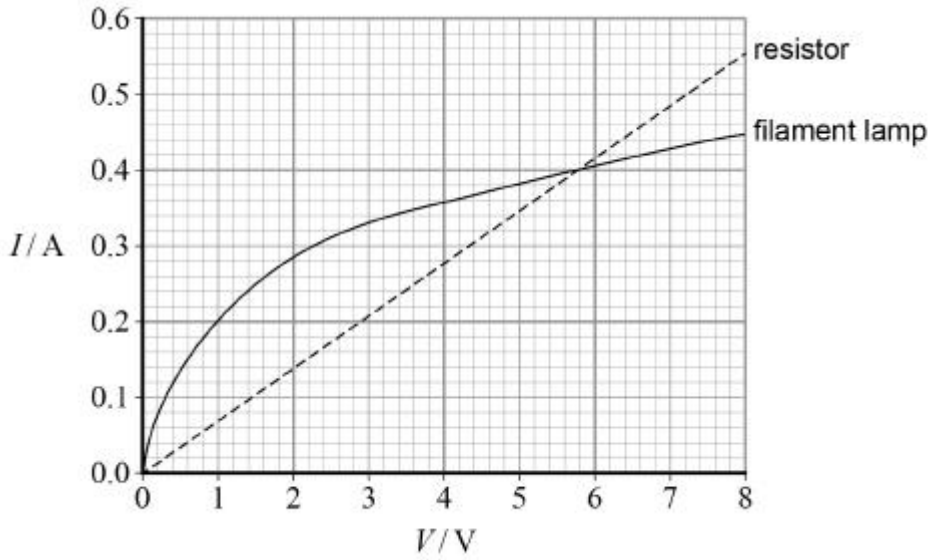
Name of the Student:_____
Max. Marks : 25 Marks **Time :** 25 **Minutes**

Q1.

The graph below shows the current–voltage (I–V) characteristics for a resistor and a filament lamp.



(a) Explain, in terms of electron motion, why the I–V characteristic for the filament lamp is a curve.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Determine the resistance of the resistor.

resistance = _____ Ω

(1)

(c) The resistor and the filament lamp are connected in series with a supply of variable emf and negligible internal resistance.

Determine the emf that produces a current of 0.18 A in the circuit.

emf = _____ V

(3)

(d) The resistor and filament lamp are now connected in parallel.

Determine the resistance of the parallel combination when the emf of the supply is adjusted to be 4.0 V.

resistance = _____ Ω

(3)

(e) The resistance of the filament lamp at its working temperature is 14 Ω.

The filament has a length of 0.36 m and a diameter of 32 μm.

Calculate the resistivity of the metal that is used for the filament when the lamp is at its working temperature.

Give an appropriate unit for your answer.

resistivity = _____ unit _____

(3)

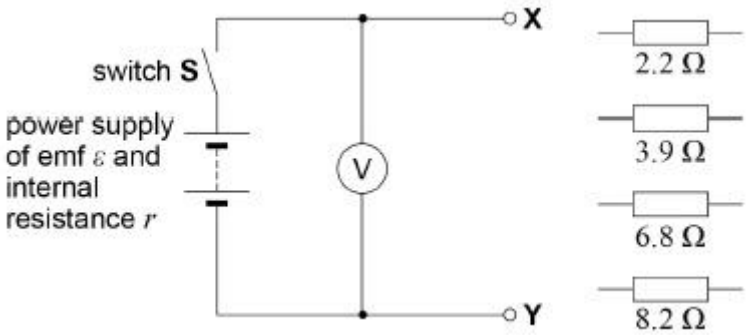
(Total 14 marks)

Q2.

This question is about an experiment to determine the internal resistance of a power supply.

A student is given the circuit and the four resistors of known resistance shown in **Figure 1**.

Figure 1



The student can change the external resistance R of the circuit between terminals **X** and **Y**. This is done by connecting different combinations of **two** resistors in series or in parallel between **X** and **Y**. This method can produce **12 different values** for R.

(a) Calculate the largest value of R that the student can obtain using **two** resistors.

largest value of R = _____ Ω

(1)

(b) Calculate the smallest value of R that the student can obtain using **two** resistors.

smallest value of R = _____ Ω

(2)

(c) With switch **S** closed (in the on position) and no resistors connected between **X** and **Y** the voltmeter reading V is 1.62 V.

