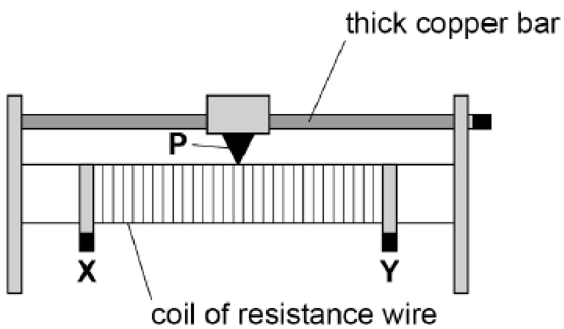
Electricity – 2022 AS Physics

1. June /2022/Paper_ 7407/1/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

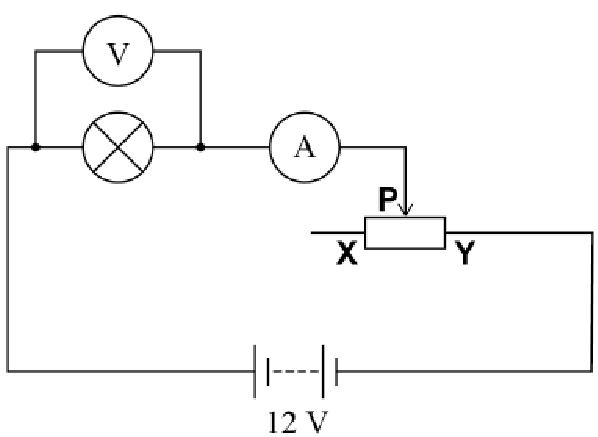


| 0 | 8 | . | 1 |

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 $12\ V$.

The $12\ V$ 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 $0.75\ V$.

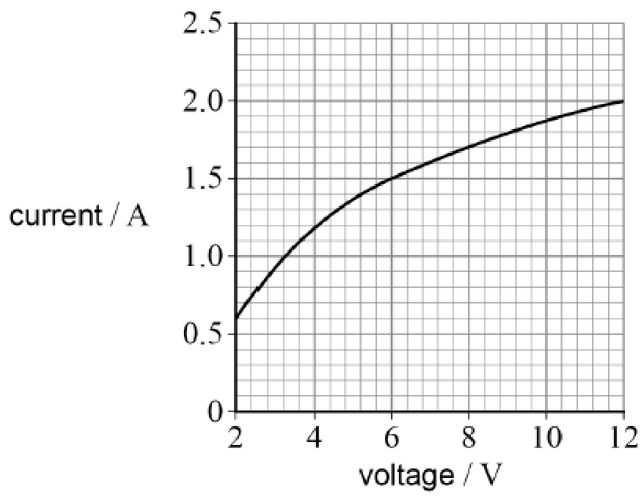
Calculate the resistance of the lamp when the voltmeter reading is $0.75\ V$.

[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]

____

____

____

____

____

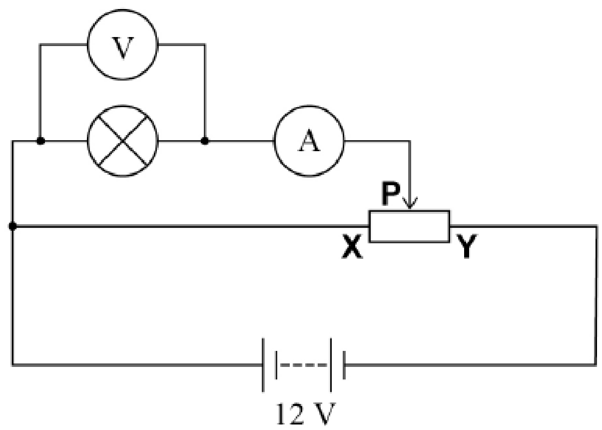
____

____

____

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.

