

7

(a)

A battery with internal resistance  $r$  is connected to an ideal ammeter, as shown in Fig. 7.1.

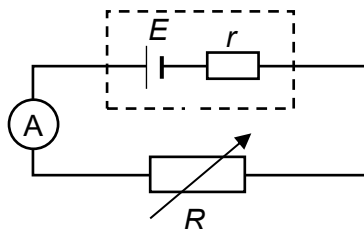


Fig. 7.1

Fig. 7.2 shows the variation of current  $I$  in the circuit with potential difference  $V$  across the variable resistor  $R$ .

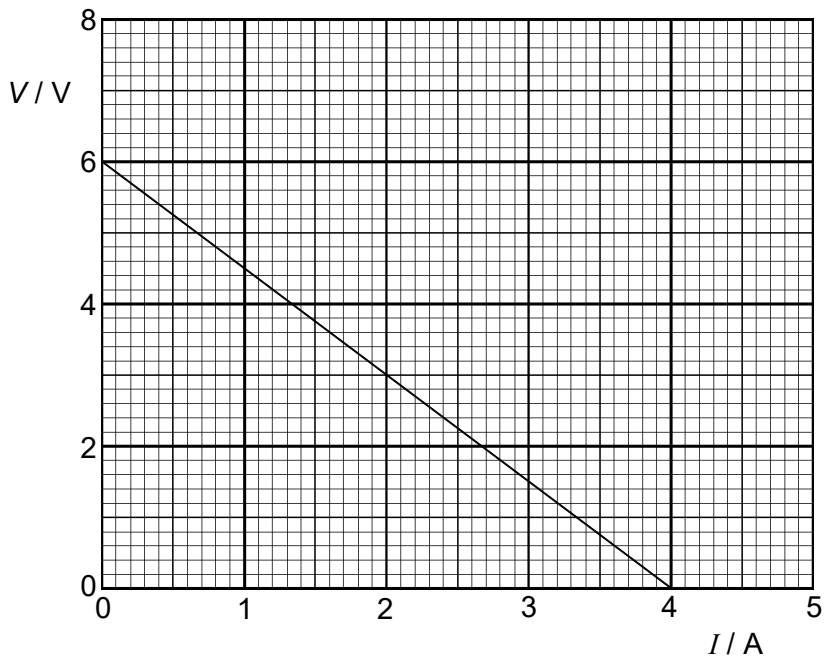


Fig. 7.2

(i)

Define

1. *potential difference*

.....  
.....[1]

2. *resistance*.

.....  
.....[1]

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(ii)

State and explain if the variable resistor is an *ohmic* conductor.

.....  
.....[1]

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(iii)

1. With reference to Fig. 7.2, express  $V$  in terms of  $I$ . [1]

2. Hence, state the e.m.f. of the battery  $E$  and the internal resistance  $r$ .

$E =$  ..... V [1]

$r =$  .....  $\Omega$  [1]

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(iv)

When the current in the variable resistor  $R$  is 0.40 A, calculate the

1. resistance of the variable resistor  $R$ .

2. power dissipated in the variable resistor  $R$ .

$R = \dots\dots\dots \Omega$  [1]

power = ..... W [1]

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**(b)**

Sketch and explain the  $I$ - $V$  graph of a filament lamp.

.....

.....

.....

.....

.....

.....

**(c)**

When a potential difference of 12.0 V is applied across the uniform filament wire of a headlight,  $2.0 \times 10^{20}$  electrons pass through this filament in 6.0 s. The material of the filament has resistivity  $7.9 \times 10^{-7} \Omega \text{ m}$  and its radius is  $9.0 \times 10^{-5} \text{ m}$ .

(i)

Calculate the electric current through the filament wire.

current = ..... A [2]

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**(ii)**

Determine the resistance of this headlight.

resistance = .....  $\Omega$  [1]

**(iii)**

Find the length of the filament in the headlight.

length = ..... m [2]



(d)

A battery of e.m.f.  $9.0\text{ V}$  and internal resistance  $r$  is connected to four ideal voltmeters, one ideal ammeter and six resistors, four of which have values as shown in Fig. 7.3. The voltmeter  $V_2$  reads  $4.0\text{ V}$ .

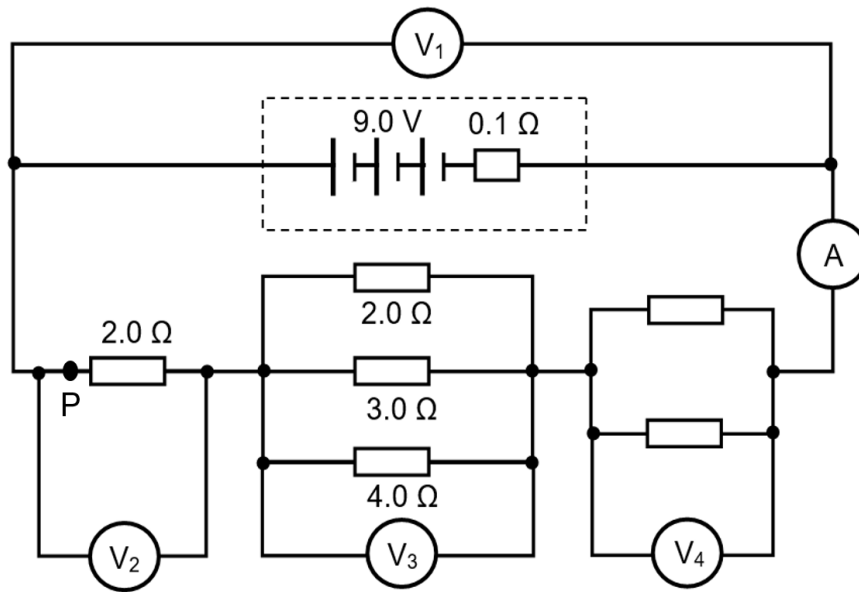


Fig. 7.3

(i)

Calculate the reading of voltmeter,  $V_3$ .

reading of  $V_3 = \dots\dots\dots V$  [2]

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**(ii)**

State the reading on voltmeter,  $V_1$  and  $V_2$  when there is a break in wire at point P.

reading of  $V_1$  = ..... V

reading of  $V_2$  = ..... V [2]

[Total: 20]