The student concludes that this voltmeter reading equals the emf ε of the power supply.

State why the student's conclusion that ε = 1.62 V was correct.

_____

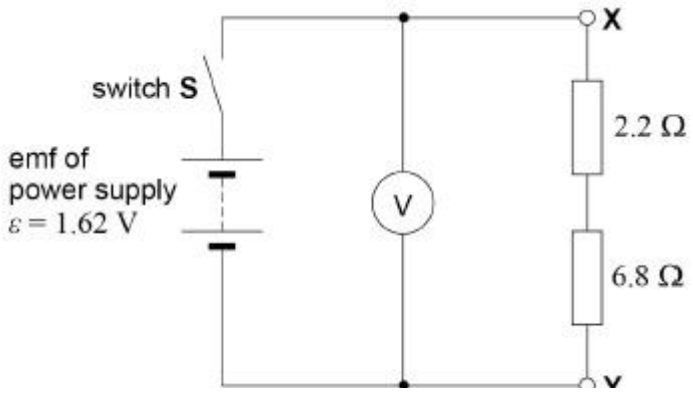
_____

_____

(1)

(d) **Figure 2** shows one particular combination and arrangement of two resistors that the student could use.

Figure 2



When **S** is closed the voltmeter reading V is 1.14 V.

Explain why V is less than 1.62 V when **S** is closed.

_____

_____

_____

(1)

(e) It can be shown that

$$\varepsilon - V = r \times \frac{V}{R}$$

where *r* is the internal resistance of the power supply.

Determine (ε – V) and $\frac{V}{R}$ for this circuit using the data given in part (d).

($\varepsilon - V$) = _____ V

$\frac{V}{R}$ = _____ V Ω^{-1}

(1)

(f) The student obtains values of V for five further different values of R.

These data were used to produce the graph of ($\varepsilon - V$) against $\frac{V}{R}$ in **Figure 3**.

Plot the point you determined in part (e) on **Figure 3** and add a suitable best-fit line.

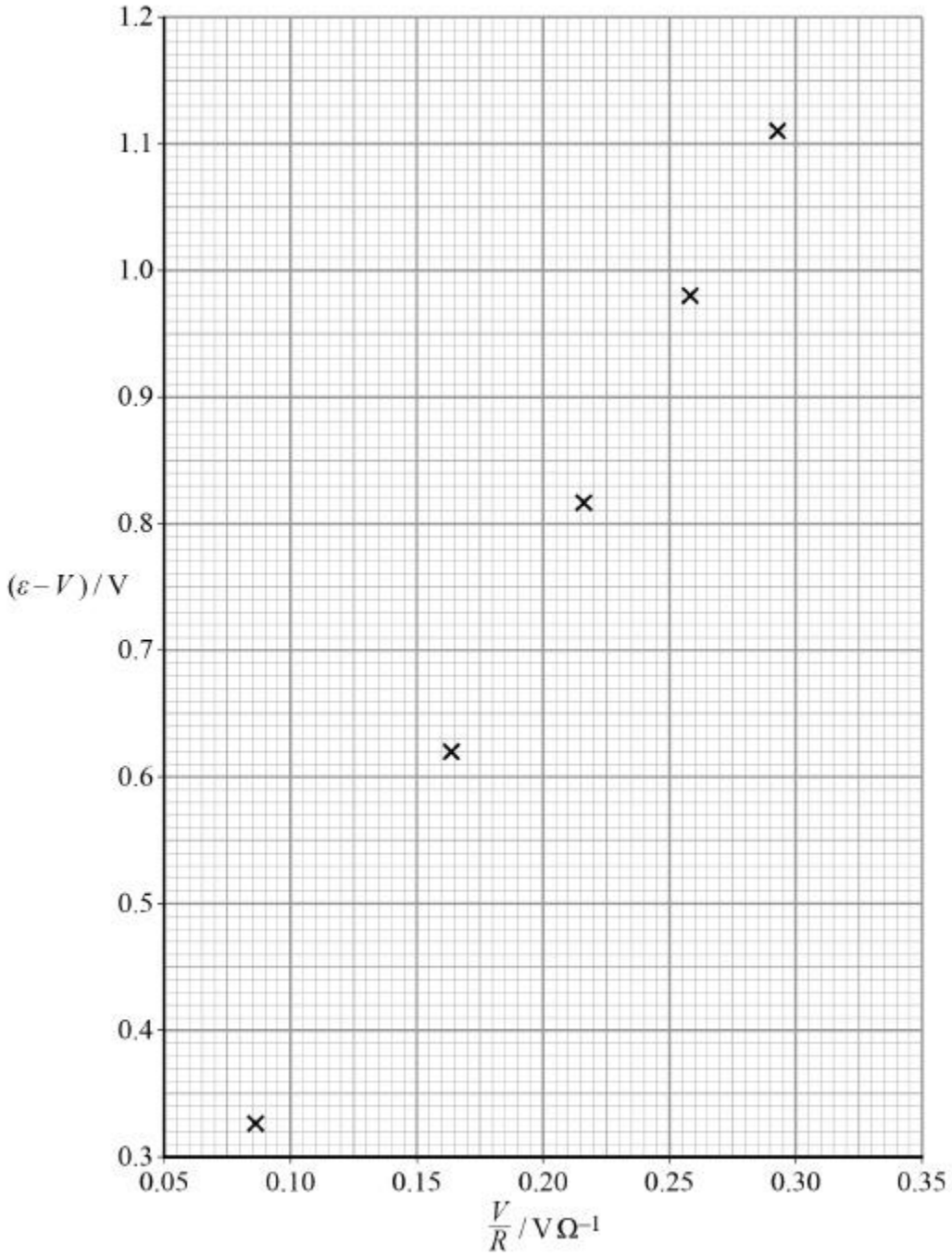
(1)

