10. D.C. Circuits

10.3 Potential dividers

Paper 2

Question Paper

1 **(b)** A battery of electromotive force (e.m.f.) 9.0 V and negligible internal resistance is connected in series with a variable resistor X and a thermistor Y as shown in Fig. 5.1.

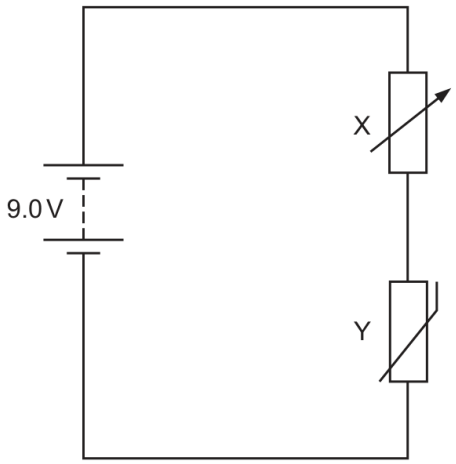


Fig. 5.1

Fig. 5.2 shows the relationship between temperature and resistance for the thermistor.

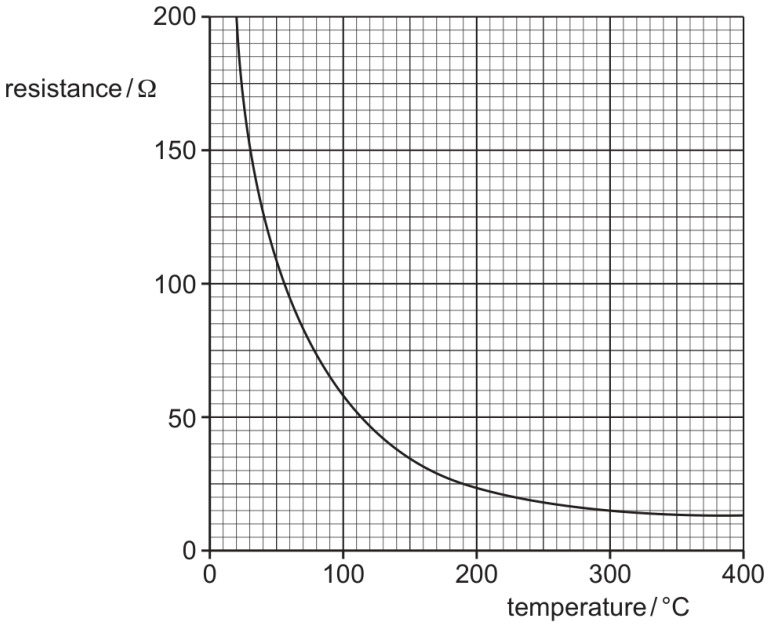


Fig. 5.2

(iii) The resistance of X is increased. The temperature of Y remains at 190 °C.

By reference to the current in the circuit, state and explain the effect of this change, if any, on the potential difference **across Y**.

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..... [3]

2 A battery of electromotive force (e.m.f.) 9.6 V and negligible internal resistance is connected in series with two fixed resistors and a thermistor, as shown in Fig. 7.1.

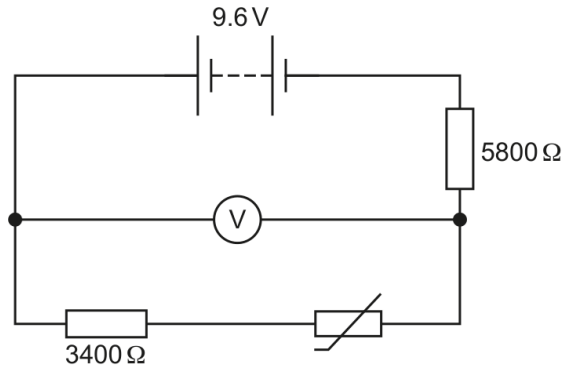


Fig. 7.1

The fixed resistors have resistances of 3400 Ω and 5800 Ω. The reading on the voltmeter in the circuit is 6.0 V.

(d) The environmental conditions change causing an increase in the resistance of the thermistor.

State whether there is a decrease, increase or no change to:

(iii) the potential difference across the thermistor.

..... [1]

3 **(a)** A battery of electromotive force (e.m.f.) 9.0 V and negligible internal resistance is connected to a light-dependent resistor (LDR) and a fixed resistor, as shown in Fig. 7.1.

