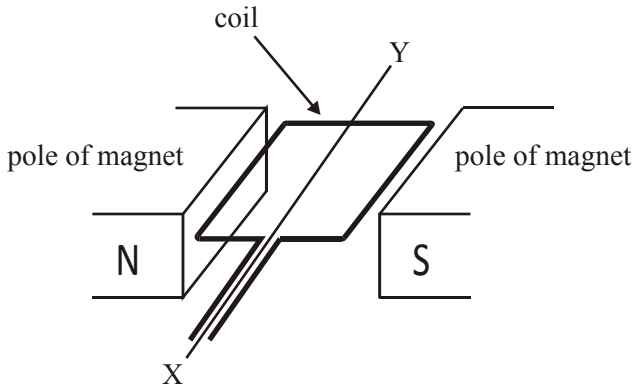
MAGNETIC FIELDS AND FORCES REVIEW

1. The diagram shows a coil of wire that can rotate between the poles of a magnet about the axis XY.

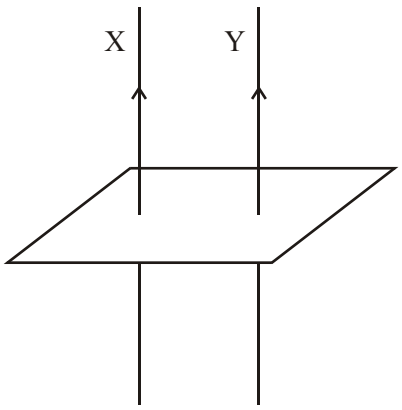


A current is passed through the coil by means of a commutator connected to the ends of the coil. What is the position of the coil in the magnetic field so that its turning effect is a maximum and what is the position of the coil when the current is reversed so that the coil rotates continuously?

	plane of coil for maximum turning effect	**plane of coil for reversal of current**
A.	parallel to direction of field	parallel to direction of field
B.	normal to direction of field	parallel to direction of field
C.	parallel to direction of field	normal to direction of field
D.	normal to direction of field	normal to direction of field

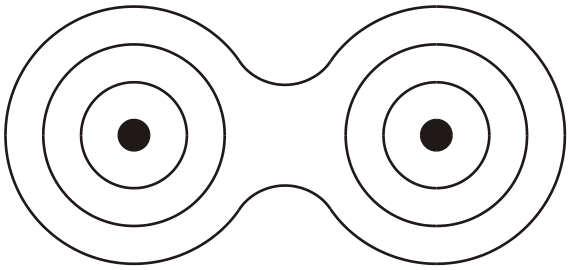
(1)

2. Two long, vertical wires X and Y carry currents in the same direction and pass through a horizontal sheet of card.

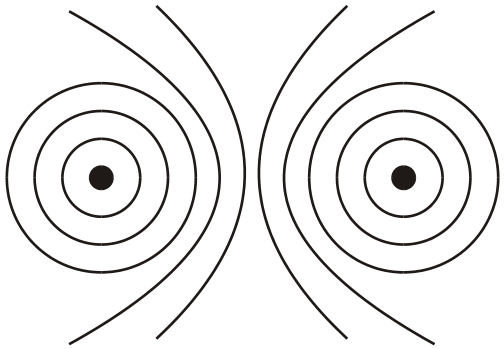


Iron filings are scattered on the card. Which **one** of the following diagrams best shows the pattern formed by the iron filings? *(The dots show where the wires X and Y enter the card.)*

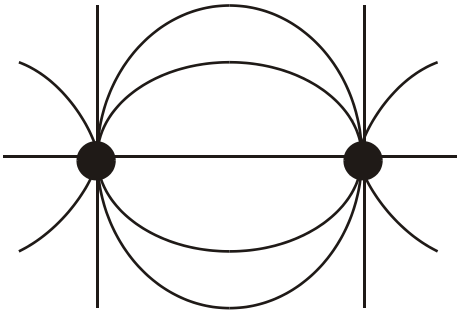
A.



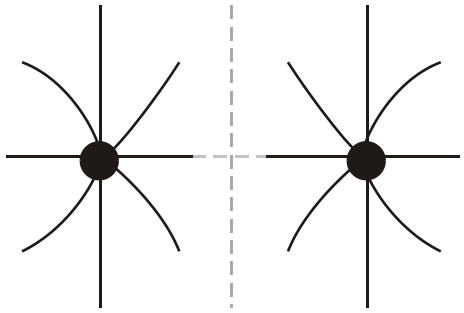
B.



C.

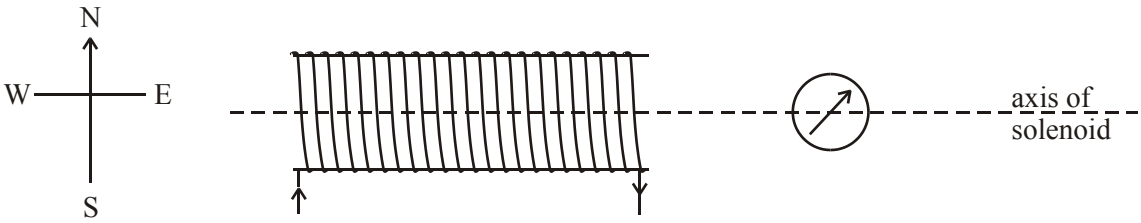


D.



