Electricity 2

1.

A potential divider circuit based on a light-dependent resistor (LDR) is shown in Fig. 5.1. The supply has negligible internal resistance.

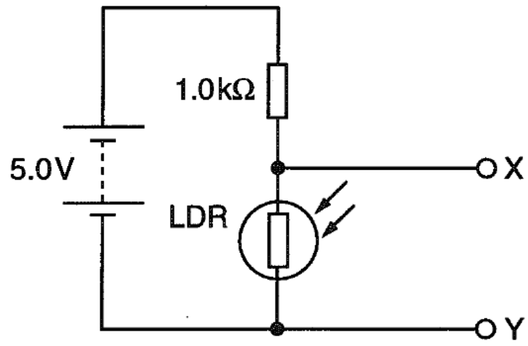

Fig. 5.1

(a) The light intensity falling upon the LDR is increased. State

(i) how the resistance of the LDR changes,

....

.... [1]

(ii) how the p.d. across the LDR changes.

....

.... [1]

(b) At a particular light intensity, the resistance of the LDR is 420 Ω.

(i) Calculate the p.d across the LDR.

p.d. = ... V [3]

(ii) An electronic circuit of resistance 50 Ω is connected between the terminals X and Y.

1. Show that the total resistance of the parallel combination of this electronic circuit and the LDR is about 45 Ω.

[1]

2. Calculate the p.d. across this electronic circuit.

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

2.

(a) Fig. 3.1 shows the circuit symbol for a particular component.

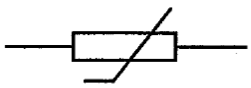

Fig. 3.1

Name the component and state how its resistance changes as the temperature of the component is increased.

[2]

(b) Fig. 3.2 shows a potential-divider circuit. The battery has negligible internal resistance and the voltmeter has very high resistance.

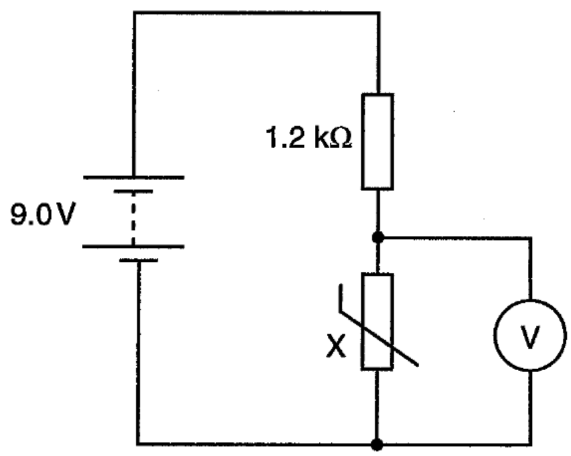

Fig. 3.2

(i) At a particular temperature, the resistance of component X is 4.2 kΩ. Calculate the voltmeter reading.

voltmeter reading = ... V [3]

(ii) State how your answer to **(b)(i)** changes when the temperature of the component X is **increased**.

....

.... [1]

3.

(a) Kirchhoff's first law is based on the conservation of an electrical quantity. State the law and the quantity conserved.

....

....

.... [2]

(b) Fig. 4.1 shows a potential divider circuit. The battery has negligible internal resistance and the voltmeter has very high resistance.

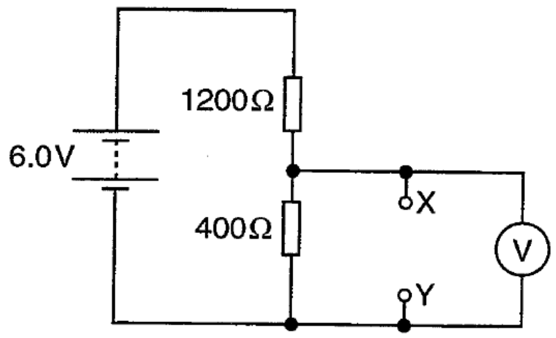

Fig. 4.1

(i) Show that the voltmeter reading is 1.5 V.

[2]

(ii) An electric device rated at 1.5 V, 0.1 A is connected between the terminals X and Y. The device has constant resistance. The voltmeter reading drops to a very low value and the device fails to operate, even though the device itself is not faulty.

1. Calculate the total resistance of the device and the 400 Ω resistor in parallel.

resistance = ... Ω [3]

2. Calculate the p.d across the device when it is connected between X and Y.

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

3. Why does the device fail to operate?

.... [1]

4.

(a) (i) Place a tick (✓) in the box for an alternative unit for the volt.

JC ☐

Js^{-1} ☐

JC^{-1} ☐ [1]

(ii) The statement below is that for Kirchhoff's second law.

The algebraic sum of the e.m.f.s around a loop in a circuit is equal to the algebraic sum of the p.d.s around the loop.

Fig. 5.1 shows an electrical circuit.

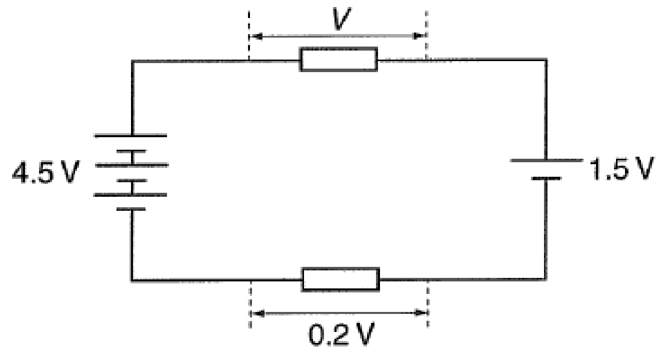

Fig. 5.1

Use this law to determine the p.d. V.

