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**

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

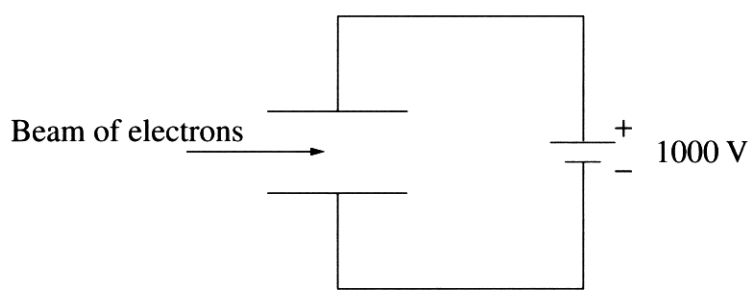
$E = 200\,000$ Vol m^{-1}

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

$E = \frac{F}{q}$ $F = Eq$ $F = 200000 \times -1.602 \times 10^{-19}$

$F = -3.204 \times 10^{-14}$ 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.

$F = qE = qVB$ $F = VB$

~~$E = VB$~~ $E = VB$ E

E

$-3.204 \times 10^{-14} = 3 \times 10^6 \times B$

$200\,000$

$B = \frac{-3.204 \times 10^{-14} \div 200\,000}{3 \times 10^6}$

$B = -2.136 \times 10^{-15}$ T.