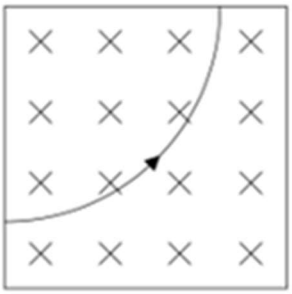
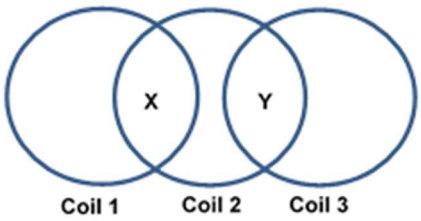
1 A particle is in a region of uniform magnetic field. The field is directed into the plane of the page. The path of this particle is shown in the figure below.



What is this particle and what is the direction of the electric field for it to pass through with no deflection?

	This particle is	Direction of electric field is
A	a positive ion	upwards
B	a positive ion	downwards
C	an electron	upwards
D	an electron	downwards

2 Three insulated coils of wires are placed on top of one another such that there are overlapping regions. Each of the coils carries identical current but their directions are unknown. Region X is found to have a resultant magnetic field pointing out of the paper while region Y is found to have a magnetic flux density of near zero.

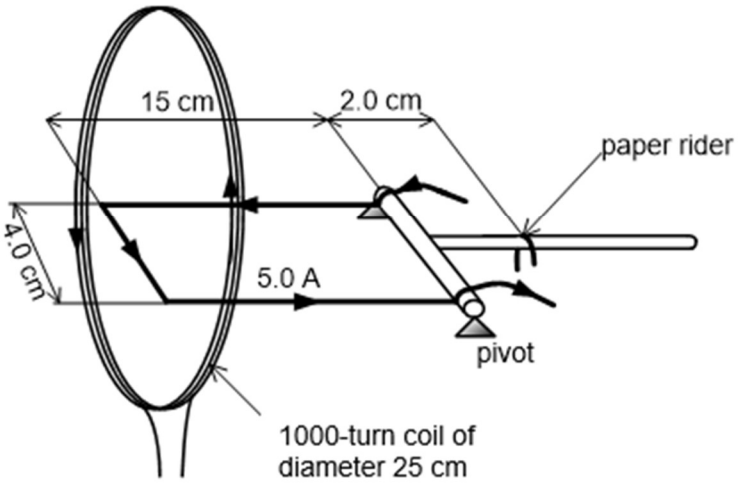


Which of the following is a possible configuration of the direction of flow of the currents in the coils?

	Coil 1	Coil 2	Coil 3
A	clockwise	clockwise	counterclockwise
B	clockwise	counterclockwise	counterclockwise
C	counterclockwise	clockwise	clockwise
D	counterclockwise	counterclockwise	clockwise

3 One end of a flat rectangular coil of negligible mass is placed at the centre of a 1000-turn circular coil of diameter 25 cm as shown.

A current of 5.0 A is passed through the rectangular coil.
When a 5.0 g paper rider is placed 2.0 cm to the right of the pivot, the rectangular coil is balanced horizontally.

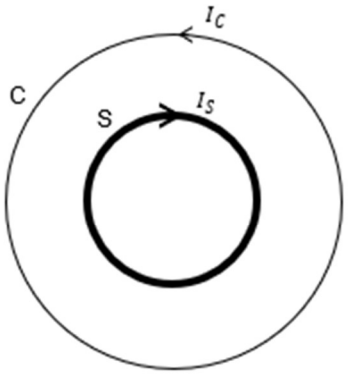


What is the magnitude of the current in the 1000-turn circular coil in order for the rectangular coil to remain horizontal?

A 3.3 A **B** 5.0 A

C 6.5 A **D** 9.0 A

4 A long solenoid S has 15 turns per unit length. A circular loop of wire C is placed over S as shown in the diagram below. S and C are coaxial. A current I_S of 0.20 A is passed through S and a current I_C of 0.90 A is passed through C in the directions shown.

