

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

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

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

$$E = 200\,000$$

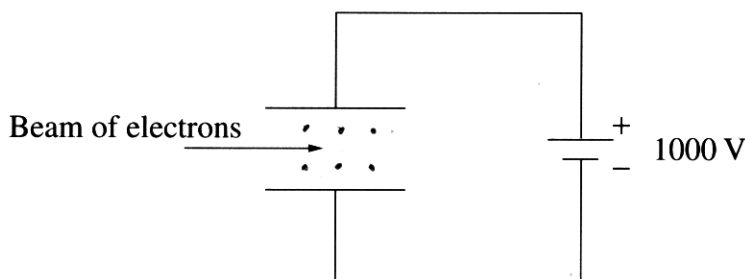
- (b) Calculate the magnitude of the electrostatic force acting on an electron between the plates. 1

$$F = eE$$

$$200\,000 = 6.626 \times 10^{-34} f$$

$$f = 3 \times 10^{38} \text{ N}$$

- (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 magnetic field must be directed out of page, as shown in the diagram.

$$Eq = qvB \sin \theta$$

$$E = vB$$

$$B = \frac{E}{v}$$

$$= \frac{200000}{1000}$$

$$= 200$$