Electricity - 1

1.

(a) Name an instrument used to measure

(i) electric current,

.... [1]

(ii) potential difference.

.... [1]

(b) The electric charge ΔQ passing a point in a circuit is given by the equation

$$\Delta Q = I\Delta t.$$

State what is represented by the other symbols I and Δt.

I: ....

Δt: .... [2]

(c) A 1.2 kW water heater is switched on for 1500 s. During this time, a charge of 7.5×10^3 C passes. Calculate

(i) the electric current,

current = ... A [2]

(ii) the p.d. across the heater,

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

(iii) the electrical energy transformed by the heater,

energy = ... J [2]

(iv) the cost of using the heater given that the cost of 1 kW h is 6.4 p.

Cost = ………………………p

2.

(a) **(i)** State the unit of electric charge.

.... [1]

(ii) Name an instrument that may be used to measure the potential difference (p.d.) across an electrical component.

.... [1]

(b) A 36 W lamp draws a constant current of 3.0 A over a period of 600 s from a battery. Calculate

(i) the p.d. across the lamp,

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

(ii) the energy transferred by the lamp,

energy = ... J [2]

(iii) the charge passing through the lamp,

charge = ... C [3]

(iv) the number of electrons passing through the lamp.

number = ... [2]

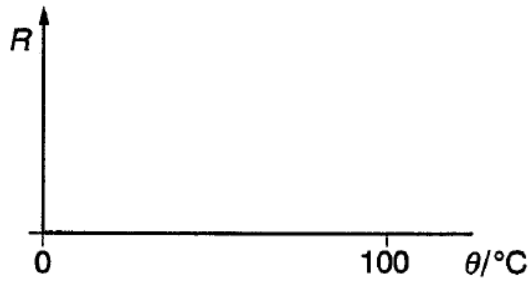
3.

(a) **Define electrical resistance.**

....

.... [2]

(b) With the aid of a sketch graph, describe how the resistance R of a negative temperature coefficient (NTC) thermistor changes with temperature θ.



....

....

....

....

....

.... [2]

(c) Fig. 2.1 shows the I/V characteristic of a tungsten filament lamp.

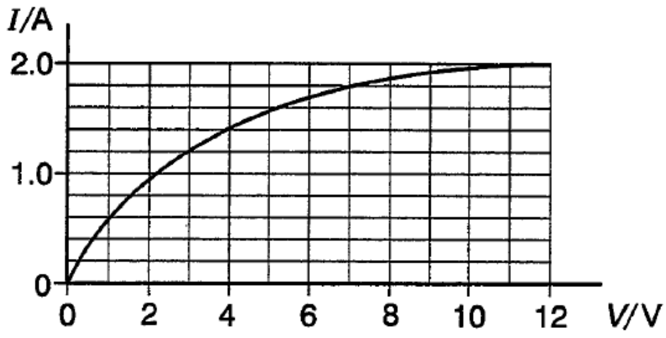


Fig. 2.1

(i) State how, and explain why, the resistance of the filament lamp changes as the potential difference V across it increases.

....

....

....

.... [2]

(ii) A 5.0 Ω resistor and the tungsten filament lamp are connected in series to a d.c. power supply of e.m.f. 24 V. The current drawn from the power supply is 2.0 A.

1. Calculate the total power delivered by the supply.

power .... W [2]

2. Use **Fig. 2.1** to determine the resistance of the filament lamp when the current in it is 2.0 A.

resistance = ... Ω [2]

3. Calculate the total resistance of the series combination of the filament lamp and the resistor.

resistance = ... Ω [1]

4. Calculate the internal resistance of the supply.

internal resistance = ... Ω [2]

4.

(a) Define electrical resistivity.

....

.... [2]

(b) Fig. 3.1 illustrates a metallic resistor constructed by depositing a thin layer of metal on a plastic strip. This particular resistor has resistance 5.0 Ω, length 1.2×10^{-2} m and width 2.0×10^{-3} m.