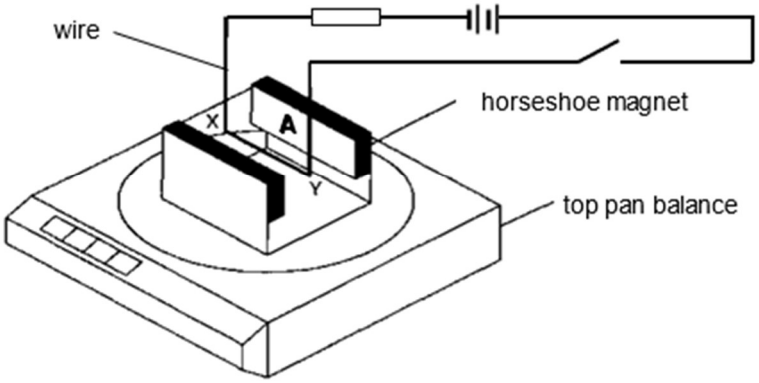


The radius of S is 0.80 m and the radius of C is 1.6 m.

What is the magnitude of the resultant magnetic flux density at the centre of C?

A 0 T **B** 1.0×10^{-6} T **C** 3.4×10^{-6} T **D** 4.1×10^{-6} T

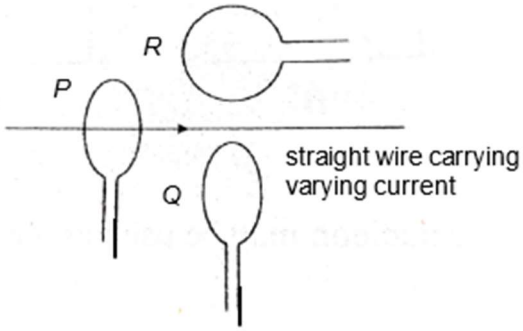
5 A horseshoe magnet rests on a top-pan balance with a wire XY situated between the poles of the magnet. The wire is part of the circuit as shown. When the switch is closed, the reading on the balance increases.



Which one of the following correctly gives the direction of the magnetic force on wire XY and the magnetic pole of face **A** of the horseshoe magnet?

	Direction of magnetic force on wire XY	Magnetic pole of face **A** of the horseshoe magnet
A	Upwards	North pole
B	Upwards	South pole
C	Downwards	North pole
D	Downwards	South pole

6 Three identical circular coils *P*, *Q* and *R* are placed near a long straight wire that carries a varying current. The planes of coils *P* and *Q* are perpendicular to the wire that passes through the centre of coil *P*. Coil *R* and the wire lie in the same plane.

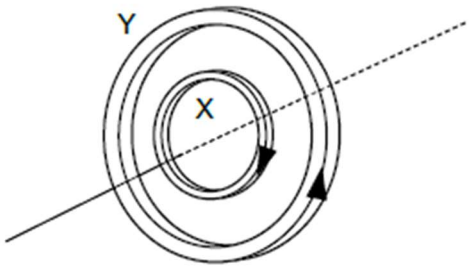


Which of the coils will develop an e.m.f. across the ends?

A *P* only **B** *Q* only

C *R* only **D** *P* and *Q* only

7 Two flat circular coils, X and Y, each with 50 turns, are arranged as shown in the diagram.

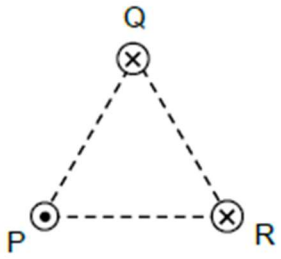


X has radius 0.050 m and carries a current of 2.0 A. Y has radius 0.10 m and carries a current 4.0 A in the opposite direction to X.

What is the magnitude of the total magnetic flux density at the centre of the coils?

