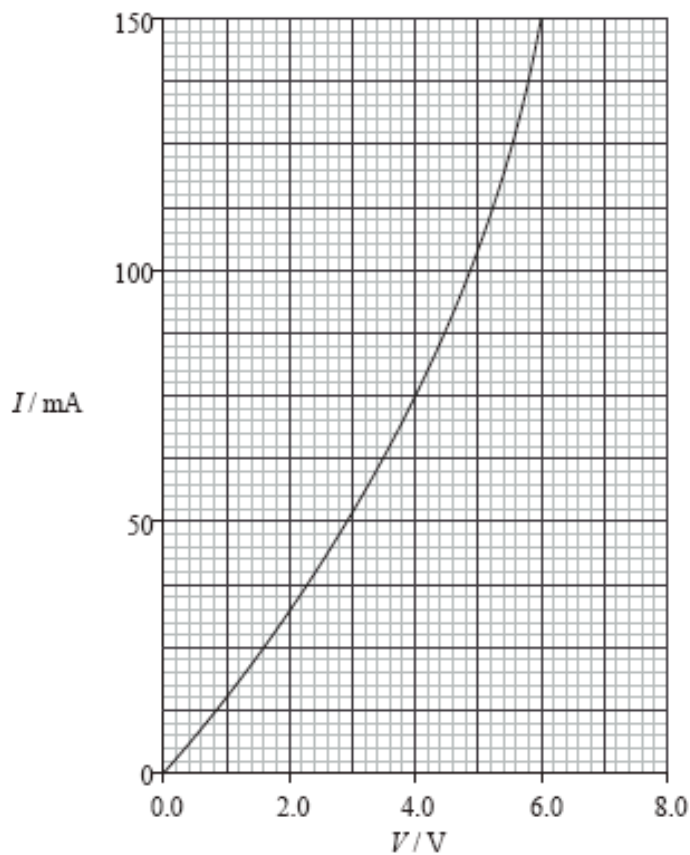
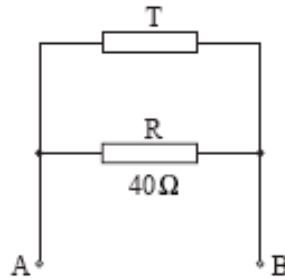


The graph below shows the I - V (current-voltage) characteristic of an electrical component T.



- (a) On the graph above, draw the I - V characteristic in the range $V=0$ to $V=6.0\text{V}$ for a resistor R having a constant resistance of 40Ω . [1]

- (b) The component T and the resistor R are connected in parallel as shown below.



When a battery of constant e.m.f. E and negligible internal resistance is connected between the terminals A and B, the current in the resistor R is 100 mA.

- (i) Calculate the e.m.f. E of the battery. [1]

.....

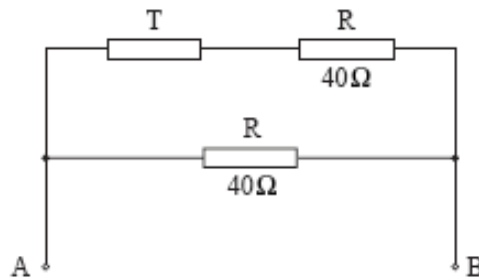
- (ii) Use the graph to determine the current in T. [1]

.....

- (iii) Calculate the power dissipation in T. [2]

.....

- (c) In order to reduce the power dissipation in component T, a second resistor R of resistance $40\ \Omega$ is connected in series with T. The circuit is shown below.



The battery connected between A and B is unchanged.

Use the graph to determine

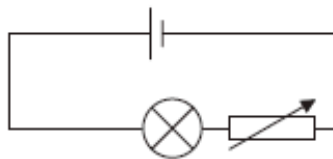
- (i) the current in resistor T. [2]

.....