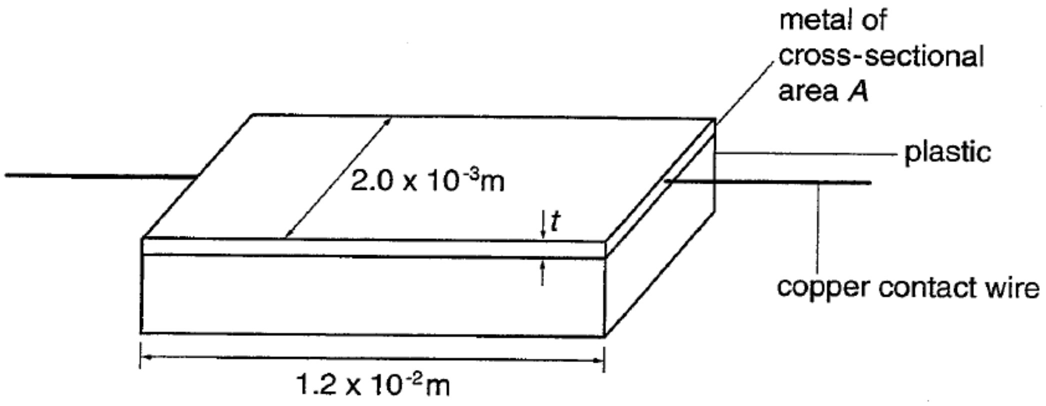


Fig. 3.1

(i) The resistivity of the metal is 4.3×10^{-6} Ω m. Calculate the cross-sectional area *A* of the resistor.

A = ... m² [3]

(ii) What is the thickness *t* of the resistor?

t = ... m [1]

5.

Fig. 3.1 shows the variation with the potential difference V of the resistance R of a tungsten filament lamp.

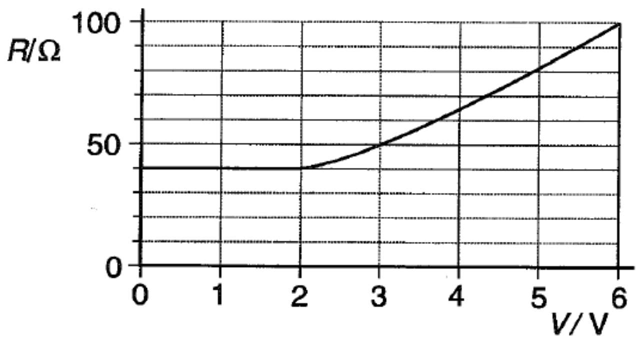


Fig. 3.1

(a) Use Fig. 3.1 to calculate, for a p.d of 3.0 V,

(i) the current in the lamp,

current = ... A [3]

(ii) the power dissipated by the lamp.

power = ... W [2]

(b) (i) Suggest why the resistance of the lamp does not change significantly over the range 0 to 2.0 V.

.... [1]

(ii) The tungsten filament lamp is at room temperature when the p.d. across it is zero.

1. State the resistance of the lamp at room temperature.

resistance = ... Ω [1]

2. The resistivity of tungsten at room temperature is $5.4 \times 10^{-8}\,\Omega\,m$. The filament has a radius of $1.0 \times 10^{-5}\,m$. Calculate the cross-sectional area *A* and length *l* of the filament.

A = ... m^2

l = ... m

Comment on the length of the filament.

....

.... [5]

6.

A cell has an e.m.f of 1.28 V and an internal resistance *r*. Fig. 4.1 illustrates an external resistor of resistance 1.10 Ω placed across the terminals of this cell.

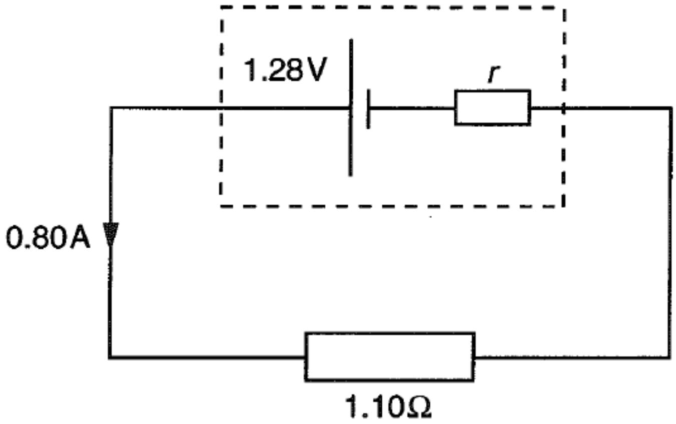


Fig. 4.1

The cell provides a current of 0.80 A. Calculate

(i) the total resistance of the circuit,

resistance = ... Ω [2]

(ii) the internal resistance *r*,

r = ... Ω [2]

(iii) the p.d. across the terminals of the cell.

p.d = ... V [1]

7.