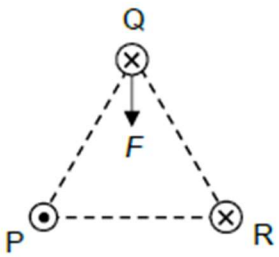
A zero **B** $2000\mu_0$ **C** $3000\mu_0$ **D** $4000\mu_0$

8 Three long vertical wires pass through the corners of an equilateral triangle PQR. They carry equal currents into or out of the paper in the directions shown in the diagram.

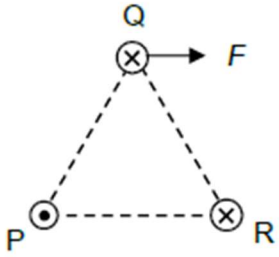


Which diagram shows the resultant force *F* on the wire at Q?

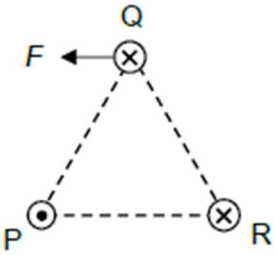
A



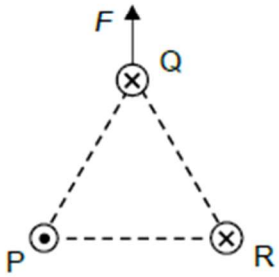
B



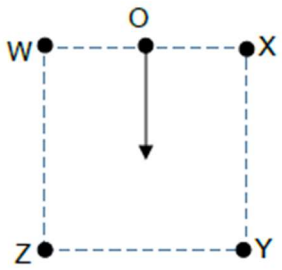
C



D



9 Four parallel current carrying conductors are placed vertically at the corners of a square WXYZ. The magnitudes of the current at W and X are I while the magnitudes of the current at Y and Z are $2I$.



O is the mid-point between W and X.
If there is to be a resultant magnetic flux density produced at O in the direction shown, which option gives the largest magnetic flux density?

	current into the plane	current out of the plane
A	W and Z	X and Y
B	X and Z	W and Y
C	W and Y	X and Z
D	X and Y	W and Z

10 An electron P, having a speed v, travels at right-angles to a uniform magnetic field. P then travels in a circular orbit of period T and orbital radius r.

Another electron Q travels at right-angles to the same magnetic field. Q travels in a circular orbit of radius $2r$. What are the period and speed of Q?

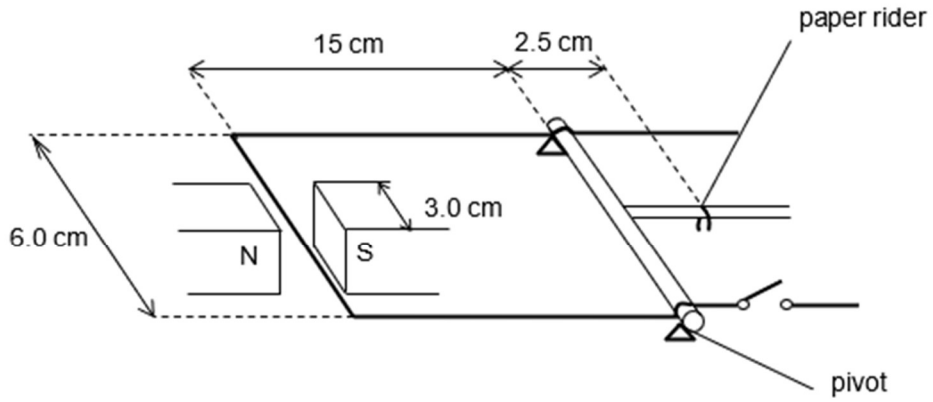
	period	speed
A	$2T$	v
B	$0.5T$	v
C	T	$2v$
D	T	$0.5v$

11 A current balance consists of a U-shaped wire frame of length 15 cm and breadth 6.0 cm.

3.0 cm of the wire is in a uniform magnetic field of flux density 60 mT.

