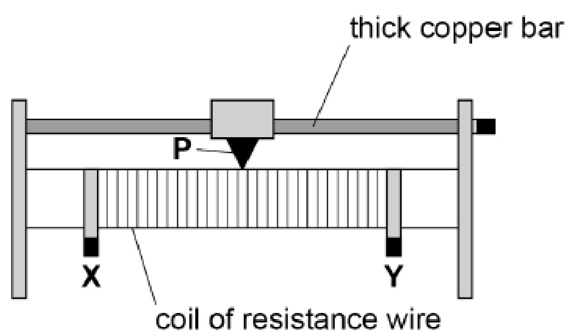
Electricity – AS Physics

1. No.8

0 8 **Figure 11** shows a variable resistor that has a maximum resistance of $25\ \Omega$.
A sliding contact **P** is mounted on a thick copper bar. **P** can be set to any position between **X** and **Y**.

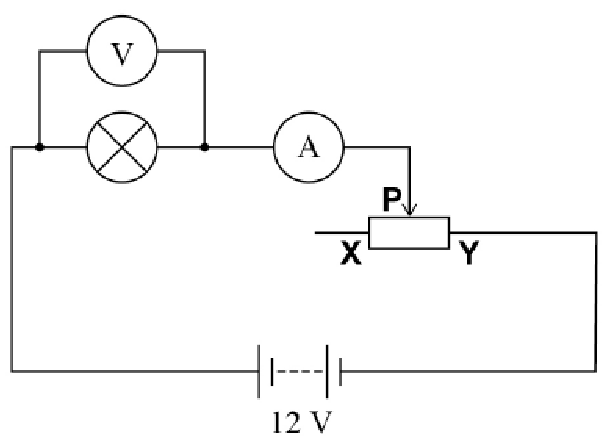
Figure 11



0 8 . 1 **Figure 12** shows the variable resistor being used to investigate the variation of current with voltage for a filament lamp.
The normal operating voltage of the lamp is $12\ \text{V}$.

The $12\ \text{V}$ battery has negligible internal resistance.

Figure 12



The position of **P** is adjusted so that the reading on the voltmeter is at its minimum value of $0.75\ \text{V}$.

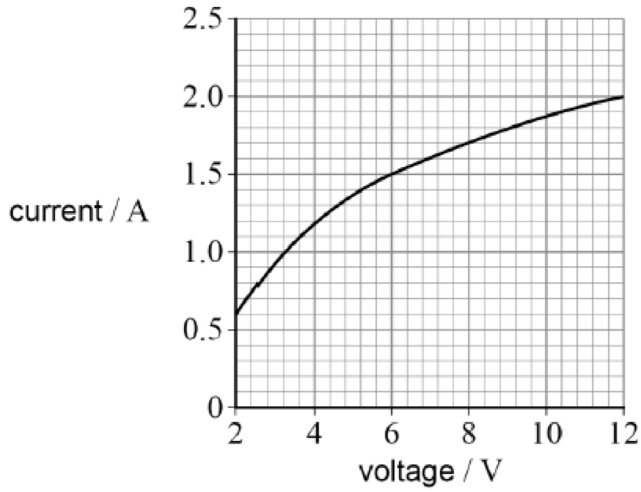
Calculate the resistance of the lamp when the voltmeter reading is $0.75\ \text{V}$.

[2 marks]

resistance = ____________________ Ω

0 8 . 2 **Figure 13** shows the variation of current with voltage for the lamp between 2 V and 12 V.

Figure 13



Calculate the resistance of the lamp when the voltage across the lamp is 8.0 V.

[2 marks]

resistance = ______________________ Ω

0 8 . 3 Explain, in terms of electron movement, why the resistance of the filament lamp changes as the voltage changes as shown in **Figure 13**.

