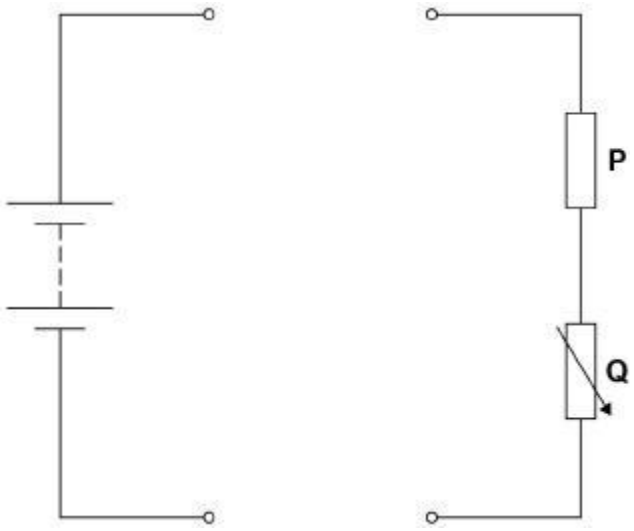
Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Q1.

Figure 1 shows a partly-completed circuit used to investigate the emf ε and the internal resistance r of a power supply.

The resistance of **P** and the maximum resistance of **Q** are unknown.

Figure 1



(a) Complete **Figure 1** to show a circuit including a voltmeter and an ammeter that is suitable for the investigation.

(1)

(b) Describe

- a procedure to obtain valid experimental data using your circuit
- how these data are processed to obtain ε and r by a graphical method.

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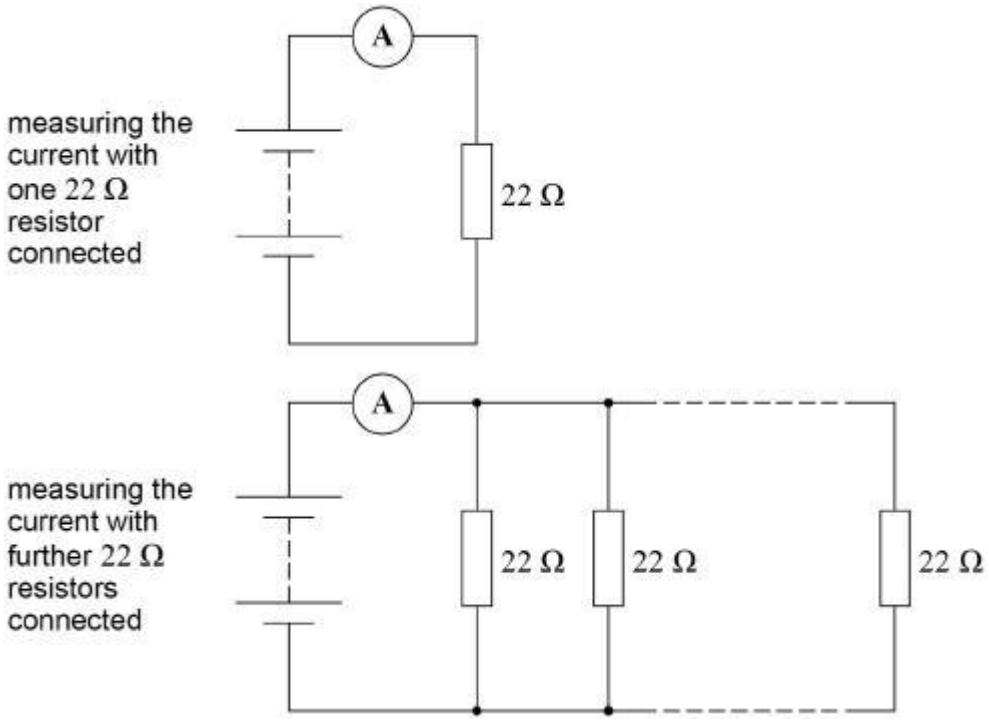
(4)

Figure 2 shows a different experiment carried out to confirm the results for ε and r.

Figure 2



Initially the power supply is connected in series with an ammeter and a 22 Ω resistor. The current I in the circuit is measured.

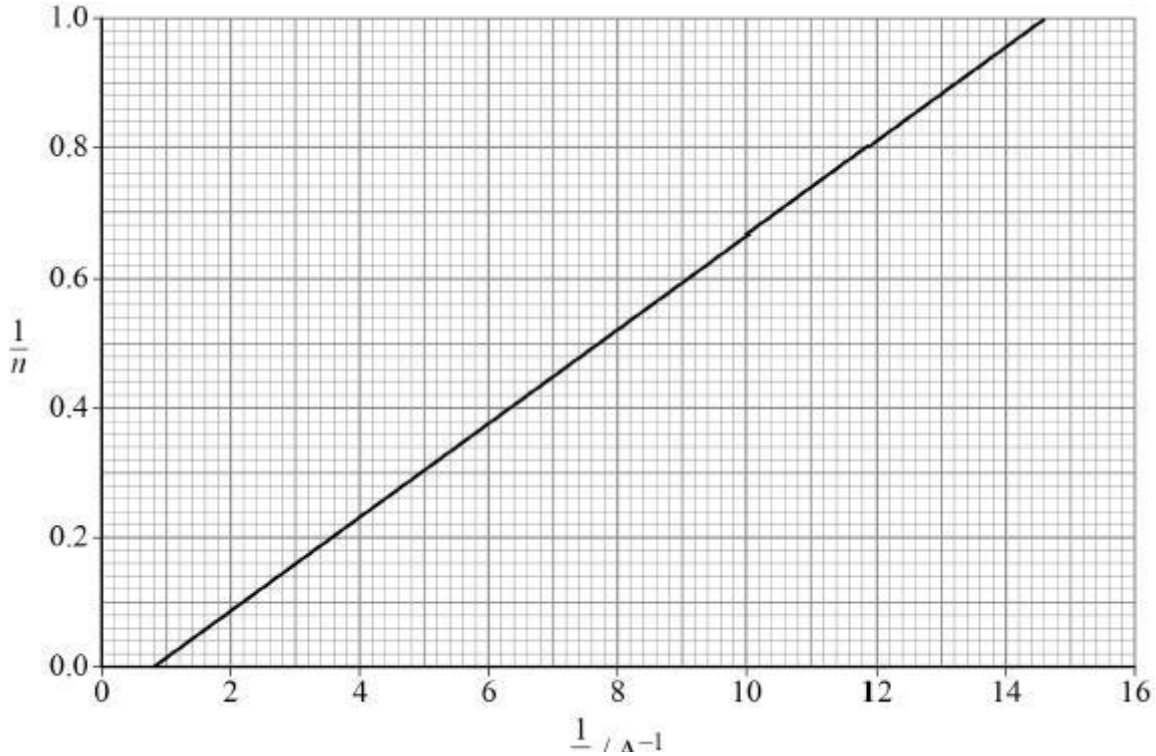
The number n of 22 Ω resistors in the circuit is increased as shown in **Figure 2**. The current I is measured after each resistor is added.

