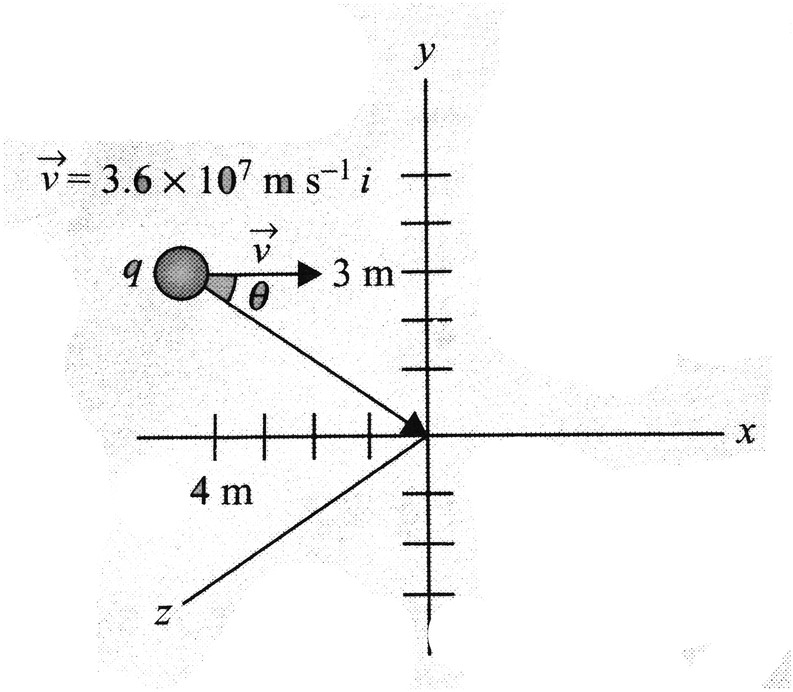
PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

SOURCES OF MAGNETIC FIELD

Illustration

1. A point chanrge of magnitude $q = 4.5nC$ is moving with speed $v = 3.6 \times 10^7 ms^{-1}$ parallel to the x-axis along the line $y = 3m$. Find the magnetic field at the origin produced by this charge when the charge is at the point $x = -4m, y = 3m$, as shown in Fig.



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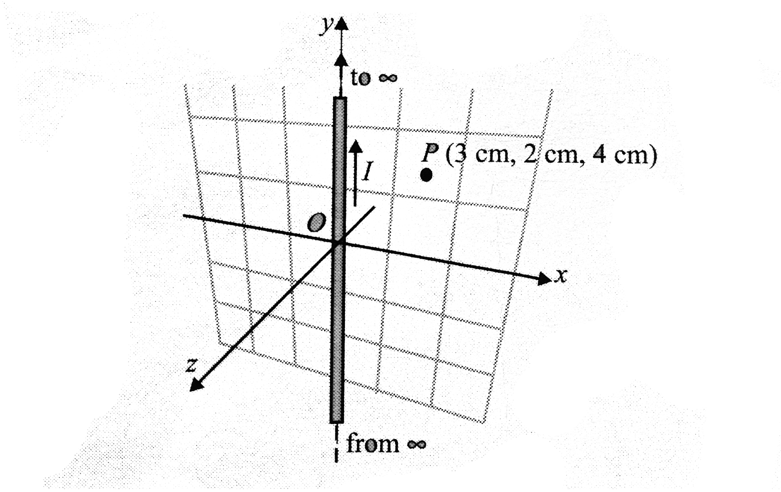
2. A long straight wire carrying current $i = 10A$ lies along y-axis. Find the magnetic field at P(3cm, 2cm,4cm).



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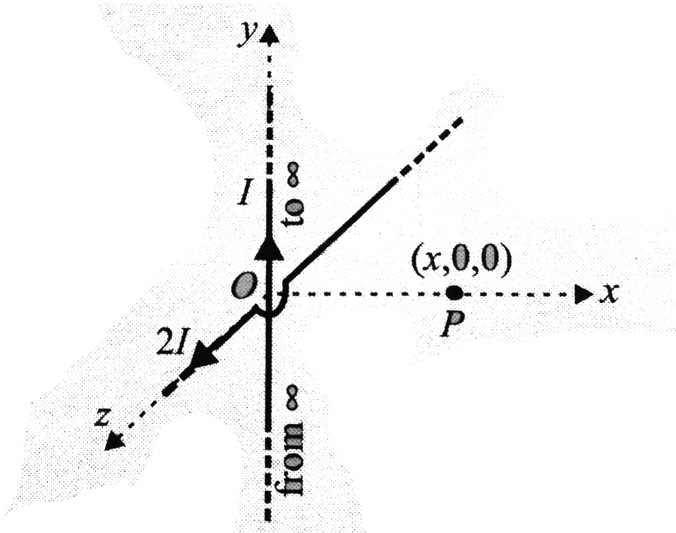
3. Two long straight currents carrying wires having currents I and 2I lie along y-and z-axis, respectively, as shown in Fig. Find $\overrightarrow{B}$ at a point P(x,0).



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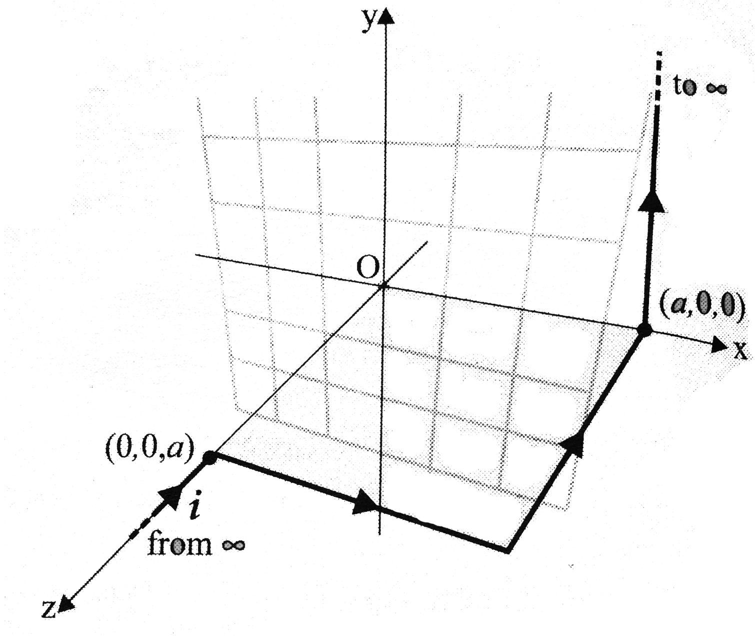
4. Find $\overrightarrow{B}$ at the origin due to the long wire carrying current I.



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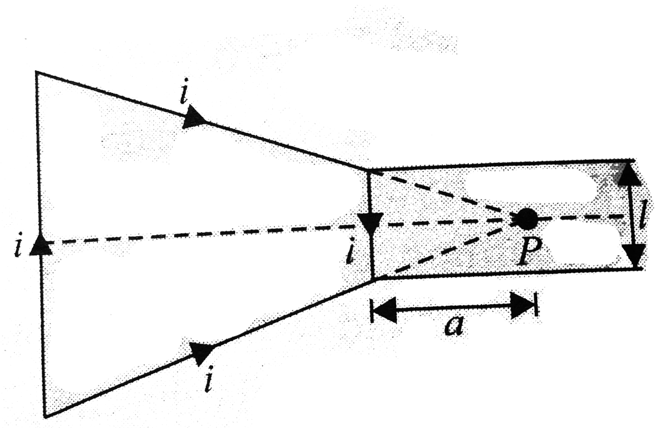
5. A current I flows in a circuit shaped like an isosceles trapizium. The ratio of the bases is 2. The length of the smaller base is l. Calculate the megnetic field induction at point P located in the plane of the trapizium, but at a distance a from the midpoint of the smaller base,



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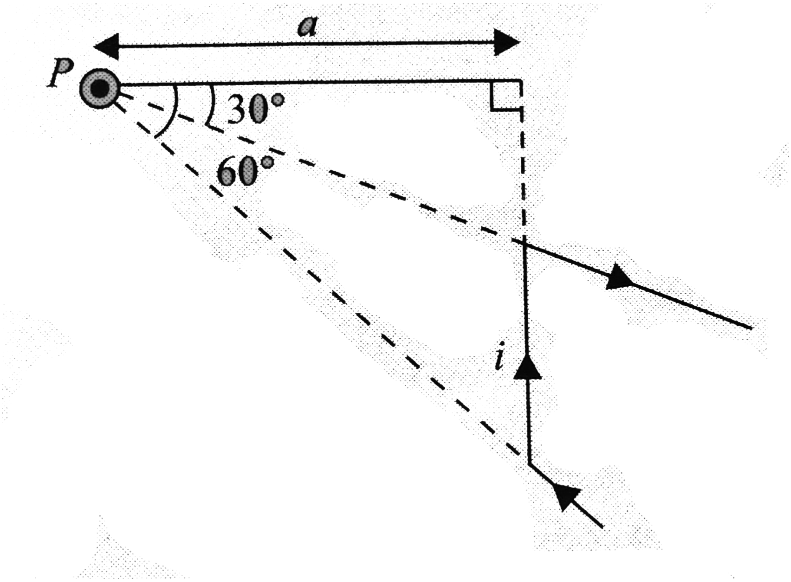
6. Find the magnitude and direction of magnetic field at point P due to the current carrying wire as shown in



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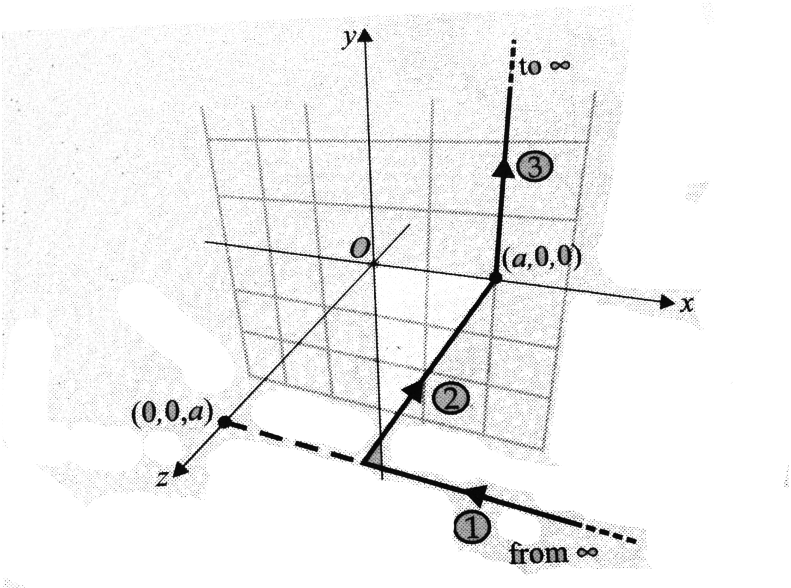
7. An infinite current carrying conductor is bent into three segment (1), (2) and (3) as shown in Fig. If it carries a current i, find the magnetic induction at the origin.



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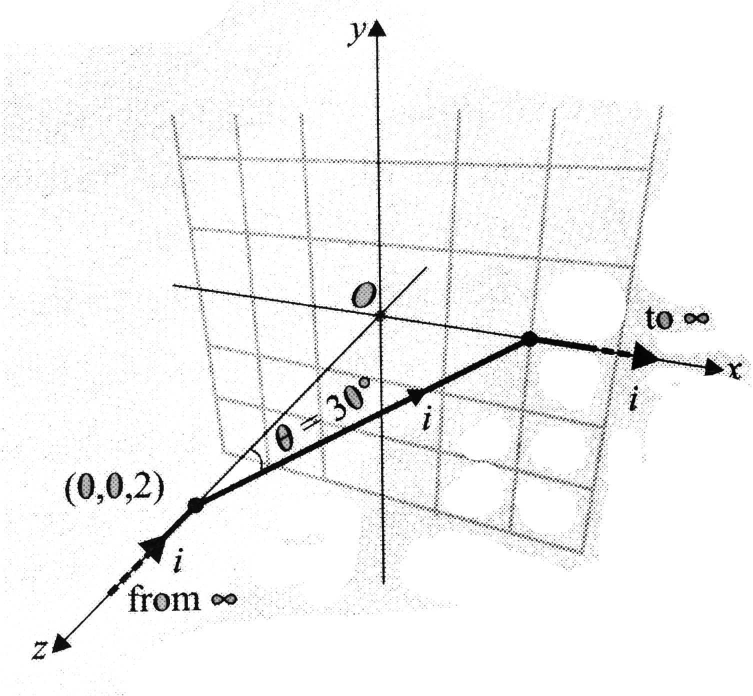
8. Find the field at the origin O due to the current $i = 2A$.



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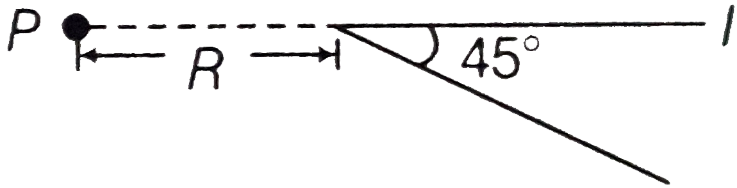
9. A long straight wire, carrying I is bent at its mid-point to form an angle of 45°). Induction of magnetic field (in tesla) at point P, distant R from point of bending is equal to



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10. Two straight infinitely long and thin parallel wires are spaced 0.1m apart and carry a current of 10A each. Find the magnetic field at a point distance 0.1m from both wires in the two cases when the currents are in the (a) same and (b) opposite directions.

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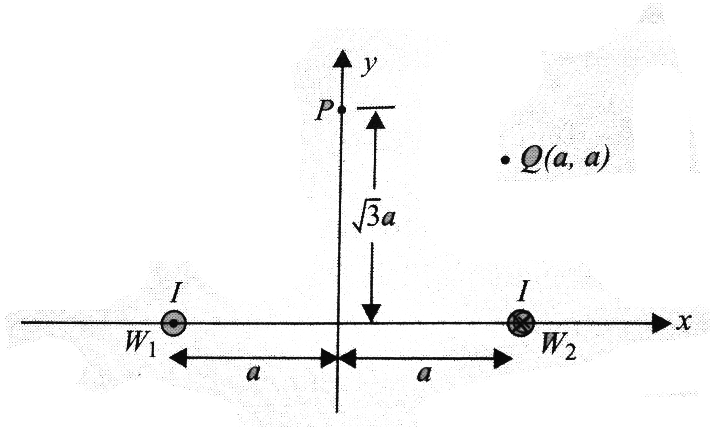
11. In Fig. Two long wires W_1 and W_2, each carrying current I, are placed parallel to each other and parallel to z-axis. The direction of current in W_1 is outward and in W_2 it is inward. Find $\overrightarrow{B}$ at p and Q.



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12. A square loop of side $6cm$ carries a current of $30A$. Calculate the magnitude of magnetic field B at a point P lying on the axis of the loop and a distance $\sqrt{7}$ cm from centre of the loop.

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13. Calculate the magnetic field at point O for the current-carrying wire segment shown in Fig. The wire consists of two straight portions and a circular arc of radius a, which subtends an angle θ.

