

Question 25 (6 marks)

A pair of parallel metal plates, placed in a vacuum, are separated by a distance of  $5.00 \times 10^{-3}$  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

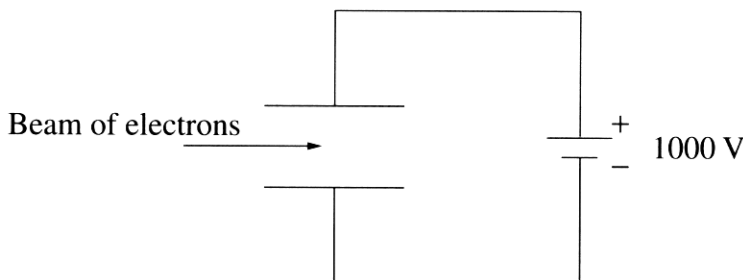
$$E = \frac{V}{d} = \frac{1000}{5.00 \times 10^{-3}} = 200000 \text{ V/m}$$

$$= 2.0 \times 10^5 \text{ V/m}$$

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

$$F = qvE =$$

- (c) A beam of electrons is fired with a velocity of  $3.00 \times 10^6$  m s<sup>-1</sup> 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.

$$F = qvB = 1.602 \times 10^{-19} \times 3.00 \times 10^6 \times 1000$$

$$= 4.806 \times 10^{-10} \text{ N}$$