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

For Examiner's Use

(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 0.25Ω is connected in series with a resistor R, as shown in Fig. 7.1.

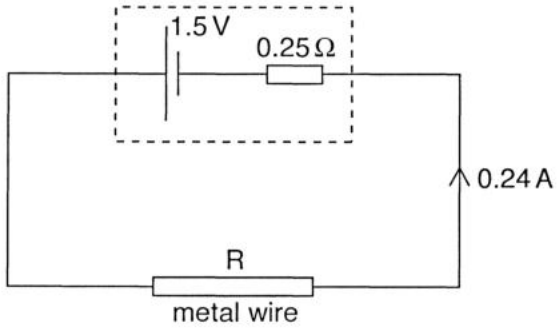

Fig. 7.1

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]

[Turn over

(ii) the total energy transferred by the cell,

For Examiner's Use

energy = ... J [2]

(iii) the energy transferred in the resistor R,

energy = ... J [3]

(iv) the resistance of R.

resistance = ... Ω [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.

For Examiner's Use

(i) Calculate the new resistance of R.

resistance = ... Ω [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 Ω and a thermistor, as shown in Fig. 7.2.

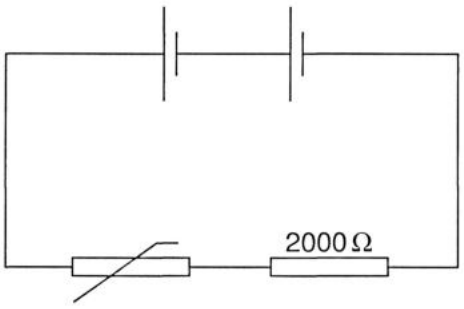

Fig. 7.2

The thermistor has resistance 4000 Ω at 0 °C and 1800 Ω at 20 °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

For Examiner's Use

1. at 0 °C,

potential difference = ... V [1]

2. at 20 °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 °C to 2.4V at 20 °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.

[3]