When the switch is open, the current balance is horizontal and in equilibrium when a paper rider of mass 5.0 g is placed at 2.5 cm to the right of the pivot as shown in the diagram.

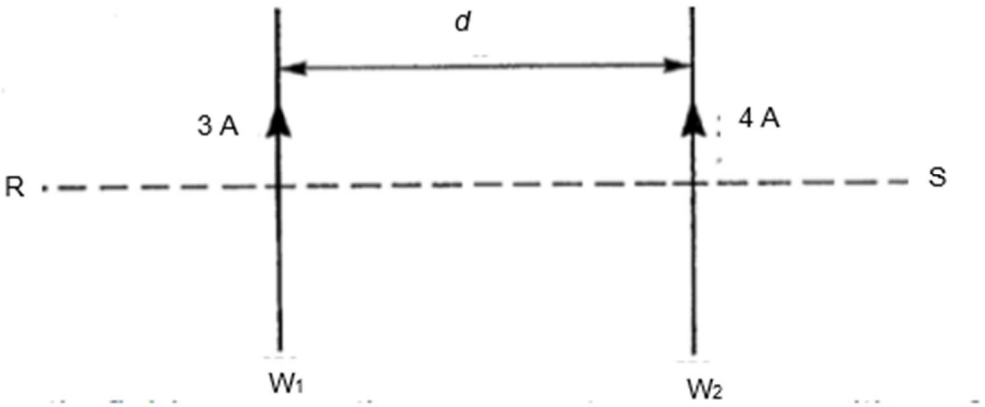
When the switch is closed, the current balance is in equilibrium when the same paper rider is placed 6.8 cm to the right of the pivot.



What is the value of the current in the wire when the switch is closed?

A 1.2 A **B** 3.9 A **C** 7.8 A **D** 12 A

12 Two vertical wires W_1 and W_2 are distance d apart carrying currents of 3 A and 4 A respectively.



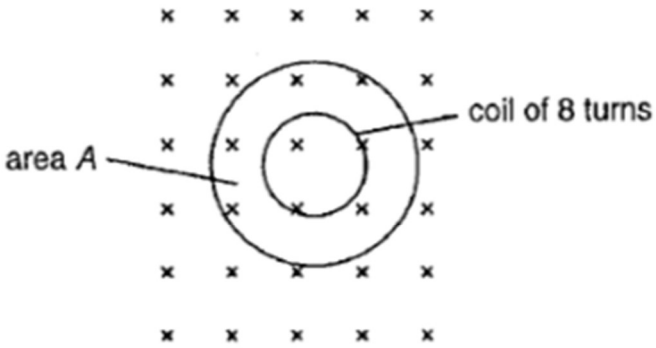
The combined magnetic fields due to these currents gives a position of zero magnetic flux density on the horizontal line RS passing through the wires.

What is the distance of this position from the wire W_1?

A $\frac{1}{4}d$ **B** $\frac{3}{7}d$

C $\frac{4}{7}d$ **D** $\frac{3}{4}d$

13 A uniform magnetic field of flux density B passes normally through a plane area A. In this plane lies a coil of eight turns of wire, each of area $\frac{1}{4}A$.