V = ... V [2]

(b) Fig. 5.2 shows a potential divider circuit.

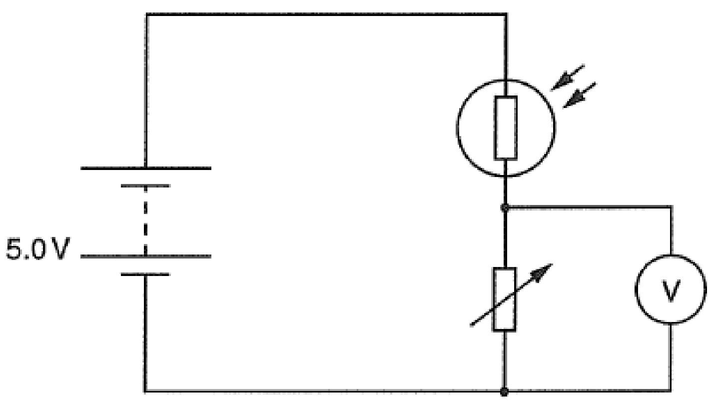

Fig. 5.2

The voltmeter has a very large resistance and the battery may be assumed to have negligible internal resistance.

For a particular intensity of light, the resistance of the LDR is 2.4 kΩ. The variable resistor is set on its maximum resistance of 4.7 kΩ.

(i) Calculate the reading on the voltmeter.

voltmeter reading = ... V [3]

(ii) State how the answer to **(b)(i)** changes when the light intensity is decreased.

....

....

.... [1]

[Total: 7]

5.

(a) Show that the unit for electrical resistivity is Ω m.

[1]

(This question continues on the next page)

(b) Fig. 4.1 shows a simple design for a 'movement' sensor used in an earthquake region. The supply has negligible internal resistance.

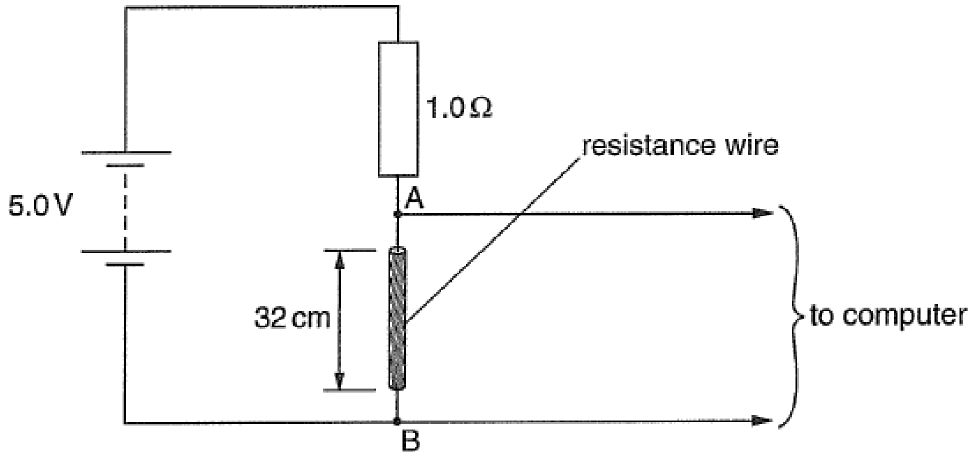

Fig. 4.1

A resistance wire is stretched between two rigid steel plates, not shown in the diagram. During an earthquake, ground movement changes the separation between the plates and so the length of wire changes.

The wire has a radius of 0.62 mm and length 32 cm. It is made of a material of resistivity $6.8 \times 10^{-6}\ \Omega m$.

(i) Show that the resistance of the wire is 1.8 Ω.

[3]

(ii) Calculate the potential difference (p.d.) between A and B.

p.d. = ... V [3]

(iii) The length of the wire increases. State and explain the effect on the p.d. between A and B.

....

....

....[2]

6.

Fig. 4.1 shows a car battery of e.m.f. 12 V and internal resistance 0.014 Ω connected to the starter motor of a car. When the car engine is being started, the car battery provides a current of 160 A to the starter motor.

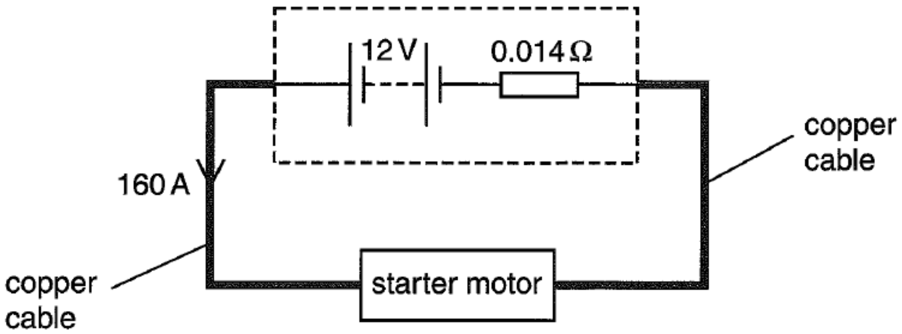

Fig. 4.1

(a) Show that the p.d. across the internal resistance is about 2.2 V.

[1]

(This question continues on the next page)

(b) Determine the terminal p.d. across the battery.

p.d. = ... V [1]

(c) The cables connecting the battery to the starter motor have total length 0.85 m and diameter 8.0 mm.

(i) Show that the cross-sectional area of the cable is 5.0×10^{-5} m^2.

[1]

(ii) The cables are made from copper of resistivity 1.7×10^{-8} Ω m. Calculate the total resistance of the cables.

resistance = ... Ω [3]

(iii) State and explain how your answer to **(c)(ii)** would change if the cable had half the length but twice the diameter.

[2]