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14. Shown in Fig. is a conductor carrying current I. Find the magnetic field intensity at point O.

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15. A battery is connected between two points A and B on the circumference of a uniform conducting ring of radius r and resistance R. One of the arc AB of the ring subtends an angle θ at the centre. The value of the magnetic field produced at the centre due to the current in the ring is

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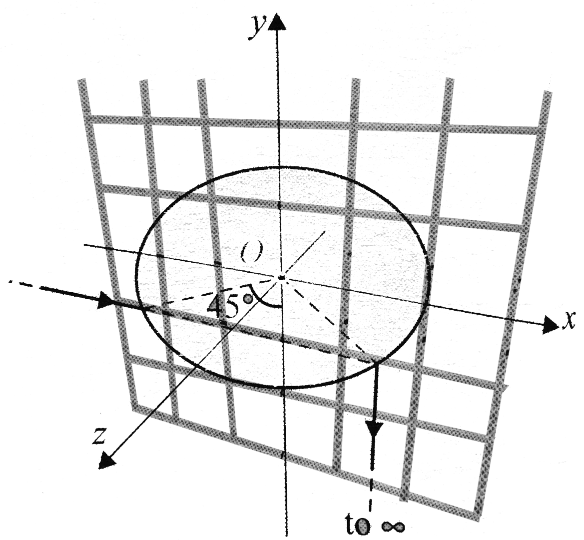
16. What is the magnitude of magnetic field at the centre O of loop of radius $\sqrt{2}m$ made of uniform wire when a current of 1amp entres in the loop and taken out of it by two long wires as shown in the Fig.



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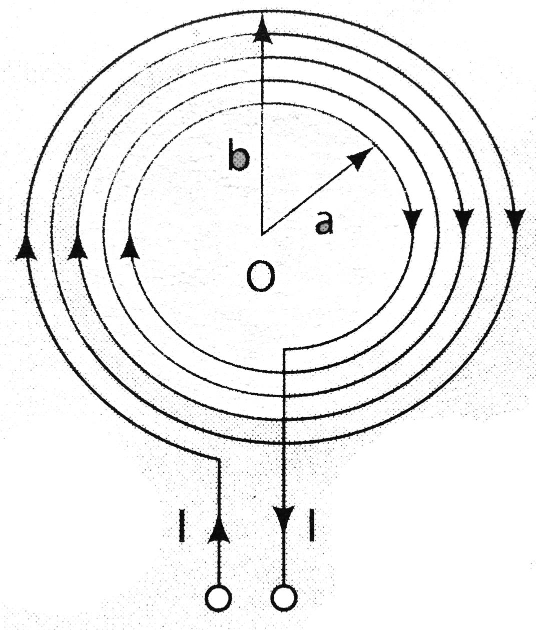
17. A thin insulated wire forms a plane spiral of $N = 100$ turns carrying a current $i = 8mA$. The inner and outer radii are equal to $a = 5cm$ and $b = 10cm$.

Find the magnetic induction at the centre of the spiral



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18. A solenoid 60 cm long and of radius 4 cm has 3 layer of windings 300 turns each. A 2.3 cm long wire of mass 2.5g lies inside the solenoide near its centre normal to its axis, both the wire and the axis of the solenoid are in the horizontal plane. The wire is connected through two leads parallel to the axis of the solenoid to an external battery which supplies a current of 6A in the wire. What value of current (with appropriate sense of circulation) in the windings of the solenoid can support the weight of the wire?

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19. A solenoid of length 0.6 m has a radius of 2 cm and is made up of 600 turns If it carries a current of 4 A, then the magnitude of the magnetic field inside the solenoid is

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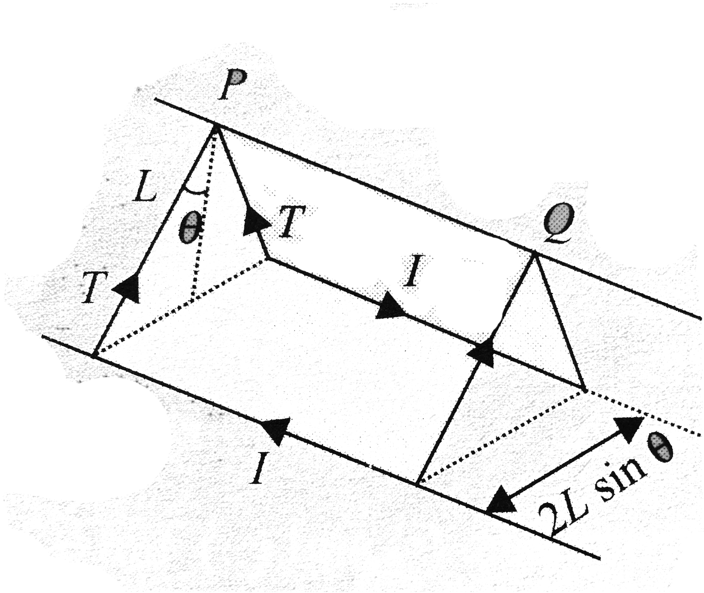
20. Two long parallel wires carry currents of equal magnitude but in opposite directions. These wires are suspended from rod PQ by four chords of same length L as shown in Fig The mass per unit length of the wires is λ. Determine the value of θ assuming it to be small.



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21. Two parallel horizontal conductors are suspended by two light vertical threads each 75 cm long. Each conductor has a mass of $40gm^{-1}$, and when there is no current they are 0.5 cm apart. Equal current in the two wires result in a separation of 1.5 cm. Find the values and directions of currents. Take $g = 9.8 ms^{-2}$.

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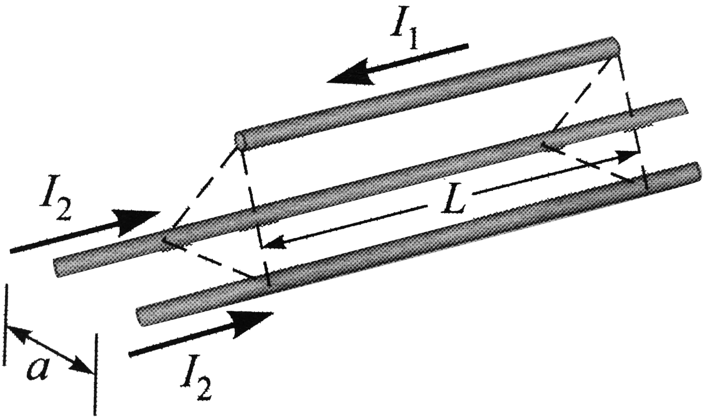
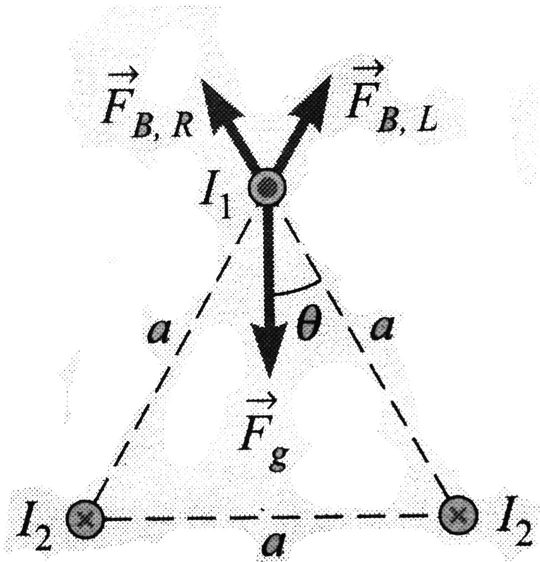
22. Two infinetely long, parallel wires are lying on the ground at distance $a = 1 cm$ apart as shown in Fig. A third wire, of length L=10m and mass 400g, carries a current of $I_1 = 100 A$ and is levitated above the first two wires, at a horizontal position midway between them. The infinitely long wires carry equal currents I_1 in the same directions, but in the direction opposite that in the leviated wire. What current must the infinately long wires carry so that the three wires form an equilateral triangle?





(b)

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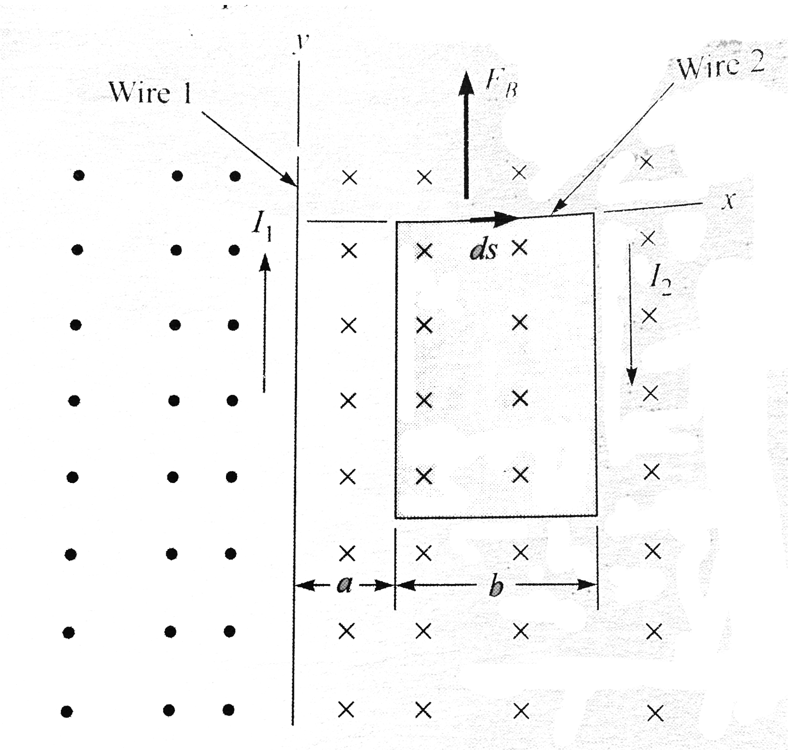
23. Wire 1 in Fig. is oriented along the y-axis and carries a steady current I_1. A rectangular loop located to right of the wire and in the x-y plane carries a current I_2. Find the magnetic force exerted by wire (1) on the top of wire (2) of length b in the loop, labeled "wire (2)" in the figure.



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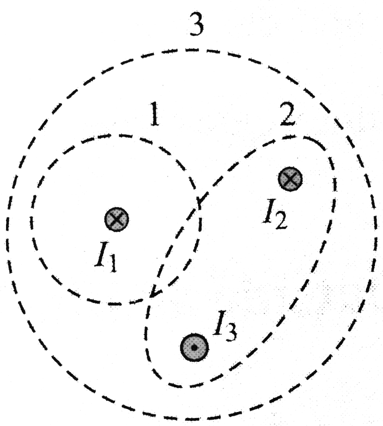
24. Figure shows three current carrying conductors and three imaginary loops. Calculate the current enclosed by each of the loops.



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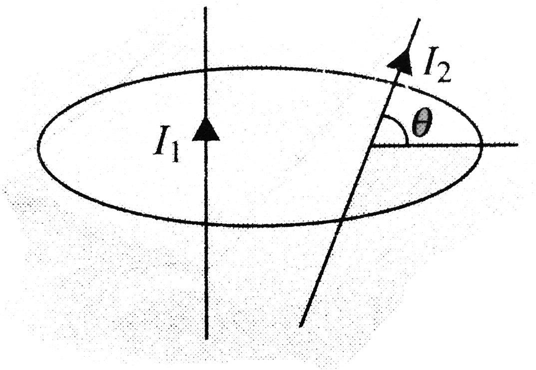
25. Figure shows two current carrying wires piercing the plane of an imaginary loop. One of the wires is normal to the plane of the loop while the other is at an angle. Calculate the net current enclosed.



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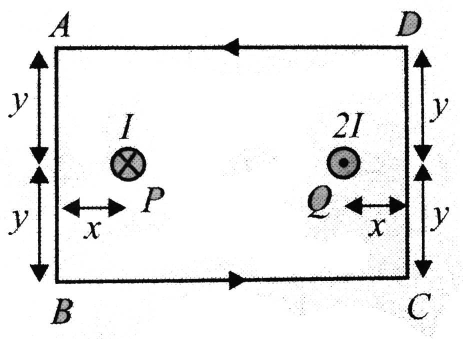
26. Let B_P and B_Q be the magnetic field produced by wire P and Q which are placed symmetrically in a rectangular loop ABCD. Current in wire P is directed I inward and in Q is 2I outward.



If $\int_A^B \vec{B}_Q . d\vec{l} = 2\mu_0 T - m$

$\int_D^B \vec{B}_P . d\vec{l} = -2\mu_0 T - m$

$\int_A^B \vec{B}_P . d\vec{l} = -\mu_0 T - m$

Then find I.

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27. Consider a co axial cable which consists of an inner wilre of radius a surrounded by an outer shell of inner and outer radii b and c respectively. The inner wire caries a current I and outer shell carries an equal and opposite current. The magnetic field at a distance x from the axis where $b < x < c$ is

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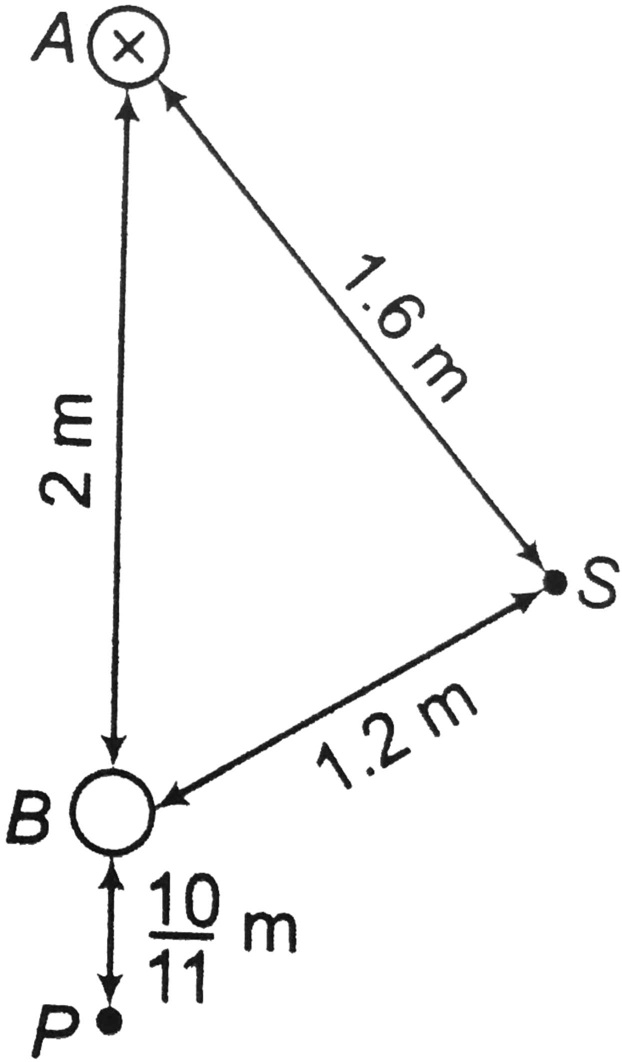
Solved Example

1. Two long straight parallel wieres are $2m$ apart, perpendicular to the plane of the paper. The wire A carries a current of $9.6A$, directed into the plane of the paper. The wire B carries a current such that the magnetic field of induction at the point P, at a distance of $\frac{10}{11}$ m from the wire B, is zero. find

a. the magnitude and directiion of the current in B.

b. the magnitude of the magnetic field of induction of the pont S.

c. the force per unit length on the wire B.