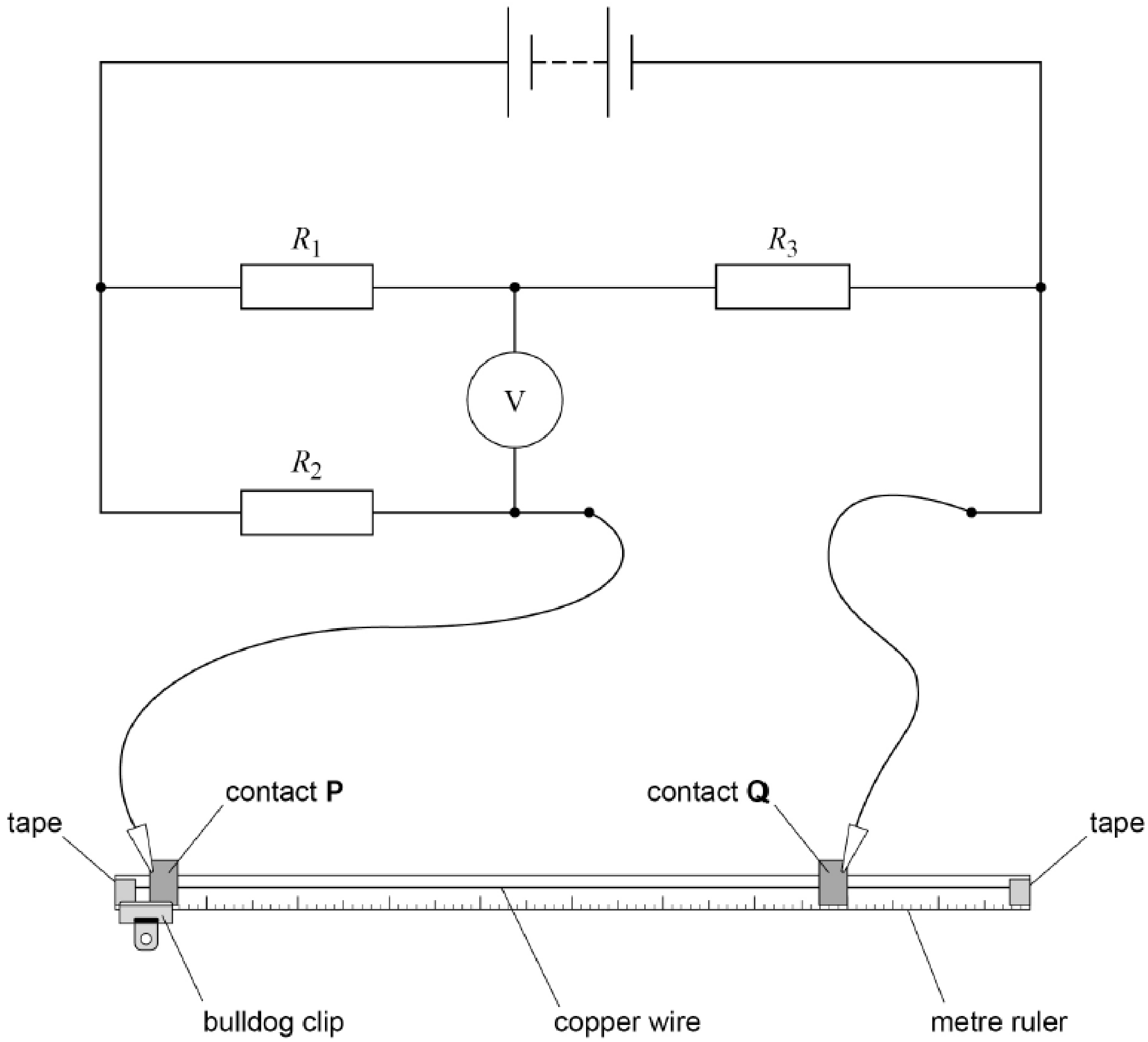
Discuss, without calculation, whether either of these two reasons is correct.

