1)

A cylindrical piece of a soft, electrically-conducting material has resistance R. It is rolled out so that its length is doubled but its volume stays constant.

What is its new resistance?

A $\frac{R}{2}$ **B** R **C** $2R$ **D** $4R$

2)

A copper wire of cross-sectional area $2.0\,mm^2$ carries a current of 10 A.

How many electrons pass through a given cross-section of the wire in one second?

A 1.0×10^1 **B** 5.0×10^6 **C** 6.3×10^{19} **D** 3.1×10^{25}

3)

When a potential difference V is applied between the ends of a wire of diameter d and length l, the current in the wire is I.

What is the current when a potential difference of $2V$ is applied between the ends of a wire of the same material of diameter $2d$ and the length $2l$? Assume that the temperature of the wire remains constant.

A I **B** $2I$ **C** $4I$ **D** $8I$

4)

Two wires made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has a diameter of 2 mm. Wire Q has a diameter of 1 mm.

What is the ratio $\frac{\text{current in P}}{\text{current in Q}}$?

A $\frac{1}{4}$ **B** $\frac{1}{2}$ **C** 2 **D** 4

5)

A household electric lamp is rated as 240 V, 60 W. The filament of the lamp is made from tungsten and is a wire of constant radius 6.0×10^{-6} m. The resistivity of tungsten at the normal operating temperature of the lamp is $7.9 \times 10^{-7}\ \Omega$ m.

(a) For the lamp at its normal operating temperature,

(i) calculate the current in the lamp,

current = ... A

(ii) show that the resistance of the filament is 960 Ω.

[3]

(b) Calculate the length of the filament.

length = ... m [3]

(c) Comment on your answer to **(b)**.

....

.... [1]

6)

A straight wire of unstretched length L has an electrical resistance R. When it is stretched by a force F, the wire extends by an amount ΔL and the resistance increases by ΔR. The area of cross-section A of the wire may be assumed to remain constant.

(a) **(i)** State the relation between R, L, A and the resistivity ρ of the material of the wire.

....

.... [1]

(ii) Show that the fractional change in resistance $\frac{\Delta R}{R}$ is equal to the strain in the wire.

[2]

7)

An electric shower unit is to be fitted in a house. The shower is rated as 10.5 kW, 230 V. The shower unit is connected to the 230 V mains supply by a cable of length 16 m, as shown in Fig. 6.1.

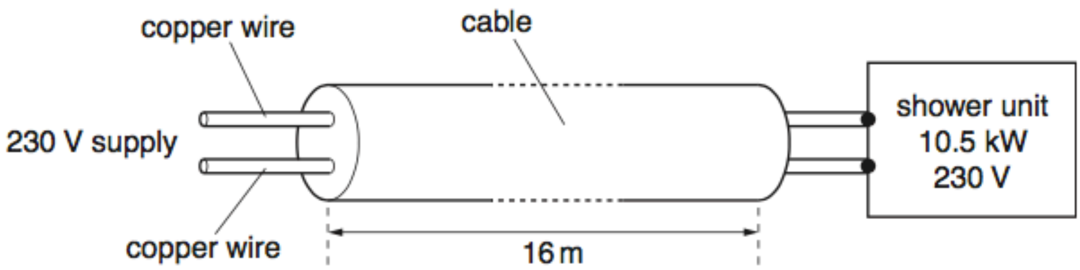

Fig. 6.1

(a) Show that, for normal operation of the shower unit, the current is approximately 46 A.

[2]

(b) The resistance of the two wires in the cable causes the potential difference across the shower unit to be reduced. The potential difference across the shower unit must not be less than 225 V.
The wires in the cable are made of copper of resistivity $1.8 \times 10^{-8}\,\Omega\,m$.
Assuming that the current in the wires is 46 A, calculate

(i) the maximum resistance of the cable,

resistance = ... Ω [3]

(ii) the minimum area of cross-section of each wire in the cable.

area = ... m^2 [3]

(c) Connecting the shower unit to the mains supply by means of a cable having wires with too small a cross-sectional area would significantly reduce the power output of the shower unit.

(i) Assuming that the shower is operating at 210V, rather than 230V, and that its resistance is unchanged, determine the ratio

$$\frac{\text{power dissipated by shower unit at 210 V}}{\text{power dissipated by shower unit at 230 V}}.$$

ratio = ... [2]

(ii) Suggest and explain one further disadvantage of using wires of small cross-sectional area in the cable.

....

....

.... [2]

8)

A metal wire strain gauge is firmly fixed across a crack in a wall, as shown in Fig. 9.1, so that the growth of the crack may be monitored.

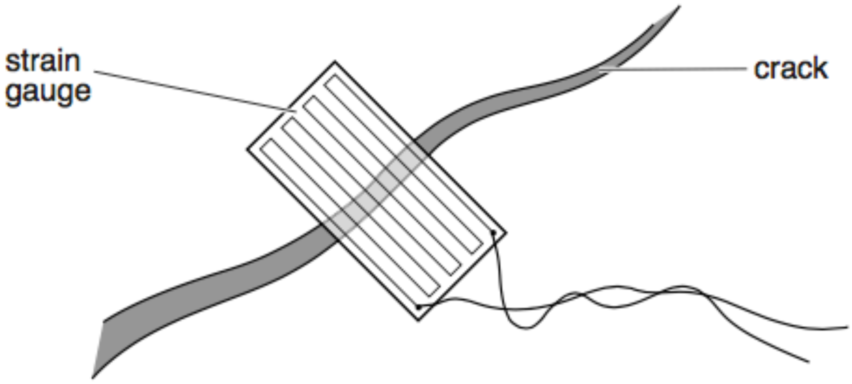

Fig. 9.1

(a) Explain why, as the crack becomes wider, the resistance of the strain gauge increases.

....

....

....

.... [3]

(b) The strain gauge has an initial resistance of 143.0 Ω and, after being fixed in position across the crack for several weeks, the resistance is found to be 146.2 Ω.

The change in the area of cross-section of the strain gauge wire is negligible.

Calculate the percentage increase in the width of the crack. Explain your working.

increase = ... % [3]

9)

An aluminium wire of length 1.8 m and area of cross-section 1.7×10^{-6} m^2 has one end fixed to a rigid support. A small weight hangs from the free end, as illustrated in Fig. 9.1.

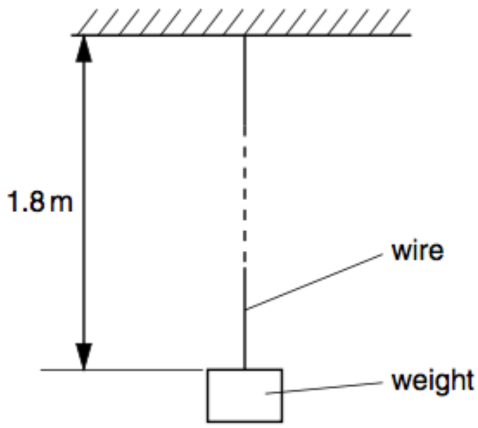

Fig. 9.1

The resistance of the wire is 0.030 Ω and the Young modulus of aluminium is 7.1×10^{10} Pa.

The load on the wire is increased by 25 N.

(a) Calculate

(i) the increase in stress,

increase = ... Pa

(ii) the change in length of the wire.

change = ... m
[4]

(b) Assuming that the area of cross-section of the wire does not change when the load is increased, determine the change in resistance of the wire.

change = ... Ω [3]