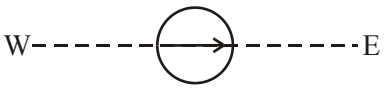
(1)

3. A current-carrying solenoid is placed with its axis pointing east-west as shown below. A small compass is situated near one end of the solenoid.

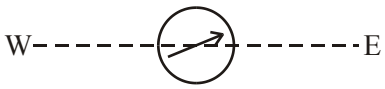


The axis of the needle of the compass is approximately 45° to the axis of the solenoid. The current in the solenoid is then doubled. Which of the following diagrams best shows the new position of the compass needle?

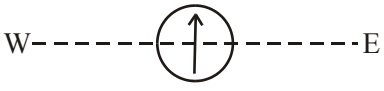
A.



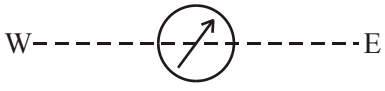
B.



C.



D.



(1)

4. This question is about the force between current-carrying wires.

Diagram 1 below shows two long, parallel vertical wires each carrying equal currents in the same direction. The wires pass through a horizontal sheet of card. Diagram 2 shows a plan view of the wires looking down onto the card.

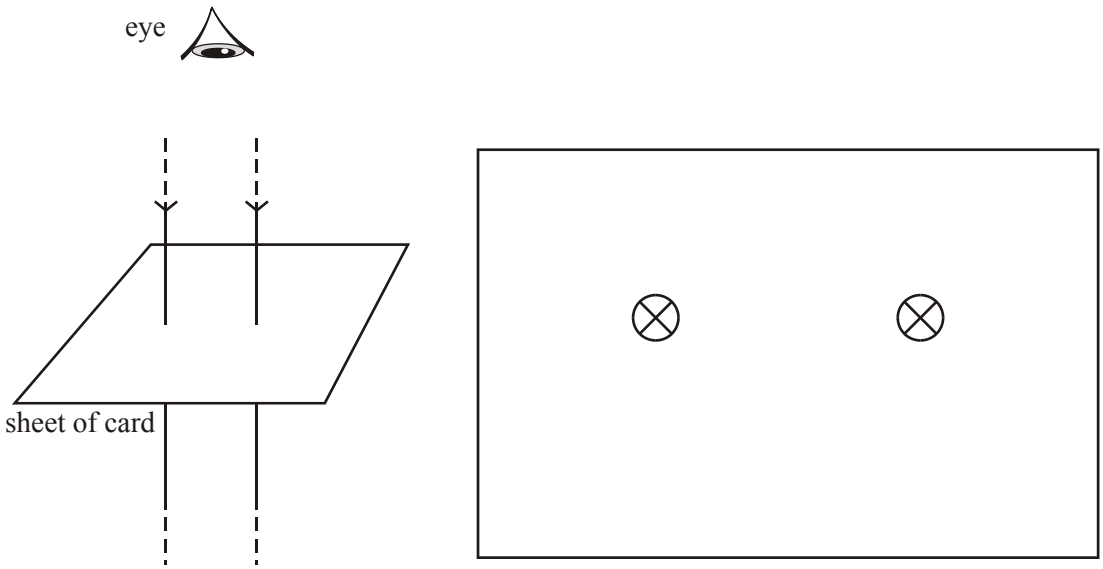


diagram 1 diagram 2

(a) (i) Draw on diagram 1 the direction of the force acting on each wire.

(1)

(ii) Draw on diagram 2 the magnetic field pattern due to the currents in the wire.

(3)

(b) The card is removed and one of the two wires is free to move. Describe and explain the changes in the velocity and in acceleration of the moveable wire.

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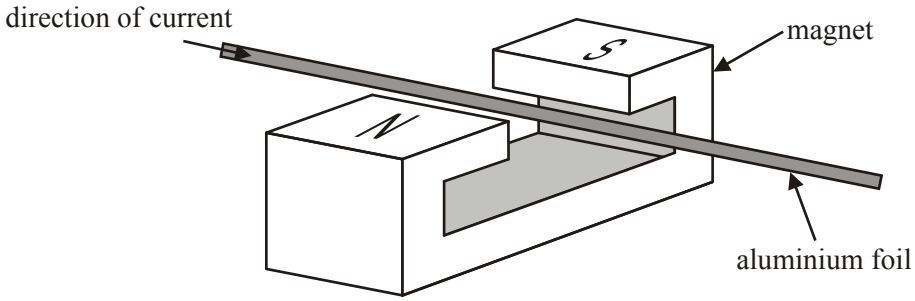
(3)

(Total 7 marks)

5. A strip of aluminium foil is held between the poles of a strong magnet, as shown below.



When a current is passed through the aluminium foil in the direction shown, the foil is deflected. In which direction is this deflection?