[3 marks]

2. June /2022/Paper_ 7407/2/No.2

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

Figure 3

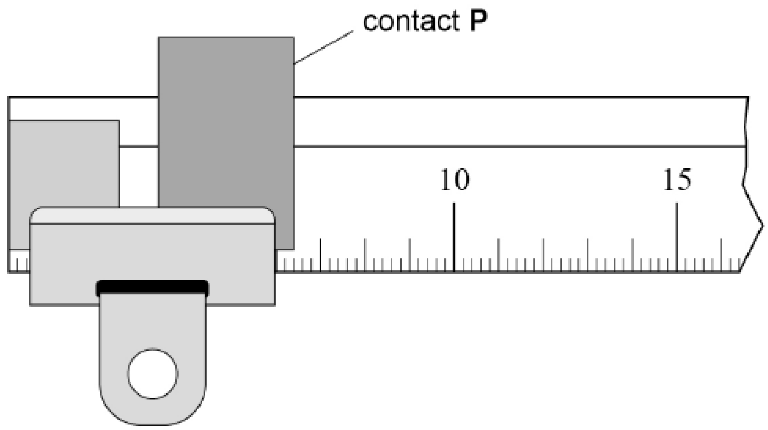


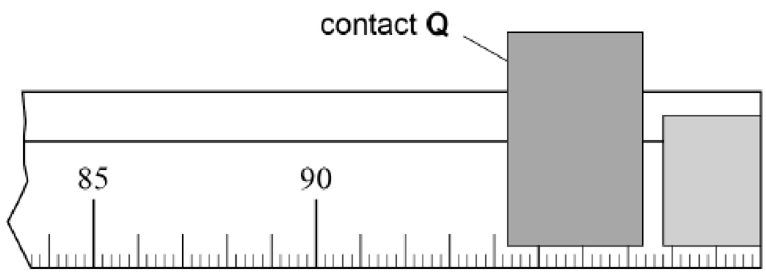
The copper wire is fixed with tape to a metre ruler that has 2 mm graduations.
Contact **P** is placed on the wire close to one end of the ruler and held firmly in place using a bulldog clip.
When contact **Q** is placed on the wire as shown in **Figure 3** the voltmeter shows a non-zero reading.

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

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

[2 marks]

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

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

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 = $0.38\ \text{mm}$

[2 marks]

ρ = ____________________ $\Omega\ \text{m}$

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

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

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]

____

____

____

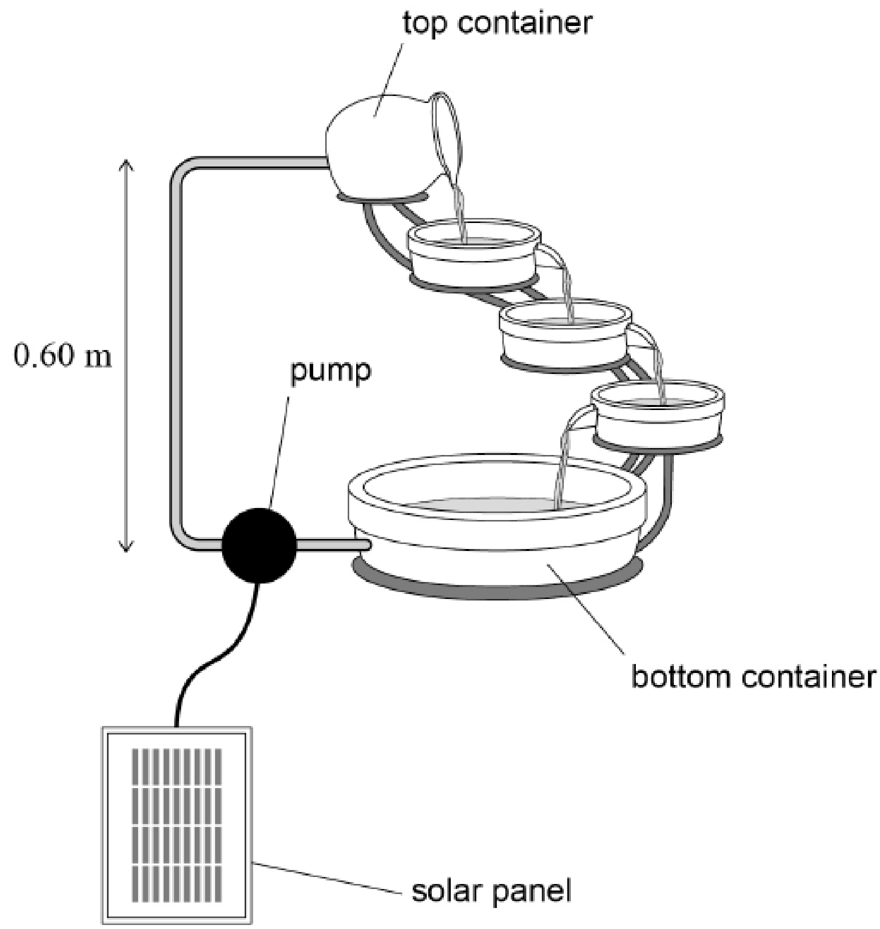
0 2 . 6 Calculate, in mm, the diameter of a constantan wire that has the **same** resistance per unit length as the copper wire.

