Answer **one** question from this section in the spaces provided.

8 Fig. 8.1 shows apparatus used for deflecting an electron beam into a circular path.

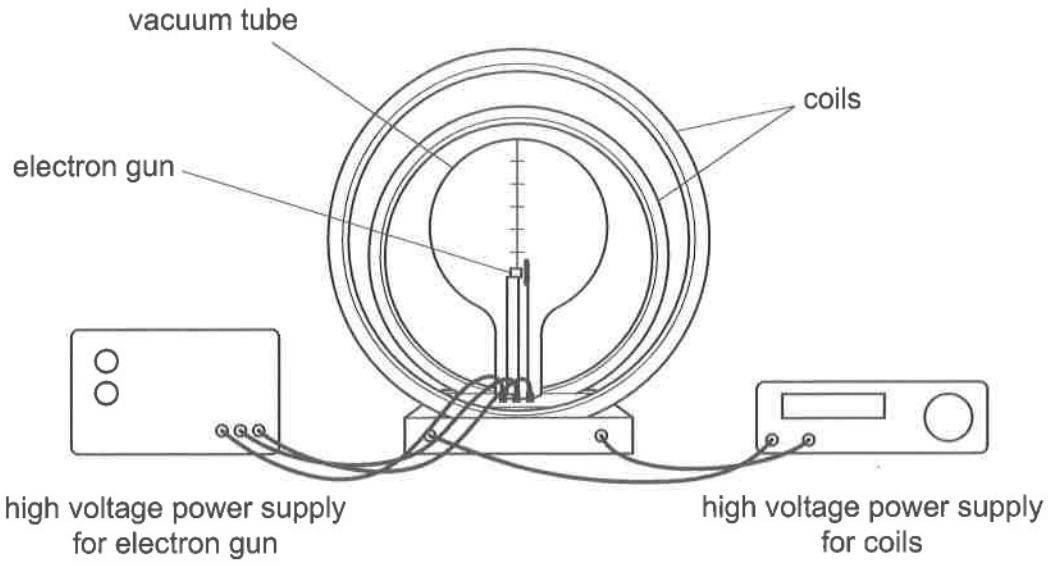

Fig. 8.1

(a) Fig. 8.2 shows a diagram of the electron gun.

Electrons are emitted from a hot cathode. The electric field between the cathode and the anode accelerates the electrons through an accelerating potential difference (p.d.).

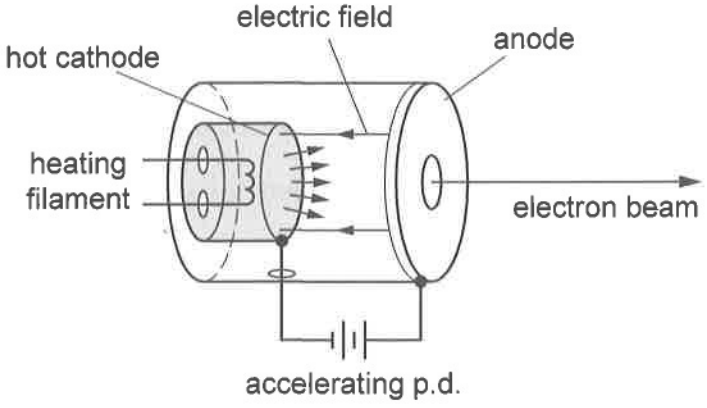

Fig. 8.2

(i) Define *electric field strength* at a point.

.....

..... [1]

(ii) Explain why the electron gun in Fig. 8.2 must be in a vacuum.

.....

.....

.....

..... [2]

(iii) The kinetic energy of the electrons increases by 2.48×10^{-16} J between leaving the cathode and reaching the anode.

Calculate the accelerating p.d.

accelerating p.d. = ... V [2]

(iv) Explain why the electrons reaching the anode have a range of speeds.

.....

.....

.....

..... [2]

(b) Fig. 8.3 shows one of the coils in Fig. 8.1.

