7 **(a)** State what is meant by

(i) the *resistance* of a wire,

.....

..... [1]

(ii) the *resistivity* of the material of a wire.

.....

.....

..... [2]

(b) A flat circular coil is connected in series with a battery of e.m.f. 6.0 V and internal resistance 0.10 Ω, as shown in Fig. 7.1.

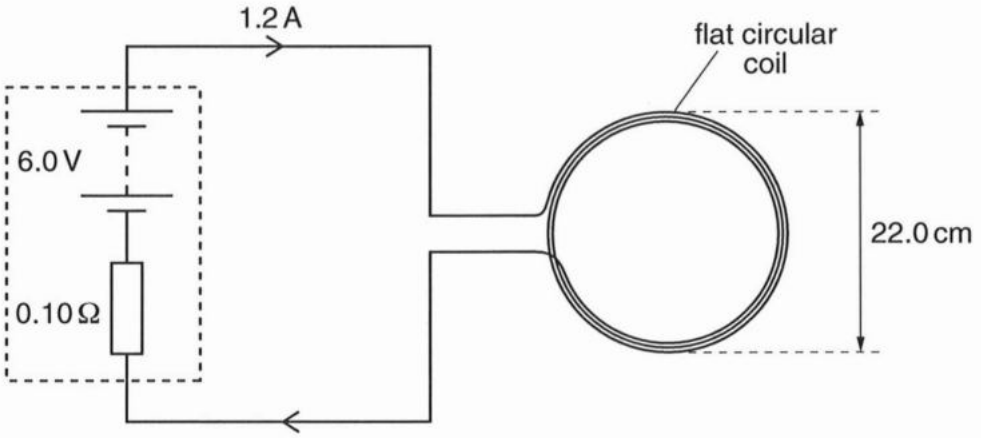

Fig. 7.1

The current in the circuit is 1.2 A.

(i) Show that the resistance of the coil is 4.9 Ω.

[2]

(ii) The flat coil has a diameter of 22.0 cm. It is made of copper wire of diameter 0.60 mm. The resistivity of copper is $1.7 \times 10^{-8}\,\Omega\,\text{m}$.

Determine the number of turns on the coil.

number = ... [4]

(c) Two flat coils, each one similar to that in **(b)**, are fixed so that their planes are parallel and are separated by a constant distance, as shown in Fig. 7.2.

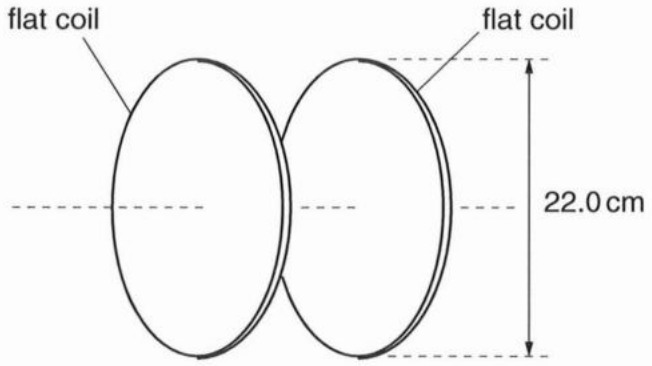

Fig. 7.2

The current I in both coils is 1.2 A.

The magnetic flux density B in the region between the two coils is uniform and given by the expression

$$B = 0.72\,\mu_0 \frac{NI}{r}$$

where N is the number of turns on each of the flat coils of radius r.
The permeability of free space is μ_0.

Use your answer in **(b)(ii)** to show that the magnetic flux density B is approximately 1.2 mT.

[1]

(d) The space between the coils in **(c)** is a vacuum.

An electron is accelerated from rest in a vacuum through a potential difference of 250 V. It then travels at right-angles to the uniform magnetic field produced by the two coils in **(c)**.

Calculate, for the electron,

(i) the magnitude of its momentum,

momentum = ... Ns [3]

(ii) the radius of its orbit in the magnetic field.

radius = ... m [3]

(e) The magnetic field in **(d)** is rotated. The initial direction of the electron is now at an angle to the direction of the uniform magnetic field, as shown in Fig. 7.3.

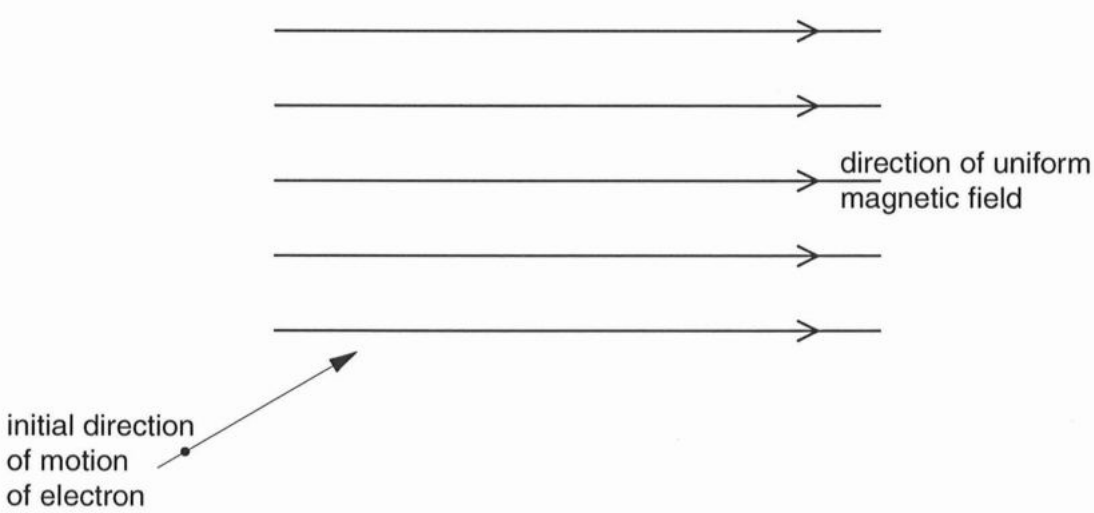

Fig. 7.3

By considering the components of the velocity parallel to the magnetic field and at right-angles to the magnetic field, describe and explain qualitatively the motion of the electron in the field.

.....

.....

.....

.....

.....

..... [4]