1 Fig. 3.1 shows how the resistance of a thermistor varies with temperature.

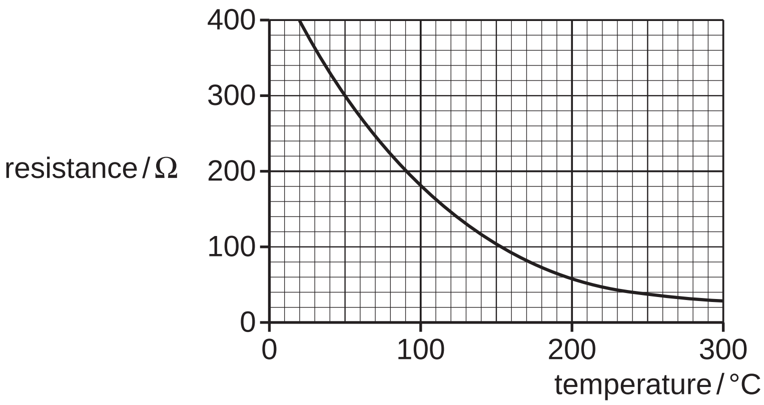

Fig. 3.1

The thermistor is used in the potential divider circuit of Fig. 3.2 to monitor the temperature of an oven. The 6.0 V d.c. supply has zero internal resistance and the voltmeter has infinite resistance.

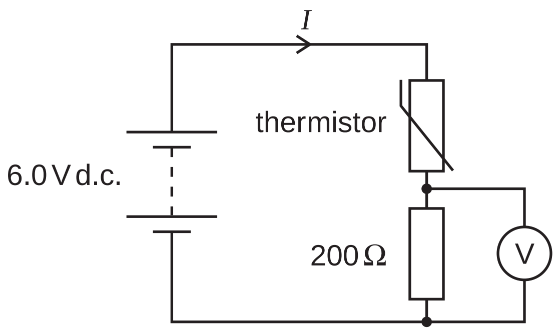

Fig. 3.2

(a) State and explain how the current I in the circuit changes as the thermistor is heated.

....

....

....

....

....

....

....

.... **[3]**

(b) Use Fig. 3.1 to calculate the voltmeter reading when the temperature of the oven is 240 °C.

voltmeter reading = ... V **[4]**

(c) A light-dependent resistor (LDR) is another component used in sensing circuits.

(i) Complete Fig. 3.3 with an LDR between **X** and **Y**.

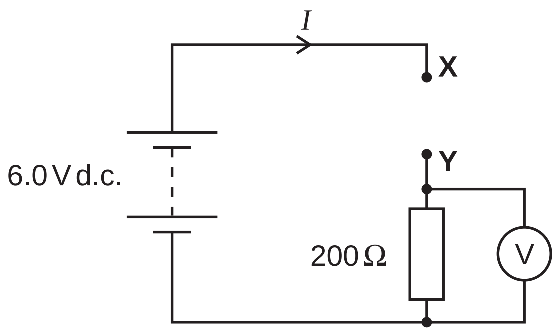

Fig. 3.3

[1]

(ii) State with a reason how the voltmeter reading varies as the intensity of the light incident on the LDR increases.

....

....

....

....

....

.... **[2]**

[Total: 10]

2 Fig. 4.1 shows part of a circuit where three resistors are connected together.

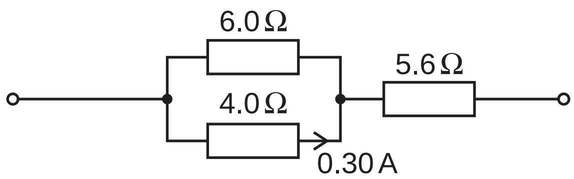

Fig. 4.1

The current in the 4.0Ω resistor is 0.30A.

(a) Explain why the current in the 6.0Ω resistor is 0.20A.

....

....

....

....

.... **[2]**

(b) **(i)** State the law which enables you to calculate the current in the 5.6Ω resistor.

....

.... **[1]**

(ii) Calculate the current in the 5.6Ω resistor.

current = ... A **[1]**

(c) Calculate the total resistance *R* of the combination of resistors.

