

## Charged Particles in Magnetic Fields

1. Protons, each of mass  $m$  and charge  $e$ , follow a circular path when travelling perpendicular to a magnetic field of uniform flux density  $B$ . What is the time taken for one complete orbit?

A  $\frac{2\pi eB}{m}$

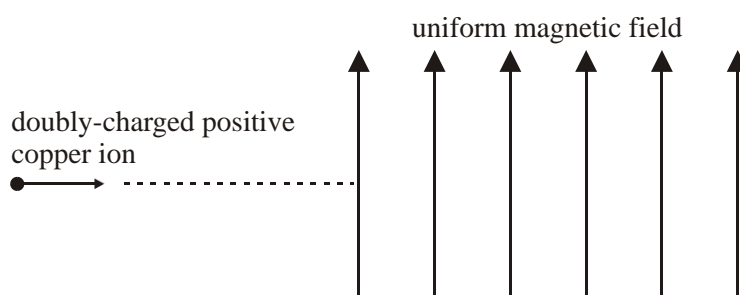
B  $\frac{m}{2\pi eB}$

C  $\frac{eB}{2\pi m}$

D  $\frac{2\pi m}{eB}$

(Total 1 mark)

2. (a)



The diagram above shows a doubly-charged positive ion of the copper isotope  ${}_{29}^{63}\text{Cu}$  that is projected into a vertical magnetic field of flux density 0.28 T, with the field directed upwards. The ion enters the field at a speed of  $7.8 \times 10^5 \text{ m s}^{-1}$ .

- (i) State the initial direction of the magnetic force that acts on the ion.

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- (ii) Describe the subsequent path of the ion as fully as you can.  
Your answer should include both a qualitative description and a calculation.

mass of  ${}^{63}_{29}\text{Cu}$  ion =  $1.05 \times 10^{-25}$  kg

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(5)

- (b) State the effect on the path in part (a) if the following changes are made separately.

- (i) The strength of the magnetic field is doubled.

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- (ii) A singly-charged positive  ${}^{63}_{29}\text{Cu}$  ion replaces the original one.

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(3)

(Total 8 marks)