[3 marks]

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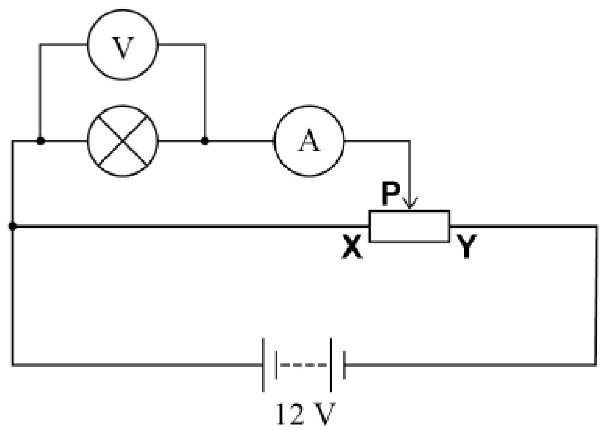
0 8 . 4 **Figure 14** shows an alternative circuit used to investigate the variation of current with voltage for the lamp.

Figure 14



The circuit components are the same as in **Figure 12**.
When the voltage across the lamp is 12 V its resistance is 6.0 Ω.

P is moved to position **Y**.

Calculate the total resistance of the circuit.

[2 marks]

total resistance = ____________________ Ω

0 8 . 5 Calculate the power transferred by the battery when **P** is at position **Y**.

[2 marks]

power = ____________________ W

0 8 . 6 A student wants to control the brightness of the lamp.

He gives two reasons why the circuit in **Figure 14** is better than the circuit in **Figure 12** for controlling the brightness. The two reasons are:

- the **Figure 14** circuit can achieve a greater range of voltages across the lamp
- the **Figure 14** circuit is more efficient at transferring energy to the lamp.

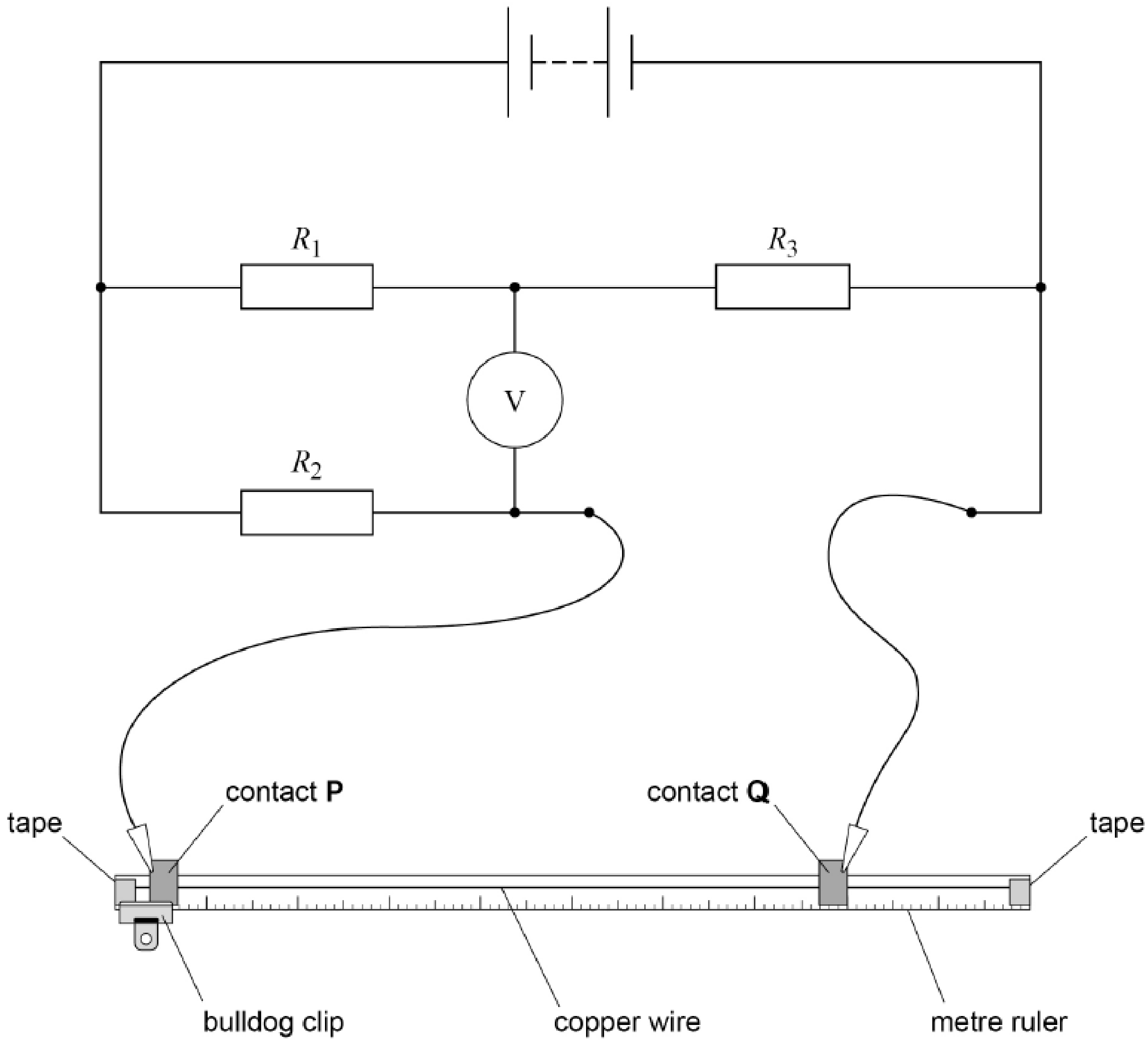
Discuss, without calculation, whether either of these two reasons is correct.

