

6 (a) Define electric potential difference.

[1]

(b) A battery is connected to two resistors X and Y, as shown in Fig. 6.1.

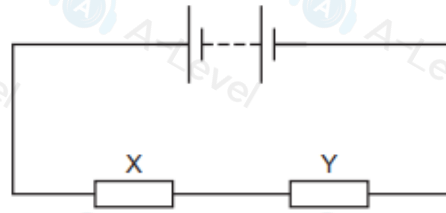


Fig. 6.1

The resistance of resistor X is greater than the resistance of resistor Y.

State and explain which resistor dissipates more power.

[3]

(c) A battery of electromotive force (e.m.f.) 9.0V and internal resistance r is connected to two resistors P and Q, as shown in Fig. 6.2.

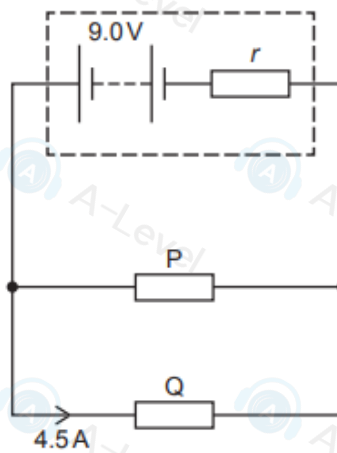


Fig. 6.2

A total charge of 650C moves through resistor P in a time interval of 540s. During this time resistor P dissipates 4800J of energy. The current in resistor Q is 4.5A. Assume that the e.m.f. of the battery remains constant.

Calculate:

(i) the current in resistor P

current = A [2]

(ii) the potential difference across resistor P

potential difference = V [2]

(iii) the internal resistance r of the battery.

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

[Total: 10]

- 6 The ends of a metal resistance wire are connected to a battery of electromotive force (e.m.f.) 8.0V and negligible internal resistance, as shown in Fig. 6.1.

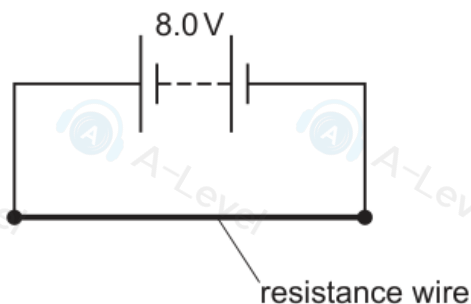


Fig. 6.1

The power dissipated by the resistance wire is 36 W.

(a) Calculate:

- (i) the current in the resistance wire

current =A [2]

- (ii) the number of free electrons that pass through the resistance wire in a time of 50 s

number = [2]

- (iii) the resistance of the wire.

resistance = Ω [2]

- (b) The metal of the resistance wire in the circuit has a resistivity of $1.4 \times 10^{-6} \Omega \text{m}$. The cross-sectional area of the wire is 0.25 mm^2 .

- 6 (a) A network of three resistors of resistances R_1 , R_2 and R_3 is shown in Fig. 6.1.

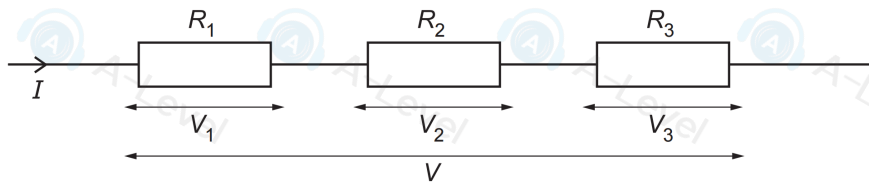


Fig. 6.1

The individual potential differences across the resistors are V_1 , V_2 and V_3 . The current in the combination of resistors is I and the total potential difference across the combination is V .

Show that the combined resistance R of the network is given by

$$R = R_1 + R_2 + R_3.$$

[2]

- (b) A battery of electromotive force (e.m.f.) 8.0V and negligible internal resistance is connected to a thermistor, a switch X and two fixed resistors, as shown in Fig. 6.2.

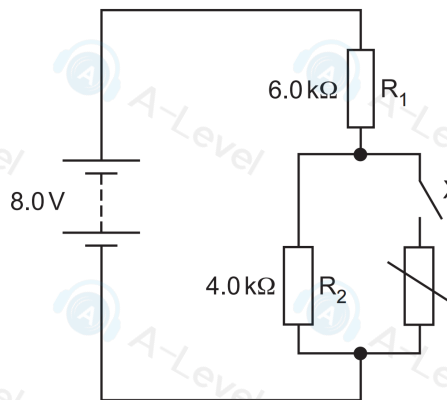


Fig. 6.2

Resistor R_1 has resistance 6.0 k Ω and resistor R_2 has resistance 4.0 k Ω .

