O Level Pure Physics Structured

Current and DC Circuits Test 3.0

Q1

(a) Fig. 12.1 shows a variable potential divider (potentiometer), a power supply and a lamp.

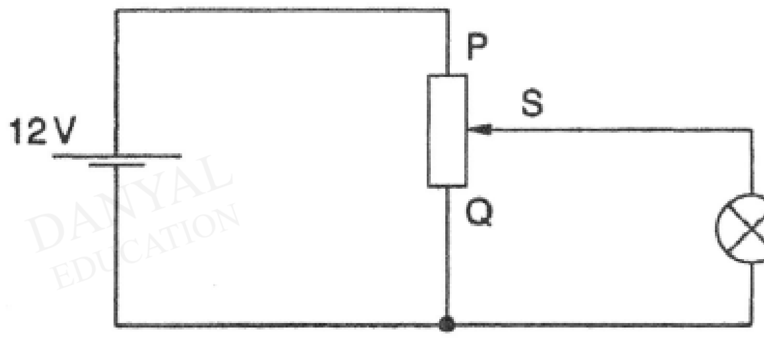


Fig. 12.1

(i) On Fig. 12.1,

1. mark with a letter **X** the position of an ammeter to measure the current in the lamp,

2. add a voltmeter to measure the potential difference (p.d.) across the lamp. [2]

(ii) The sliding contact **S** moves from **P** to **Q**. Describe what happens to the brightness of the lamp.

.... [1]

(b) The lamp is marked 12 V, 200 mA.
When the potential difference across the lamp is in the range 0 to 1.0 V, the resistance of the lamp has a constant value of 11 Ω.

(i) Calculate the current in the lamp when the potential difference across it is 1.0 V.

current = ... [2]

(ii) Calculate the power dissipated by the lamp when the potential difference across it is 1.0 V

power = ... [2]

(iii) On Fig. 12.2, sketch a graph to show how the current in the lamp changes with the p.d. across it. [3]

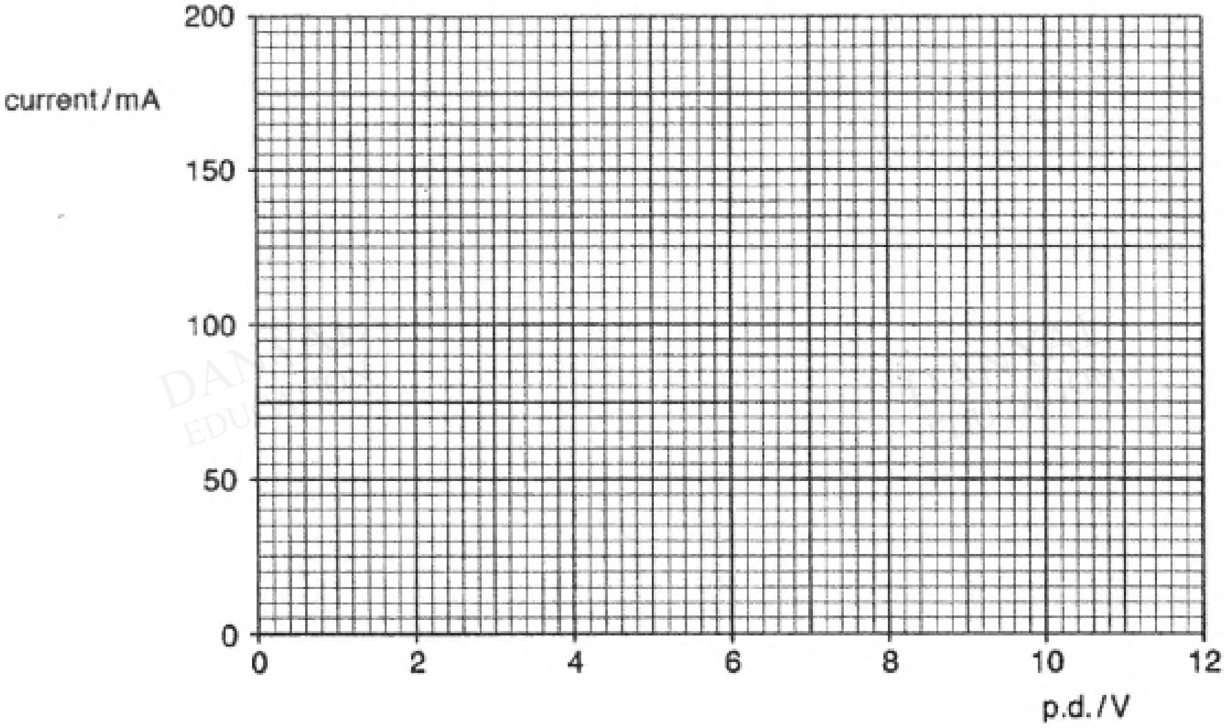
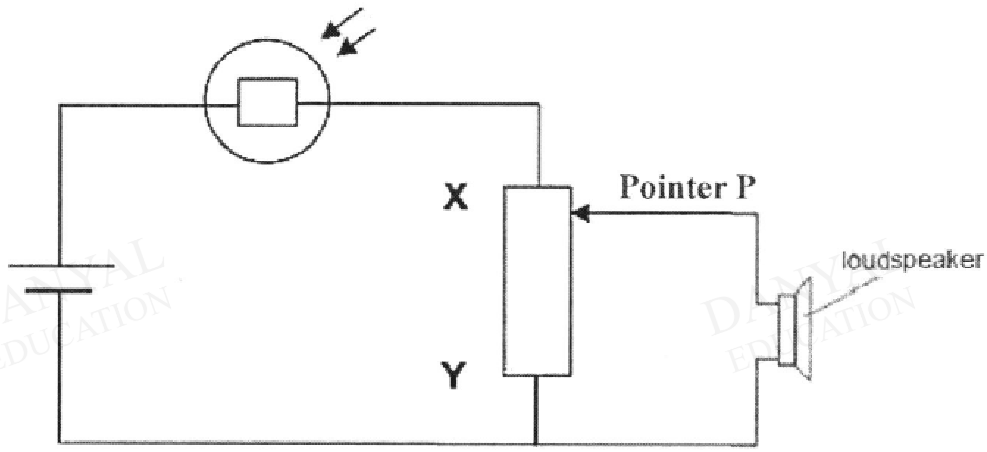


