5 (a) (i) Express the volt (V) in SI base units.

SI base units = …… [2]

(ii) The unit for potential difference (p.d) and electromotive force (e.m.f) is the volt.

Explain the difference between p.d. and e.m.f. using energy considerations.

……

……

……

…… [2]

(b) A battery of e.m.f. E and internal resistance r is connected in series with a NTC thermistor of resistance R_T, as shown in Fig. 5.1.

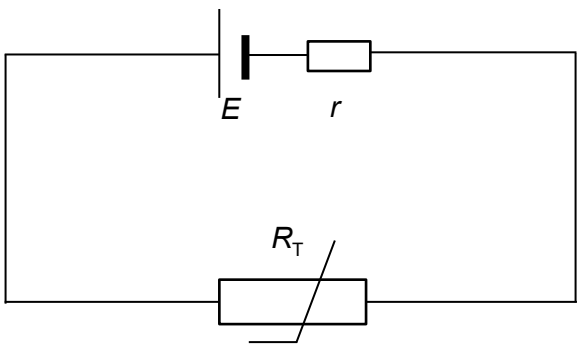

Fig. 5.1

(i) Give expressions, in terms of E, r and R_T for the power P dissipated in the internal resistance.

P = …… [2]

(ii) At 24°C, the resistance of the thermistor is the same as the resistance of the internal resistor.

State and explain the changes to the power dissipated in the internal resistance when the temperature increases.

……

……

…… [2]

(c) Two lengths of resistance wire, X and Y, made from different materials, are connected in series to a power supply, as shown in Fig. 5.2.

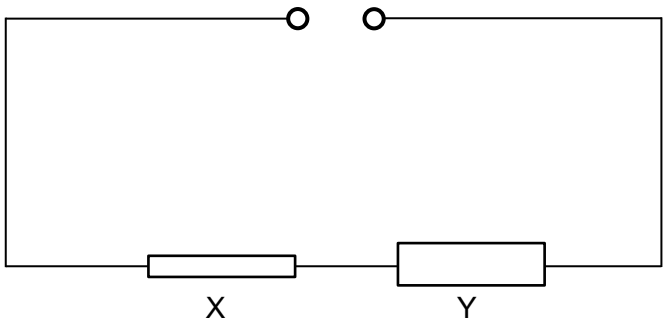

Fig. 5.2

Wire X has half the radius of wire Y.

The drift velocity of the electrons in wire X is three times the drift velocity of the electrons in wire Y.

Determine the ratio

$$\frac{\text{number density of charge carriers in Y}}{\text{number density of charge carriers in X}}.$$

Show your working.

ratio = …… [3]