

- 7 (a) Electromotive force (e.m.f.) and potential difference (p.d.) may both have the volt as a unit.

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- (i) Define the *volt*.

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

- (ii) By reference to energy transfers, distinguish between e.m.f. and p.d.

e.m.f. ....  
.....  
p.d. ....  
..... [2]

- (b) A cell of e.m.f. 1.5V and internal resistance  $0.25\Omega$  is connected in series with a resistor R, as shown in Fig. 7.1.

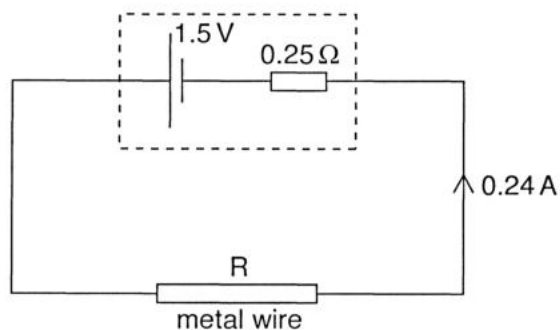


Fig. 7.1

The resistor R is made of metal wire.

A current of 0.24 A passes through R for a time of 5.0 minutes.

Calculate

- (i) the charge that passes through the cell,

charge = ..... C [1]

(ii) the total energy transferred by the cell,

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energy = ..... J [2]

(iii) the energy transferred in the resistor R,

energy = ..... J [3]

(iv) the resistance of R.

resistance = .....  $\Omega$  [2]

- (c) A second similar cell is now connected in series with the cell in (b) and the resistor R. The current in the circuit is 0.41 A and the resistance of R changes.

(i) Calculate the new resistance of R.

resistance = .....  $\Omega$  [2]

- (ii) Resistor R is made of metal wire. Suggest why the answers in (b)(iv) and (c)(i) are different.

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

- (d) The cells in (c) are now connected in series with a fixed resistor of resistance  $2000\ \Omega$  and a thermistor, as shown in Fig. 7.2.

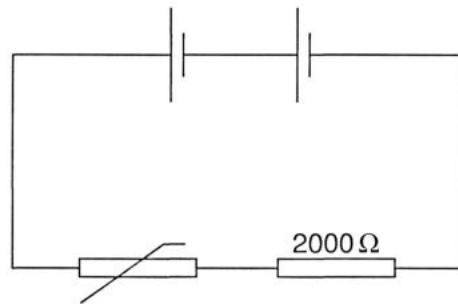


Fig. 7.2

The thermistor has resistance  $4000\ \Omega$  at  $0^\circ\text{C}$  and  $1800\ \Omega$  at  $20^\circ\text{C}$ .

- (i) Explain why, in this circuit, the internal resistance of the cells may be considered to be negligible.

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

(ii) Determine the potential difference across the thermistor

1. at  $0^{\circ}\text{C}$ ,

potential difference = ..... V [1]

2. at  $20^{\circ}\text{C}$ .

potential difference = ..... V [1]

(iii) In one particular application of the circuit of Fig. 7.2, it is desired that the potential difference across the **fixed** resistor should range from 1.2V at  $0^{\circ}\text{C}$  to 2.4V at  $20^{\circ}\text{C}$ .

Determine whether, by substituting a different fixed resistor in the circuit of Fig. 7.2, it is possible to achieve this range of potential differences.

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