[1 mark]

diameter = ____________________ mm

3. June /2022/Paper_ 7407/2/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. June /2022/Paper_ 7407/2/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. June /2022/Paper_ 7407/2/No.31

A 12 Ω resistor is connected across the terminals of a cell that has an emf of 2.0 V and an internal resistance of 4.0 Ω.

What is the terminal pd?

[1 mark]

A 0.50 V

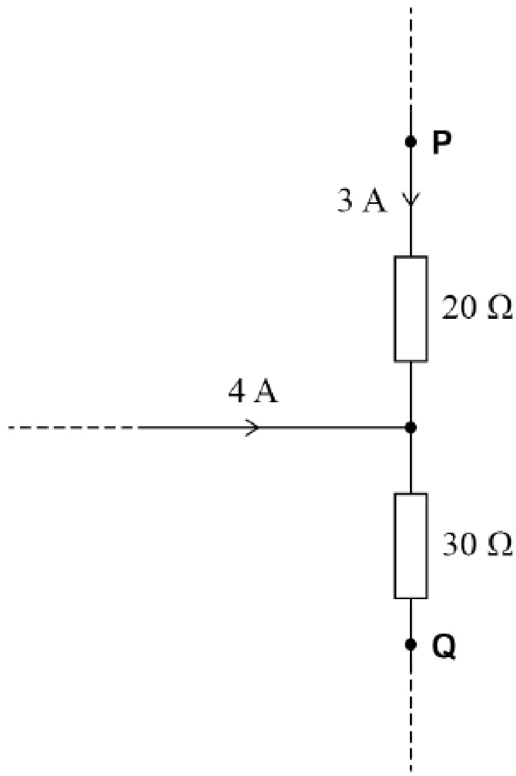
B 0.75 V

C 1.30 V

D 1.50 V

6. June /2022/Paper_ 7407/2/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 ⬭

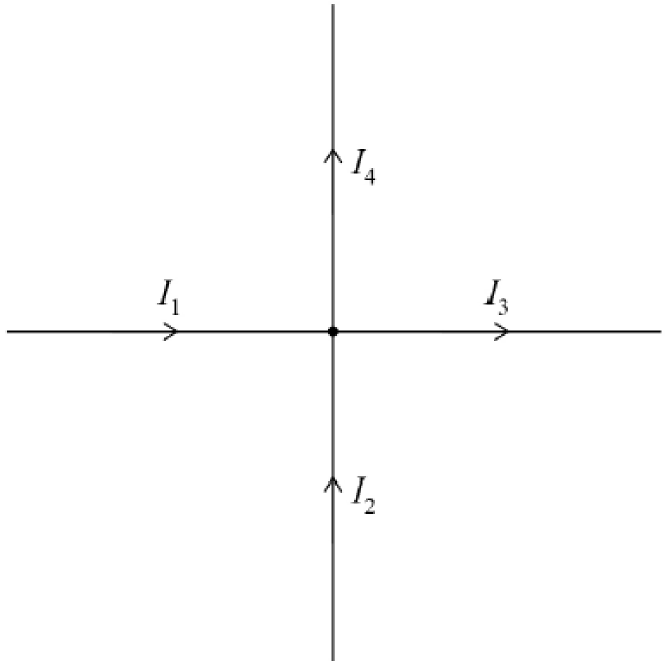
B 70 V ⬭

C 180 V ⬭

D 270 V ⬭

7. June /2022/Paper_ 7407/2/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. June /2022/Paper_ 7407/2/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. ⬭