Current, Potential Difference & Power

Question paper 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Current of Electricity
Sub Topic	Current, Potential Difference & Power
Paper Type	Theory
Booklet	Question paper 1

Time Allowed: **80 minutes**

Score: **/66**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** Distinguish between *electromotive force* (e.m.f.) and *potential difference* (p.d.).

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..... [2]

(b) A battery of e.m.f. 12V and internal resistance 0.50Ω is connected to two identical lamps, as shown in Fig. 6.1.

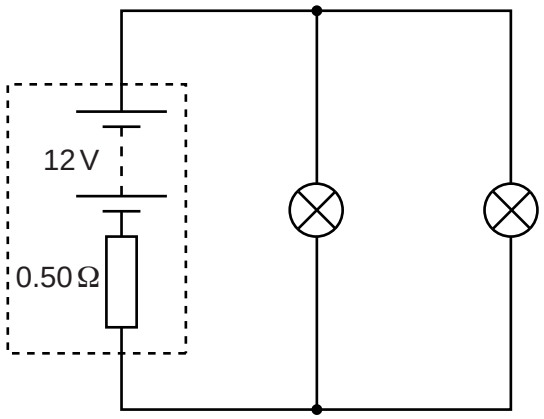

Fig. 6.1

Each lamp has constant resistance. The power rating of each lamp is 48W when connected across a p.d. of 12V.

(i) Explain why the power dissipated in each lamp is not 48W when connected as shown in Fig. 6.1.

.....

.....

..... [1]

(ii) Calculate the resistance of one lamp.

resistance = ... Ω [2]

(iii) Calculate the current in the battery.

current = ... A [2]

(iv) Calculate the power dissipated in one lamp.

power = ... W [2]

(c) A third identical lamp is placed in parallel with the battery in the circuit of Fig. 6.1. Describe and explain the effect on the terminal p.d. of the battery.

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..... [2]

2 **(a)** Define *potential difference* (p.d.).

.....[1]

(b) A power supply of e.m.f. 240 V and zero internal resistance is connected to a heater as shown in Fig. 6.1.

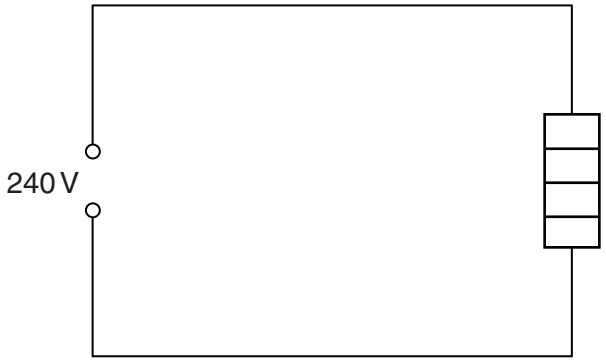

Fig. 6.1

The wires used to connect the heater to the power supply each have length 75 m. The wires have a cross-sectional area 2.5 mm^2 and resistivity 18 nΩ m. The heater has a constant resistance of 38 Ω.

(i) Show that the resistance of each wire is 0.54 Ω.

[3]

(ii) Calculate the current in the wires.

current = ... A [3]

(iii) Calculate the power loss in the wires.

power = ... W [3]

(c) The wires to the heater are replaced by wires of the same length and material but having a cross-sectional area of 0.50 mm^2. Without further calculation, state and explain the effect on the power loss in the wires.

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..... [2]

3 Two resistors A and B have resistances R_1 and R_2 respectively. The resistors are connected in series with a battery, as shown in Fig. 6.1.

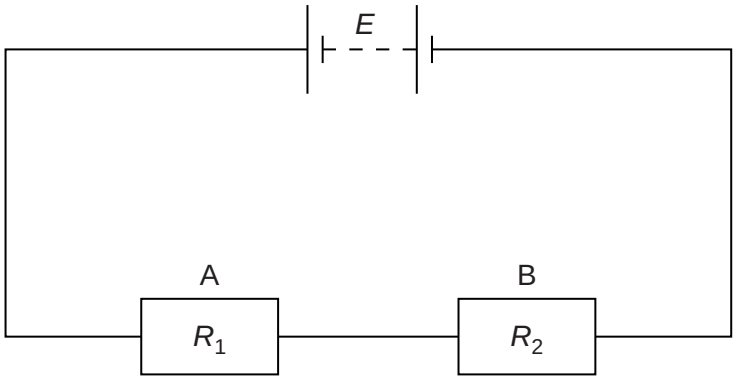

Fig. 6.1

The battery has electromotive force (e.m.f.) E and zero internal resistance.

(a) State the energy transformation that occurs in

(i) the battery,

.....

..... [1]

(ii) the resistors.

.....

..... [1]

(b) The current in the circuit is I.

State the rate of energy transformation in

(i) the battery,

..... [1]

(ii) the resistor A.

..... [1]

(c) The resistors are made from metal wires. Data for the resistors are given in Fig. 6.2.

resistor	A	B
resistivity of metal	ρ	$\rho / 2$
length of wire	l	l
diameter of wire	d	$2d$

Fig. 6.2

Use information from Fig. 6.2 to determine the ratio

$$\frac{\text{power dissipated in A}}{\text{power dissipated in B}}.$$

ratio = ... [3]

(d) The resistors A and B are connected in parallel across the same battery of e.m.f. E. Determine the ratio

$$\frac{\text{power dissipated in A}}{\text{power dissipated in B}}.$$

ratio = ... [2]

4 **(a)** Define *charge*.