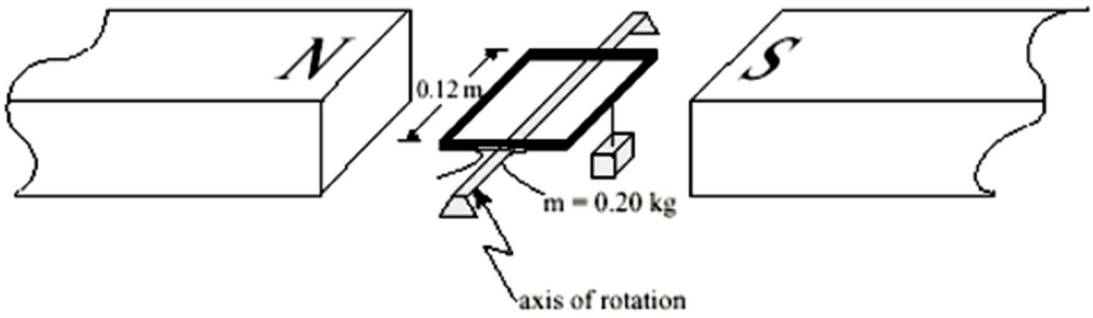


What is the magnetic flux linkage for the coil in terms of B and A?

A $\frac{1}{4}BA$ **B** $2BA$

C $4BA$ **D** $8BA$

14 A 35 loop square coil 0.12 m on a side is positioned in a 0.050 T magnetic field. A 0.20 kg mass is suspended from one side of the coil as shown in the diagram below.

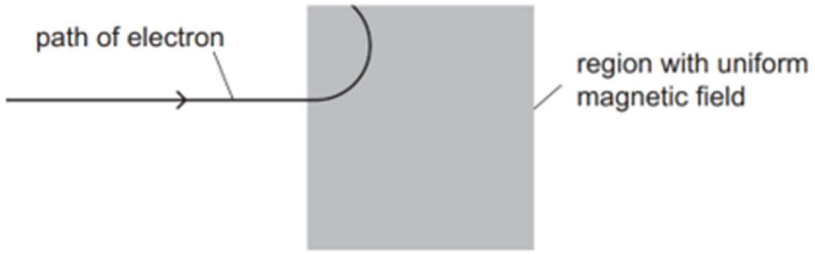


How much current must pass through the coil in order for the coil to remain horizontal?

A 2.3 A **B** 4.7 A **C** 9.3 A **D** 330 A

15 An electron, travelling in a straight line at 1.46×10^7 m s^{-1}, enters a region where there is a uniform magnetic field.

The diagram shows the path followed by the electron before it enters the magnetic field and within the field.

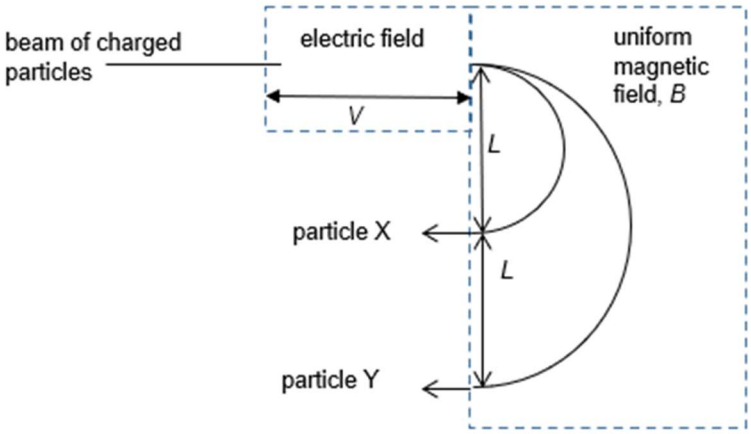


In the magnetic field, the electron follows a semi-circular path of diameter 0.0700 m.

In which direction is the magnetic field and what is the size of the magnetic flux density?

	direction of magnetic field	size of magnetic flux density/T
A	into page	1.19×10^{-3}
B	into page	2.38×10^{-3}
C	out of page	1.19×10^{-3}
D	out of page	2.38×10^{-3}

16 A beam consists of two different particles X and Y. Initially of negligible energy, they are both accelerated through the same potential difference V before entering a region with uniform magnetic field of strength B. Particles X and Y exit from the magnetic field at distance L and $2L$ from the entry point respectively.



α_X and α_Y are the mass to charge ratio of particles X and Y respectively. Which of the following is correct?

