

# Electrical circuits

## Question Paper 3

Level	A Level
Subject	Physics
Exam Board	OCR
Topic	Electrons , waves and photons
Sub-Topic	Electrical circuits
Booklet	Question Paper 3

**Time Allowed:** 58 minutes

**Score:** / 48

**Percentage:** /100

**Grade Boundaries:**

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

- 1 Fig. 3.1 shows a thermistor and fixed resistor of  $200\ \Omega$  connected through a switch **S** to a 24V d.c. supply of negligible internal resistance. The voltmeter across the fixed resistor has a very high resistance.

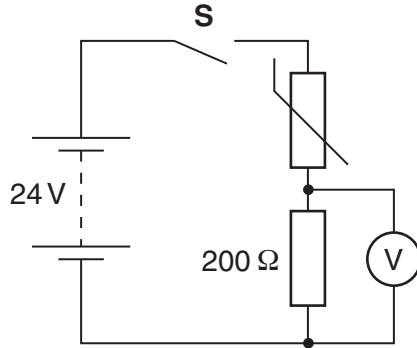


Fig. 3.1

- (a) When the switch **S** is closed the voltmeter initially measures 8.0V.

Calculate

- (i) the current  $I$  in the circuit

$$I = \dots\dots\dots \text{ A [2]}$$

- (ii) the potential difference  $V_T$  across the thermistor

$$V_T = \dots\dots\dots \text{ V [1]}$$

- (iii) the resistance  $R_T$  of the thermistor

$$R_T = \dots\dots\dots \ \Omega \text{ [2]}$$

- (iv) the power  $P_T$  dissipated in the thermistor.

$$P_T = \dots\dots\dots \text{ W [2]}$$

- (b) A few minutes after closing the switch **S** the voltmeter reading has risen to a steady value of 12V. The value of the fixed resistor remains at  $200\Omega$ .

Explain why

- (i) the potential difference across the fixed resistor has increased

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

- (ii) the resistance of the thermistor must now be  $200\Omega$ .

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

- (c) Sketch, on the labelled axes of Fig. 3.2 below, a possible *I-V* characteristic for:

- (i) the fixed resistor. Label it **R**. [2]  
(ii) the thermistor. Label it **T**. [2]

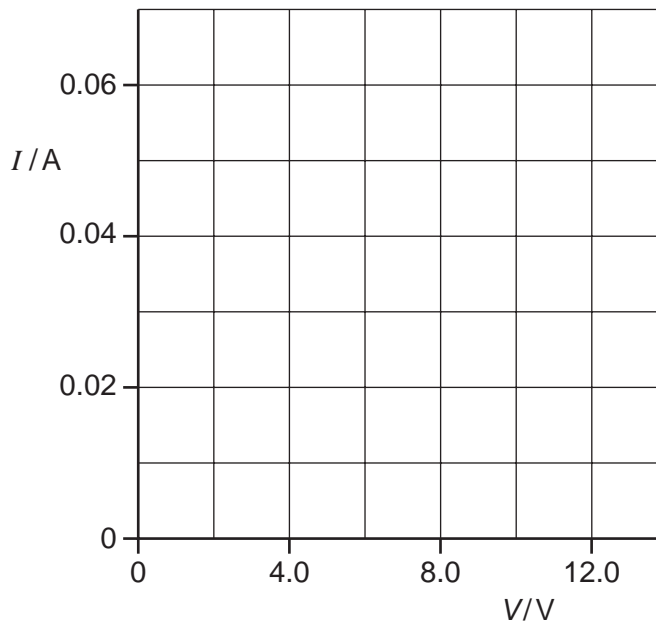


Fig. 3.2

[Total: 15]

- 2 Fig. 3.1 shows a circuit consisting of a battery of electromotive force 16.0V and negligible internal resistance, two resistors and a thermistor.

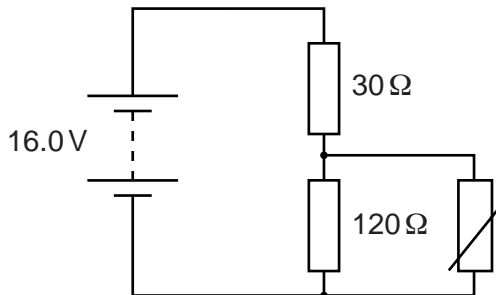


Fig. 3.1

- (a) (i) Define the term *electromotive force* (*e.m.f.*).

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

- (ii) Explain the meaning of the term *internal resistance*.

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

- (b) The thermistor has a resistance of 360 Ω at 20 °C. Calculate

- (i) the total resistance *R* of the thermistor and the resistor of resistance 120 Ω at 20 °C

$R = \dots\dots\dots \Omega$  [2]

- (ii) the potential difference *V* across the thermistor.

$V = \dots\dots\dots V$  [3]



3 (a) Fig. 2.1 shows combinations of resistors connected to a power supply of e.m.f.  $E$ .