.....[1]

(b) A heater is made from a wire of resistance 18.0 Ω and is connected to a power supply of 240 V. The heater is switched on for 2.60 Ms.

Calculate

(i) the power transformed in the heater,

power = ... W [2]

(ii) the current in the heater,

current = ... A [1]

(iii) the charge passing through the heater in this time,

charge = ... C [2]

(iv) the number of electrons per second passing a given point in the heater.

number = ... s^{-1} [2]

5 **(a)** Define *potential difference* (p.d.).

.....[1]

(b) A battery of electromotive force 20 V and zero internal resistance is connected in series with two resistors R_1 and R_2, as shown in Fig. 6.1.

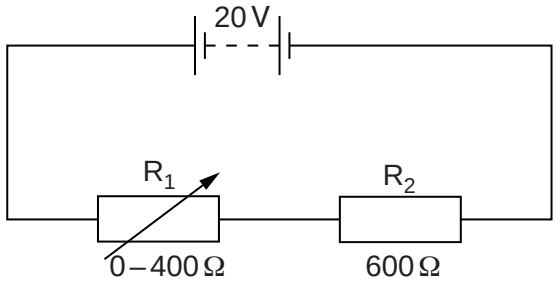

Fig. 6.1

The resistance of R_2 is 600 Ω. The resistance of R_1 is varied from 0 to 400 Ω.

Calculate

(i) the maximum p.d. across R_2,

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

(ii) the minimum p.d. across R_2.

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

(c) A light-dependent resistor (LDR) is connected in parallel with R_2, as shown in Fig. 6.2.

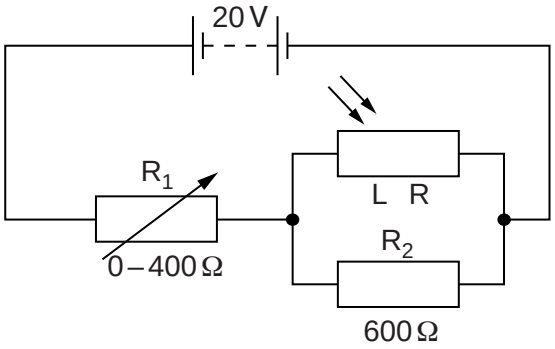

Fig. 6.2

When the light intensity is varied, the resistance of the LDR changes from 5.0 kΩ to 1.2 kΩ.

(i) For the **maximum** light intensity, calculate the total resistance of R_2 and the LDR.

total resistance = ... Ω [2]

(ii) The resistance of R_1 is varied from 0 to 400 Ω in the circuits of Fig. 6.1 and Fig. 6.2. State and explain the difference, if any, between the minimum p.d. across R_2 in each circuit. Numerical values are not required.

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..... [2]

6 **(a)** The output of a heater is 2.5 kW when connected to a 220 V supply.

(i) Calculate the resistance of the heater.

resistance = ... Ω [2]

(ii) The heater is made from a wire of cross-sectional area $2.0 \times 10^{-7}\,m^2$ and resistivity $1.1 \times 10^{-6}\,\Omega m$.

Use your answer in **(i)** to calculate the length of the wire.

length = ... m [3]

(b) The supply voltage is changed to 110 V.

(i) Calculate the power output of the heater at this voltage, assuming there is no change in the resistance of the wire.

power = ... W [1]

(ii) State and explain quantitatively **one** way that the wire of the heater could be changed to give the same power as in **(a)**.

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.....[2]

7 A battery of electromotive force 12V and negligible internal resistance is connected to two resistors and a light-dependent resistor (LDR), as shown in Fig. 4.1.

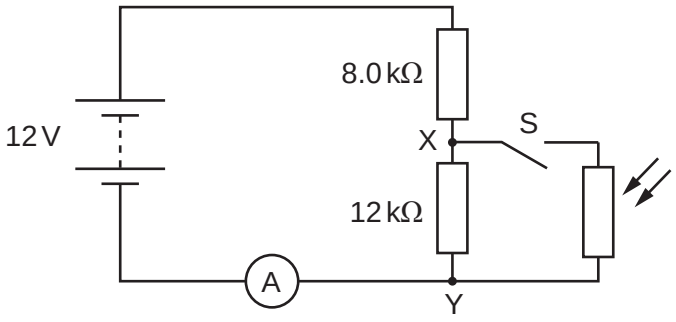

Fig. 4.1

An ammeter is connected in series with the battery. The LDR and switch S are connected across the points XY.

(a) The switch S is open. Calculate the potential difference (p.d.) across XY.

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

(b) The switch S is closed. The resistance of the LDR is 4.0 kΩ. Calculate the current in the ammeter.

current = ... A [3]

(c) The switch S remains closed. The intensity of the light on the LDR is increased. State and explain the change to

(i) the ammeter reading,

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..... [2]

(ii) the p.d. across XY.

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..... [2]