(a) Define electrical *resistivity*.

....

.... [2]

(b) Fig. 4.1 shows a conducting paint in a cylindrical glass vessel.

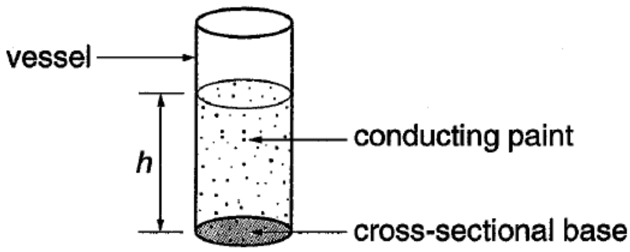


Fig. 4.1

The volume of the paint is $1.2 \times 10^{-5}\,m^3$ and the vessel has base of area $3.0 \times 10^{-4}\,m^2$.

(i) Show that the height h of the paint column is 4.0 cm.

[1]

(ii) Calculate the resistance of the paint column of height 4.0 cm. The resistivity of the paint is $6.9 \times 10^{-2}\,\Omega\,m$.

resistance = ... Ω [2]

(c) State and explain how your answer to **(b)(ii)** changes when the same volume of paint is poured into a cylindrical glass vessel having a base of double the cross-sectional area.

....

....

....

....

.... [2]

8.

(a) A student solders two resistors together as shown in Fig. 5.1.

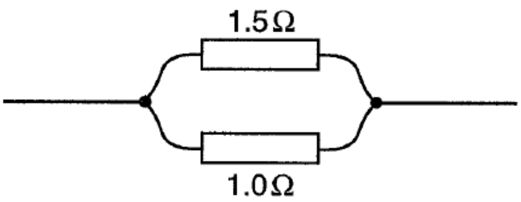


Fig. 5.1

(i) State whether the two resistors are connected in a series or in a parallel combination.

.... [1]

(ii) Show that the total resistance of the combination of resistors is 0.6 Ω.

[2]

(b) Fig. 5.2 shows the soldered resistors from **(a)** connected across the terminals of a cell.

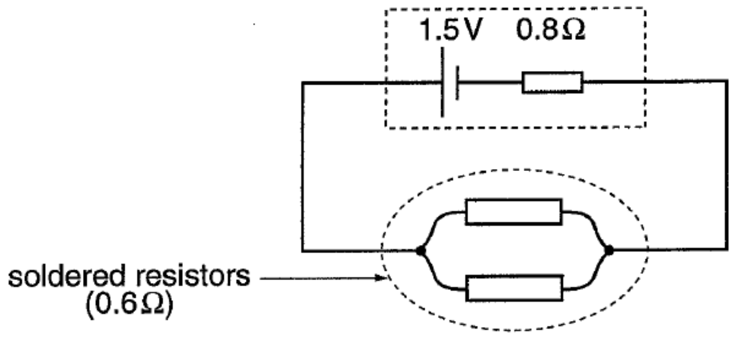


Fig. 5.2

The cell has internal resistance 0.8 Ω and e.m.f. 1.5 V.

(i) Define *e.m.f.* in terms of energy transformed and electric charge.

....

....[2]

(ii) Suggest why a cell has internal resistance.

.... [1]

(iii) Calculate the total resistance *R* of the circuit in Fig. 5.2.

R = ... Ω [2]

(iv) Hence calculate the current I in the circuit.

I = ... A [2]

(v) 1. Write an equation for the power dissipated by a current-carrying resistor.

2. For the circuit in Fig. 5.2, calculate the ratio:

$$\frac{\text{power dissipated by internal resistance}}{\text{power dissipated by total external resistance}}.$$

ratio = ... [4]