(g) Use **Figure 3** to determine *r*.

r = _____ Ω

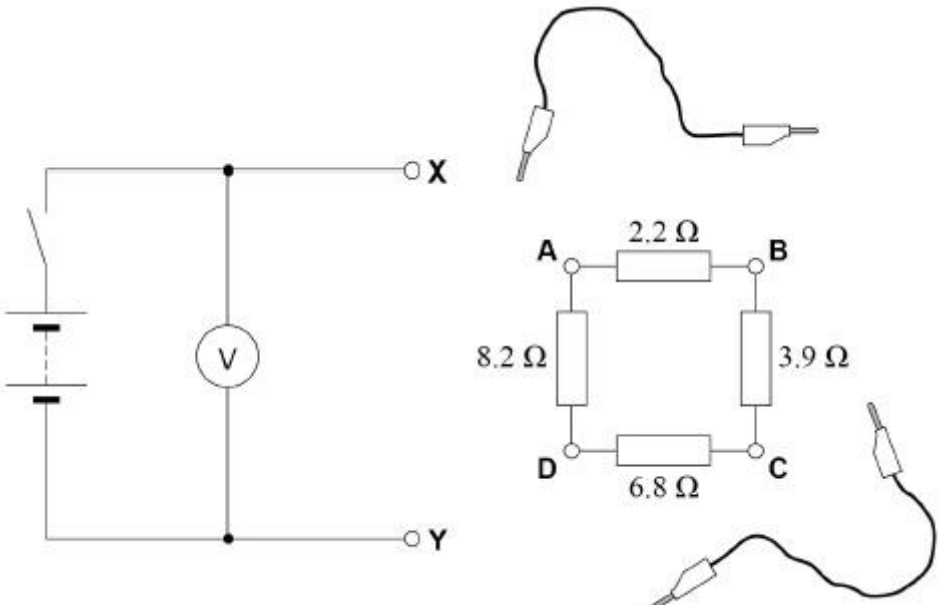
(2)

Figure 3



(h) **Figure 4** shows a different method for varying the resistance R described in part (a).

Figure 4



The four resistors are connected in a loop with sockets **A**, **B**, **C** and **D** at each junction. Two leads are used to connect the resistor loop to **X** and **Y**.

Discuss whether this method is an improvement over the method described in part (a). In your answer, you should refer to the number of different values that can be obtained for R.

_____

_____

_____

_____

_____

_____

(2)

(Total 11 marks)