- (ii) the power dissipation in T. [2]

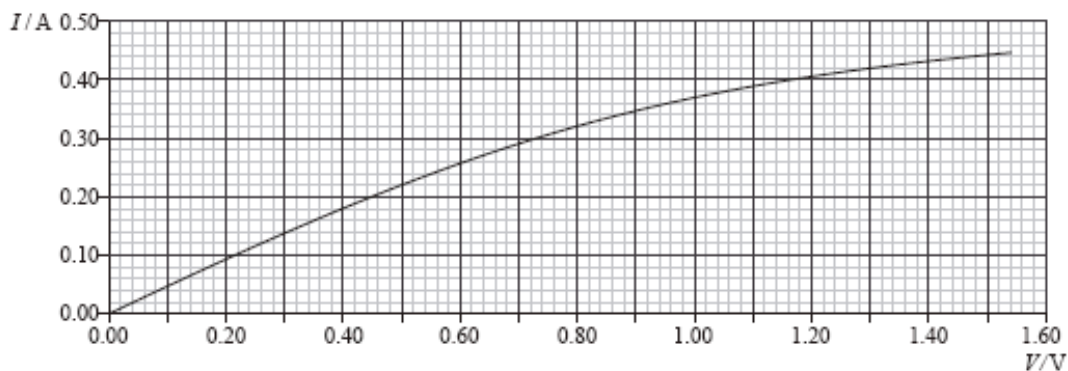
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- (f) The diagram below shows part of a circuit that may be used to determine the current - potential difference (I - V) characteristics of a lamp.



An ammeter and a voltmeter are required. On the diagram above, draw symbols to show the correct positions of the ammeter and the voltmeter. [2]

- (g) The I - V characteristics for one lamp are shown below.



- (i) State a range of values of the current I for which the lamp may be considered to show ohmic behaviour. [1]

.....

- (ii) The potential difference across the lamp is 0.80 V. Calculate the resistance of the lamp at this potential difference. [2]

.....

- (a) Define e.m.f. and state Ohm's law. [2]

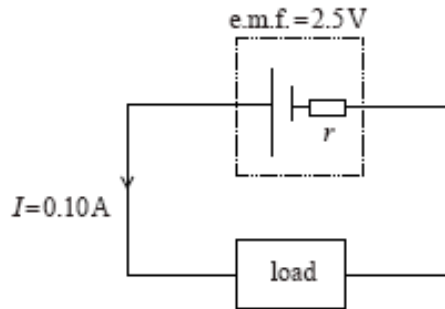
e.m.f.:

.....

Ohm's law:

.....

- (b) In the circuit below an electrical device (load) is connected in series with a cell of e.m.f. 2.5V and internal resistance r . The current I in the circuit is 0.10A.



The power dissipated in the load is 0.23 W.

Calculate

- (i) the total power of the cell. [1]

.....

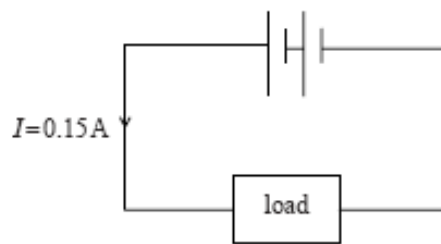
- (ii) the resistance of the load. [2]

.....

- (iii) the internal resistance r of the cell. [2]

.....

- (c) A second identical cell is connected into the circuit in (b) as shown below.



The current in this circuit is 0.15 A. Deduce that the load is a non-ohmic device. [4]

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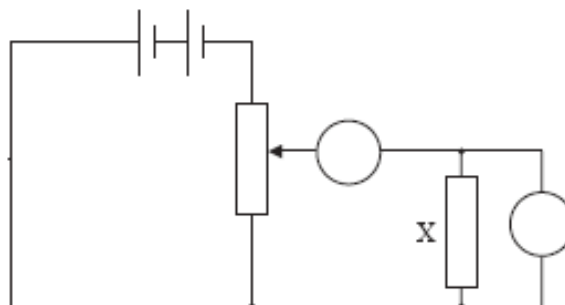
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- (a) The diagram below shows the circuit used to measure the current-voltage (I - V) characteristic of an electrical component X.



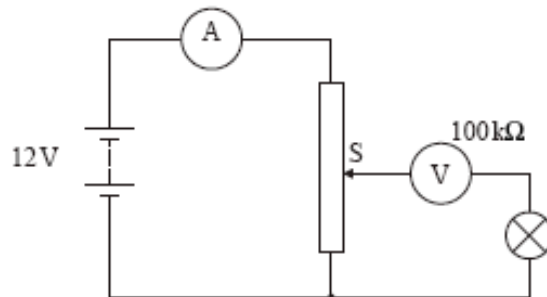
On the diagram above,

- (i) label the ammeter A and the voltmeter V. [1]
- (ii) mark the position of the contact of the potentiometer that will produce a reading of zero on the voltmeter. Label this position P. [1]

A particular filament lamp is rated at 12V, 6.0mA. It just lights when the potential difference across the filament is 6.0V.

