

Name of the Student: _____

Max. Marks : 17 Marks

Time : 17 Minutes

Q1.

A battery of emf 7.4 V and negligible internal resistance is used to power a heating element inside a glove. The heating element has a resistance of $3.7 \, \Omega$.

- (a) The designers state that the battery can produce a current of 2.0 A in the heating element for 240 minutes.

Calculate the energy dissipated in the heating element in this time.

energy dissipated = _____ J

(3)

- (b) The length of the heating element needed is about 0.85 m.
 The designer considers using a carbon fibre tape for the heating element.
 The table gives information for the carbon fibre tape.

Cross-sectional area / m^2	Resistivity / $\Omega \text{ m}$
4.9×10^{-6}	2.0×10^{-5}

Deduce whether the carbon fibre tape is suitable for making the heating element for the glove.

(2)

- (c) A light emitting diode (LED) is used to indicate that the switch in the glove is closed, as shown in **Figure 1**. Resistor R limits the current in the LED.

Figure 1

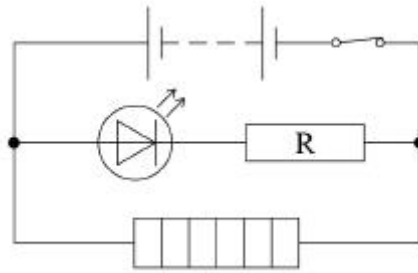
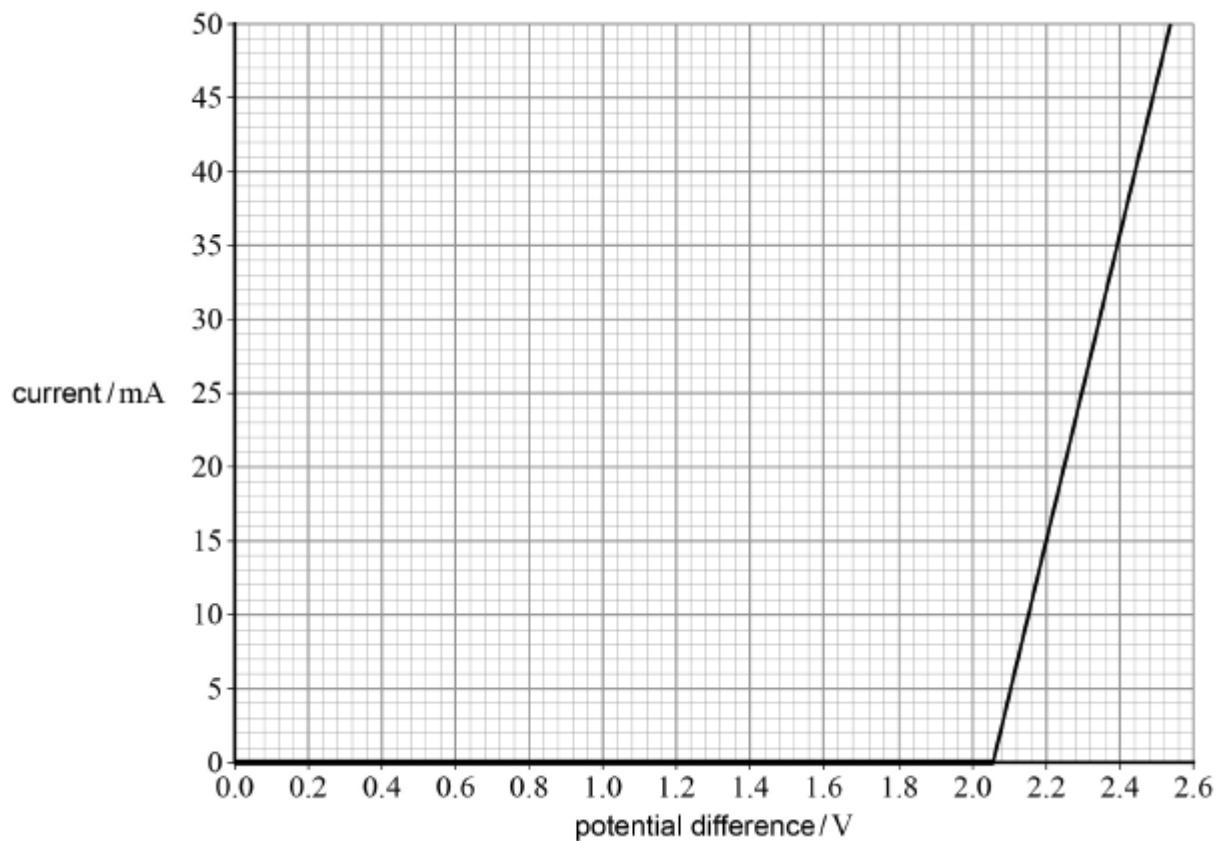


Figure 2 shows part of the characteristic graph for the LED.