R = ... Ω **[3]**

(d) To cause the current of 0.30 A in the 4.0 Ω resistor, the resistor combination is connected to a d.c. supply of electromotive force (e.m.f.) 5.0 V.

(i) Explain the term *e.m.f.*

....

....

.... **[2]**

(ii) Show that the terminal potential difference across the supply is 4.0 V.

[1]

(iii) Calculate the internal resistance of the supply.

internal resistance = ... Ω **[2]**

[Total: 12]

3 **(a)** A student wishes to determine the power dissipated in a variable resistor connected to a cell.

(i) Part of the circuit for this experiment is shown in Fig. 3.1. Complete the circuit of Fig. 3.1 showing how the variable resistor is connected and how the potential difference across it is measured. **[3]**

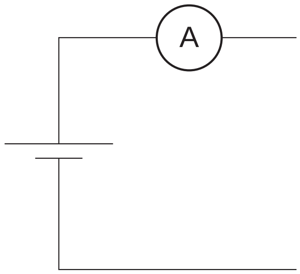

Fig. 3.1

(ii) Fig. 3.2 shows the variation of the potential difference *V* across the variable resistor with the current *I* in it.

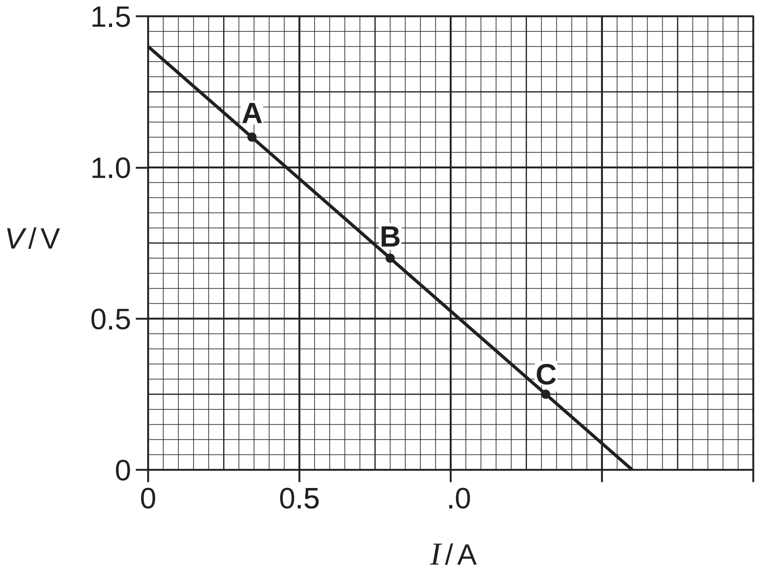

Fig. 3.2

1 The potential difference *V* across the variable resistor is also the terminal p.d. across the cell. Describe how the potential difference across the cell varies with the **resistance** *R* of the variable resistor. Suggest why the terminal p.d. varies in this way.

....

....

....

....

....

 .... **[3]**

2 By referring to the points **A** and **C**, justify that the power dissipated in the variable resistor is a maximum at or near point **B**.

....

....

....

....

.... **[3]**

3 Determine the e.m.f. *E* of the cell.

E = ... V **[1]**

4 Calculate the internal resistance *r* of the cell.

r = ... Ω **[2]**

(b) In Fig. 3.1, the cell is replaced by a solar cell as the source of e.m.f.
A solar cell transforms light energy into electrical energy. The maximum intensity of sunlight on the solar cell is $800\,\text{W}\,\text{m}^{-2}$. The surface area of the cell is $2.5 \times 10^{-3}\,\text{m}^2$.

(i) Define the term *intensity*.

....

.... **[1]**

(ii) The maximum power delivered by the solar cell to the variable resistor is 0.25W. Determine the maximum efficiency of the solar cell.

maximum efficiency = ... **[3]**

[Total: 16]

4 Fig. 4.1 shows how the resistance of a light-dependent resistor (LDR) varies with the intensity of the light incident on it.

