

Energy, Power and Resistance

Question Paper 4

Level	A Level
Subject	Physics
Exam Board	OCR
Topic	Electrons , waves and photons
Sub-Topic	Energy, power and resistance
Booklet	Question Paper 4

Time Allowed: 53 minutes

Score: / 44

Percentage: /100

Grade Boundaries:

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

1 A set of Christmas tree lights consists of 40 identical filament lamps connected in series across a supply of 240V.

(a) Define *resistance*.

.....
 [1]

(b) Each lamp when lit normally carries a current of 250 mA.

Calculate

(i) the potential difference V across a lamp

$V = \dots\dots\dots$ V [1]

(ii) the resistance R of a lamp.

$R = \dots\dots\dots$ Ω [2]

(c) Fig. 1.1 shows the results of an experiment to find how the current in one of the lamps varies with the potential difference across it.

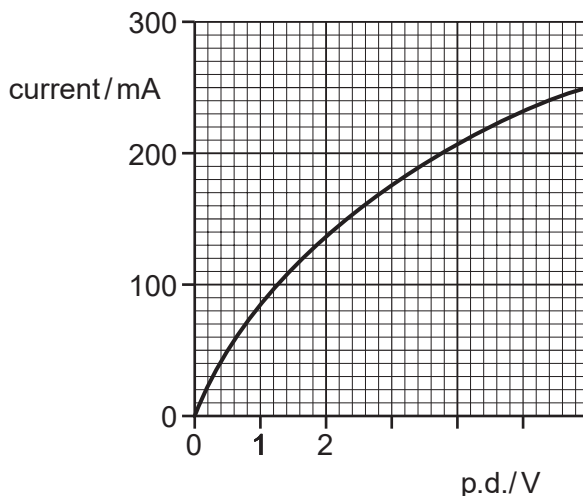


Fig. 1.1

(i) Draw a diagram of the circuit that you would use to perform this experiment.

[3]

(ii) The resistance of the lamp when at room temperature is 10Ω . Using Fig. 1.1 sketch a graph on the axes of Fig. 1.2 of the variation of resistance R with current for the lamp.

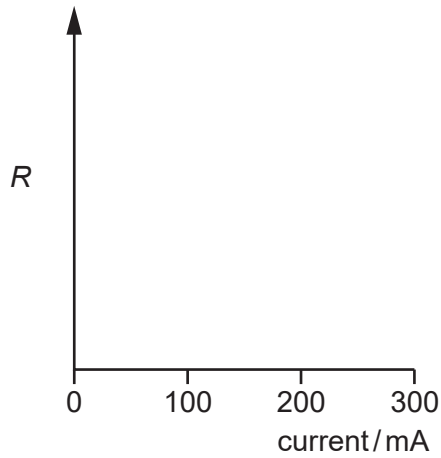


Fig. 1.2

[2]

(iii) Explain why the resistance of the lamp varies as shown by the graph you have drawn on Fig. 1.2.

.....

.....

.....

..... [2]

(d) In an alternative design for the set of Christmas tree lights, a 100Ω resistor is connected in parallel with each lamp.

(i) Describe what happens to the brightness in each set of lamps when one lamp filament burns out.

1 original set
..... [1]

2 alternative set
.....
..... [1]

(ii) Calculate the current drawn from the supply for the alternative set of lamps with all lamps working.

current = A [3]

[Total: 16]