(i) Switch X is open.

Calculate the potential difference across R_1 .

potential difference = V [2]

(ii) Switch X is now closed. The resistance of the thermistor is $12.0\text{ k}\Omega$.

Calculate the current in the battery.

current = A [2]

(c) The switch X in the circuit in (b) remains closed. The temperature of the thermistor decreases.

By reference to the current in the battery, state and explain the effect, if any, of the decrease in temperature on the power produced by the battery.

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.....
.....

[3]

[Total: 9]

- 5 (a) Two progressive sound waves meet to form a stationary wave. The two waves have the same amplitude, wavelength, frequency and speed.

State the other condition that must be fulfilled by the two waves in order for them to produce the stationary wave.

..... [1]

- (b) A stationary wave is formed on a string that is stretched between two fixed points A and B. Fig. 5.1 shows the string at time $t = 0$ when each point is at its maximum displacement.

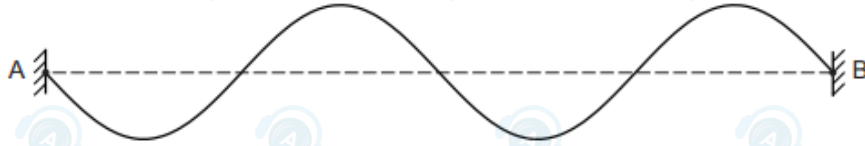


Fig. 5.1

Distance AB is 0.80 m. The period of the stationary wave is 0.016 s.

- (i) On Fig. 5.1, sketch a solid line to show the position of the string:

- at time $t = 0.004$ s (label this line P)
- at time $t = 0.024$ s (label this line Q).

[2]

- (ii) Determine the speed of a progressive wave along the string.

speed = ms^{-1} [3]

- (c) A beam of vertically polarised light of intensity I_0 is incident normally on a polarising filter that has its transmission axis at 30° to the vertical, as shown in Fig. 5.2.

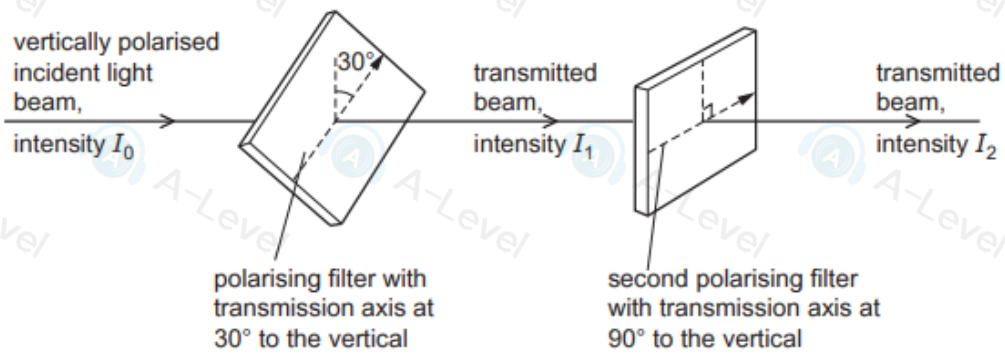


Fig. 5.2

The transmitted light from the first polarising filter has intensity I_1 . This light is then incident normally on a second polarising filter that has its transmission axis at 90° to the vertical. The transmitted light from the second filter has intensity I_2 .

Calculate:

- (i) the ratio $\frac{I_1}{I_0}$

$$\frac{I_1}{I_0} = \dots\dots\dots [2]$$

- (ii) the ratio $\frac{I_2}{I_0}$.

$$\frac{I_2}{I_0} = \dots\dots\dots [2]$$

[Total: 10]

5 (a) (i) State the conditions required for the formation of a stationary wave.

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

(ii) State the phase difference between any two vibrating particles in a stationary wave between two adjacent nodes.

phase difference =° [1]

(b) A motorcycle is travelling at 13.0 m s^{-1} along a straight road. The rider of the motorcycle sees a pedestrian standing in the road directly ahead and operates a horn to emit a warning sound. The pedestrian hears the warning sound from the horn at a frequency of 543 Hz . The speed of the sound in the air is 334 m s^{-1} .

(i) Calculate the frequency, to three significant figures, of the sound emitted by the horn.

frequency = Hz [2]

(ii) The motorcycle rider passes the stationary pedestrian and then moves directly away from her. As the rider moves away, he operates the horn for a second time. The pedestrian now hears sound that is increasing in frequency.

State the variation, if any, in the speed of the motorcycle when the rider operates the horn for the second time.

..... [1]

(c) A beam of vertically polarised monochromatic light is incident normally on a polarising filter, as shown in Fig. 5.1.