

7 (a) Define magnetic flux density.

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 .....  
 ..... [2]

(b) A particle of mass  $m$  and charge  $+Q$  moves at speed  $v$  into a region where there is a uniform magnetic field, as shown in Fig. 7.1.

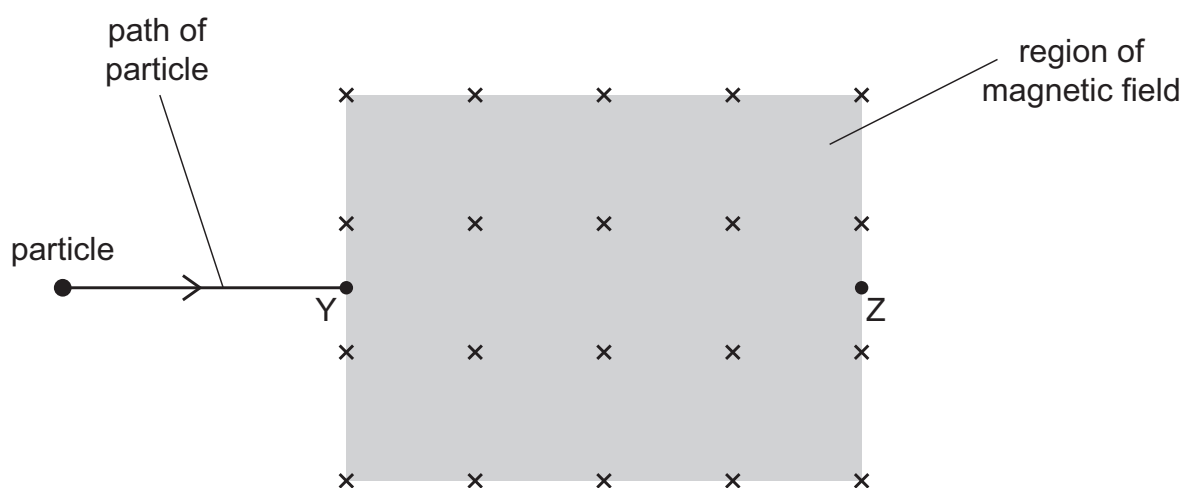


Fig. 7.1

The uniform magnetic field is into the page and has flux density  $B$ . The particle enters the region of the field at point Y.

(i) State an expression, in terms of some or all of  $m$ ,  $Q$ ,  $B$  and  $v$ , for the magnetic force  $F$  that acts on the particle when it is at point Y.

$F =$  ..... [1]

(ii) On Fig. 7.1, draw an arrow at point Y to indicate the direction of the force in (b)(i). [1]

(iii) On Fig. 7.1, draw a line to show a possible path for the particle through the region of the magnetic field. [1]

(c) (i) Explain how an electric field can be used with the magnetic field to ensure that the particle in (b) now passes through point Z.

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 .....  
 .....  
 .....  
 ..... [3]

(ii) Derive an expression for  $v$  in terms of  $B$  and the electric field strength  $E$ .

$v =$  ..... [2]