8 **(a)** By reference to energy transfers, distinguish between electromotive force (e.m.f.) and potential difference (p.d.).

.....

.....

.....

.....[2]

(b) A circuit is set up as shown in Fig. 8.1.

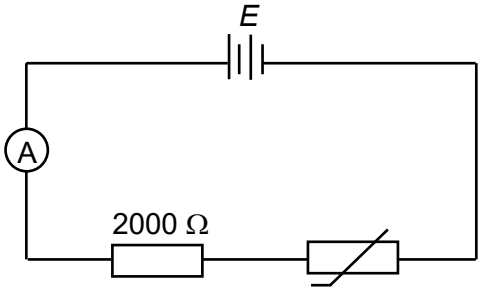

Fig. 8.1

The source of negligible internal resistance is found to provide 2.4×10^5 J of electrical energy to the 2000 Ω resistor and thermistor when a charge of 2.2×10^4 C passes through the ammeter. At room temperature, the thermistor has a resistance of 1800 Ω.

(i) Sketch on Fig. 8.2 the variation with temperature θ of resistance R in a thermistor.

Fig. 8.2

[1]

(ii) For the thermistor at room temperature,

1. show that the e.m.f. of the source is 11 V.

[1]

2. determine the time taken for the charge of 2.2×10^4 C to pass through the ammeter.

time = ... s [2]

3. determine the ratio

$$\frac{\text{power dissipated in thermistor}}{\text{total power supplied by the cell}}$$

ratio = ... [2]

(c) A uniform resistance wire PQ of length 1.2 m is subsequently connected across the resistor and thermistor, as shown in Fig. 8.3. An ideal voltmeter is connected between point Y and a moveable contact M on the wire.

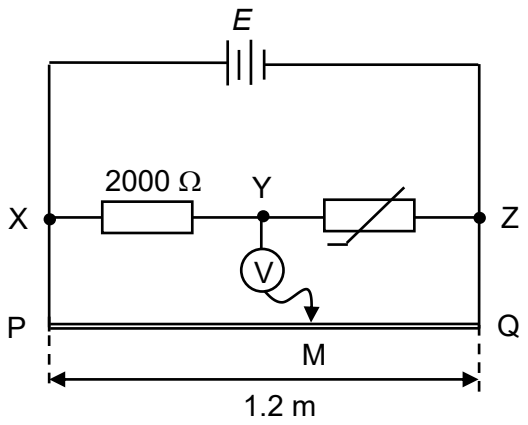

Fig. 8.3

(i) At room temperature, the contact M is moved along PQ until the voltmeter shows zero reading.

Calculate the length of wire between M and Q

length of wire = ... m [2]

(ii) State and explain the effect, if any, on the length of the wire between M and Q for the voltmeter to remain at zero deflection if each of the following changes takes place independently.

1. The thermistor is warmed slightly.

.....

.....

.....[2]

2. A uniform wire of the same material but with a larger cross sectional area is used for PQ.

.....

.....

.....[2]

(d) The heating element of an electric heater is made of nichrome wire. Nichrome has a resistivity of $1.0 \times 10^{-6}\ \Omega$ m at the operating temperature of the heater. The heater is rated at 240 V, 1200 W.

(i) Determine the resistance of the nichrome wire when the heater is operating normally.

resistance = ... Ω [2]

(ii) Calculate the length of nichrome wire of diameter 0.40 mm required for the heater.

length of wire = ... m [2]

(iii) The potential difference across the heater is then reduced to 180 V. Assuming the resistance of the nichrome wire remains constant, state and explain how this change affects the time taken to dissipate the same amount of thermal energy.

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.....

.....

.....[2]

[Total: 20]