7 **(a)** Define the resistance of a circuit component.

.....

..... [1]

(b) Fig. 7.1 shows a 5.0V cell with negligible internal resistance connected in series with a uniform resistance wire XY. The resistance wire in Fig. 7.1 is drawn to scale.

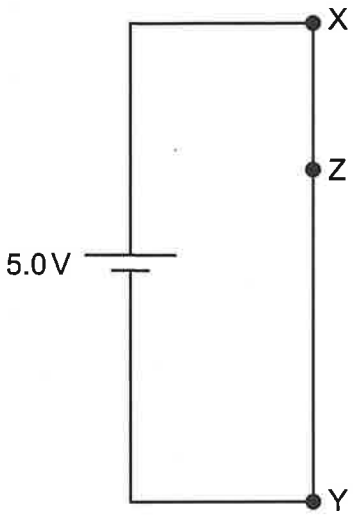

Fig. 7.1

(i) Determine the potential difference (p.d.) between points Z and Y.

p.d. = ... V [2]

(ii) Show that the resistance of a wire is given by

$$R = \frac{\rho D L^2}{m}$$

where ρ is the resistivity of the wire, D is the density of the wire, L is the length of the wire and m is the mass of the wire.

[2]

(iii) A student suggests that, if the length of the wire is doubled, the resistance increases by a factor of four.

Explain whether the student is correct.

.....

.....

.....

..... [2]

(c) (i) On Fig. 7.2, sketch the I-V characteristic for a semiconductor diode.

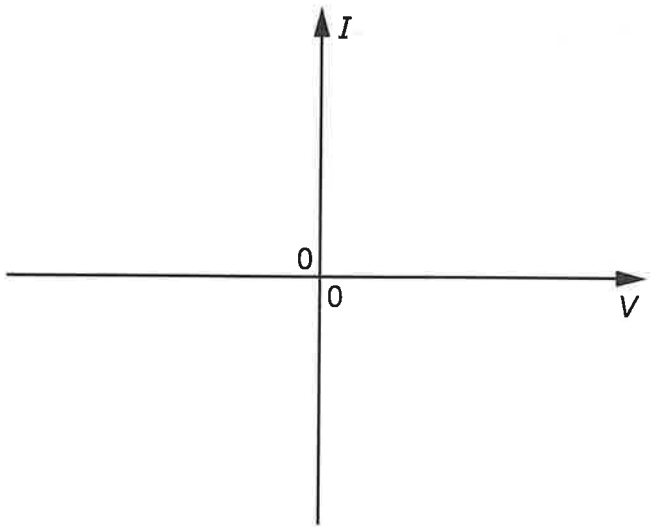

Fig. 7.2

[2]

(ii) Describe how the resistance of the diode varies with V.

.....

.....

..... [2]

(iii) A light emitting diode (LED) is connected in series with a 1.5 V cell and a 250 Ω resistor so that the LED emits light.

Draw a circuit diagram showing how the components are connected.

[2]

(iv) Suggest why the 250 Ω resistor is necessary.

.....

.....

..... [2]

(d) A potential divider circuit is constructed using a battery with negligible internal resistance, a resistor and a negative temperature coefficient (NTC) thermistor, as shown in Fig. 7.3.

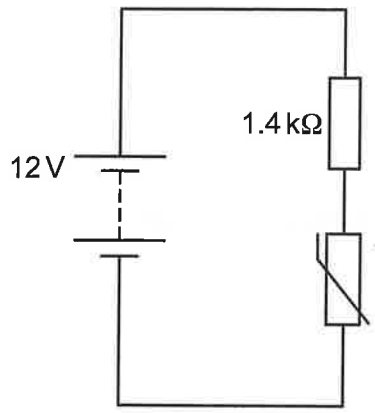

Fig. 7.3

The resistance of the thermistor at 5.0 °C is 1.5 kΩ.

(i) Calculate the p.d. across the fixed resistor when the thermistor is at 5.0 °C.

p.d. = ... V [2]

(ii) Explain what happens to the p.d. across the fixed resistor and the current in the circuit as the temperature of the thermistor rises.

.....

.....

.....

.....

.....

..... [3]

[Total: 20]