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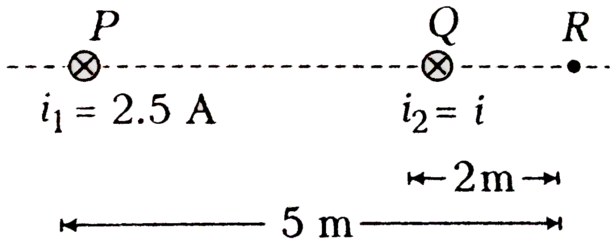
2. Two long parallel wires carrying current 2.5 A and I in the same direction (directed into plane of the paper 0 are held ar P and Q respectively,such that they are perpendicular to the plane of paper .The points O and Q are located at distance of 5 m and 2 m respectively,from a collinear point R

(i0 An electron moving with a velocity of 4×10^5m/s along positive x-direction experiences a force of magnitude 3.2×10^{-20} n at the point R.Find the value of i

(ii) Find all positions at which a third long parallel wire carrying a current of magnitude 2.5 A may be placed, so that magnetic field at R is zero



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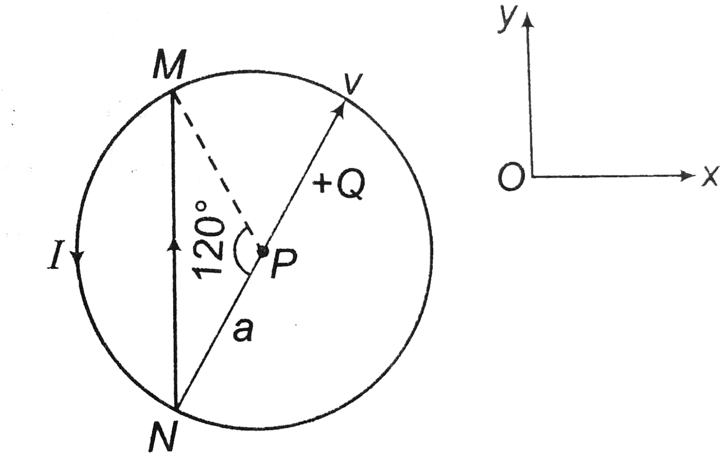
3. A wire loop carrying a current I is placed in the xy-plane as shown in figure



a. If a particle chsarge +Q and mass m is placed at in centre P and given a velocity v along NP (see figure), find its instaneous acceleration.

If an external uniform magnetic induction field $B = B\hat{i}$ is applied, find the force and the torque acting on the loop due to this field.

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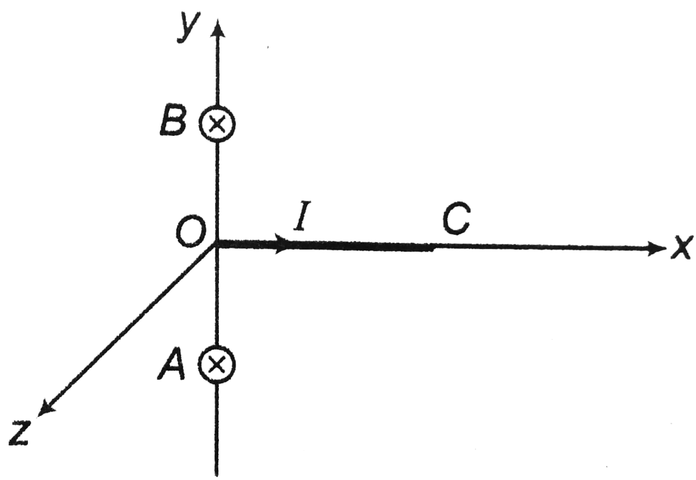
4. A straight segment OC (of lengh L) of a circuit carrying a current I is placed along the x-axis. Two infinitely long straight wire A and B each extending from $z = -\infty \to +\infty$ are fixed at $y = -a$ and $y = +a$ respectively as show in the figure. If the wires A and B each carry a current I into the plane of the paper, obtain the expression for the force acting on the segment OC. What will be the force on OC if the current in the wire B is reversed?



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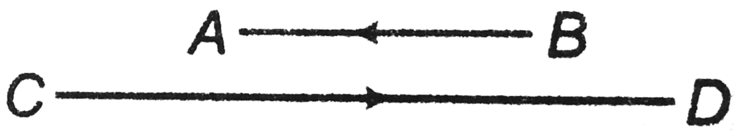
5. A long horizontal wire AB,which is free to move in a vertical plane and carries a steady current of $20A$, is in equilibrium at a height of $0.01m$ over another paralllel long wire CD which is fixed in a horizontal plane and carries a steady current of $30A$, as shown in figure. Show that when AB is slightly depressed it executes simple harmonic motion. Find the period of oscillations.



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6. Three infinitely long thin wires, each carrying current i in the same dieretion, are the xy plane of a gravity free space. The central wire is along the y-axis while the other two are along $x = \pm d$

i find the locus of the points for which the magnetic field B is zero.

ii If the central wire is displaced along the z-direction by a small amount and released, show that it will execute simple harmonic motion. If the linear mass density of the wires is λ, find the frequency of oscillation.

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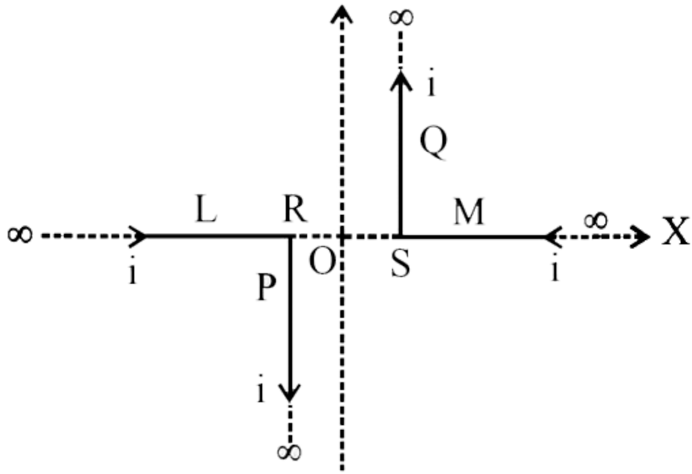
7. A pair of stationary and infintely long bent wires are placed in the XY planes as shown in fig. The wires carry currents of $I = 10 amperes$ each as shown . The segments P and Q are parallel to the $Y - a\xi s$ such that $OS = OR = 0.02m$. Find the magnitude and direction of the magnetic induction at the origin O.



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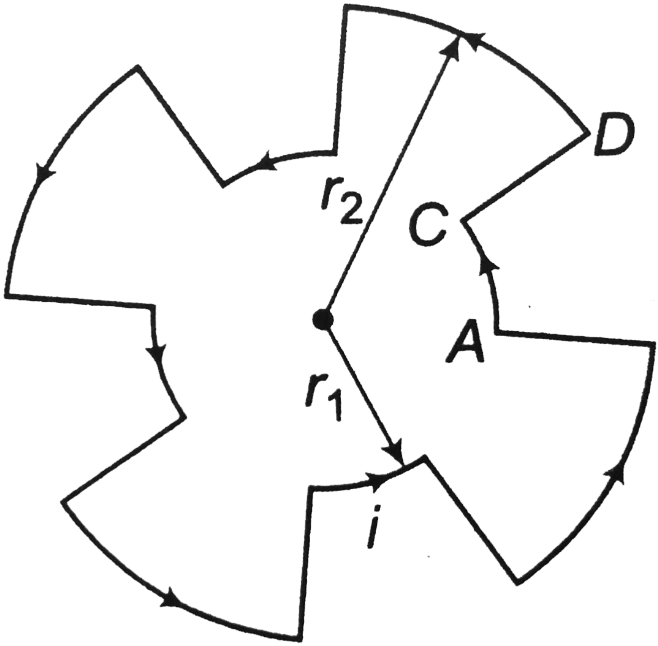
8. A current of $10A$ flows around a closed path in a circuit which is in the horizontal plane as shown in the figure. The circuit consists oi eight alternating arcs of radii $r_1 = 0.08m$ and $r_2 = 0.12m$. Each subtends the same angle at the centre.



a. Find the magnetic field produced by this circuit at the centre.

b. An infinitely long straight wire carrying as current of $10A$ is passing through the centre of the above circuit vertically with the direction of the current being into the pane of the circuit. what is the force acting on the wire at the centre due to the current in the circuit? What is the force acting on the arc AC and the straight segment CD due to the current at the centre?

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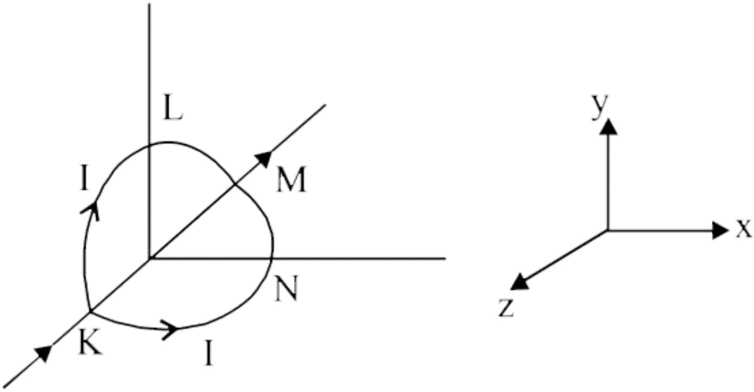
9. A circular loop of radius R is bent along a diameter and given a shapes as shown in the figure. One of the semicircles (KNM) lies in the $x - z$ plane with their centres and the other one (KLM) in the $y - z$ plane with their centres at the origin. current I is flowing through each of the semi circles as shown in figure.

(a) A particle of charge q is released at the origin with a velocity $\overrightarrow{v} = -v_0 \hat{i}$. Find the instantaneous force

$\vec{F}$ on the particle . Assume that space is gravity free.

(b) If an external uniform magnetic field $B_0\hat{j}$ is applied , determine the force $\vec{F}_1$ and $\vec{F}_2$ on the semicircles KLM and KNM due to the field and the net force $\vec{F}$ on the loop.



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10. Centers of two similar coils P and Q having same number of turns are located at the coordinates (0.4,0) and (0,0.3) such that the plane of coils are perpendicular to X-and Y-axis respectively. The areas of cross section of coils P and Q are in the ration $4:3$ Coil P has 16 A current in clockwise direction and coil Q has $9\sqrt{3}A$ current in anticlockwise direction as seen from the origin. A small compass needle is placed at the origin. Find the deflection in the needle, assuming the earth's magnetic field negligible and the radii of the coils very small compared to their distances from the origin.

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11. A coil of radius R carries current i_1. Another concentric coil of radius $r(r < < R)$ carries current i_2. Planes of two coils are mutually perpendicular and both the coil are free to rotate about common diametre. Find maximum kinetic energy of smaller coil when both the coils are released, masses of coils are M and m, respectively.

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12. A current I flows along a round loop. Find the integral $\int \overrightarrow{B} . \overrightarrow{dr}$ along the axis of the loop within the

range from $(-\infty)$ to $(+\infty)$. Explain the result obtained.

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13. Inside a long straight uniform wire of round cross-section there is a long round cylindrical cavity whose axis is parallel to the axis of the wire and displaced from latter by a distance d. If a direct current of density $\vec{j}$ flows along the wire, then magnetic field inside the cavity will be

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14. A long cylinder of uniform cross section and radius R is carrying a current i along its length and current density is uniform cross section and radius r in the cylinder parallel to its length. The axis of the cylinderical cavity is separated by a distance d from the axis of the cylinder. Find the magnetic field at the axis of cylinder.

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15. A non-conducting thin disc of radius R charged uniformly over one side with surface density s rotates about its axis with an angular velocity ω. Find

(a) the magnetic induction at the centre of the disc,

(b) the magnetic moment of the disc.

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16. A sphere of radius R, uniformly charged with the surface charge density σ rotates around the axis passing through its centre at an angular velocity. (a) Find the magnetic induction at the centre of the rotating sphere. (b) Also, find its magnetic moment.

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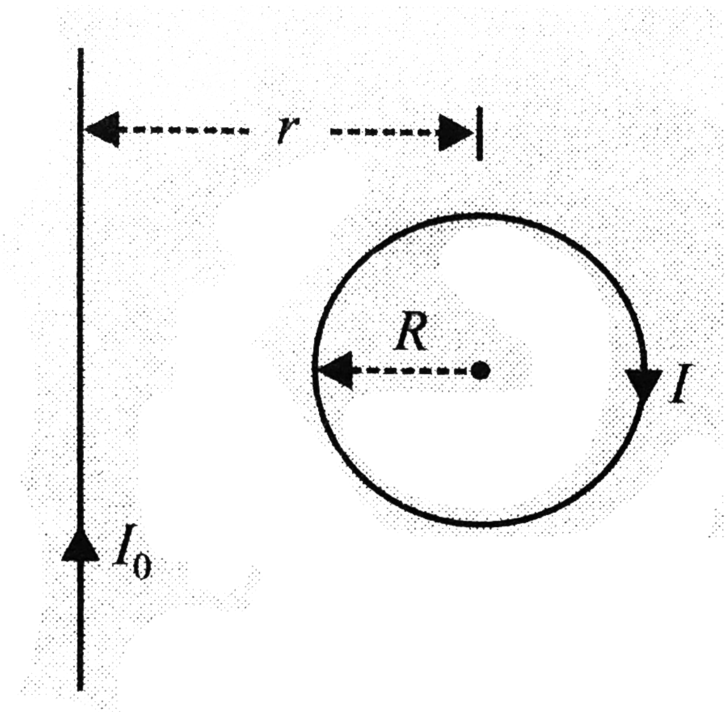
17. A long straight wire is coplanar with a current carrying circular loop of radius R as shown in Fig. Current flowing through wire and the loop is I_0 and I, respectively. If distance between centre of loop and wire is $r = 2R$, calculate force of attraction between the wire and the loop.



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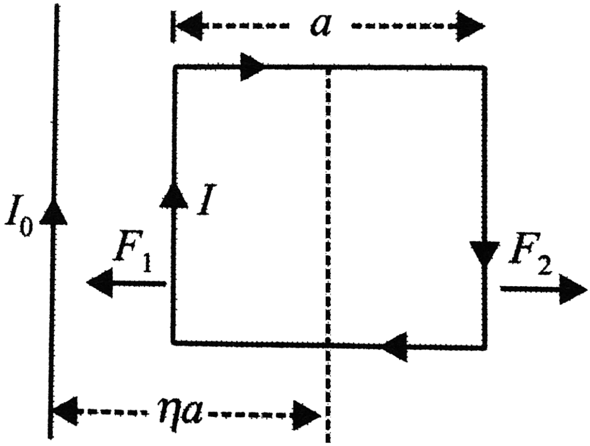
18. A square frame carrying a current $I = 0.90A$ is located in the same plane as a long straight wire carrying a current $I_0 = 5A$, The frame side has a length $a = 8cm$. The axis of the frame passing through the mid-point of the opposite sides is parrallel to the wire and is separated form it by a distance $h = 15$ times greater tahn the side of the frame.