[3 marks]

2. No.2

0 2 **Figure 3** shows a circuit used to find the resistance per unit length of a copper wire.

Figure 3

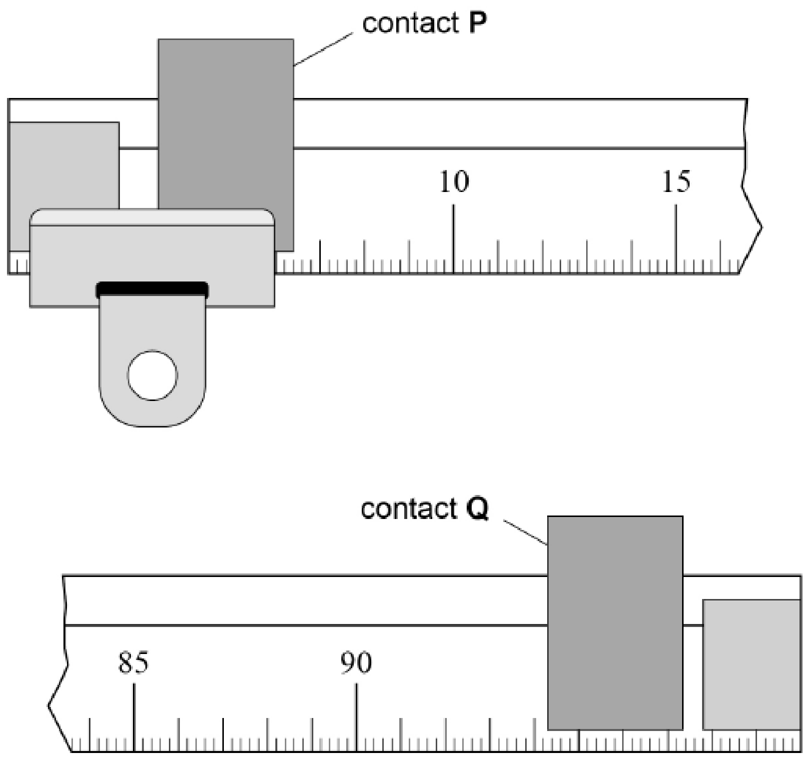


The copper wire is fixed with tape to a metre ruler that has 2 mm graduations.
Contact **P** is placed on the wire close to one end of the ruler and held firmly in place using a bulldog clip.
When contact **Q** is placed on the wire as shown in **Figure 3** the voltmeter shows a non-zero reading.

Q is moved along the wire until the voltmeter reading is zero.

Figure 4 shows enlarged views of the position of **P** and the new position of **Q**.

Figure 4



0 2 . 1 Determine, in m, the length x of copper wire between **P** and **Q**.

[1 mark]

$x =$ ______________________ m

0 2 . 2 When the voltmeter reading is zero:

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

where R_4 is the resistance of the copper wire between **P** and **Q**.

Determine, in $\Omega\ \mathrm{m}^{-1}$, the resistance per unit length of the copper wire.

$R_1 = 2.2\ \mathrm{M\Omega}$
$R_2 = 3.9\ \mathrm{k\Omega}$
$R_3 = 75\ \Omega$

[2 marks]

resistance per unit length = ____________________ $\Omega\ \mathrm{m}^{-1}$

0 2 . 3 The diameter d of the copper wire is approximately $0.4\ \mathrm{mm}$.