A. Vertically downwards

B. Vertically upwards

C. Towards the North pole of the magnet

D. Towards the South pole of the magnet

(1)

6. A charged particle of mass m and charge q is travelling in a uniform magnetic field with speed v such that the magnetic force on the particle is F. The magnetic force on a particle of mass $2m$, charge q and speed $2v$ travelling in the same direction in the magnetic field is

A. $4F$.

B. $2F$.

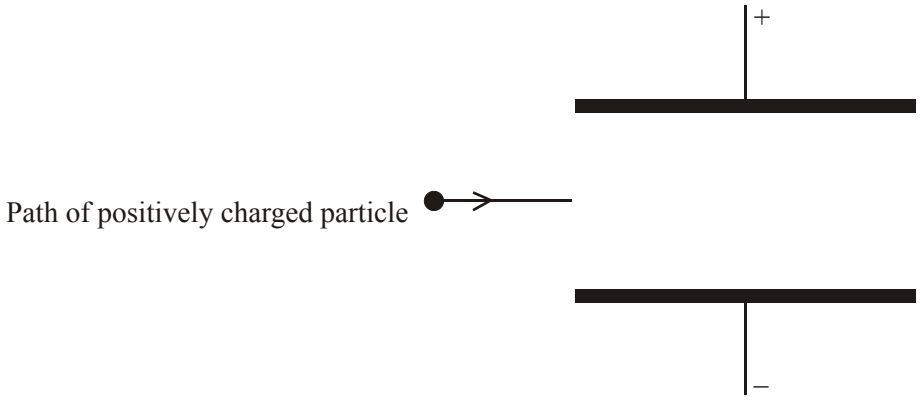
C. F.

D. $\frac{1}{2}F$.

(1)

7. This question is about forces on charged particles in electric and magnetic fields.

The diagram shows two parallel plates situated in a vacuum. One plate is at a positive potential with respect to the other.



A positively charged particle passes into the region between the plates. Initially, the particle is travelling parallel to the plates.

(a) On the diagram,

(i) draw lines to represent the electric field between the plates.

(3)

(ii) show the path of the charged particle as it passes between, and beyond, the plates.

(2)

(b) An electron is accelerated from rest in a vacuum through a potential difference of 750 V.

(i) Determine the change in electric potential energy of the electron.

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(2)

(ii) Deduce that the final speed of the electron is 1.6×10^7 ms^{-1}.

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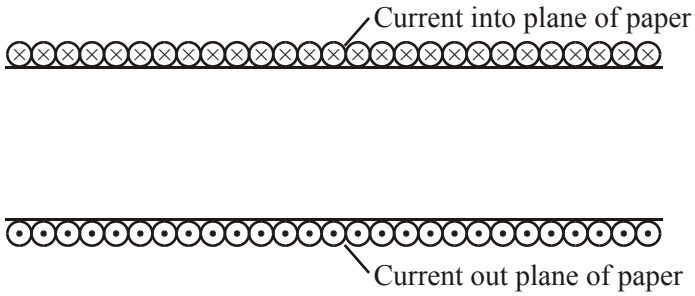
(2)

The diagram below shows a cross-section through a current-carrying solenoid. The current is moving into the plane of the paper at the upper edge of the solenoid and out of the plane of the paper at the lower edge. There is a vacuum in the solenoid.



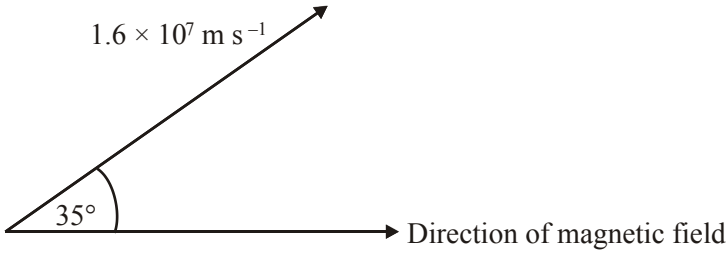
(c) (i) Sketch lines to represent the magnetic field inside and at each end of the solenoid.

(4)

(ii) A positively charged particle enters the solenoid along its axis. On the diagram, show the path of the particle in the solenoid.

(1)

An electron is injected into a region of uniform magnetic field of flux density 4.0 mT. The velocity of the electron is 1.6×10^7 m s^{-1} at an angle of 35° to the magnetic field, as shown below.



(d) (i) Determine the component of the velocity of the electron normal to the direction of the magnetic field.

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(2)

(ii) Describe, making calculations where appropriate, the motion of the electron due to this component of the velocity.

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(4)

(iii) Determine the component of the velocity of the electron along the direction of the magnetic field.

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(1)

(iv) State and explain the magnitude of the force on the electron due to this component of the velocity.

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(2)

(e) With reference to your answers in (d), describe the shape of the path of the electron in the magnetic field. You may draw a diagram if you wish.

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(2)

(Total 25 marks)