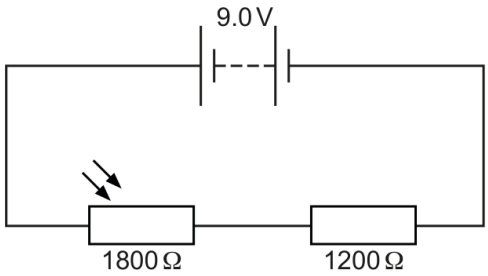


Fig. 7.1

The LDR and fixed resistor have resistances of 1800 Ω and 1200 Ω respectively.

Calculate the potential difference across the LDR.

potential difference = ... V [2]

(b) The circuit in **(a)** is now modified by adding a uniform resistance wire XY and a galvanometer, as shown in Fig. 7.2.

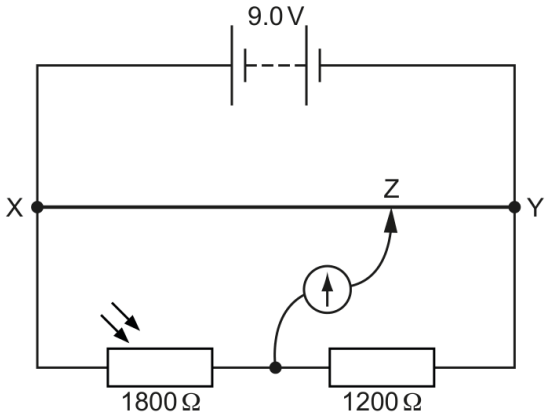


Fig. 7.2 (not to scale)

The length of the wire XY is 1.2 m. The movable connection Z is positioned on the wire XY so that the galvanometer reading is zero.

(i) Calculate the length XZ along the resistance wire.

length XZ = ... m [2]

4 **(b)** A battery of electromotive force (e.m.f.) *E* and negligible internal resistance is connected in series with a fixed resistor and a light-dependent resistor (LDR), as shown in Fig. 6.1.

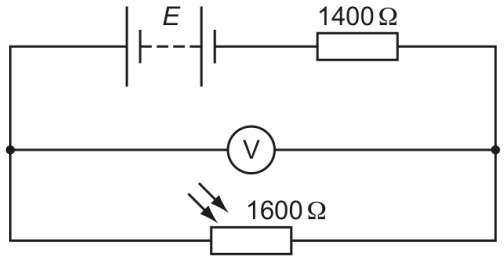


Fig. 6.1

The resistance of the fixed resistor is 1400 Ω. The intensity of the light illuminating the LDR causes it to have a resistance of 1600 Ω. A voltmeter connected across the LDR reads 6.4 V.

(c) The environmental conditions change causing a decrease in the resistance of the LDR in **(b)**. The temperature of the environment does not change.

State whether there is a decrease, increase or no change to:

(iii) the reading of the voltmeter.

..... [1]

5 **(b)** A battery of electromotive force (e.m.f.) 8.0 V and negligible internal resistance is connected to a thermistor, a switch X and two fixed resistors, as shown in Fig. 6.2.

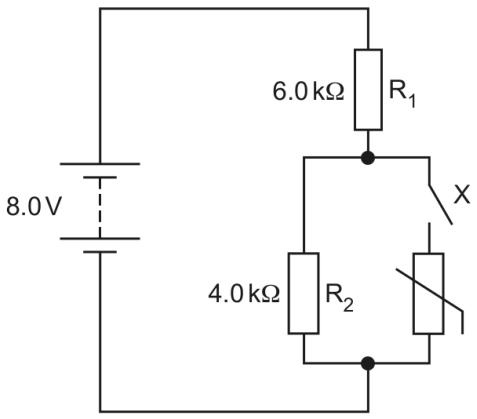


Fig. 6.2

Resistor R_1 has resistance 6.0 kΩ and resistor R_2 has resistance 4.0 kΩ.

(i) Switch X is open.

Calculate the potential difference across R_1.

potential difference = ... V [2]

6 **(c)** Fig. 5.2 shows a circuit with a battery of electromotive force (e.m.f.) 12.0 V connected to a linear potentiometer AB and two identical filament lamps P and Q.

