Oxford Cambridge and RSA

A Level Physics A

H556/02 Exploring physics

Question Set 5

1 **(a)** Fig. 18.1 shows a circuit.

Both positive so e.m.fs cancel

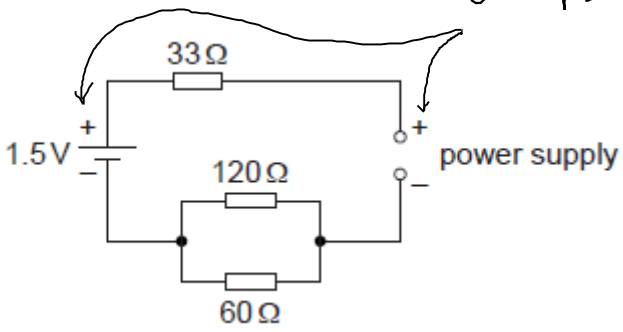


Fig. 18.1

The cell has e.m.f. 1.5 V. The cell and the variable power supply both have negligible internal resistance.

(i) The e.m.f. of the power supply is set at 4.2 V.
Calculate the current I in the 33 Ω resistor.

R of resistors in parallel → $R_p = \left(\frac{1}{60} + \frac{1}{120}\right)^{-1} = 40\ \Omega$

Total $R = 40 + 33 = 77\ \Omega$

$I = \frac{V}{R} = \frac{4.2 - 1.5}{77} = 0.037\ A$

I = 0.037 A **[3]**

(ii) The e.m.f. of the variable supply is now slowly decreased from 4.2 V to 0 V.
Describe the effect on the current I in the 33 Ω resistor. **[2]**

I decreases up to 1.5 V, where it is 0. It then reverses direction and increases below 1.5 V.

(b)* A group of students are investigating the power dissipated in a variable resistor connected across the terminals of a cell. The cell has e.m.f. 1.5 V.
The students determine the power P dissipated in the variable resistor of resistance R.

Fig. 18.2 shows the data points plotted by the students on a graph of P (y-axis) against R (x-axis).

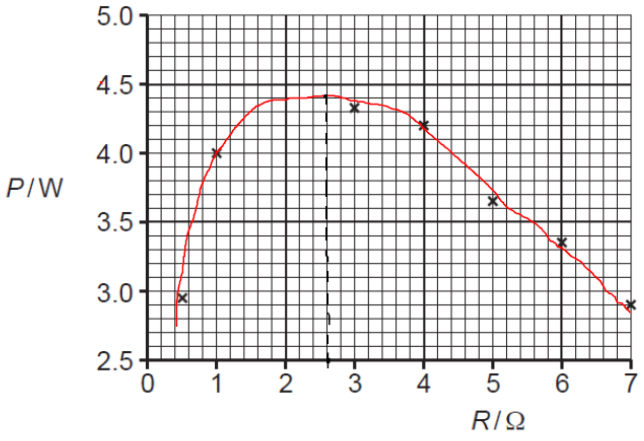
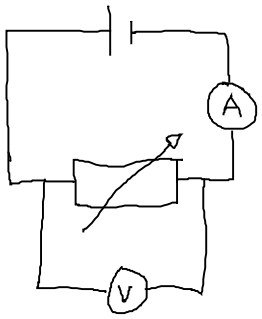


Fig. 18.2

The group of students know that **maximum power** is dissipated in the variable resistor when *R* is equal to the internal resistance *r* of the cell.

Describe, with the help of a suitable circuit diagram, how the students may have determined *P* and *R*. Use Fig. 18.2 to estimate the internal resistance *r* of the cell and discuss any limitations of the data plotted by the group.



- Vary R to get changing values of P
- Measure R by $R = V/I$ from voltmeter and ammeter readings
- Measure P by $P = VI$
- Peak P is at $R = 2.6\,\Omega$ so $r = 2.6\,\Omega$
- Limitations: need more data, especially in the region of the peak between $1\,\Omega$ and $3\,\Omega$. Also, error bars would be useful to aid drawing a line of best fit.

[6]

Total Marks for Question Set 5: 11