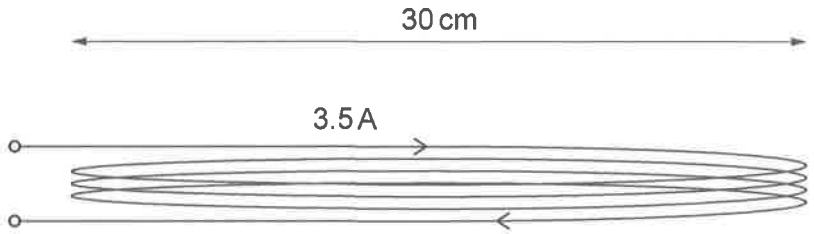

Fig. 8.3 (not to scale)

The flat circular coil has 120 turns and a diameter of 30 cm. The current in the coil is 3.5A.

(i) Calculate the magnitude of the magnetic flux density B at the centre of the coil in Fig. 8.3 due to the current of 3.5A.

B = ... T [2]

(ii) Inside the dashed region on Fig. 8.4, sketch the magnetic field pattern due to the current in the flat coil.

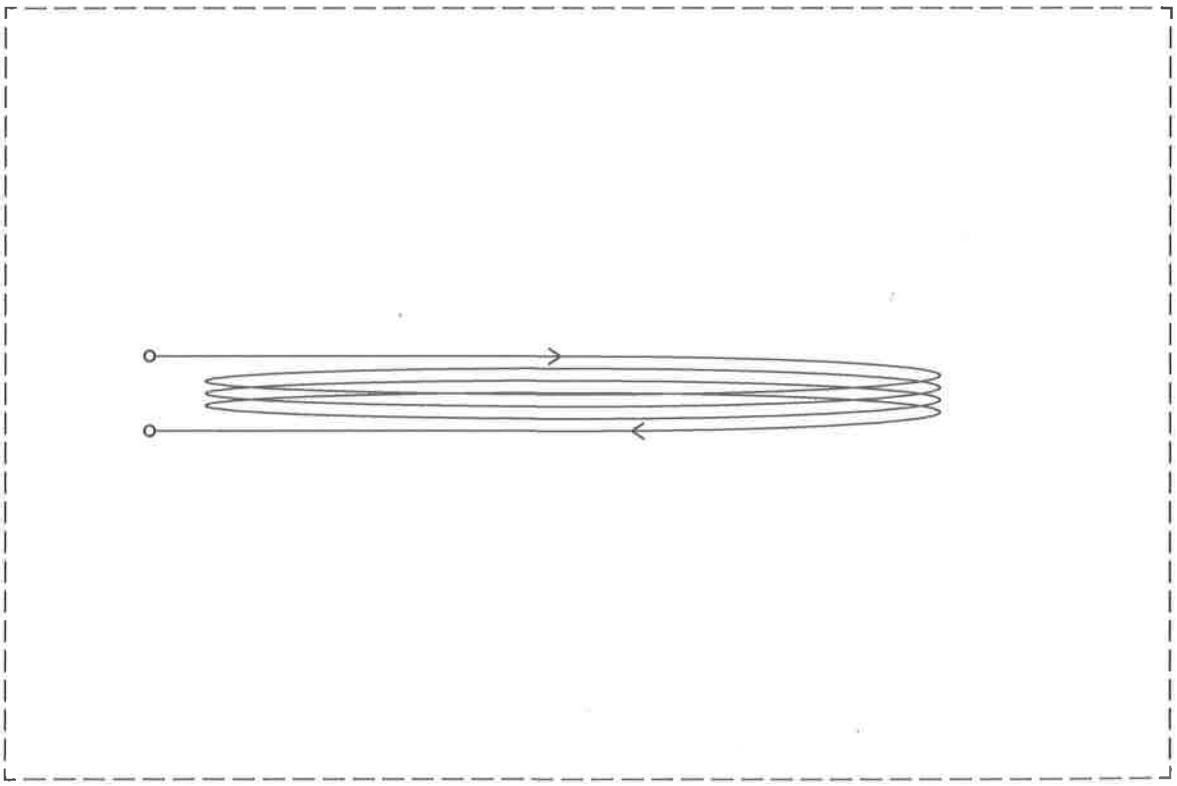

Fig. 8.4 (not to scale) [3]

(c) The uniform magnetic field created by the two coils in Fig. 8.1 has a magnetic flux density of $1.43B$, where B is the magnetic flux density calculated in **(b)(i)**.