Find:

(a) ampere force acting on the frame.

(b) The machanical work to be performed in order to turn the frmae through 180° about its axis, with the current maintained constant.



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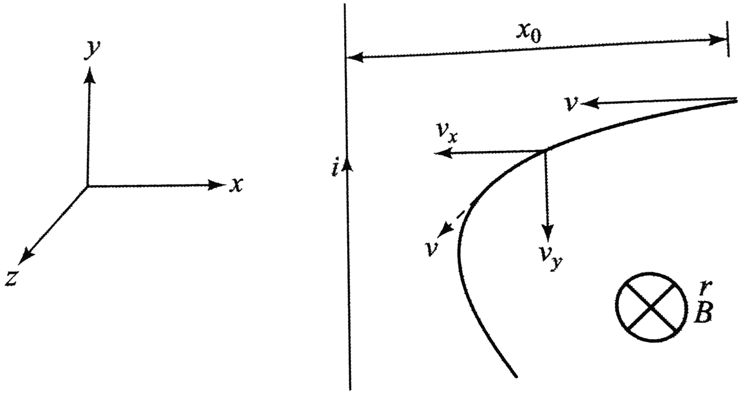
19. A long straight wire carries a current i. A particle having a positive charge q and mass m, kept at distance x_0 from the wire is projected towards it with speed v. Find the closest distance of approach of charged particle to the wire.



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20. From the surface of a round wire of radius a carrying a direct current i, a positive charge q escapes with a velocity v_0 perpendicular to the surface. Find what the maximum distance of the electron will be from the axis of the wire before it turns back due to the action of the magnetic field generated by the current.

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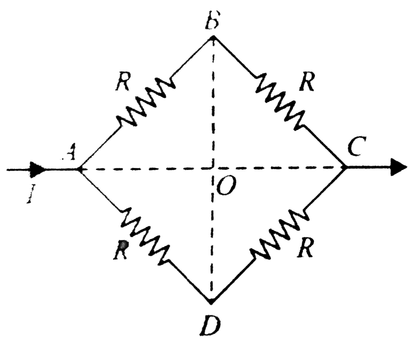
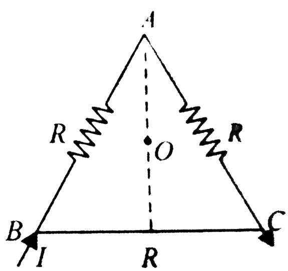
Concept Exercise 2.1

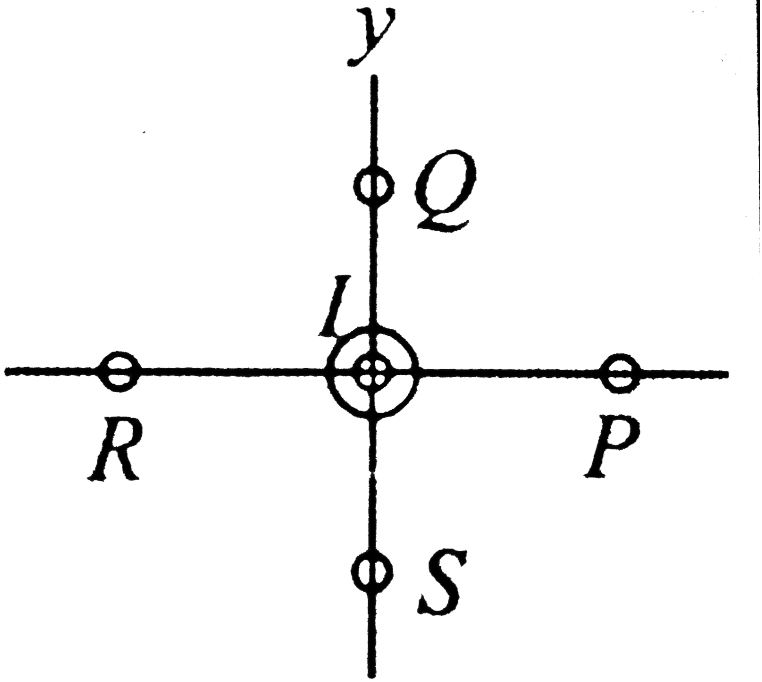
1. (a). Find the magnetic field B at point O (centre) of

(i). ABCD, which is a square of side l.

(ii). ABC, which is an equilateral triangle of side l.







(b) Twelve uniform wires of equal length l and each of resistance r are connected to form a skelton cube. A battary of emf E is connected between two diagonally opposite corners of the cube. The magnetic induction at the centreof the cube is ....

(c) An infinately long straight wire is placed at the origin along the z-axis. The current I flows along the positive z-axis. Find the unit vecotrs showing the direction of magnetic field at the four points: $P(a, 0), Q(0, b), R(a, 0)$ and $S(0, -b)$

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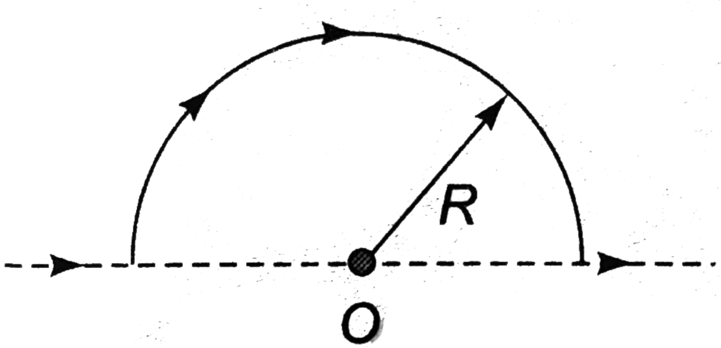
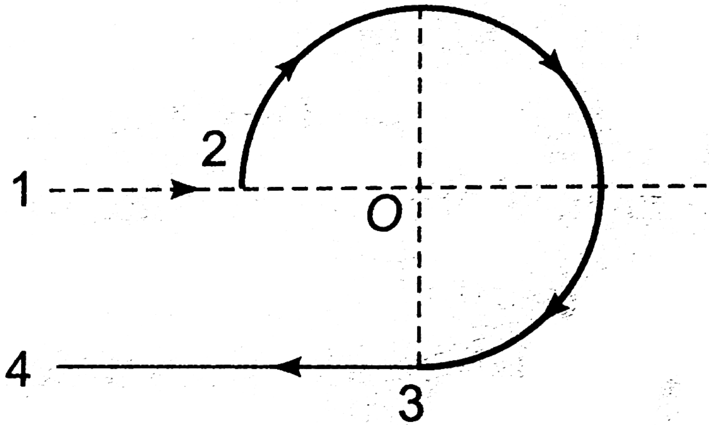
2. Calculate the magnetic field at point O in each of the following cases:

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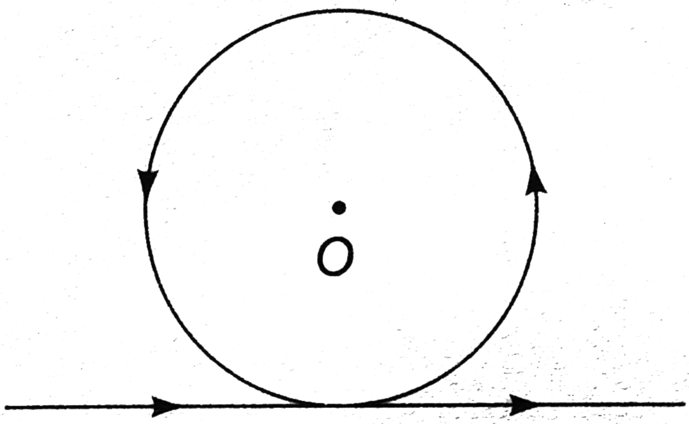
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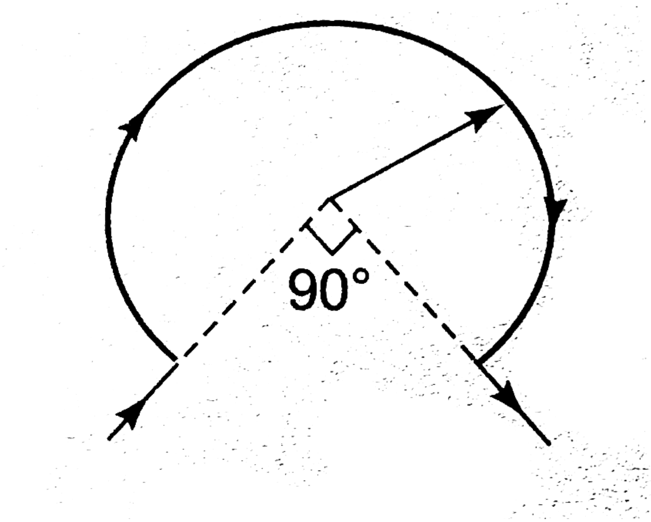

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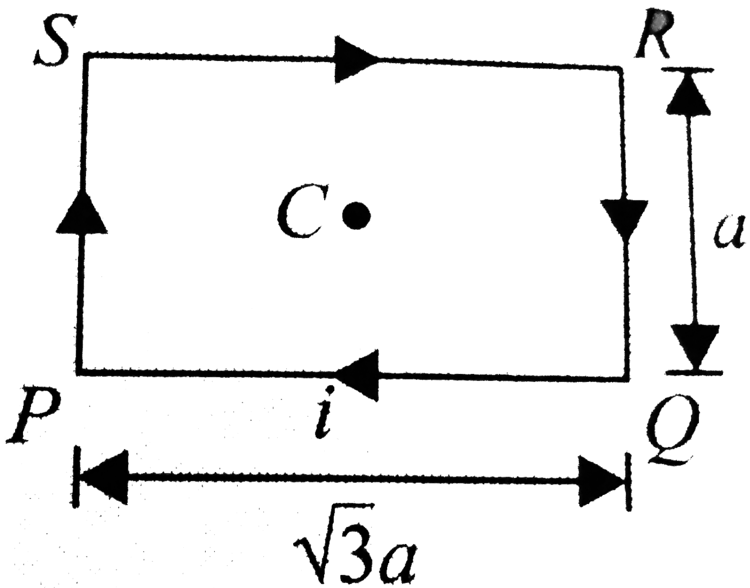
3. Find resultant magnetic field at C in Fig



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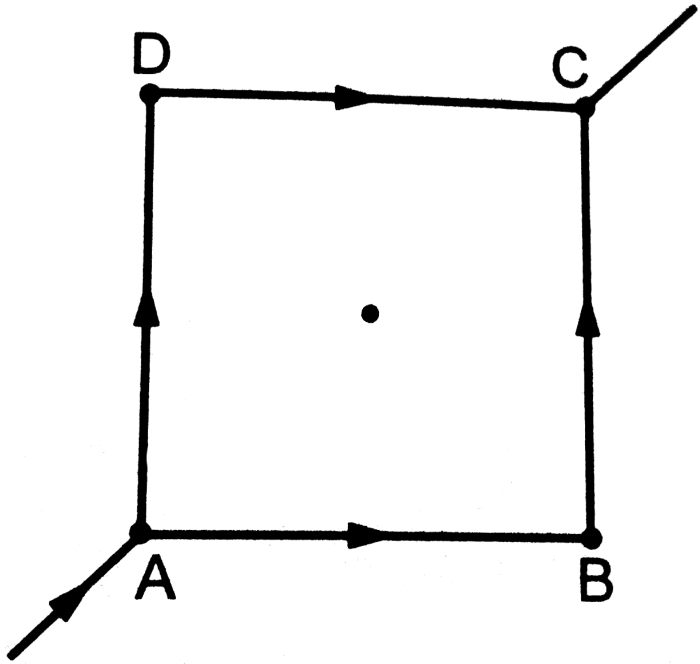
4. Figure shows a square loop made from a uniform wire. Find the magnetic field at the centre of the

square

if a battery is connected between the points A and C.



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5. In Fig. There are two parallel long wires (placed in the plane of paper) carrying currents 2I and I.

Consider point A,C and D on the line perpendicular to both the wires and also in the plane of the paper. The distances are mentioned. Find (a) $\vec{B}$ at A,C and D (b) position of points on line ACD where $\vec{B}$ 0 is.

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6. In Fig. a larger metal sheet of width w carries a current I(uniformly distributed in its width w). Find the magnetic field at point P which lies on the plane of the sheet.

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7. Find magnetic field at point P shown in Fig. point P is on the bisector of angle between the wires.

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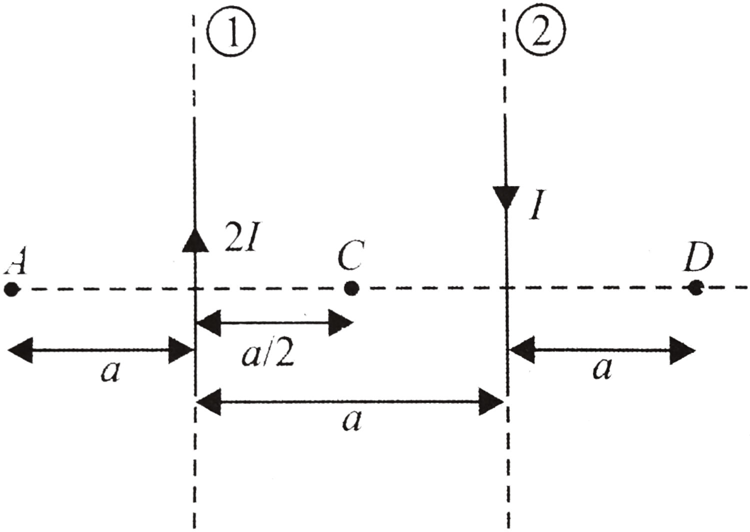
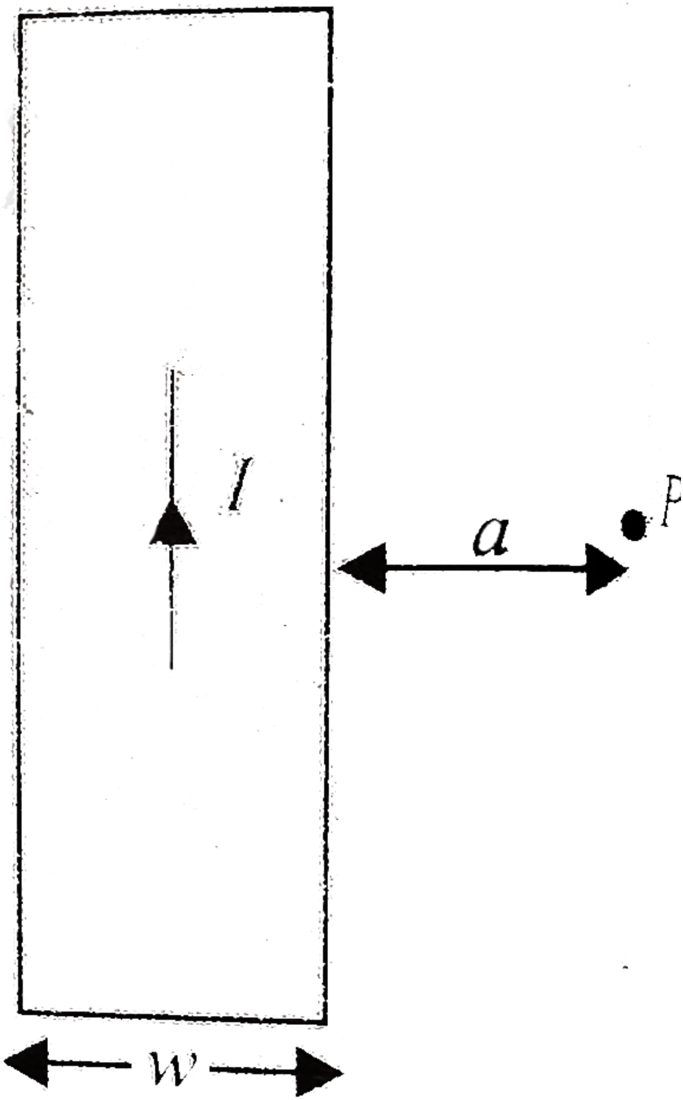
8. Find magnetic field at C by the system of current carrying wire.