Suggest:

- a suitable measuring instrument to accurately determine d
- how to reduce the effect of random error on the result for d.

[3 marks]

0 2 . 4 Determine the resistivity ρ of copper.

diameter d of the copper wire $= 0.38\ \mathrm{mm}$

[2 marks]

$\rho =$ ____________________ $\Omega\ \mathrm{m}$

The copper wire is replaced with a constantan wire of diameter $0.38\ \mathrm{mm}$.

$$\frac{\text{resistivity of constantan}}{\text{resistivity of copper}} = 30$$

0 2 . 5 Suggest **one** change to the circuit to make the voltmeter read zero for the same value of x as in Question **02.1**.

[1 mark]

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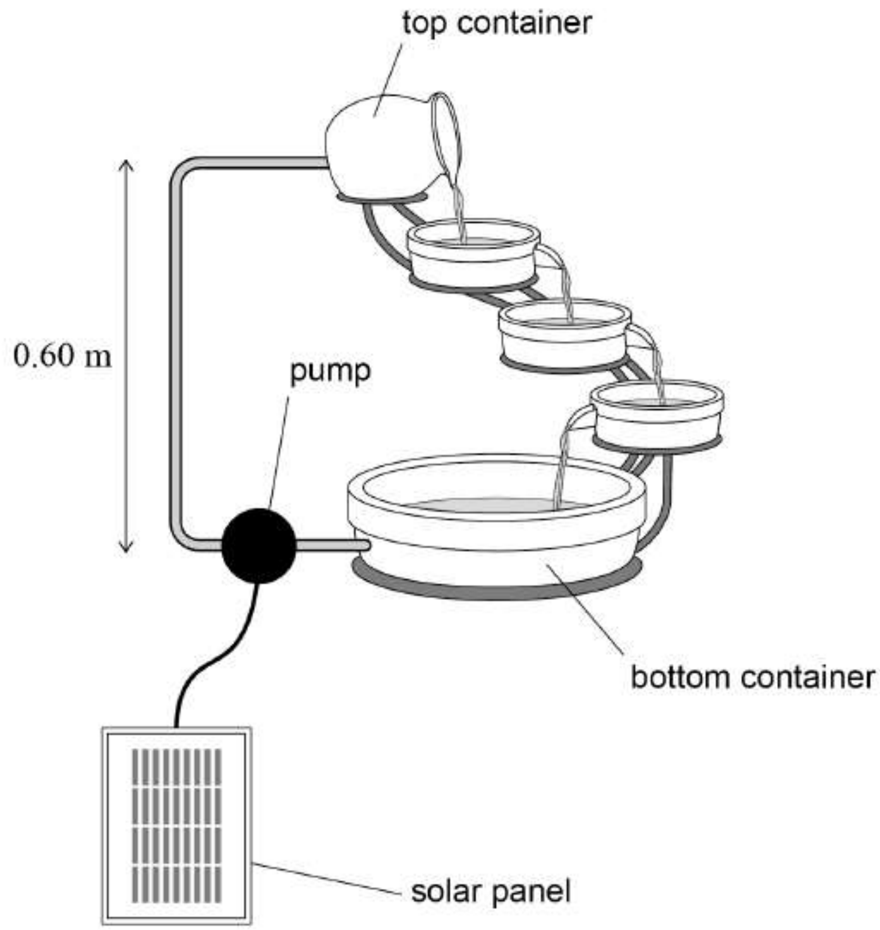
0 2 . 6 Calculate, in mm, the diameter of a constantan wire that has the **same** resistance per unit length as the copper wire.

[1 mark]

diameter = ____________________ mm

3. No.28

A solar panel powers a pump for a water feature.



Solar energy is incident on the solar panel at a rate of 1.5 W.
Water from the bottom container is continually pumped through a vertical height of 0.60 m to the top container.

The overall efficiency of the solar panel and the pump is 20%.

What mass of water can be pumped into the top container each second?