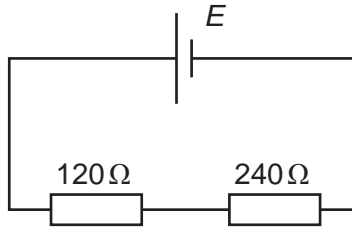


Fig. 2.1a

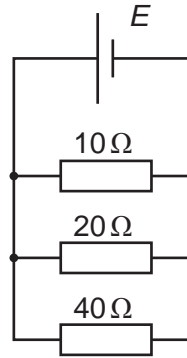


Fig. 2.1b

(i) For the circuit of Fig. 2.1a

1 calculate the total resistance  $R_s$

$R_s = \dots\dots\dots \Omega$  [1]

2 state one electrical quantity which is the same for both resistors.

$\dots\dots\dots$  [1]

(ii) For the circuit of Fig. 2.1b

1 calculate the total resistance  $R_p$

$R_p = \dots\dots\dots \Omega$  [2]

2 state one electrical quantity which is the same for all the resistors.

$\dots\dots\dots$  [1]

- (b) Fig. 2.2 shows the  $I$ – $V$  characteristics of two electrical components, a resistor, line **R** and a thermistor, line **T**.

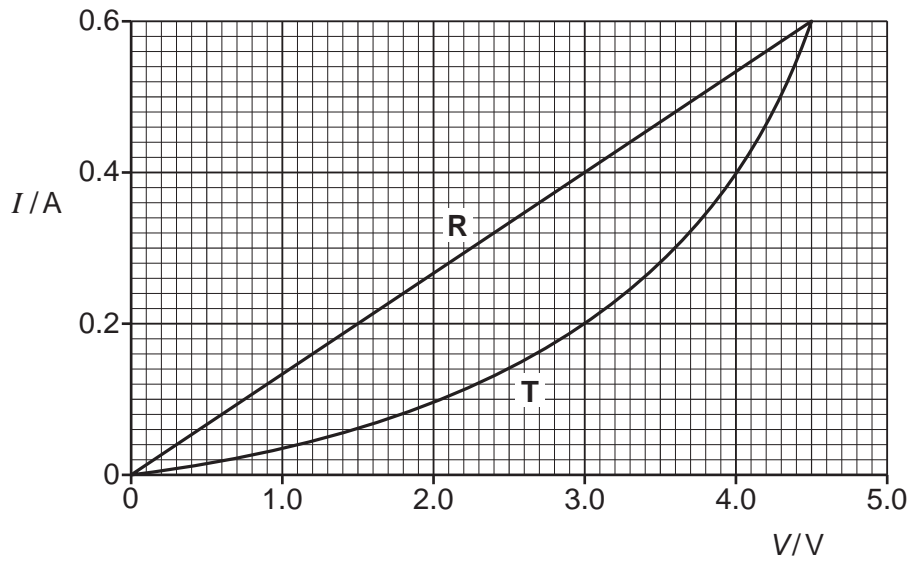


Fig. 2.2

- (i) State Ohm's law. Use Fig. 2.2 to explain why component **R** obeys Ohm's law.

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**[3]**

- (ii) The resistor and the thermistor can be connected to a variable voltage supply of negligible internal resistance in two ways as shown in Fig. 2.3a and Fig. 2.3b.

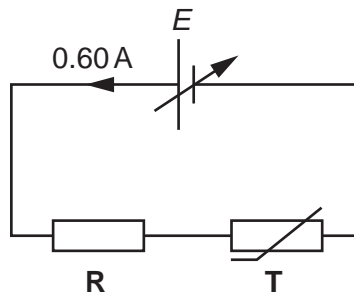


Fig. 2.3a

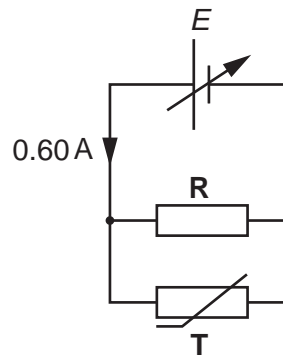


Fig. 2.3b

The voltage of the supply is varied in each circuit until the current drawn from it is 0.60 A. Use data from Fig. 2.2 to explain why the e.m.f.  $E$  of the supply is

1 9.0V in Fig. 2.3a

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

2 3.0V in Fig. 2.3b.

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

(iii) The thermistor is now connected on its own across the terminals of the supply set at 4.5V. Fig. 2.4 shows the variation of current  $I$  with time  $t$  from the moment the thermistor is connected to the supply.

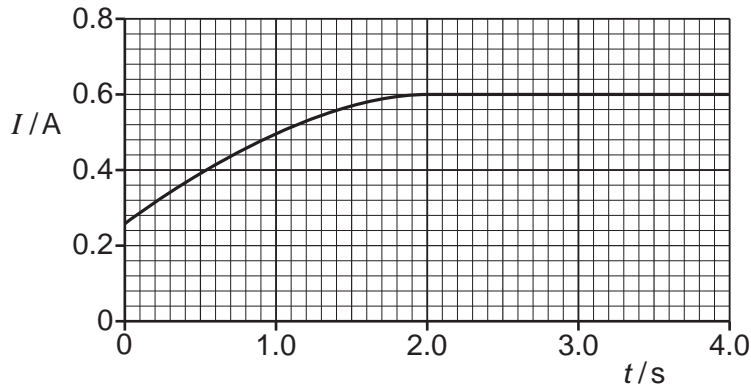


Fig. 2.4

Explain the shape of the graph in Fig. 2.4.

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..... [3]