①
②
I
2I
A
C
D
a/2
a
a
a



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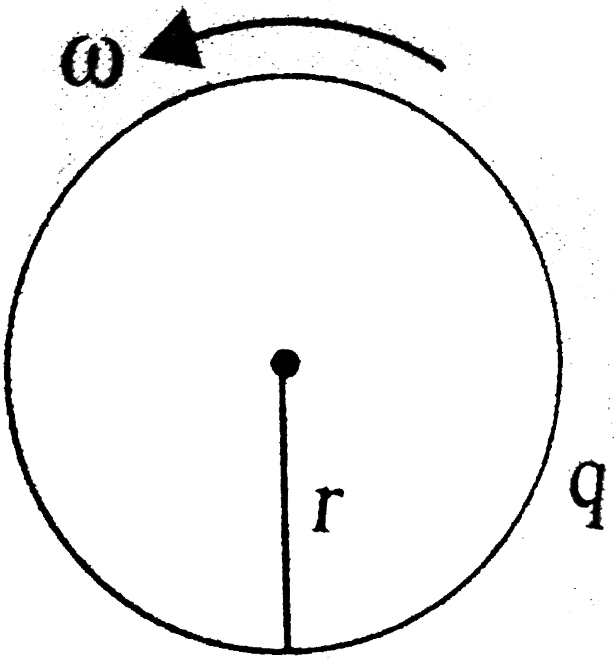
9. A conducting ring of radius r having charge q is rotating with angular velocity ω about its axes. Find the magnetic field at the centre of the ring.



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10. Suppose that the current density in a wire of radius a varius with r according to Kr^2 where K is a constant and r is the distance from the axis of the wire. Find the magnetic field at a point at distance r form the axis when (a) r $<$ a and (b) r $>$ a.

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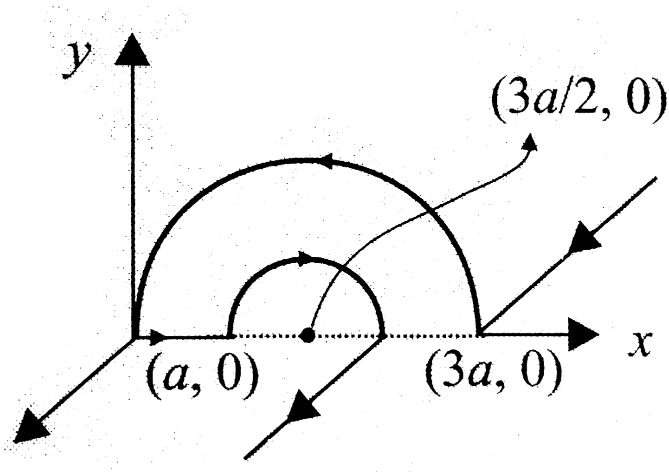
11. In Fig. Find the magnetic field at common centre.



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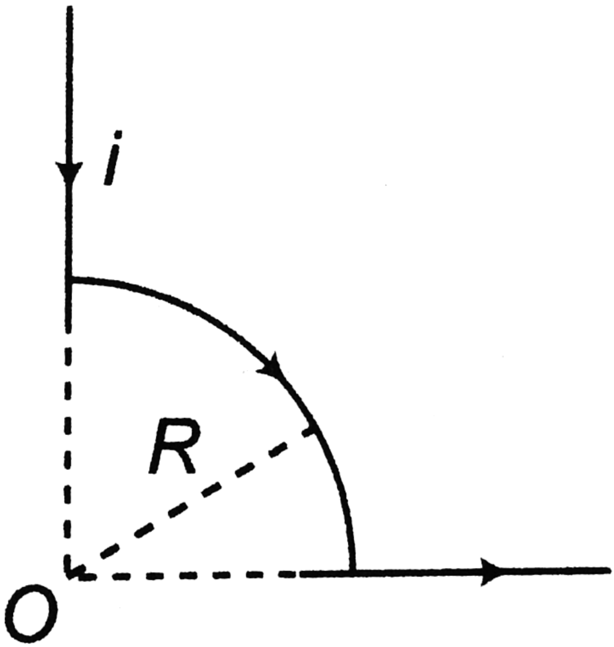
12. The segment of wire shown in figure carries a current of $i = 5.0A$ where the radius of the circular arc is $R = 3.0cm$. Determine the magnitude and direction of the magnetic field at the origin.



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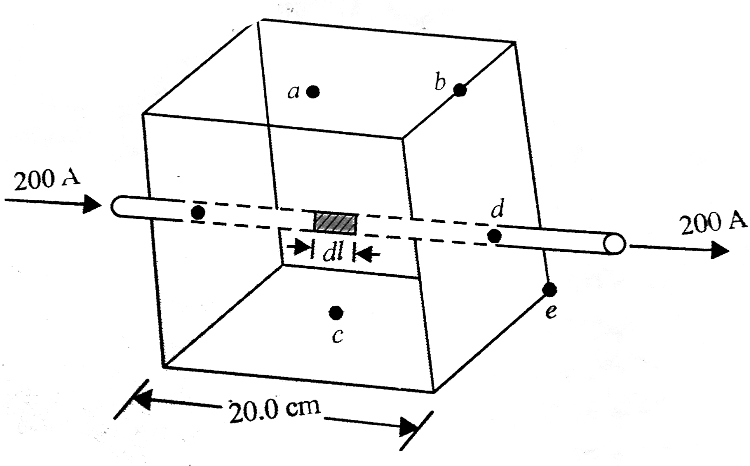
13. A long, straight wire, carrying a current 200A, runs through a cubical wooden box, entering and leaving through holes in the centre of opposite faces (as

shown in Fig). The length of each side of the box is 20 cm. Consider an element dl, $0.100cm$ long of the wire at the centre of the box. Compute the magnitude dB of the magnetic field produced by this element at the point a, b,c,d and e as shown fig. Points a,c, and dare at the centres of the faces of the cube, point b is at the midpoint of one edge, and point e is at a corner. Copy the figure and show the direction and relative magnitudes of field vectors.



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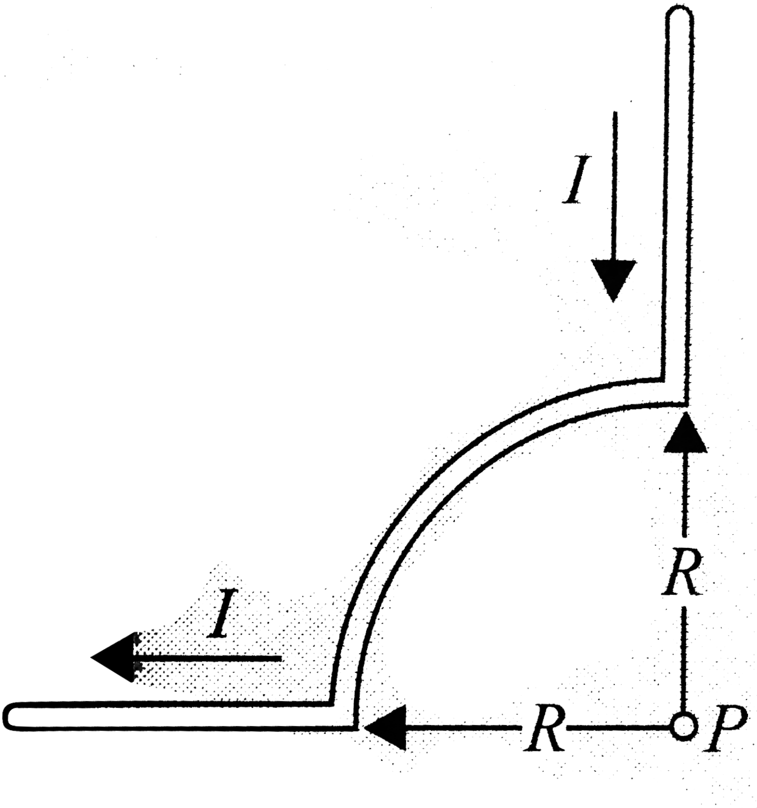
14. The wire shown in Fig. carries current I in the direction shown. The wire consists of a very long, straight section, a quarter- circle with radius R, and another long, straight section. What are magnitude and direction of net magnetic field at the center of curvature of quarter-circle section (point P)?



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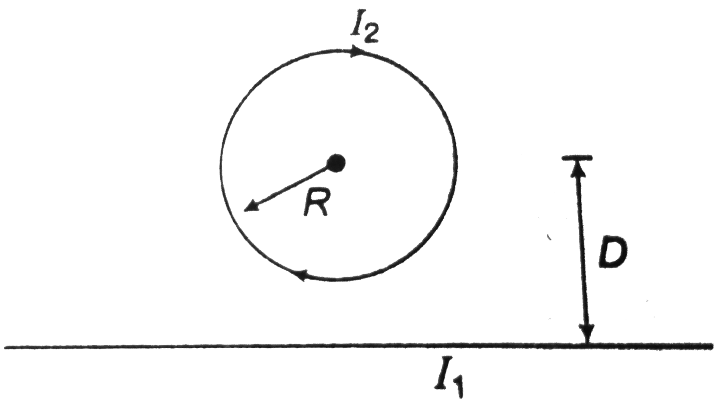
15. A circular loop of radius R carries current I_2 in a clockwise direction as shown in figure. The centre of the loop is a distance D above a long, straight wire. What are the magnitude and direction of the current I_1 in the wire if the magnetic field at the centre of loop is zero?



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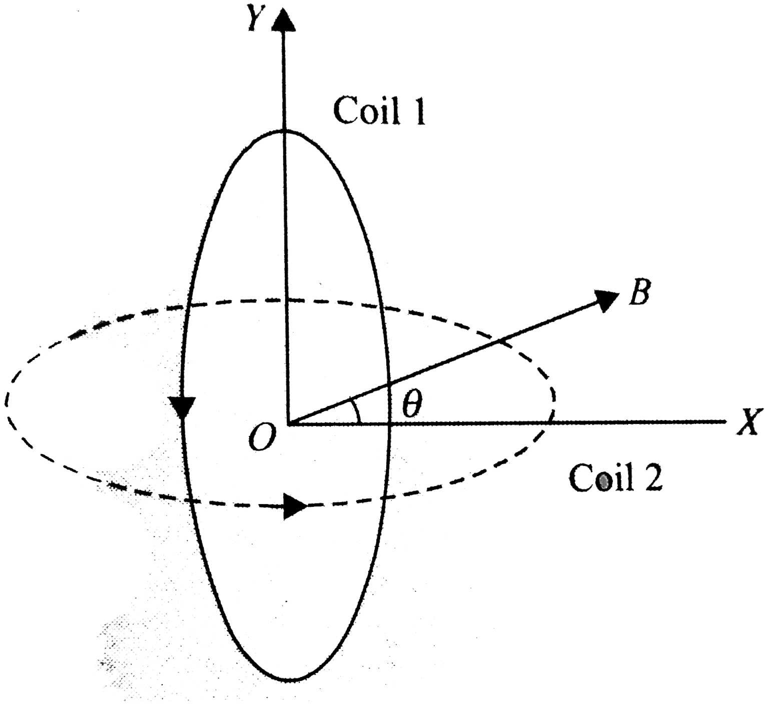
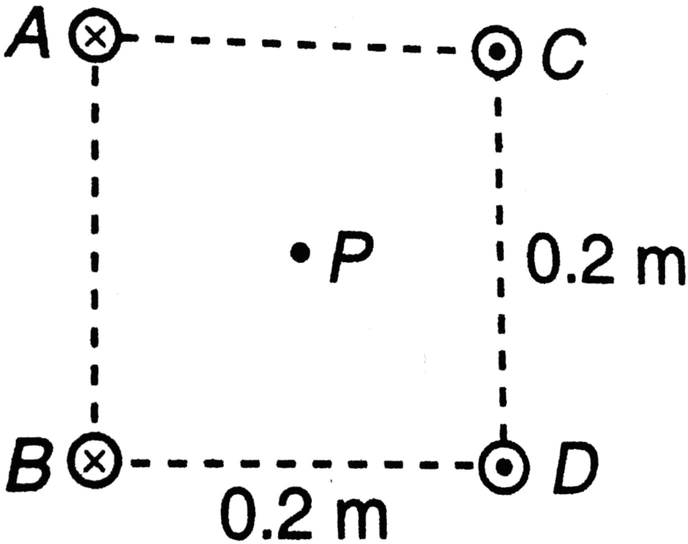
16. For the arrangement shown in Fig. determine the magnetic field at centre O.



17. Four long, parallel conductors carry equal currents of 5.0. The direction of the currents is into the pge at points. A and B and out of the page at C and D. Calculate the magnitude and directionof the mgnetic field at point P, located at the centre of the square.



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18. A long vertical wire carrying a current of 10A in the upward direction is placed in a region where a horizontal magnetic field of magnitude 2.0×10^{-3} T

exists from south to north. Find the point where the resultant magnetic field is zero.