Figure 2



The circuit is designed so that the potential difference across the LED is 2.2 V when the switch is closed.

Calculate the resistance of R.

resistance = _____ Ω

(4)

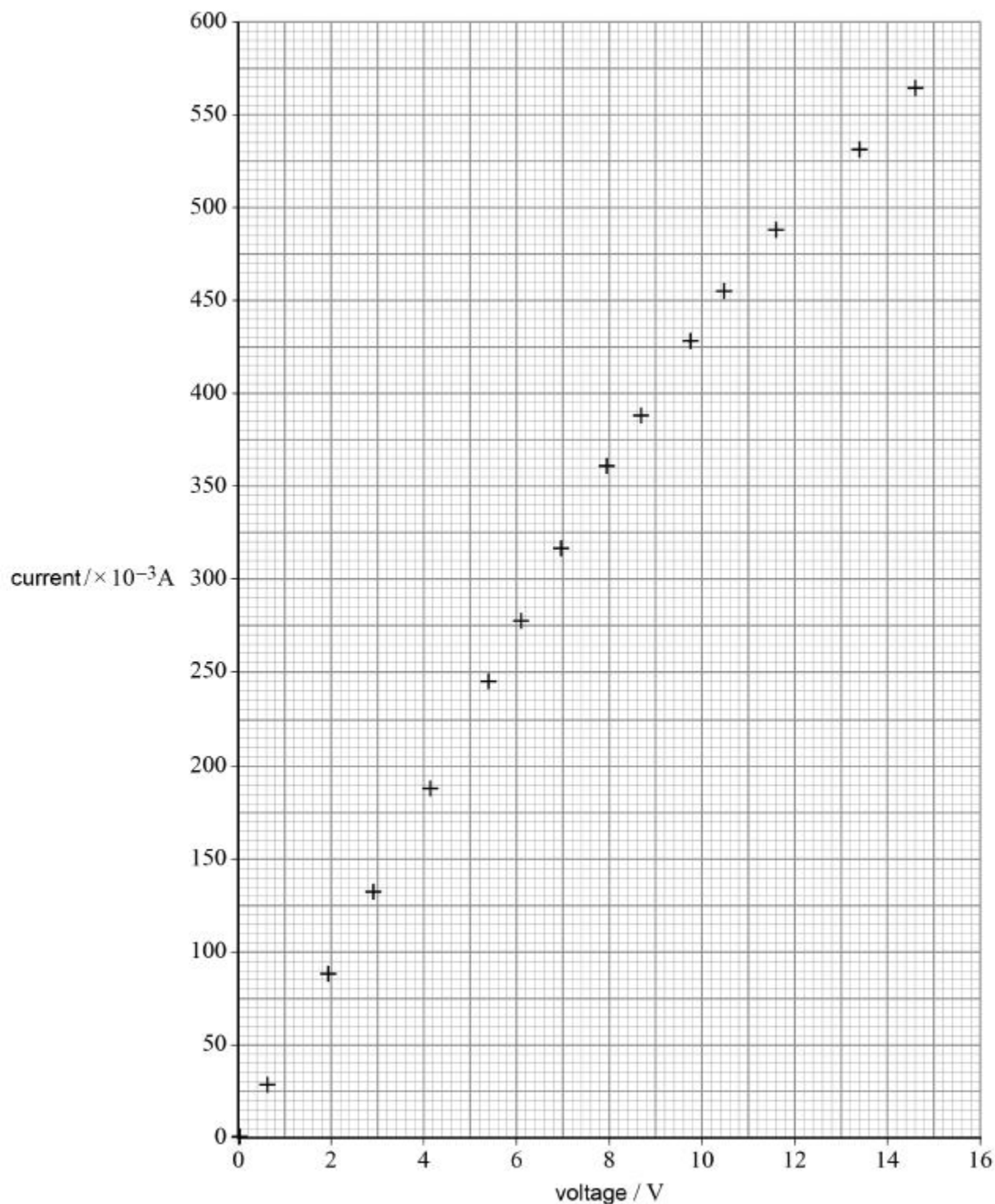
(Total 9 marks)

Q2.

