Marks

Question 25 (6 marks)

A pair of parallel metal plates, placed in a vacuum, are separated by a distance of 5.00×10^{-3} m and have a potential difference of 1000 V applied to them.

(a) Calculate the magnitude of the electric field strength between the plates. **1**

$E = \frac{V}{d}$

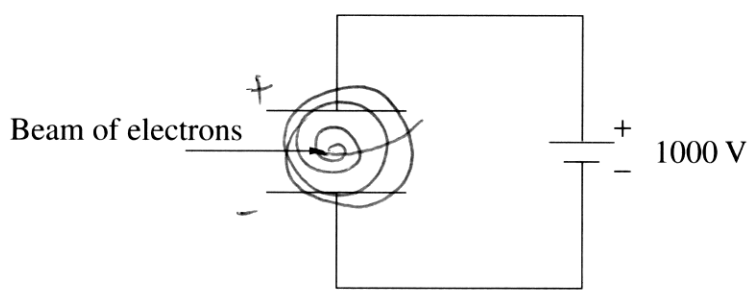
$= \frac{1000}{5.00 \times 10^{-3}}$ $\therefore E = 200\,000$ Vm^{-1}

(b) Calculate the magnitude of the electrostatic force acting on an electron between the plates. **1**

$F = qE$

$= -1.602 \times 10^{-19} \times 200\,000$ $\therefore F = -3.204 \times 10^{-14}$ N

(c) A beam of electrons is fired with a velocity of 3.00×10^{6} m s^{-1} between the plates as shown. A magnetic field is applied between the plates, sufficient to cancel the force on the electron beam due to the electric field. **4**



Calculate the magnitude and direction of the magnetic field required between the plates to stop the deflection of the electron beam.

The ~~magnitude~~ direction of the magnetic field would have to be directed into the page (N out of page, S into page)

$qvB = qE$

$B = \frac{E}{v}$ $\therefore$ The magnitude of the magnetic field would be 3.3×10^{-4} T

$= \frac{1000}{3.00 \times 10^{6}}$

$= 3.3 \times 10^{-4}$ T