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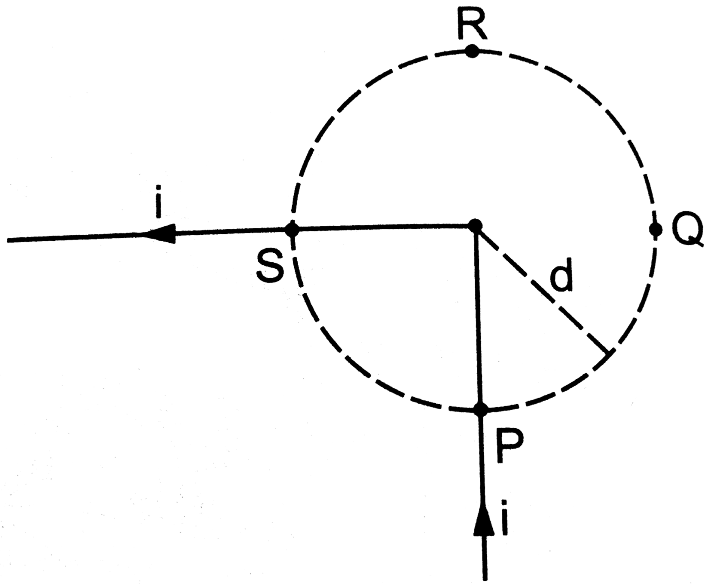
19. Figure shows a long wire bent at the middle to form a right angle. Show that the magnitudes of the magnetic fields at the points P,Q, R and S are equal and find this magnitude. `



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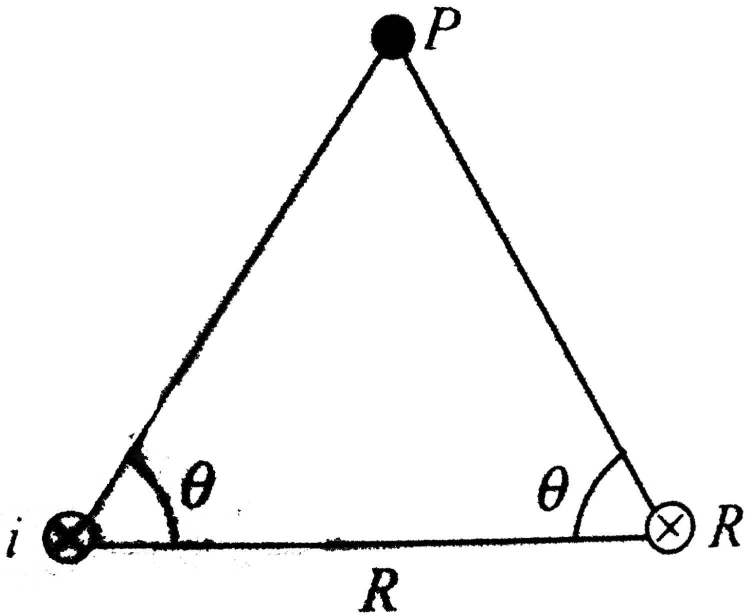
20. In Fig. two long parallel wires (seen end-on) that are a distance R apart carry equal currents i in the same sense. Find the magnitude of the magnetic field at point P , which lies quidistant from the two wires at an angle θ from the plane of the wires.



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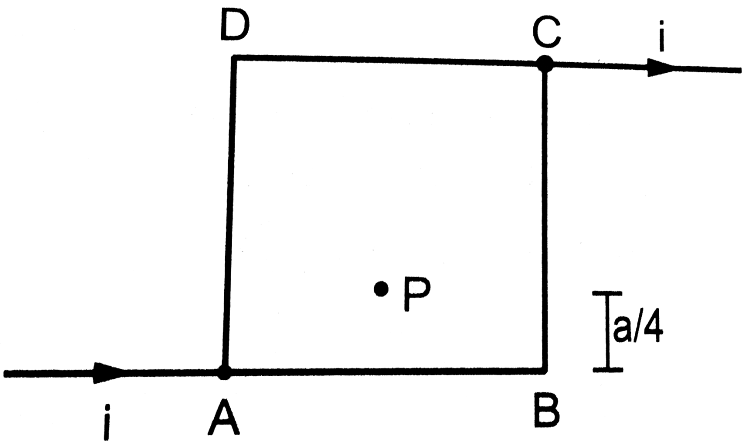
21. Figure shows a square loop of edge a made of a uniform wire. A current i enters the loop at the point

A and leaves it at the point C. Find the magnetic field at the point P which is on the perpendicular bisector of AB at a distance a/4 from it. `



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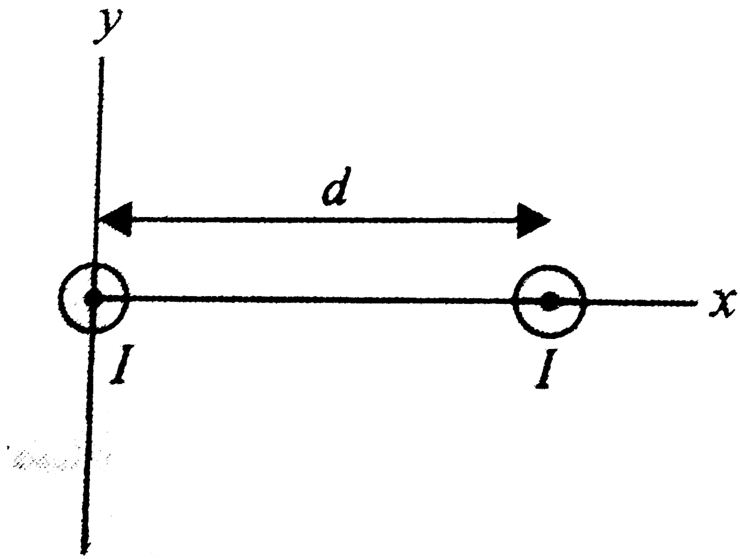
22. Let two long parallel wires, a distance d apart, carry equal currents I in the same direction. One wires at $x = 0$, the other at $x = d$ (as shown in Fig)

Determine magnetic field at any point x-axis between the wires as a function of x.



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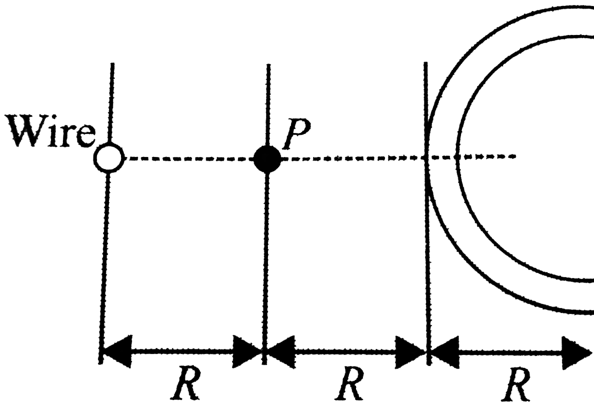
23. A long, circular pipe, with an outside radius R, carries a (uniformly distributed) current i_0 (into the paper as shown in Fig.) A wire runs parallel to the pipe at a distance 3R from centre to centre. Calculate the magnitude and direction of the current in the wire that would cause the resultant magnetic field at point P to have the same magnitude, but the opposite direction, as the resultant field at the centre of the pipe.



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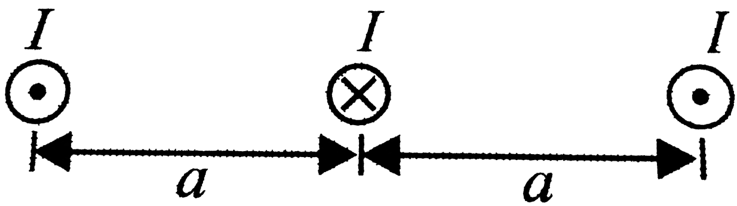
24. Shown in Fig. is an end-on view of three long, straight, parallel conductors spaced equal distances a apart. The outer conductors carry current I out of the page, the middle conductor carries current I into the page. Where in the plane of the page is the magnetic field zero?



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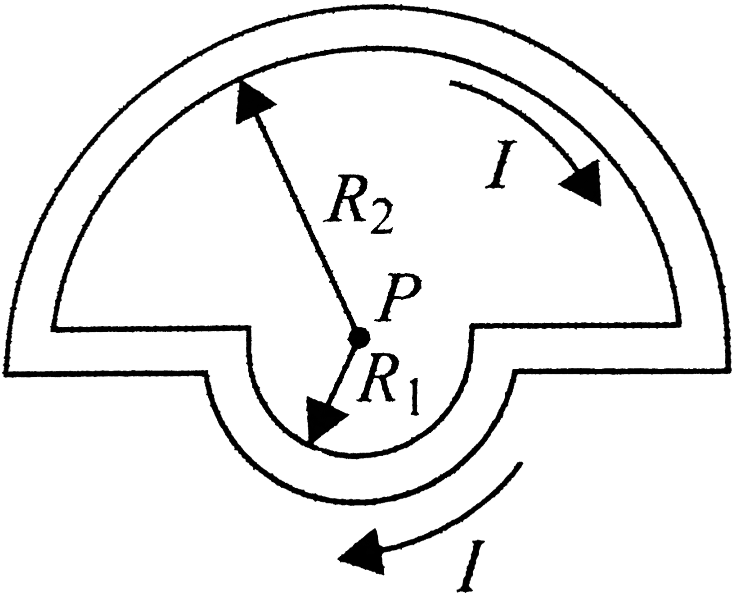
25. In Fig, find the magnetic field at point P.



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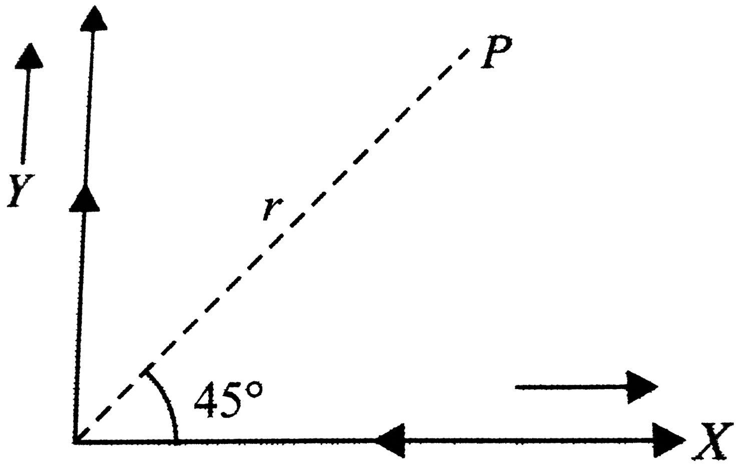
26. Current I flows through a long conducting wire bent at right angle as shown in Fig. Find the magnetic field at point P on the right angle bisector of the angle XOY at distance r form O.



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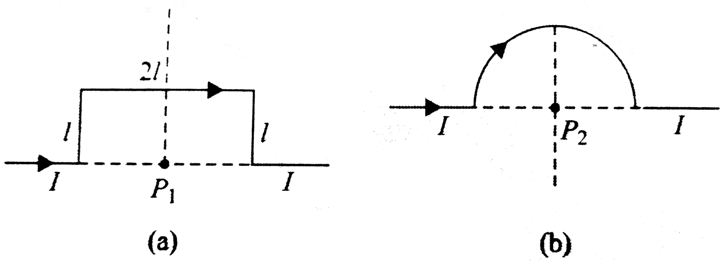
27. A wire is bent into the shape shown in fig and the magnetic field is measured at P_1 when the current in the wire is I. The same wire is then formed into the shape shown in the Fig and the magnetic field is measured at point P_2 when the current is again I. If the total length of wire is the same in each case, what is the ratio of B_1 / B_2 ?



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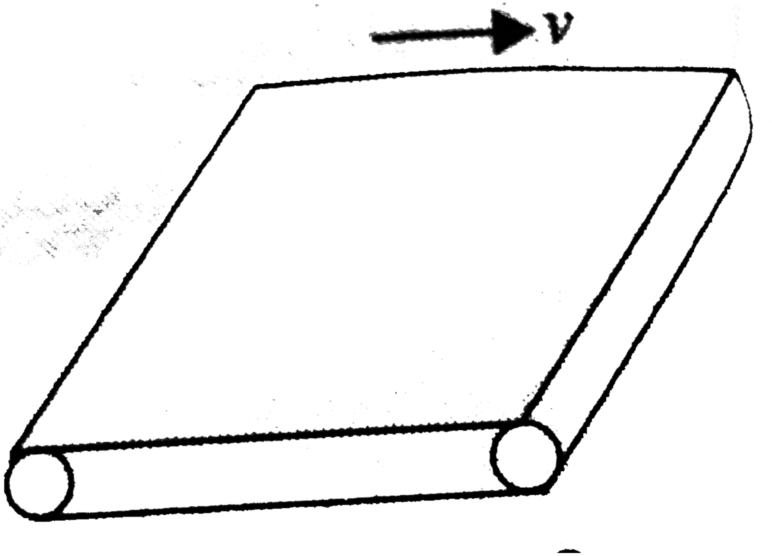
28. Charge is sprayed onto a large non-conducting belt above the left-hand roller in Fig. The belt carries the charge, with a uniform surface charge density s, as it moves with a speed v between the rollers as shown in the figure. The charge is removed by a wiper at the right-hand roller. Consider a point just above the surface on the moving belt. Find an expression for the magnitude of magnetic field at this point.



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29. An infinitely long, noc-conducting cylidner of radius R lies along the z-axis. Five long, conducting wires are parallel to the cylinder and spaced equally on the upperhalf of its surface. Each wire carries a current I in the opposite z-direction. Find the magnetic field on the z-axis. opposite z-direction. Find the magnetic field on the z-axis.

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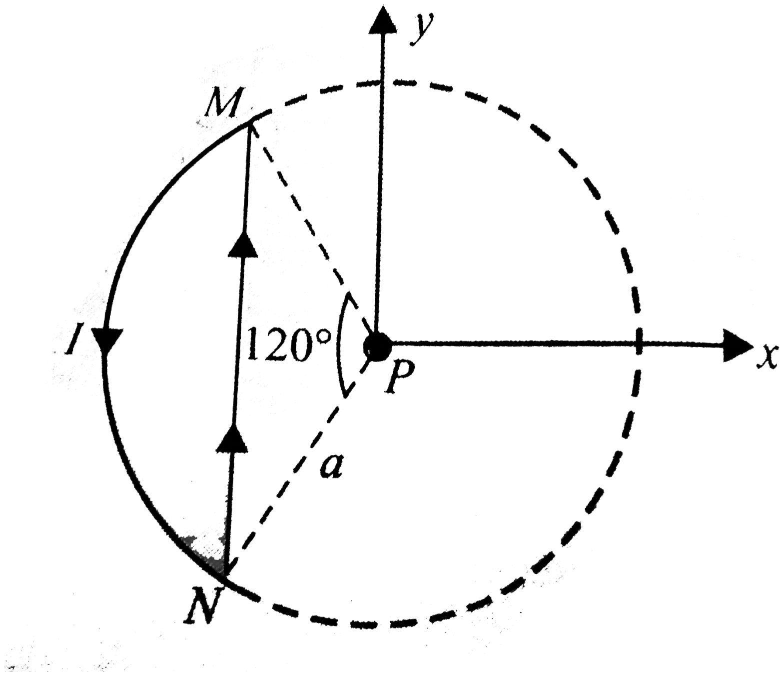
30. In Fig, find the magnetic field at point P. The loop is lying in x-y plane.



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31. Two long, straight wires, one above the other, are separated by a distance 2a and are parallel to the x-axis. Let the y-axis be in the plane of the wires in the direction form the lower wire to the upper wire. Each

wire carries current I in the +x-direction. What are the magnitude and direction of the net magnetic field of the two wires at a point in the plane of wires:

(a) midway between them?

(b) at a distance a above the upper wire?

(c) at a distance a below the lower wire?

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32. A long straight wire along the Z-axis carries a current I in the negative z-direction. The magnetic vector field B at a point having coodinates (x, y) in the z = 0 plane is

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33. Calculate the magnitude of the magnetic field at point P as shown in Fig, in terms of R, I_1 and I_2.