Fig. 12.2

Q2

7. The diagram shows a circuit consists of a light dependent resistor (LDR), a potentiometer **XY** and a loudspeaker.



When little light falls on the LDR, its resistance is 3000 Ω. When the light of strong intensity falls on the LDR, its resistance is 500 Ω.

a) Describe and explain the conditions where the loudspeaker will be the loudest. [3]

....

....

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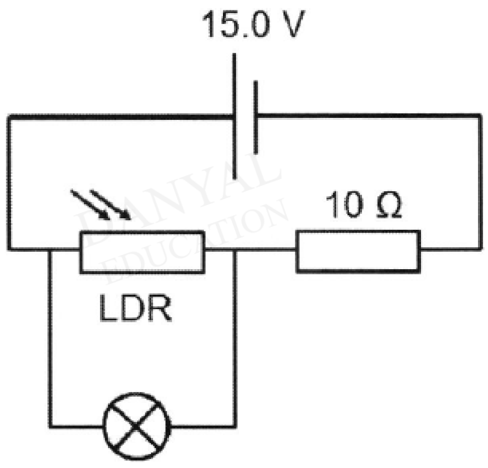
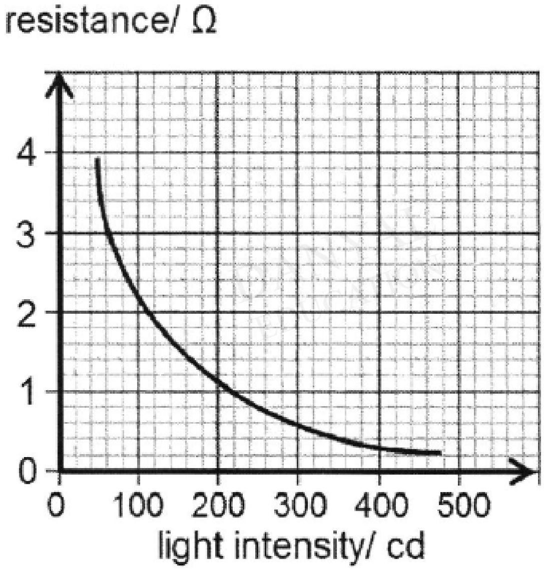
....

Q3

The figure below shows a LDR connected to a battery of e.m.f. 15.0 V in a circuit and a graph that shows how the resistance of the LDR varies with the surrounding light intensity.





(a) Describe and explain how the brightness of the filament lamp changes as the surrounding light intensity decreases.

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____

____

____ [3]

(b) Calculate the current passing through the light bulb when the surrounding light intensity is 100 cd.

current = ________________ [3]

(c) State one practical use for such a circuit.

____ [1]

Q4

Fig. 7.1 shows a potential divider circuit made from a light-dependent resistor (LDR) and a rheostat that is set to 3.0 kΩ. The potential divider is connected in series with a 12 V d.c. power supply and a voltmeter is connected across the LDR.