Initially the electrons passing through the hole in the anode are travelling normally to the magnetic field. The magnetic field is directed out of the page, as shown in Fig. 8.5.

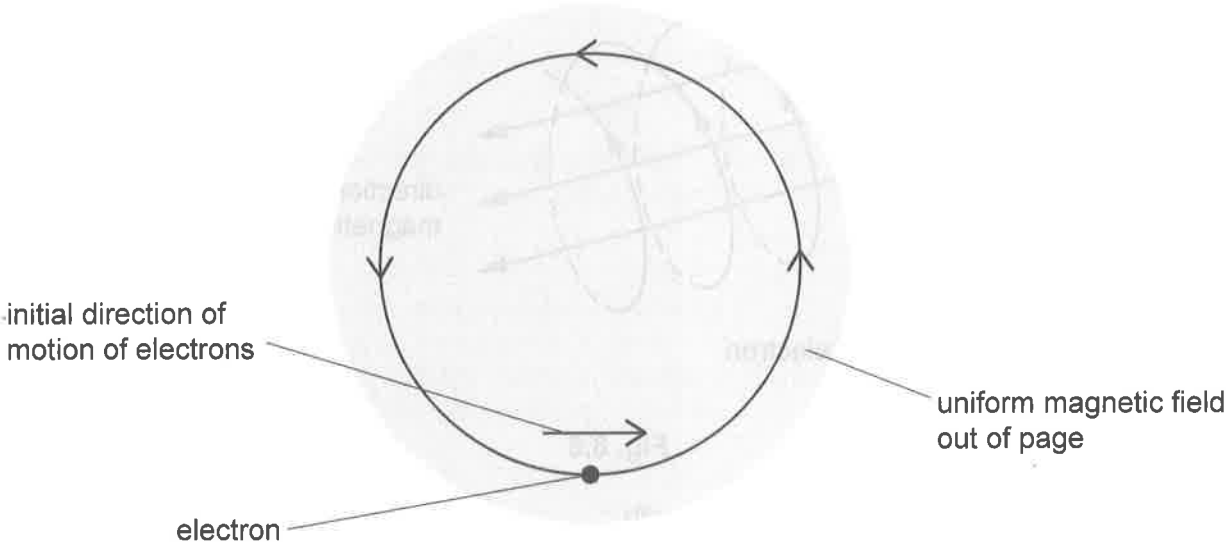

Fig. 8.5 (not to scale)

(i) Explain why the subsequent path of the electrons in the magnetic field is circular.

.....

.....

.....

.....

..... [3]

(ii) Calculate the radius of the circle followed by electrons that have a speed of $2.40 \times 10^7\,\text{m s}^{-1}$.

radius = ... m [3]

(d) An electron enters the magnetic field at an angle to the field of less than 90°. The electron follows the path shown in Fig. 8.6.

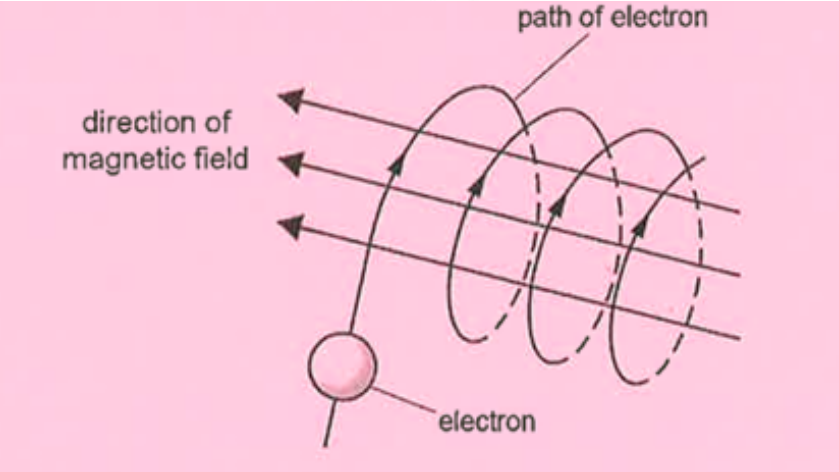

Fig. 8.6

Explain why the electron follows this path.

.....

.....

.....

..... [2]

[Total: 20]

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