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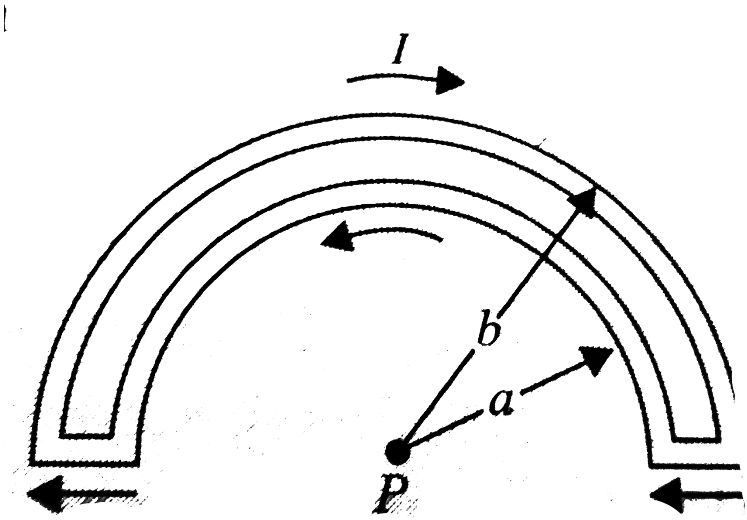
34. Two semicircles shown in Fig. have radii a and b. Calculate the net magnetic field (magnitude and direction) that the current in the wires produces at point P.



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35. A $+6\mu C$ point charge is moving at a constant velocity of $8 \times 10^6 ms^{-1}$ in the +y direction, relative to a reference frame. At the instant when the point charge is at the origin of this reference frame, what is the magnetic field vector it produces at the following points?

(a) $x = 0.500m, y = 0, z = 0,$ and (b) $x = 0, y = -0.500m, z = 0.$

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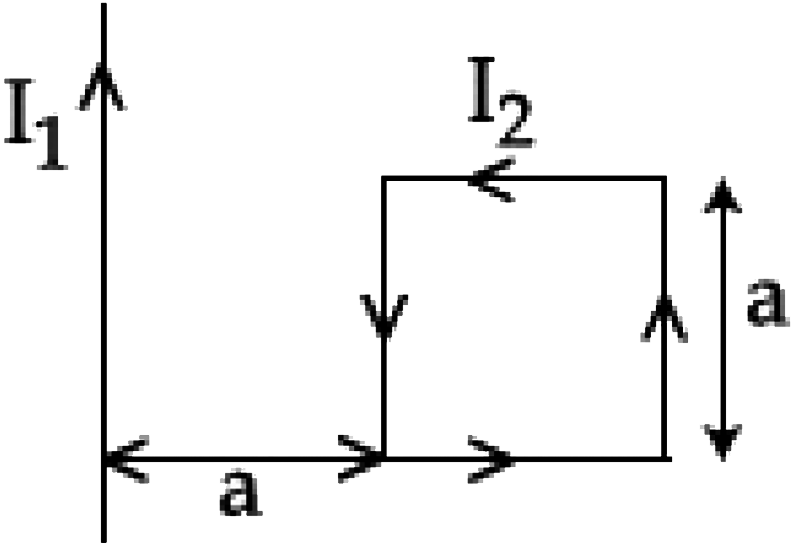
Concept Exercise 2.2

1. A rigid square loop of side 'a' and carrying current I_2 is lying on a horizontal surface near a long current I_1 carrying wire in the same plane as shown in figure.

The net force on the loop to the wire will be :



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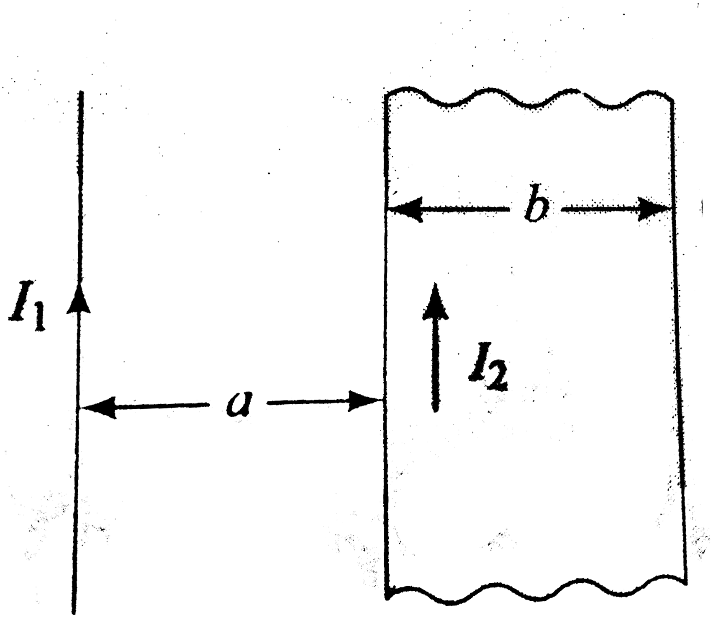
2. A long straight conductor carrying current I_1 is placed in the plane of a ribbon carrying current I_2 parallel to the previous one. The width of the ribbon is b and the straight conductor is at a distance a from the near endge. Find the force of attraction between the two.



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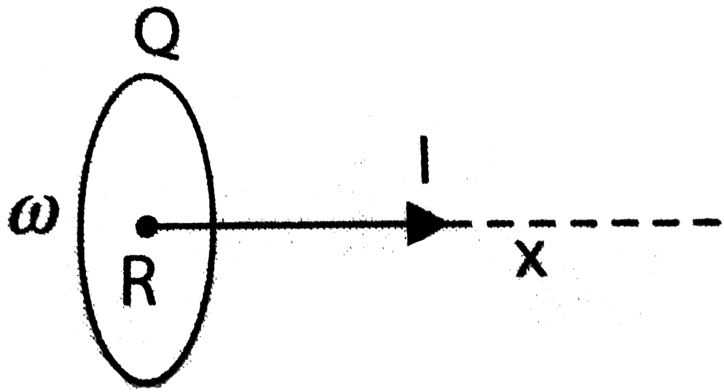
3. A charge Q is uniformly distributed over a ring which is rotating with constant angular velocity ω about an axis passing through its centre and perpendicular to the plane. A wire which carries a current I is lying perpendicular to the plane of the irng along its axis having one end at its centre. Find resultant magnetic force on the wire by the ring.



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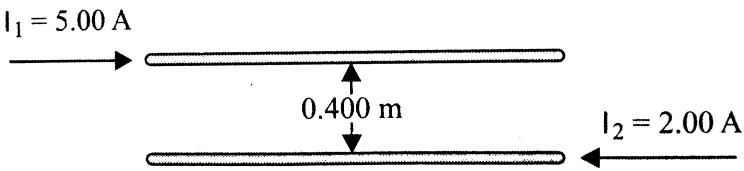
4. Two long, parallel wires are separated by a distance of $0.400m$ (as shown in Fig.) The current I_1 and I_2 have the direction shown.



(a) Calculate the magnitude of the force exerted by each wire on a 1.20m length of the other. Is the force attractive or repulsive ?

(b) Each current is doubled, so that I_1 becomes 10.0A and I_2 becomes 4.00A. Now, what is the magnitude of the force that each wire exerts on a 1.20m length of the other?

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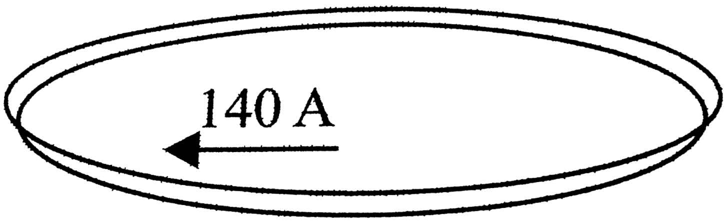
5. Two circular loops are parallel, coaxial, and almost in contact ,1.00mm apart. Each loop is 10.0 cm in radius. The loop carries a counterclockwise current of 140A.

(a) Calculate the magnetic force exerted by the bottom loop on the top loop. The upper loop has a mass of 0.0210kg.

(b)Calculate its acceleration, assuming that the only forces acting on it are the force in part and the gravitational force.



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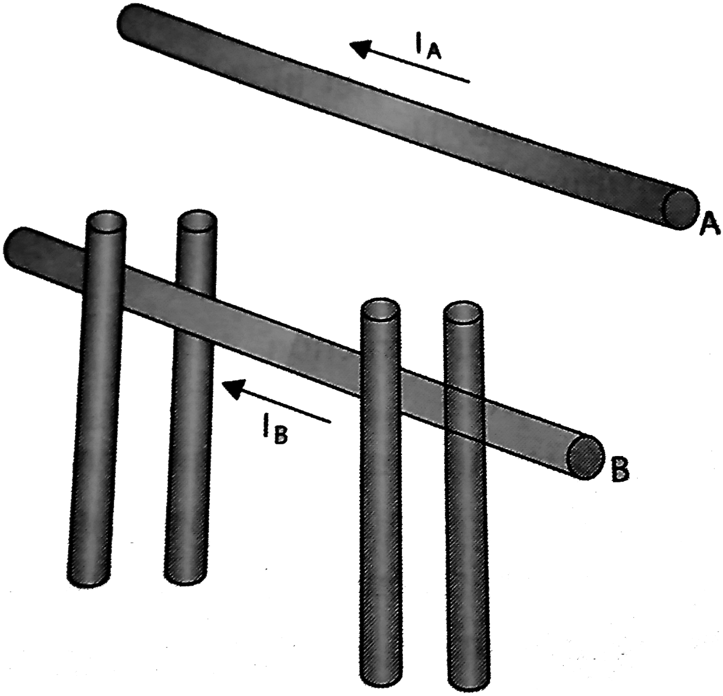
6. Two long, parallel conductors carry currents in the same direction as shown in Fig. Conductor A carries a current of 150A and is held firmly in position. Condcutor B carries current I_B and is allowed to slide freely up and down (parallel to A) between a set of non-coducting guides. If the mass per unit length of conductor B is $0.001gcm^{-1}$, what value of current I_B will result in equilibrium when the distance between the two conductors in 2.50cm?



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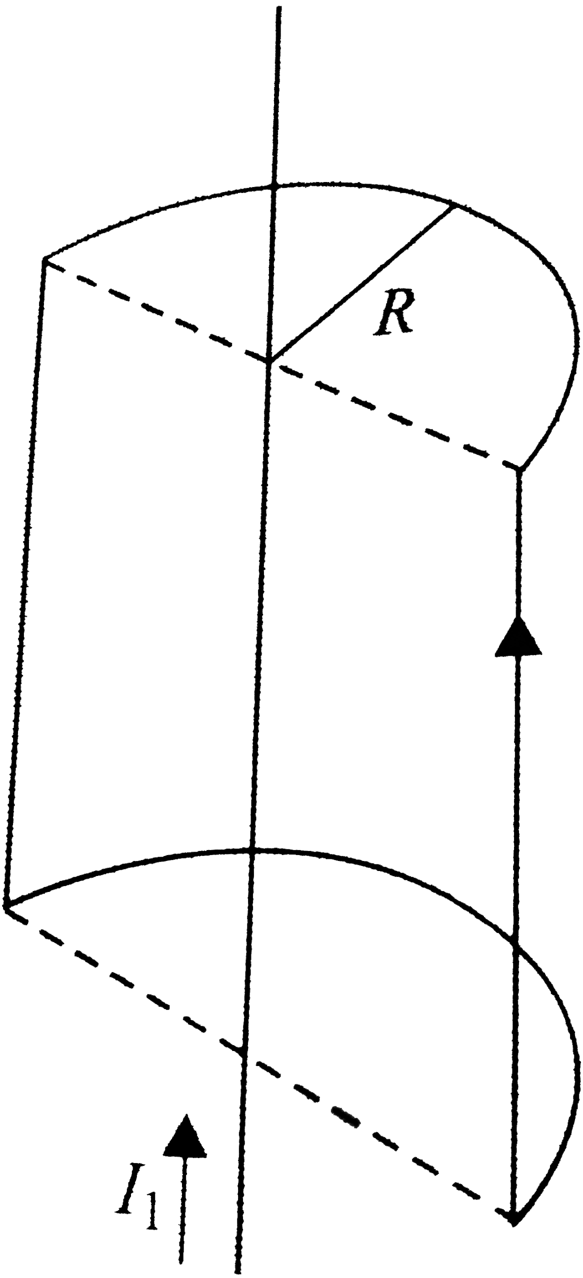
7. An infinitely long straight wire carrying a current I_1 is partially surrounded by a loop as shown in Fig. The loop has a length L, radius R, and carries a current I_2

The axis of the loop coincides with the wire. Calculate the force exerted on the loop.



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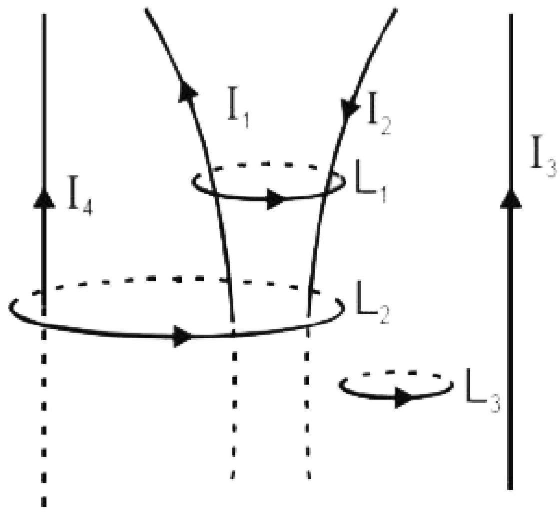
8. Find the values of $\oint \vec{B} . \vec{dl}$ for the loops L_1, L_2 and L_3 in Fig. (The sense of $\vec{dl}$ is mentioned in the figure)



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9. A closed cure encircles several conductors. The line integral $\int B.\,dI$ around this curve is $3.83 \times 10^{-7} T - m$

a. What is the net current in the conductors?

b. If you were to integrate aroundthe curve in the opposite direction, what would be the value of the line integral?

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10. Long, straight conductors with square cross sections and each carrying current I are laid side-by-side to form an infinite current sheet as shown in Fig.

The conductor lies in the x-y plane, are parallel to the y-axis and carry current in the +y direction. There are n conductors per unit length measured along x-axis.

what are the magnitude and direction of the magnetic field for distance a below the current sheet?

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Exercise (subjective)

1. Two protons move parallel to each other with an equal velocity $v = 300 kms^{-1}$. Find the ratio of forces of magnetic and electric interaction of the protons.

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2. Two coils each of 100 turns are held such that one lies in vertical plane and the other in the horizontal plane with their centres coinciding. The radius of the vetical coil is 0.20m and that of the horizontal coil is 0.30m. How will you neutralize the magnetic field of the earth at their common centre? What is the current to be passed through each coil? Horizontal component of earth's magnetic field $= 0.35 \times 10^{-4} T$ and angle of dip =30°.