A student sets up a electric circuit to measure the I - V characteristics of the filament lamp.

In the circuit, shown below, the student has connected the voltmeter and the ammeter into the circuit **incorrectly**.



The battery has e.m.f. 12V and negligible internal resistance. The ammeter has negligible resistance and the resistance of the voltmeter is $100\text{k}\Omega$.

The maximum resistance of the variable resistor is 15Ω .

- (a) Explain, without doing any calculations, whether there is a position of the slider S at which the lamp will be lit. [3]

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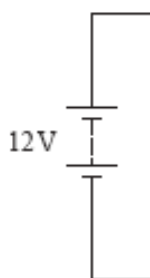
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- (b) Estimate the maximum reading of the ammeter. [2]

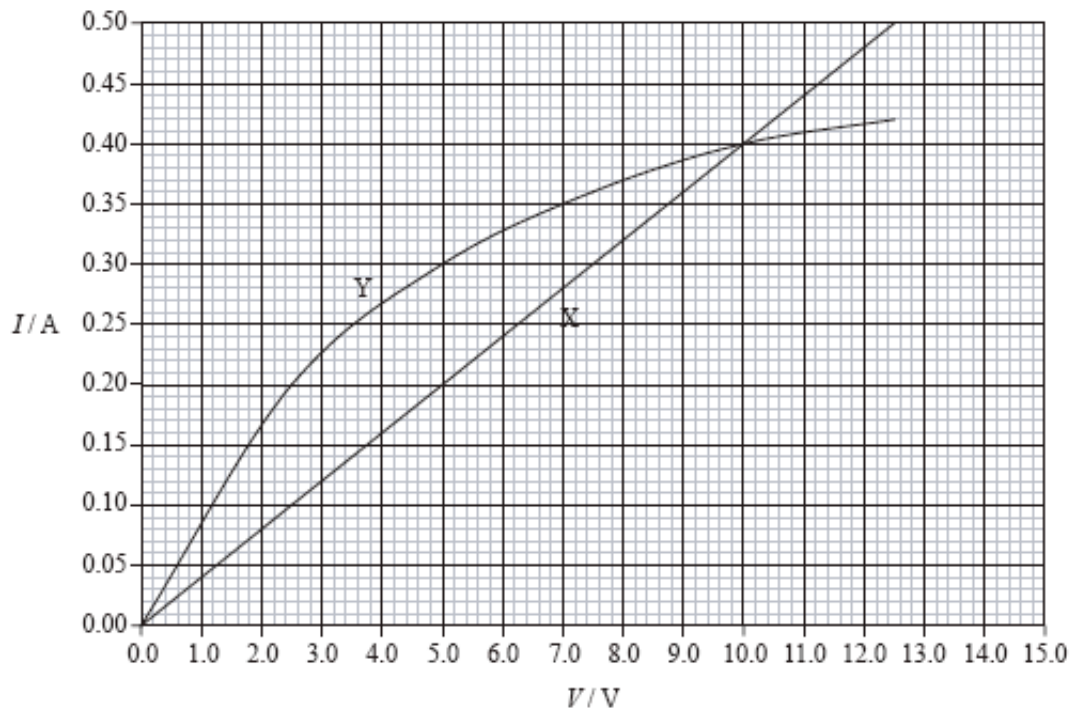
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- (c) Complete the circuit diagram below showing the correct position of the voltmeter and of the ammeter in order to determine the I - V characteristics of the filament lamp. [2]



- (b) The graph below shows the current-voltage (I - V) characteristics of two different conductors X and Y.



- (i) State the value of the current for which the resistance of X is the same as the resistance of Y and determine the value of this resistance. [2]

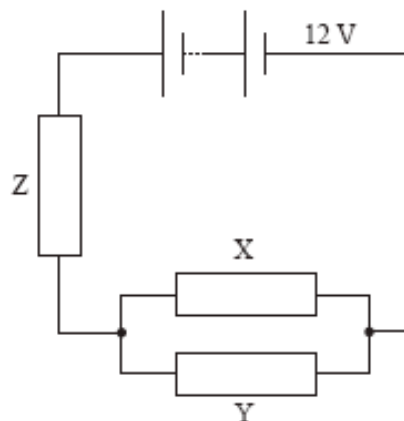
Current:

Resistance:

- (ii) Describe and suggest an explanation for the I - V characteristic of conductor Y. [3]

.....