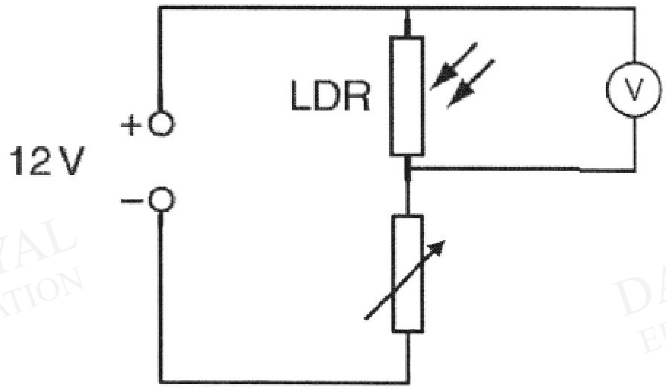

Fig. 7.1

A light shines on the LDR and the resistance of the LDR is 1.0 kΩ.

(a) Calculate

(i) the current in the circuit,

current = ... [2]

(ii) the voltage shown on the voltmeter.

voltage = ... [2]

(b) Describe and explain how the reading of the voltmeter would change when the light intensity decreases.

....

....

.... [2]

(c) Describe and explain the effect of increasing the resistance of the rheostat.

....

....

.... [2]

(d) Suggest a practical use for the circuit in Fig. 7.1.

....

.... [1]

Q5

A battery of e.m.f. E and internal resistance r is connected to a variable resistor as shown in **Fig. 11.1**.

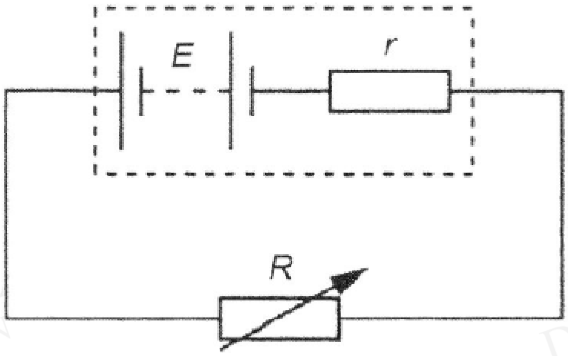

Fig. 11.1

The total power produced in the battery is P_T. The power dissipated in the variable resistor is P_R.

The variations of P_T and of P_R with resistance R of the variable resistor are shown in **Fig. 11.2**.