2 Fig. 1.1 shows the $I-V$ characteristic of a filament lamp.

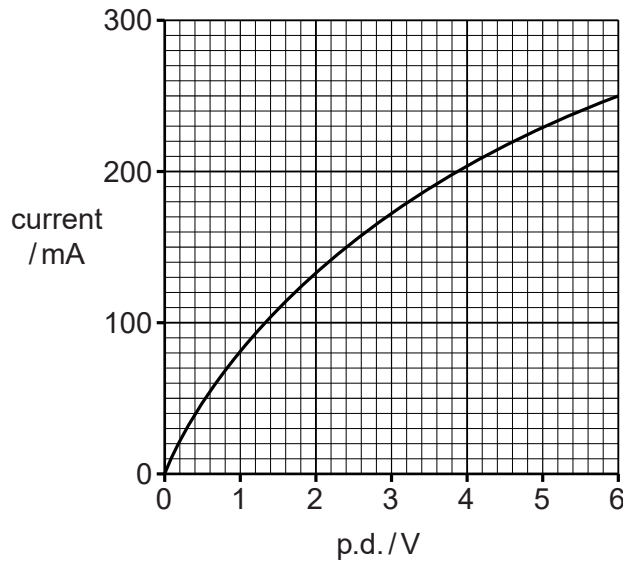


Fig. 1.1

(a) Explain how the graph of Fig. 1.1 shows that the filament lamp does not obey Ohm's law.

.....

.....

..... [2]

(b) You are to carry out an experiment to obtain the $I-V$ characteristic shown in Fig. 1.1.

(i) Draw a suitable circuit diagram for your experiment in the space below. [2]

(ii) Describe how you would carry out the experiment.



In your answer you should make clear how you make the measurements to obtain the data for the characteristic.

.....
.....
.....
.....
.....
..... [3]

(c) The lamp is connected in **parallel** with a resistor of resistance 20Ω to a 6.0V d.c. supply of negligible internal resistance. Use Fig. 1.1 to calculate the current I_p drawn from the supply.

$I_p = \dots\dots\dots$ A [3]

(d) The circuit is rearranged with the lamp connected in **series** with the 20Ω resistor to the same 6.0V supply.

(i) On Fig. 1.1 draw the $I-V$ characteristic of the resistor. [1]

(ii) Use your answer to (i) and Fig. 1.1 to determine the current I_s drawn from the supply. Explain your method.

$I_s = \dots\dots\dots$ A [3]

[Total: 14]

- 3 An electric heater has a constant resistance of 42.5Ω . It is connected to the 230 V mains supply by wires of total resistance 2.50Ω . See Fig. 2.1.

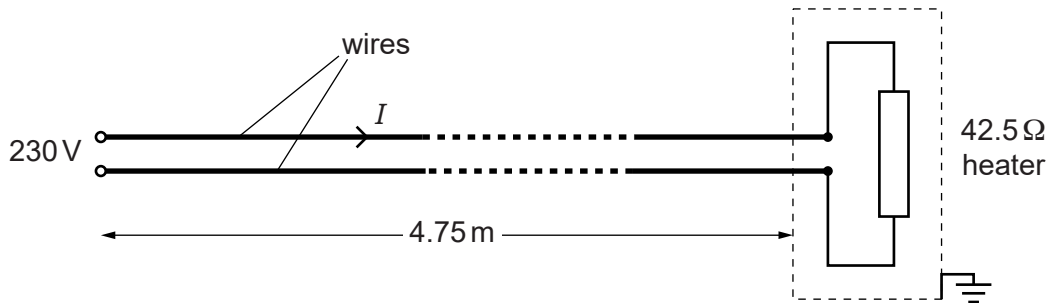


Fig. 2.1

- (a) (i) Show that the current I in the wires is about 5 A.

[2]

- (ii) Calculate the total power P dissipated in the heater and wires. Give your answer to three significant figures.

$P = \dots\dots\dots$ W [3]

- (iii) Suggest a suitable value for the fuse in the plug connecting the cable to the mains supply.

fuse value = $\dots\dots\dots$ A [1]

- (b) Calculate the cost, to the nearest penny, of using this heater for 4.0 hours, when 1 kWh costs 21p.

cost = p [2]

- (c) The wires used to connect the heater to the supply have a total length of 9.50 m. The wires are made of copper. The resistivity of copper is $1.70 \times 10^{-8} \Omega \text{ m}$.

Calculate the cross-sectional area A of the wire.

$A = \dots\dots\dots \text{ m}^2$ [3]

- (d) Suggest and explain **one** disadvantage of connecting the heater to the mains supply using thinner copper wires.

.....
.....
.....
.....
..... [3]

[Total: 14]