(c) The two conductors X and Y are connected in the circuit as shown below.



The cell has e.m.f. 12 V and negligible internal resistance. The resistor Z has resistance R and the potential difference across the conductors X and Y is 5.0 V.

(i) Use the graph in (b) to determine the total current in the circuit. [2]

.....

(ii) Determine the resistance R of the resistor Z. [2]

.....

(iii) Determine the total resistance of the parallel combination of X and Y. [2]

.....

Andrew is set the task of measuring the current-voltage (I - V) characteristics of a filament lamp. The following equipment and information are available.

| | Information |
|---------------|-----------------------------------------------------------------|
| Battery | e.m.f. = 3.0 V, negligible internal resistance |
| Filament lamp | marked "3 V, 0.2 A" |
| Voltmeter | resistance = 30 k Ω , reads values between 0.0 and 3.0 V |
| Ammeter | resistance = 0.1 Ω , reads values between 0.0 and 0.5 A |
| Potentiometer | resistance = 100 Ω |

(a) For the filament lamp operating at normal brightness, calculate

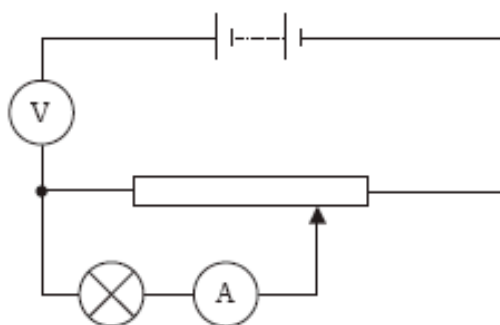
(i) its resistance. [1]

.....
.....

(ii) its power dissipation. [1]

.....
.....

Andrew sets up the following **incorrect** circuit.



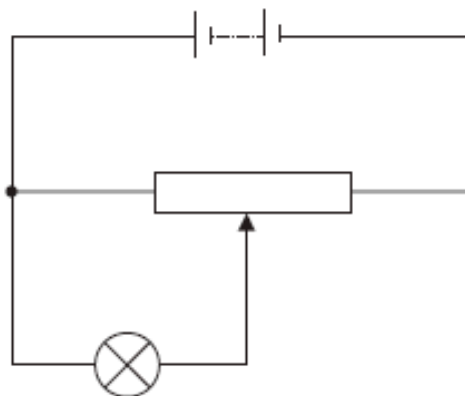
- (b) (i) Explain why the lamp will not light. [2]

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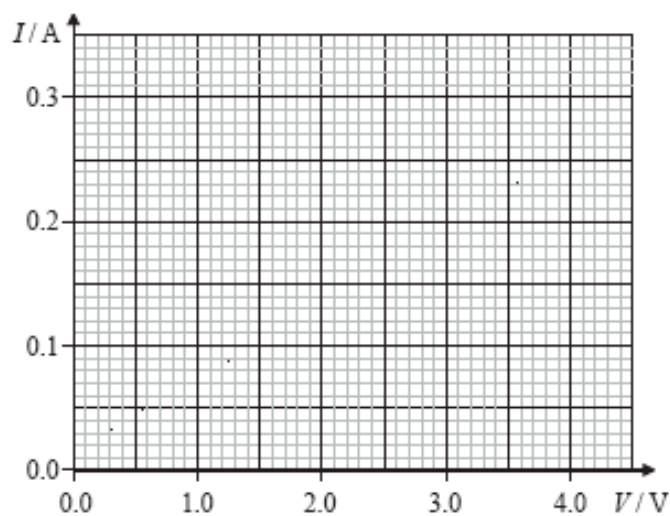
- (ii) State the approximate reading on the voltmeter. Explain your answer. [2]

.....

- (c) On the circuit diagram below, add circuit symbols to show the correct position of the ammeter and of the voltmeter in order to measure the I - V characteristics of the lamp. [2]



- (d) On the axes below draw a sketch graph to show the I - V characteristics for this filament lamp. [4]



- (e) Explain the shape of the graph that you have drawn in (d). [2]

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