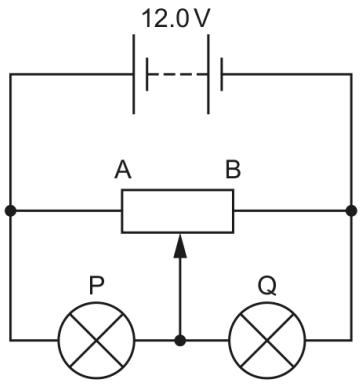


Fig. 5.2

The battery has negligible internal resistance and the lamps each have the same I–V characteristic shown in Fig. 5.1.

When the slider of the potentiometer is at its midpoint, as shown in Fig. 5.2, the current I in the battery is 1.78 A.

(d) The slider of the potentiometer in **(c)** is moved to end A.

State and explain the effect on the brightness of lamps P and Q.

lamp P: .....

.....

lamp Q: .....

.....

[2]

7 **(c)** A cell of e.m.f. 1.2 V is connected to the circuit in **(b)**, as shown in Fig. 5.2.

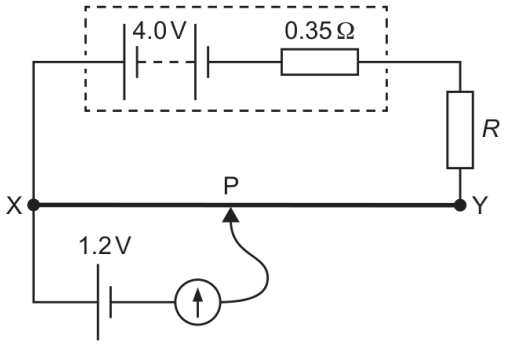


Fig. 5.2

The connection P is moved along the wire XY. The galvanometer reading is zero when distance XP is 0.30 m.

(i) Calculate the total length *L* of wire XY.

L = ... m [2]

(ii) The fixed resistor is replaced by a different fixed resistor of resistance greater than *R*.

State and explain the change, if any, that must be made to the position of P on wire XY so that the galvanometer reading is zero.

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..... [2]

8 **(c)** Three resistors have resistances of 180 Ω, 90 Ω and 30 Ω.

(ii) A potential divider circuit is produced by connecting the three resistors to a battery of electromotive force (e.m.f.) 12 V and negligible internal resistance. The potential divider circuit provides an output potential difference V_{OUT} of 8.0 V.
Fig. 5.2 shows the circuit diagram.

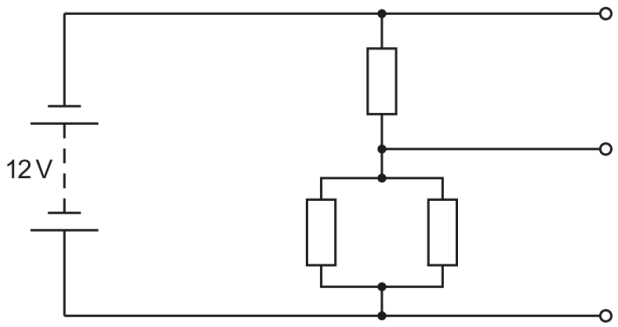


Fig. 5.2

On Fig. 5.2, label the resistances of all three resistors and the potential difference V_{OUT}. [2]

9 **(b)** A student is provided with three resistors of resistances 90 Ω, 45 Ω and 20 Ω.

(ii) A potential divider circuit is produced by connecting the three resistors to a battery of e.m.f. 9.0 V and negligible internal resistance. The potential divider circuit provides an output potential difference V_{OUT} of 3.6 V. The circuit diagram is shown in Fig. 6.2.

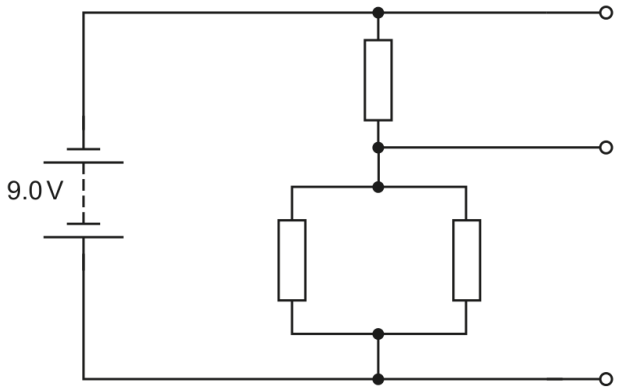


Fig. 6.2

On Fig. 6.2, label the resistances of all three resistors and the potential difference V_{OUT}. [2]