3 **(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. 3.1.

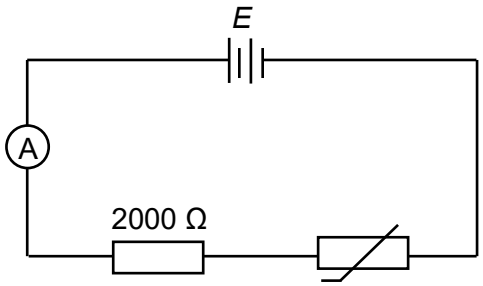

Fig. 3.1

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

For the thermistor at room temperature,

(i) show that E is 11 V.

[1]

(ii) determine the time taken for a charge of 2.2×10^4 C to pass through the ammeter.

time = ... s [2]

(iii) determine the fraction of power dissipated in the thermistor.

fraction = ... [2]

(c) A uniform resistance wire PQ of length 1.2 m is subsequently connected across the resistor and the thermistor, as shown in Fig. 3.3. A sensitive voltmeter is connected between point Y and a moveable contact M on the wire.

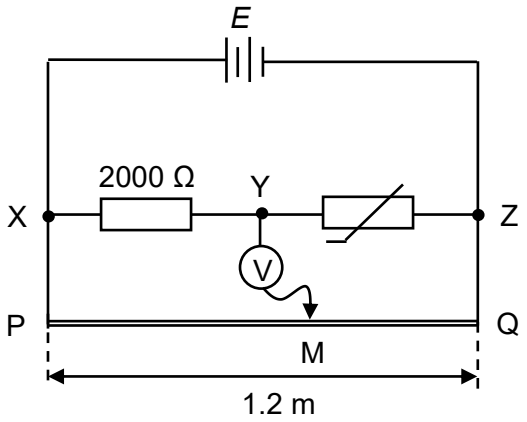

Fig. 3.3

(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 = ... 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.

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.....

.....

.....

..... [2]

2. A uniform wire of the same resistivity but with a bigger cross sectional area is used to replace PQ.

.....

.....

.....

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..... [2]

[Total: 13]