Potential Dividers 2

Have a go at the following exam questions.

OCR, G482, JUNE 2011

3 This question is about the use of a light-dependent resistor (LDR) as a light sensor in a potential divider circuit. Fig. 3.1 shows how the resistance of a particular LDR varies with light intensity.

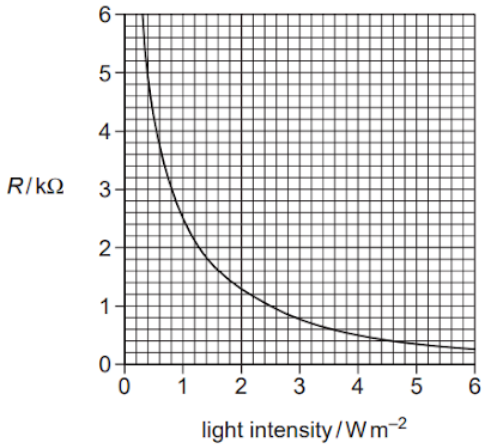

Fig. 3.1

(a) Explain the term *intensity*.

.....

..... **[1]**

(b) The intensity of daylight is about $10\,W\,m^{-2}$ and at night time is about $0.1\,W\,m^{-2}$. Describe how the resistance of the LDR changes during the day compared with how it changes at night.

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..... **[2]**

(c) Fig. 3.2 shows a light-sensing potential divider circuit where the LDR is connected in parallel to the input of an electronic circuit that operates a 230V mains lamp.

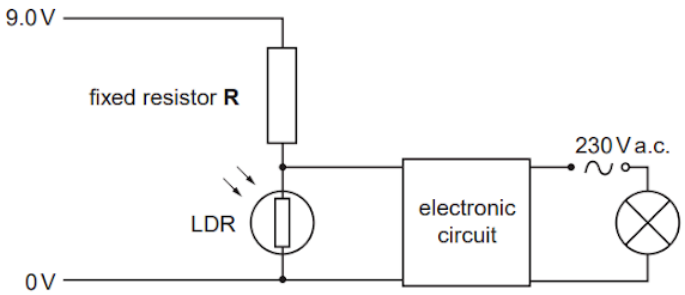

Fig. 3.2

The electronic circuit draws a negligible current. The potential difference across the LDR must be at least 5.0 V to activate the circuit and switch on the lamp. The lamp is switched on when the light intensity falls to 1.0 W m^{-2}.

(i) Use Fig. 3.1 to determine the resistance of the LDR at a light intensity of 1.0 W m^{-2}.

resistance = ... kΩ **[1]**

(ii) Calculate the current in the LDR in Fig. 3.2 for the p.d. across it to be 5.0 V.

current = ... A **[2]**

(iii) Show that the resistance of the fixed resistor **R** in Fig. 3.2 is 2.0 kΩ.

[1]

(d) The lamp switches off when the light intensity reaches 2.5 W m^{-2}. Calculate the p.d. across the LDR when this happens.

potential difference = ... V **[3]**

(e) Explain why the LDR must be shielded or be at some distance from the lamp when it switches on.

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.....

.....

..... **[2]**

[Total: 12]

2. *(a)* (i) Define resistance. [1]

.....

.....

(ii) The unit of resistance is the ohm (Ω). Show that it is possible to express the Ω as [3]

$$J\,s\,C^{-2}$$

.....

.....

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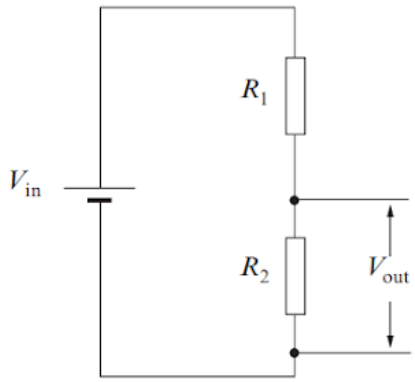
(b) The diagram shows a potential divider.



(i) Write down an equation for the current through resistors R_1 and R_2 when the input pd V_{in} is applied as shown. [1]

.....

.....

.....

(ii) Hence show that the output pd V_{out} is given by the equation [2]

$$V_{out} = \frac{R_2}{R_1 + R_2} V_{in}$$

.....