It can be shown that

$$\frac{22}{n} = \frac{\varepsilon}{I} - r$$

Figure 3 shows a graph of the experimental data.

Figure 3

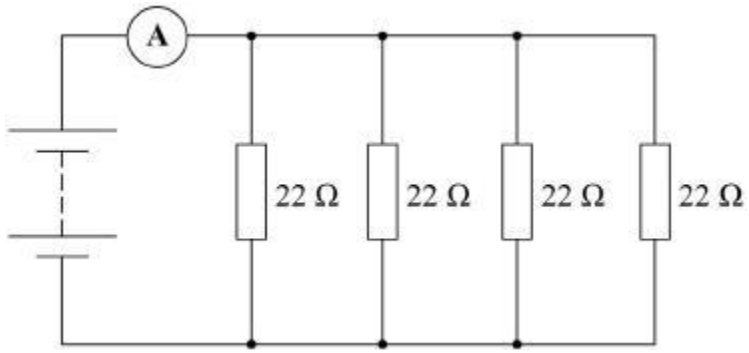


(c) Show that ε is about 1.6 V.

(2)

(d) **Figure 4** shows the circuit when four resistors are connected.

Figure 4



Show, using **Figure 3**, that the current in the power supply is about 0.25 A.

(1)

(e) Deduce, for the circuit shown in **Figure 4**,

- the potential difference (pd) across the power supply
- r.

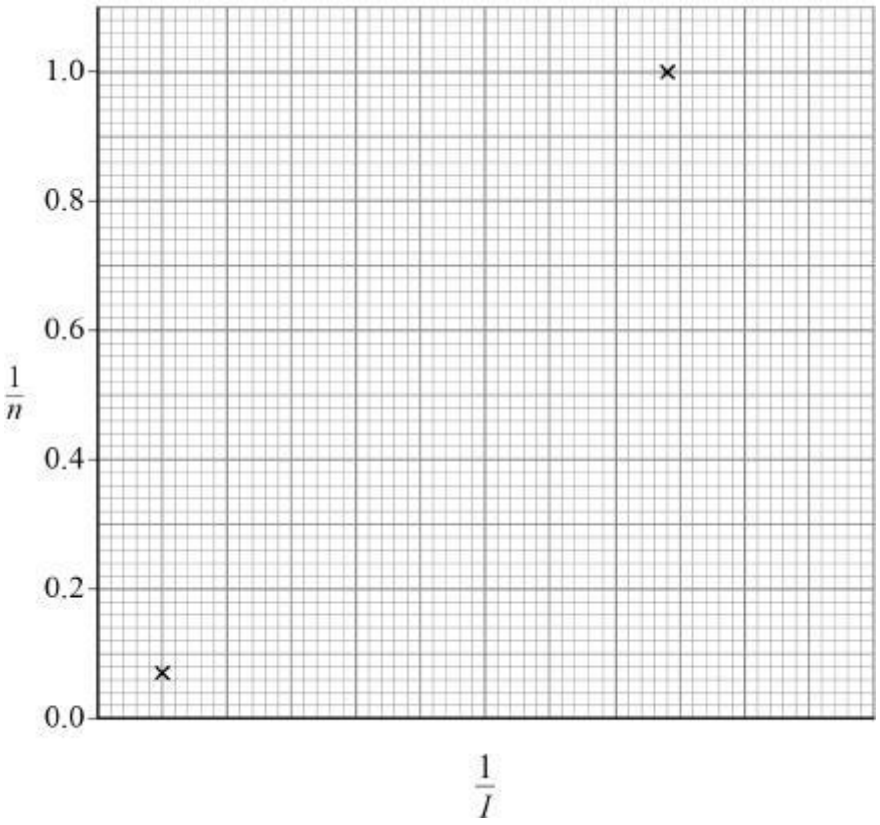
pd = _____ V

r = _____ Ω

(4)

(f) **Figure 5** shows the plots for $n = 1$ and $n = 14$

Figure 5



Three additional data sets for values of n between $n = 1$ and $n = 14$ are needed to complete the graph in **Figure 5**.

Suggest which additional values of n should be used.
Justify your answer.

_____

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_____

_____

_____

_____

(3)

(g) The experiment is repeated using a set of resistors of resistance 27 Ω.

The relationship between n and I is now

Show on **Figure 5** the effect on the plots for $n = 1$ and $n = 14$
You do **not** need to do a calculation.

(2)
(Total 17 marks)