This question is about an experiment to obtain current–voltage data for a resistor **R**.

Figure 1 shows a plot of current–voltage data for **R**.

Figure 1



(a) Draw a best-fit line for the data on **Figure 1**.

(1)

(b) Identify the data point with the greatest value of current and voltage at which **R** obeys Ohm's law.

Draw a circle around this data point on **Figure 1**.

(1)

- (c) When **R** obeys Ohm's law it has a resistance of $22.2\ \Omega$.

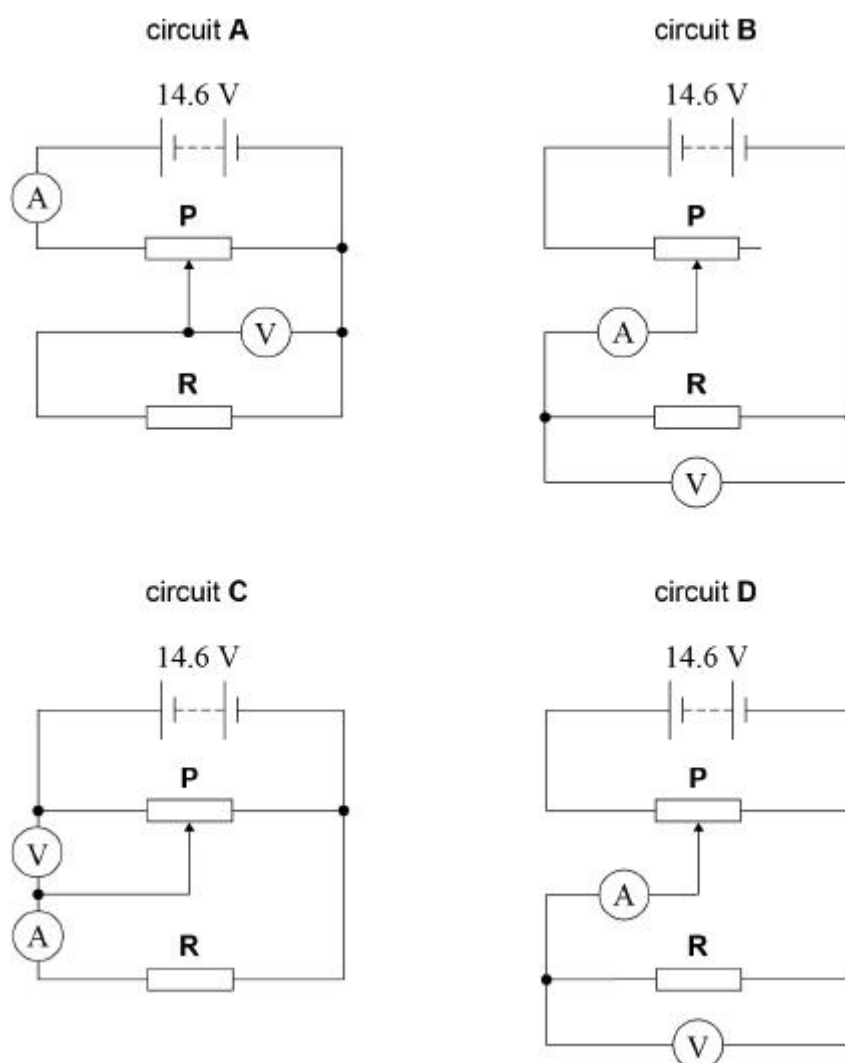
Determine the percentage increase in the resistance of **R** from its $22.2\ \Omega$ value to its value when the current is $550 \times 10^{-3}\ \text{A}$.

percentage increase = _____

(2)

- (d) One of the circuits **A** to **D** shown in **Figure 2** was used to obtain the current–voltage data in **Figure 1**. The maximum resistance of resistor **P** is twice the resistance of **R**. The battery has an emf of $14.6\ \text{V}$ and negligible internal resistance.

Figure 2



Deduce which **one** of these circuits was used to directly obtain the current–voltage data in **Figure 1**.

[illegible]

(Total 8 marks)