4 **(a)** Express the ohm (Ω) in SI base units.

base units = ... [3]

(b) An electrician is connecting two identical electric cookers to a supply.

One of the cookers is connected to the supply using wire A, and the other cooker is connected using wire B.

The current in each wire is 25.0 A when the cookers are switched on.

Table 4.1 contains information on the two electrical wires A and B.

Table 4.1

wire	cross-sectional area / mm^2	total length of wire / m	resistivity of wire material / Ωm	voltage drop per metre / $V\,m^{-1}$
A	4.00	8.0	1.68×10^{-8}	
B	6.00	12.0	2.65×10^{-8}	

(i) Calculate the rate at which electrical energy is converted into thermal energy in each wire. Give the unit.

rate for wire A = ...

rate for wire B = ...

[4]

(ii) Complete Table 4.1 to give the voltage drop per metre for each wire. [2]

(iii) Explain which wire is the most suitable for the connection to the cooker.

.....

..... [1]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

(c) In practice, for each of the connecting wires the electrician uses a cable made up of five thin wires which are electrically isolated from each other. Fig. 4.1 shows a cross-section of the cable.

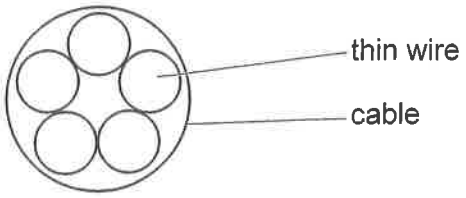

Fig. 4.1

(i) Draw a circuit diagram, representing each thin wire as a separate resistor, to show one of these cables.

[1]

(ii) The electrician measures the resistance of one of the cables as 0.0458 Ω.

Calculate the resistance of a single thin wire.

resistance = ... Ω [2]

(iii) Suggest why, for a cooker, a cable made of several thin wires is used rather than a single thick wire with the same resistance.

.....

.....

..... [2]

[Total: 15]

5 Americium-241 decays by emitting α-particles each with kinetic energy of 8.78×10^{-13} J.

(a) Calculate the speed of an α-particle emitted by americium-241.
mass of an α-particle = 6.64×10^{-27} kg

speed = ... $m s^{-1}$ [3]

(b) In a vacuum chamber, there is a magnetic field of magnetic field strength 0.682 T that is directed out of the plane of the page. A sample of americium-241 is placed in this field.

Fig. 5.1 shows that an α-particle initially travels in the plane of the page, perpendicular to the magnetic field. The arrow represents the initial path of an α-particle.

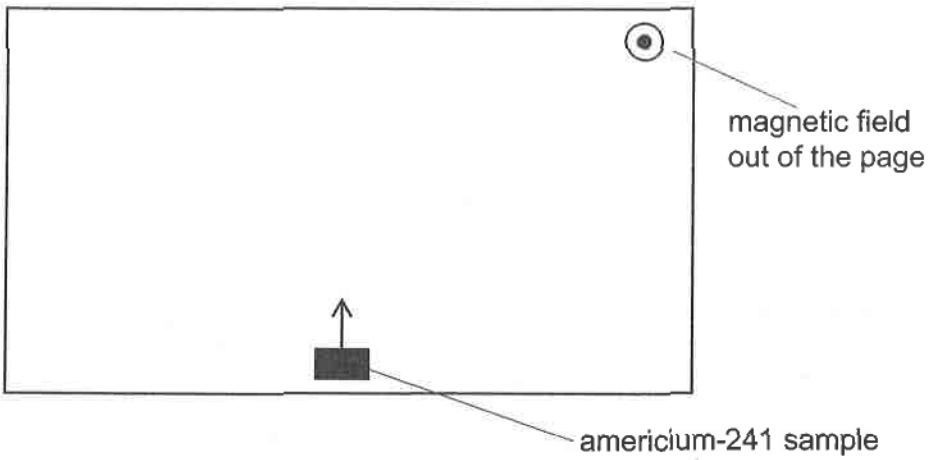

Fig. 5.1

(i) On Fig. 5.1, sketch the path of the α-particle. [1]

(ii) Calculate the magnitude of the force on the α-particle due to the magnetic field.

force = ... N [2]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

(c) State and explain one difference in the path taken by the α-particle after air is allowed to enter the vacuum chamber.

.....

.....

..... [2]

(d) The americium-241 source used in **(b)** is replaced with a source which emits β-particles.

State and explain **two** differences in the path of a β-particle compared to the path of the α-particle.

1. .....

.....

2. .....

.....

[4]

[Total: 12]