Q1. A section of current-carrying wire is placed at right angles to a uniform magnetic field of flux density *B*. When the current in the wire is I, the magnetic force that acts on this section is *F*.

What force acts when the same section of wire is placed at right angles to a uniform magnetic field of flux density 2*B* when the current is 0.25 I?

A $\frac{F}{4}$

B $\frac{F}{2}$

C *F*

D *2F*

(Total 1 mark)

Q2. 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 $\frac{2\pi eB}{m}$

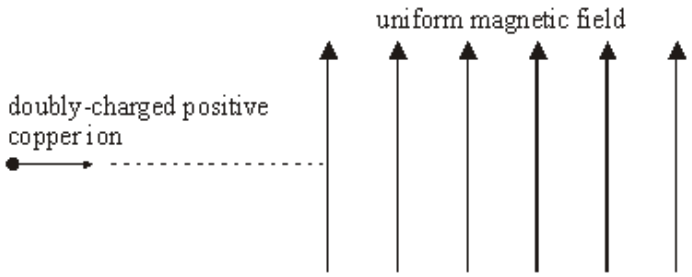
B $\frac{m}{2\pi eB}$

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

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

(Total 1 mark)

Q3. (a)



The diagram above shows a doubly-charged positive ion of the copper isotope $^{63}_{29}Cu$ 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 7.8×10^5 m s^{-1}.

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

.....

(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 $^{63}_{29}Cu$ ion = 1.05×10^{-25} kg

.....

.....

.....

.....

.....

.....

.....

.....

(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.

.....

.....

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

.....

.....

(3)
(Total 8 marks)

M1. B

[1]

M2. D

[1]

M3. (a) (i) out of plane of diagram **(1)**

(ii) circular path **(1)**
in a horizontal plane [or out of the plane of the diagram] **(1)**

$BQv = \frac{mv^2}{r}$ **(1)**

radius of path, $r \left(\frac{mv}{BQ}\right) = \frac{1.05 \times 10^{-25} \times 7.8 \times 10^{5}}{0.28 \times 2 \times 1.6 \times 10^{-19}}$ **(1)**

= 0.91(4) m **(1)**

max 5

(b) (i) radius decreased **(1)**
halved **(1)**
[or radius is halved **(1) (1)**]

(ii) radius increased **(1)**
doubled **(1)**
[or radius is doubled **(1) (1)**]

max 3

[8]