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**

$E = \frac{V}{d} = \frac{1000}{5\times10^{-3}} = 200000$ V m^{-1} $V = 1000$ $d = 5\times10^{-3}$

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

$F = qE$. $F = 200000 \times -1.602\times10^{-19}$ $q = -1.602\times10^{-19}$ C $E = 200000$

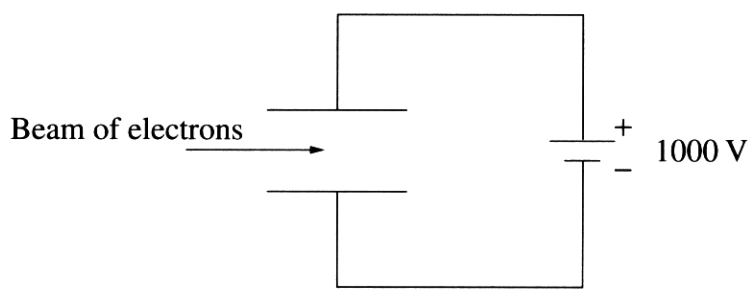
$= 3.204^{-14}$ N

(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**

$F = qvB\sin\theta$

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

$F = qE$



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

$F = qvB = qE$ $E = qvB$ $F = qE$ $q = 1.602\times10^{-19}$

$vB = E$ $v = 3\times10^6$ m s^{-1}

$F = F$ $F = qvB$ $B = qE$ $-1.602\times10^{-19} \times 3\times10^6 \times B = -1.602\times10^{-19} E$ $V = 1000$ V

$\frac{B}{B}\frac{E}{} = 3\times10^6$ $B = 2$