Question 25

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**

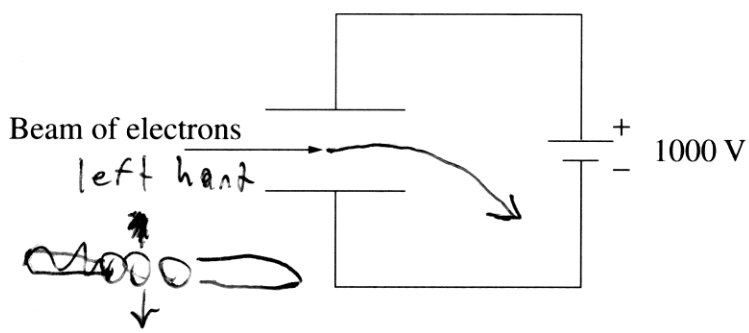
$E = \frac{V}{d} = \frac{1000}{5 \times 10^{-3}} = 20000$ V/m

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

$F = qE = -1.602 \times 10^{-19} \times 20000$

$= -3.204 \times 10^{-15}$ N/m

(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.

Magnetic field into the page

~~$F = BIL \sin\theta$~~ $F = qvB \sin\theta$

$F = -1.602 \times 10^{-19} \times 20000 \times B$

$-3.0204 \times 10^{-15} = -1.602 \times 10^{-19} \times 20000 \times B$

$\therefore B = 1$ tesla