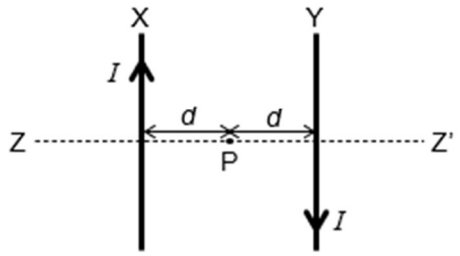
A $2\,\alpha_X = \alpha_Y$

B $\alpha_X = 2\,\alpha_Y$

C $4\,\alpha_X = \alpha_Y$

D $\alpha_X = 4\,\alpha_Y$

17 Two infinitely long straight conductors X and Y are placed parallel to each other. Each conductor carries a current I. Point P is equidistant from either conductor.
X is fixed while Y is rotated about the axis ZZ' until it is perpendicular to X and its current is out of the plane of the paper.



Which of the following statements describing what happens during the rotation is incorrect?

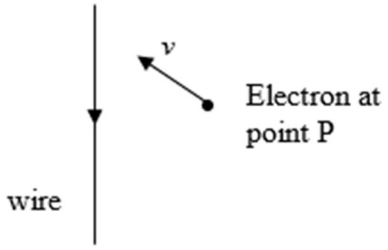
A X experiences a force to the left that decreases to zero.

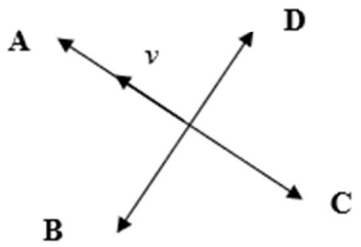
B The forces on X and Y are always equal in magnitude and opposite in direction.

C The resultant magnetic flux density at P decreases to a value that is $\sqrt{2}$ times the flux density due to each wire at P.

D The resultant magnetic flux density at P decreases to a value that is equal to the flux density due to either wire at P.

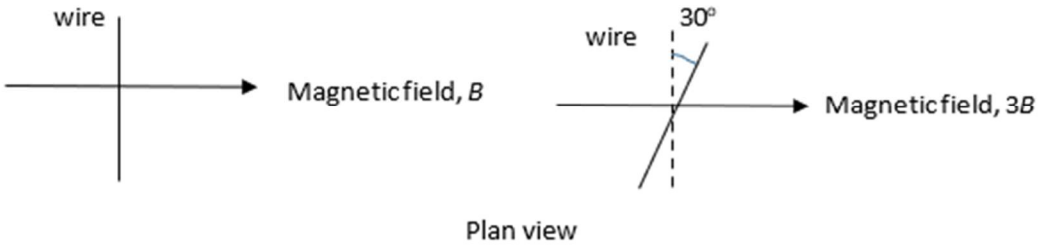
18 A long straight wire carries a current as shown. The wire lies in the plane of the page. What is the direction of the magnetic force experienced by an electron moving with speed v at point P near the wire? The electron at P is moving in the plane of the page in the direction shown. Neglect earth's magnetic field.





19

A straight, horizontal, current-carrying wire lies at right angles to a horizontal uniform magnetic field B. The field exerts a vertical force of 8.0 mN on the wire. The wire is rotated, in its horizontal plane, through 30° as shown. The flux density of the magnetic field is increased to $3B$.



Plan view

What is the new vertical force on the wire?

A 7.0 mN **B** 12 mN **C** 21 mN **D** 24 mN

20

An electric current flowing through a wire produces a magnetic field around the wire. Four wires carrying identical currents are shown placed at the corners of a square. Each wire produces a field of flux density B at the centre of the square.The symbol ⊕ indicates a current flowing along the wire into the page, and the symbol ⊙ indicates a current flowing along the wire pointing out of the page. What is the magnetic field at the centre of the square?

A 0 **B** 2.8 B **C** 3.2 B **D** 4.0 B