Q1. Which line, **A** to **D**, correctly describes the trajectory of charged particles which enter, at right angles, (a) a uniform electric field, and (b) a uniform magnetic field?

	(a) uniform electric field	(b) uniform magnetic field
A	circular	circular
B	circular	parabolic
C	parabolic	circular
D	parabolic	parabolic

(Total 1 mark)

Q2. 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 $2B$ when the current is $0.25\,I$?

A $\frac{F}{4}$

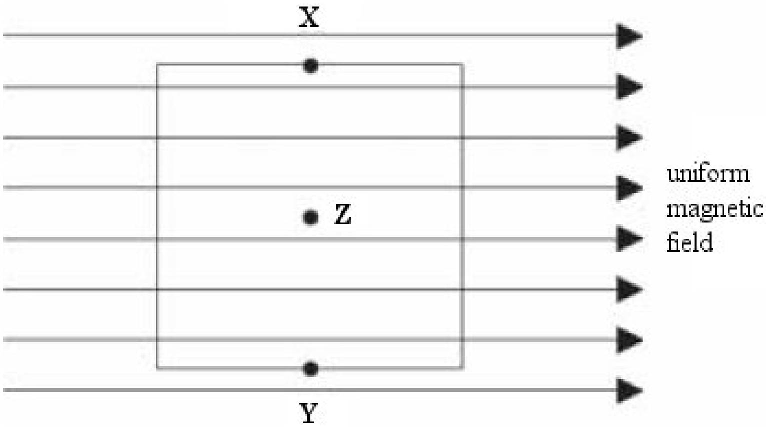
B $\frac{F}{2}$

C F

D $2F$

(Total 1 mark)

Q3.



The diagram shows a square coil with its plane parallel to a uniform magnetic field.
Which one of the following would induce an emf in the coil?

A movement of the coil slightly to the left

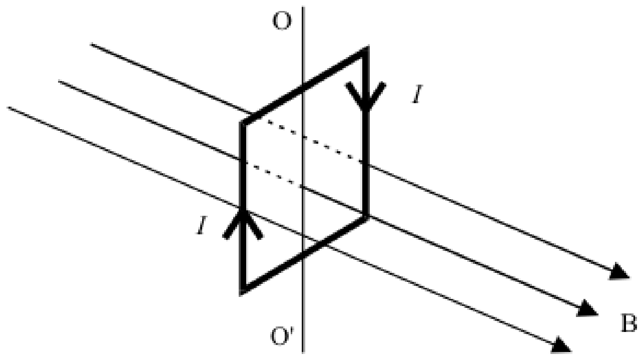
B movement of the coil slightly downwards

C rotation of the coil about an axis through XY

D rotation of the coil about an axis perpendicular to the plane of the coil through Z

(Total 1 mark)

Q4. The diagram shows a vertical square coil whose plane is at right angles to a horizontal uniform magnetic field B. A current, *I*, flows in the coil, which can rotate about a vertical axis OO'.



Which one of the following statements is correct?

A The forces on the two vertical sides of the coil are equal and opposite.

B A couple acts on the coil.

C No forces act on the horizontal sides of the coil.

D If the coil is turned through a small angle about OO', it will remain in position.

(Total 1 mark)

Q5. 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)

Q6. An α particle and a β^- particle both enter the same uniform magnetic field, which is perpendicular to their direction of motion. If the β^- particle has a speed 15 times that of the α particle, what is the value of the ratio

$$\frac{\text{magnitude of force on } \beta^-\text{particle}}{\text{magnitude of force on } \alpha \text{ particle}}?$$

A 3.7

B 7.5

C 60

D 112.5

(Total 1 mark)

Q7. 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)

Q8. Particles of mass *m* carrying a charge *Q* travel in a circular path of radius *r* in a magnetic field of flux density *B* with a speed *v*. How many of the following quantities, if changed one at a time, would change the radius of the path?

- *m*
- *Q*
- *B*
- *v*

A one

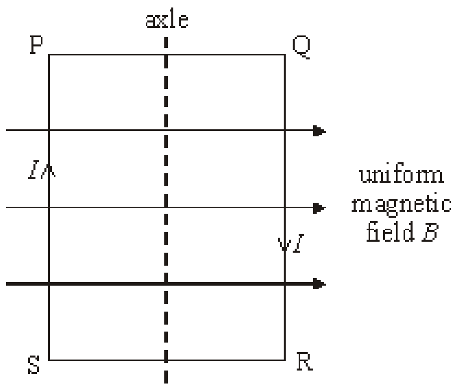
B two

C three

D four

(Total 1 mark)

Q9.



A coil, mounted on an axle, has its plane parallel to the flux lines of a uniform magnetic field *B*, as shown. When a current *I* is switched on, and before the coil is allowed to move,

A there are no forces due to *B* on the sides PQ and RS.

B there are no forces due to *B* on the sides SP and QR.

C sides SP and QR attract each other.

D sides PQ and RS attract each other.

(Total 1 mark)

Q10. (a) The equation *F* = *B*Il, where the symbols have their usual meanings, gives the magnetic force that acts on a conductor in a magnetic field.

Given the unit of each of the quantities in the equation.

F .... *B* ....

I .... l ....

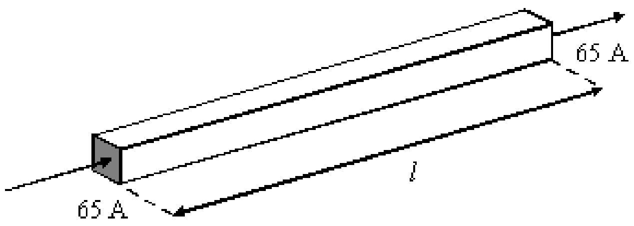
State the condition under which the equation applies.

....

....

(2)

(b) The diagram shows a horizontal copper bar of 25 mm × 25 mm square cross-section and length l carrying a current of 65 A.



(i) Calculate the minimum value of the flux density of the magnetic field in which it should be placed if its weight is to be supported by the magnetic force that acts upon it.

density of copper = 8.9×10^3 kg m^{-3}

....

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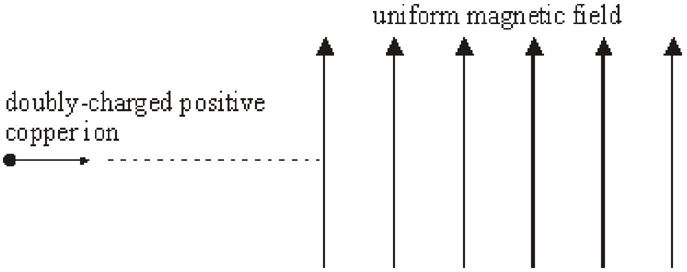
(ii) Draw an arrow on the diagram above to show the direction in which the magnetic field should be applied if your calculation in part (i) is to be valid. Label this arrow M.

(5)
(Total 7 marks)

Q11. (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.

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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 $^{63}_{29}Cu$ ion = 1.05×10^{-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 $^{63}_{29}Cu$ ion replaces the original one.

....

....

(3)

(Total 8 marks)