[1 mark]

A 5 g ☐

B 50 g ☐

C 100 g ☐

D 250 g ☐

4. No.30

As the temperature of a copper wire increases, its resistance

[1 mark]

A remains constant. ⬭

B increases. ⬭

C decreases. ⬭

D remains constant at first and then decreases. ⬭

5. No.31

A $12\ \Omega$ resistor is connected across the terminals of a cell that has an emf of $2.0\ \mathrm{V}$ and an internal resistance of $4.0\ \Omega$.

What is the terminal pd?

[1 mark]

A $0.50\ \mathrm{V}$ ⬭

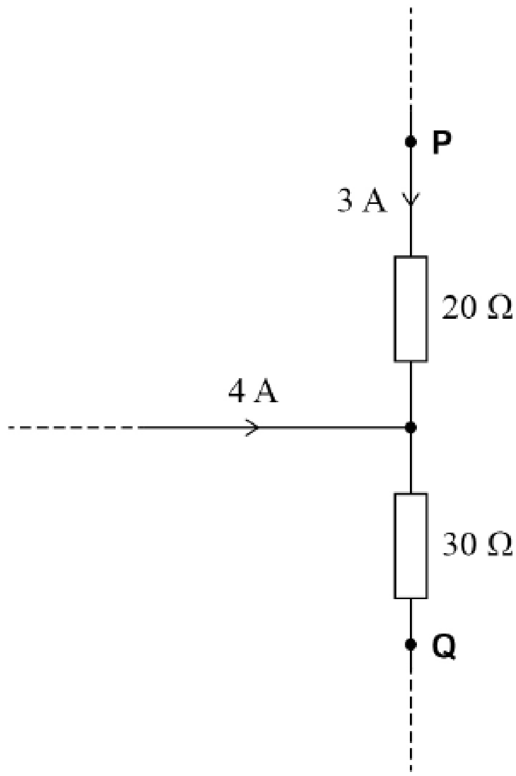
B $0.75\ \mathrm{V}$ ⬭

C $1.30\ \mathrm{V}$ ⬭

D $1.50\ \mathrm{V}$ ⬭

6. No.32

The diagram shows the currents in part of a circuit.



What is the potential difference between points **P** and **Q**?

[1 mark]

A 60 V ⬭

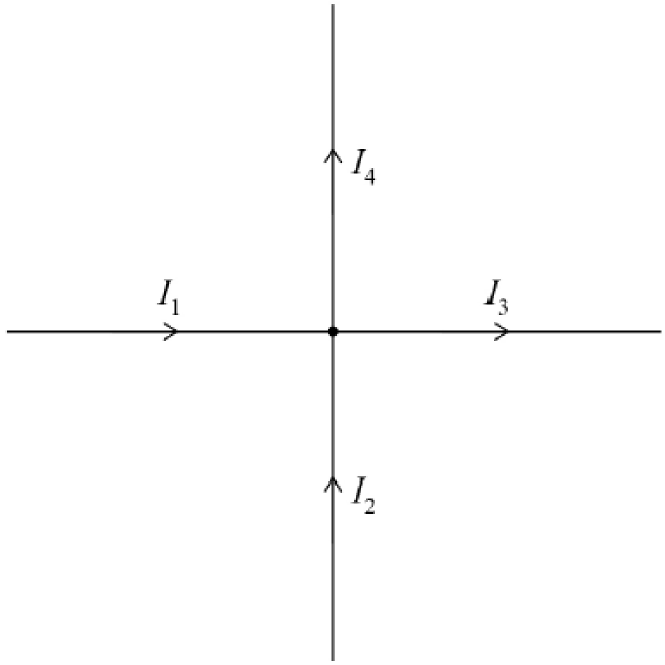
B 70 V ⬭

C 180 V ⬭

D 270 V ⬭

7. No.33

The currents in the four wires obey the relationship $I_1 + I_2 + I_3 + I_4 = 0$



This relationship is an expression of the law of conservation of

[1 mark]

A charge. ⬭

B energy. ⬭

C potential difference. ⬭

D power. ⬭

8. No.34

A practical power supply provides a steady current I for a time t to an external circuit.

The emf of the power supply during t is equivalent to

[1 mark]

A the energy dissipated in the external circuit.

B the energy dissipated in the whole circuit.

C the energy dissipated in the whole circuit, divided by the product It.

D the potential difference across the terminals of the power supply.