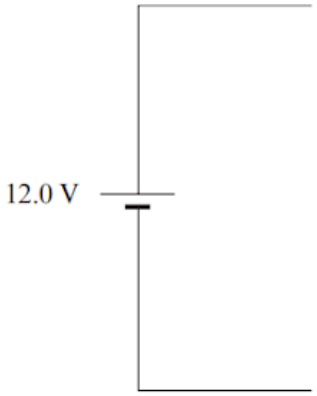
.....

.....

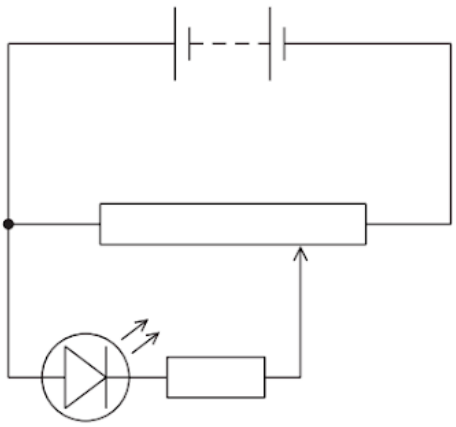
(c) Three resistors are available with values 40 Ω, 40 Ω and 80 Ω.

(i) Draw a diagram showing how **two** of these resistors can be connected together to give a combined resistance of 20 Ω. [2]

(ii) Hence, using all three of the resistors, complete the following potential divider circuit for which V_{out} = 2.4 V when V_{in} = 12.0 V. Clearly label the resistor values and V_{out} on your diagram. [2]



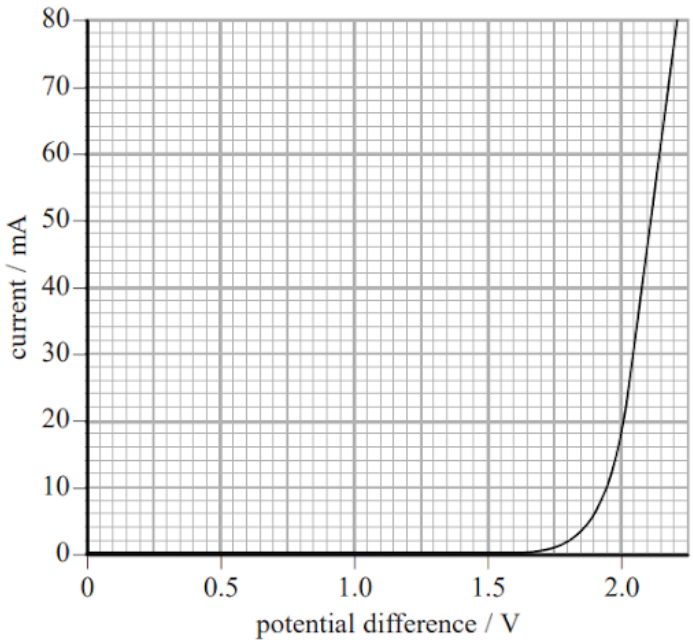
8 A student wanted to plot a graph of current against potential difference for a light emitting diode (LED). He used the circuit shown.



(a) Add an ammeter and a voltmeter to the circuit diagram that would enable the data to be collected.

(1)

(b) The graph of current against potential difference obtained by the student is shown.



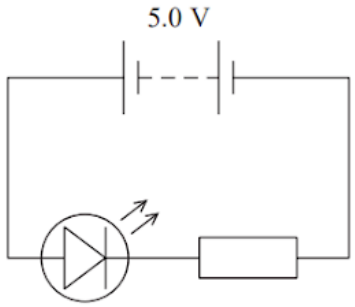
(i) The student wrote the following conclusion.

"The graph shows that in general the LED is not an ohmic conductor. However, for potential differences greater than +2 V, Ohm's law is obeyed since the graph is linear in this region."

Criticise the student's conclusion.

(2)

(ii) The student used the LED with a 5.0 V power supply as shown in the circuit.



To be lit to normal brightness the current through the LED must be 18 mA.

Calculate the resistance of the resistor needed in the circuit.

(4)

Resistance = ...