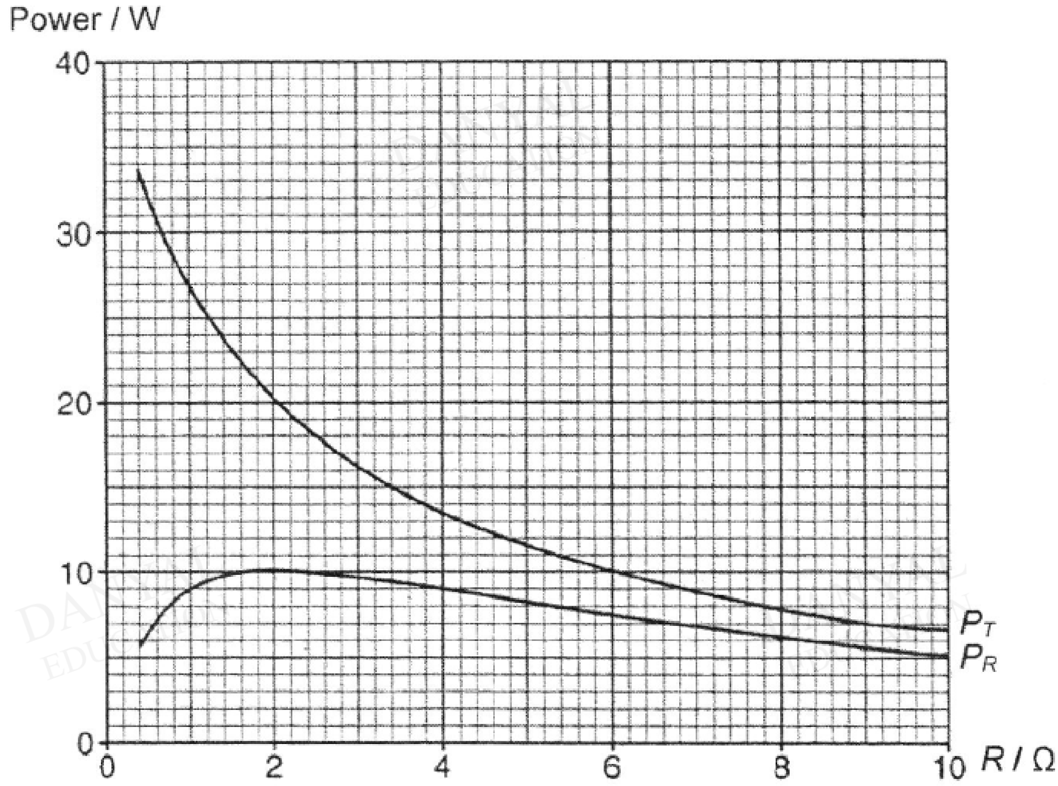

Fig. 11.2

(a) For resistance R = 4.0 Ω, use **Fig. 11.2**

(i) to show that the current in the circuit is 1.5 A, **[2]**

(ii) to determine the work done per unit charge across R,

Work done per unit charge = ... [2]

(iii) to determine the e.m.f. E of the battery.

E = ... [2]

(b) Suggest what is represented by the quantity ($P_T - P_R$).

....

.... [1]

(c) Use the values of P_T and P_R at R = 4.0 Ω and the information in **(a)(i)** to determine the internal resistance r of the battery.

r = ... [2]

Answers

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Q1

12(E) (a)(i)	1. Ammeter must be connected in series with the lamp. 2. Voltmeter must be connected in parallel to the lamp.	[1] [1]
(a)(ii)	Brightness of lamp decreases.	[1]
12(E) (b)(i)	Current (I) = V / R = 1.0 / 11 = **0.091A** (to 2 s.f.) or **0.0909A** (to 3 s.f.)	[1]: W & C/F [1]: A & U
12(E) (b)(ii)	Power = $V^2/R = 1^2 / 11$ = **0.0909W** (to 3 s.f.)	[1]: W & C/F [1]: A & U
12(E) (b)(iii)	• Graph is a straight line from the origin to (1,91) ← accept (1,90) • and then a smooth curve of decreasing gradient after that • and pass through the point (12,200)	[1] [1] [1]

Q2

a)	The LDR must be exposed to a strong light, this reduces overall resistance, thus increasing current [1]
	The pointer P must be placed after X or at X[1] This allows the PD across the loudspeaker to be the maximum[1]

Q3

(a) When the surrounding light intensity decreases, resistance of the LDR increases **[1]**
According to the potential divider rule, potential difference across LDR will increase **[1]**
The lamp will be brighter **[1]**

(b)
resistance of LDR = 2.2 Ω
Total resistance = [1 / ((1/2.2 + 1/5.0)) +] 10
= 11.5 Ω **[1]**
current = 15 / 11.527
= 1.30 A **[1]**
$V_{10\Omega}$ = 1.3 x 10
= 13 V
V_{lamp} = 15 - 13
= 2 V
current in lamp = 2 / 5
= 0.40 A **[1]**

(c) Street lamp **[1]**

Q4

'ai	V=RI or 12 = I(4000) I = 3.0 mA	M1 A1
'aii	$V = \frac{R_{LDR}}{R_{rheostat}+R_{LDR}} \times V$ or $V = \frac{1000}{3000+1000} \times 12$ V = 3.0 V	M1 A1
'b	Voltmeter reading will slowly increase. Because $V_o = \frac{R_{LDR}}{R_{rheostat}+R_{LDR}} \times V_s$. When light intensity decreases, R_{LDR} increases and Voltage will increase accordingly to the formula	B1 B1
c	It will make the circuit less sensitive/needs more changes in light intensity before voltmeter reading change by increasing $R_{rheostat}$, R_{LDR} must change even more before the voltage will make the corresponding change.	B1 B1
d	Light dependent switch/ street light/night lamp	B1

Q5

1ai	When R = 4.0 Ω, P_R = 9.0 W **[1]** $P_R = I^2R \rightarrow I = \sqrt{\frac{P_R}{R}} = \sqrt{\frac{9.0}{4.0}} = 1.5\,\text{A}$ (Shown) **[1]**	[2]
aii	$V = IR = 1.5 \times 4.0 = 6.0\,\text{V}$ (2 or 3 s.f)	Working [1] Ans [1]
aiii	When R = 4.0 Ω, P_T = 13.5 W $P_T = EI \rightarrow E = \frac{P_T}{I} = \frac{13.5}{1.5} = 9.0\,\text{V}$ (2 or 3 s.f)	Working [1] Ans [1]
1b	The power dissipated in the internal resistance of the battery.	[1]
1c	$P_T - P_R = I^2r \rightarrow r = \frac{P_T - P_R}{I^2} = \frac{13.5 - 9.0}{1.5^2} = 2.0\,\Omega$ (2 or 3 s.f)	Working [1] Ans [1]