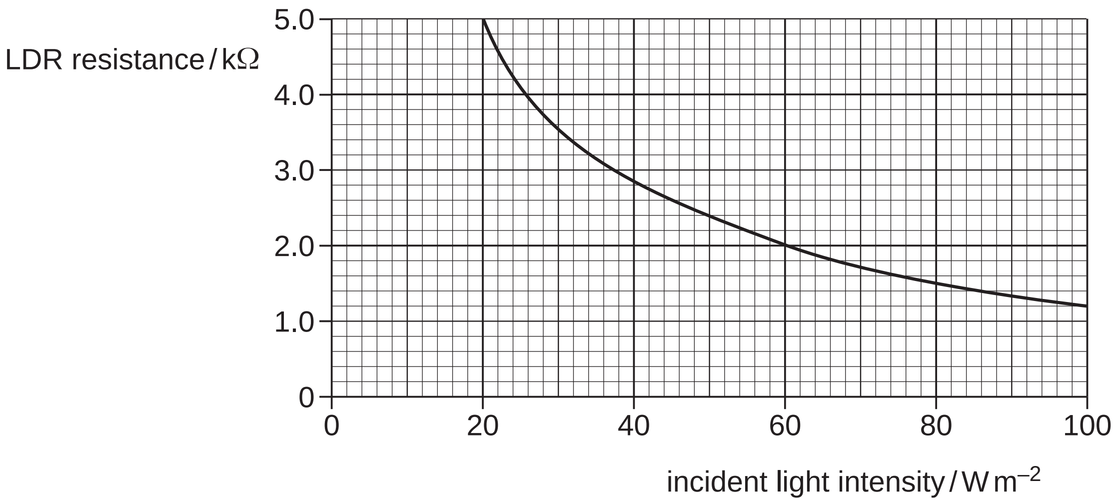

Fig. 4.1

(a) State how the resistance of the LDR changes with light intensity.

.... **[1]**

(b) Fig. 4.2 shows a light-sensing potential divider circuit where the LDR is connected in parallel to a voltmeter and data-logger.

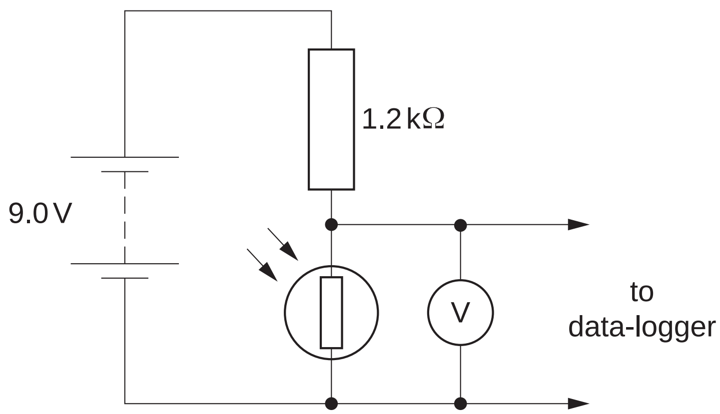

Fig. 4.2

The battery has an e.m.f. of 9.0 V and negligible internal resistance. The 1.2 kΩ resistor is made of carbon. The potential difference across the LDR is 6.0 V.

(i) State the potential difference across the 1.2 kΩ resistor.

potential difference = ... V **[1]**

(ii) Calculate the resistance R of the LDR.

R = ... kΩ **[3]**

(iii) Use Fig. 4.1 to determine the light intensity when the p.d. across the LDR is 6.0V.

light intensity = ... $W\,m^{-2}$ **[1]**

(c) **(i)** Fig. 4.1 shows that the change in resistance when the light intensity rises from $60\,W\,m^{-2}$ to $80\,W\,m^{-2}$ is 0.5kΩ. State the change in resistance when the light intensity rises from $20\,W\,m^{-2}$ to $40\,W\,m^{-2}$.

change in resistance = ... kΩ **[1]**

(ii) Larger changes in data-logger voltage are observed for changes at low light intensity rather than at high light intensity. Explain this.

....

....

....

.... **[2]**

(d) When the circuit of Fig. 4.2 is operated for a long time, the carbon resistor becomes hot. The resistivity of carbon falls as the temperature rises. State and explain the effect on the potential difference across the LDR.

....

....

....

....

....

.... **[3]**

(e) Describe briefly **two** advantages of using a data-logger to monitor the variation of light intensity falling on the LDR.

....

....

....

....

.... **[2]**

[Total: 14]