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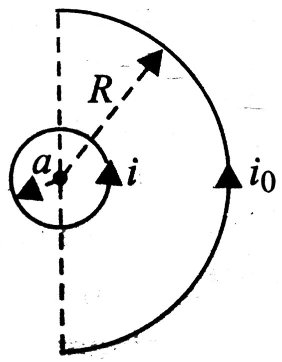
3. A small current carrying loop having current i is placed in the plane of the paper as shown Another semicircular loop having current i_0 is placed concentrically in the same plane as that of the small loop, the radius of semicircular loop being $R(R >> a)$. Find the force applied (in newton)by the smaller ring on the bigger ring. $\left(Given R = 1m, i = i_0 = \frac{40}{\mu_0}A, a = 0.1m\right)$



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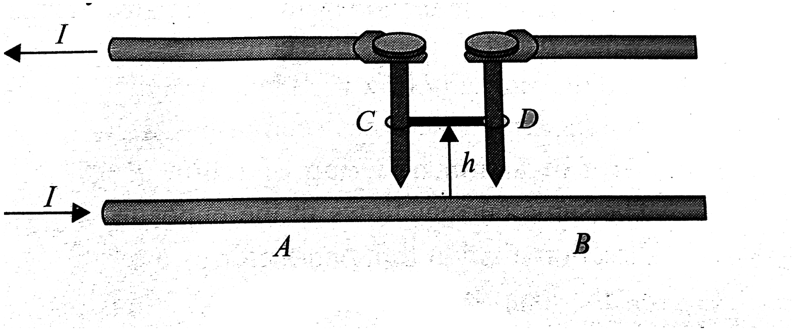
4. A long, horizontal wire AB rests on the surface of a table and carries a current I. Horizontal wire CD is vertically above wire AB, and is free to slide up and down on the two vetical mental guides C and D (as shown in Fig) Wire CD is connected through the sliding contacts to another wire that also carries a current I, opposite in direction to the current in wire AB. The mass per unit length of the wire CD is λ. To what euqilibrium heigth h will the wire CD rise, assuming that magnetic force on it is wholly due to the current in wire AB?



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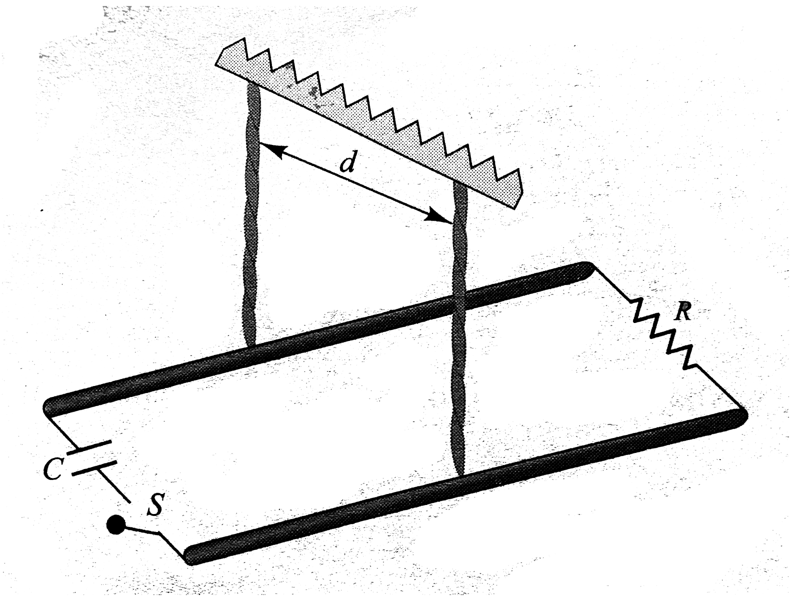
5. Two long conducting rods suspended by means of two insulating threads as shown in Fig. are connected at one end to a charged capacitor through a switch S, which initially open. At the other end , they are connected by a loose wire. The capacitor has charge Q and mass per unit length of the rod is λ. The effective resistance of the circuit after closing the switch is R.

Find the velocity of each rod when the capacitor is discharged after closing the switch. (Assume that the displacement of rods during the discharging time is negligible.)



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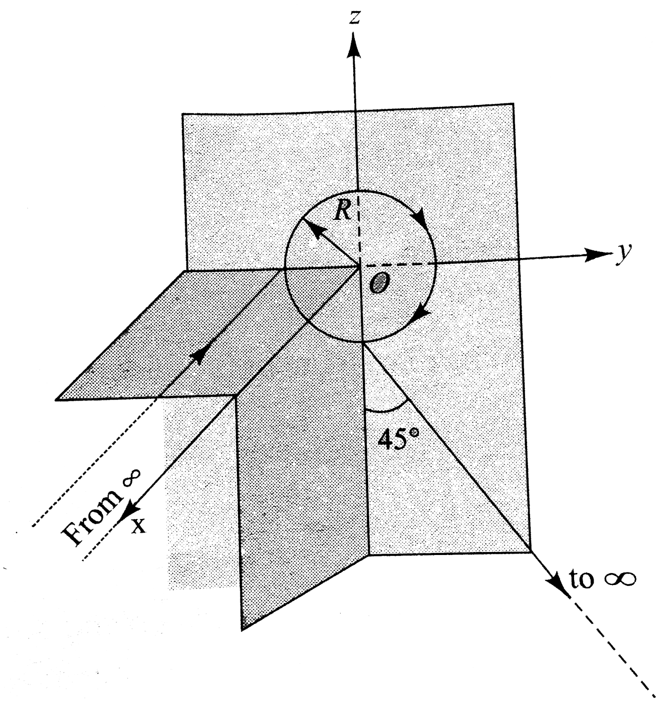
6. Calculate magnetic induction at point O if the wire carrying

a current I has the shape shown in Fig.



(The radius of the curved part of the wire is equal to R and linear parts of the wire are very long.)

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7. Find the current density as a funciton of distance r from the axis of a radially symmetrical parallel stream of electrons if the magnetic induction inside the streams varies as $B = br^{\alpha}$, where b and alpha\` are positive constants.

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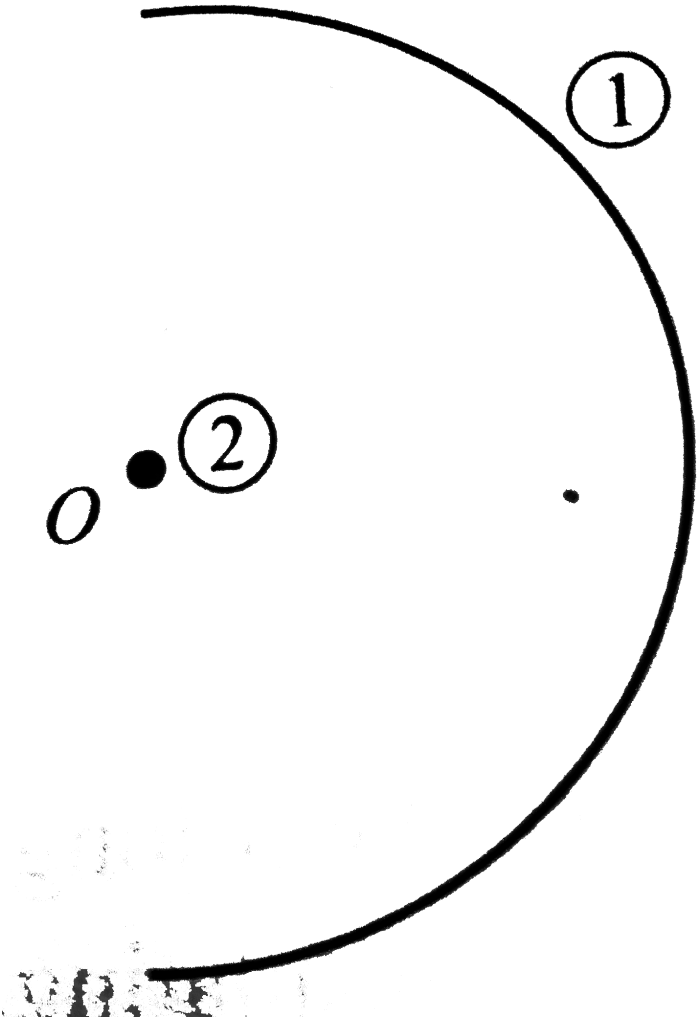
8. A direct current I flows in a long straight conductor whose cross section has the form of a thin halr-ring of radius R. The same current flows in the opposite direction along a thin conductor located on the axis of the first conductor. Find the magnetic induction froce between the given conductors reduced to a unit of their length.



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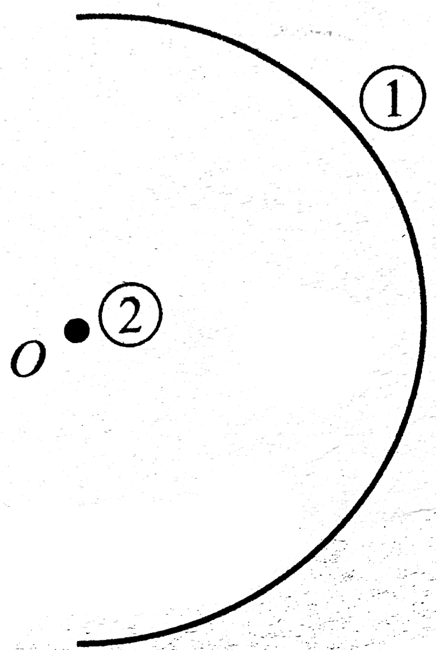
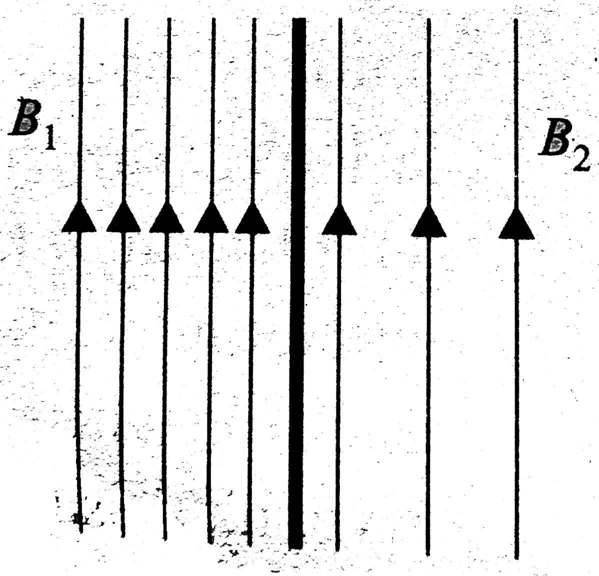
9. A conducting current-carrying plane is placed in an external uniform magnetic field. As a result, the magnetic induction becomes equal to B_1 on one side of the plane and B_2 on the other side. Find the magnetic force acting per unit area of the plane.



1
O
2



B_1
B_2

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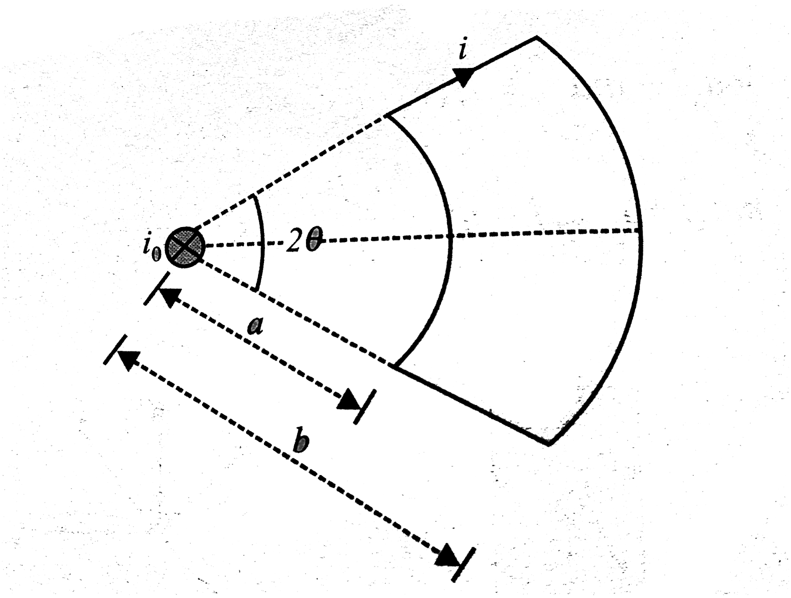
10. A loop, carring a current i, lying in the plane of the paper, is in the field of a long straight wire with current i_0 (inward) as shown in Fig. Find the torque acting on the loop.



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Exercise (single Correct)

1. A stream of electrons is projected horizontally to the right. A straight conductor carrying a current is supported parallel to the electron steam an above it. If the current in the conductor is from left to right, what will be the effect on the electron stream?

A. The electron stream will be pulled upward

B. The correct stream will be pulled downward

C. The electron stream will be retarded

D. The electron stream will be speeded up toward the right

Answer: B

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2. A charge q coulomb moves in a circle at n revolution per second and the radius of the circle is r metre. Then magnetic feild at the centre of the circle is

A. $\frac{2\pi q}{nr} \times 10^{-7} NA^{-1}m^{-1}$

B. $\frac{2\pi q}{r} \times 10^{-7} NA^{-1}m^{-1}$

C. $\dfrac{2\pi nq}{r} \times 10^{-7} NA^{-1} m^{-1}$

D. $\dfrac{2\pi q}{r} \times 10^{-7} NA^{-1} m^{-1}$

Answer: C

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3. An electron is ejected from the surface of a long, thick straight conductor carrying a current, initially in a direction perpendicular to the conductor. The electron will

A. ultimately return to the conductor

B. move in a circular path around the conductor

C. gradually move away from the conductor along a spiral

D. move in a helical path, with the conductor as the axis

Answer: A

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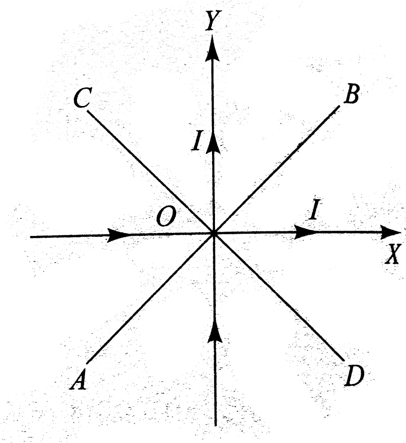
4. Two very thin metallic wires placed along X- and Y- axes carry equal currents as shown in Fig. AB and CD are lines at 45° with the axes. The magnetic field will be zero on the line



A. AB

B. CD

C. segment OB only of line AB

D. segment OC only of line CD.

Answer: A

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5. A circular current carrying coil has a radius R.The distance from the centre of the coil axis is the coil, where the magnetic induction is 1/8th of its valus at the centre of coil is

A. $R/\sqrt{3}$

B. $\sqrt{3}R$

C. $2R\sqrt{3}$

D. $(2\sqrt{3})R$

Answer: B

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6. A square conducting loop of side length L carries a current I.The magnetic field at the centre of the loop is

A. independent of L

B. proportional L

C. inversely proportional to L

D. linearly proportional to L

Answer: C

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7. A current of $1/(4\pi)$ ampere is flowing in a long straight conductor. The line integral of magnetic induction around a closed path enclosing the current carrying conductor is

A. $10^{-7} Wbm^{-1}$

B. $4\pi^{-7} Wbm^{-1}$

C. $16\pi^2 \times 10^{-7} Wbm^{-1}$

D. zero.

Answer: A

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8. A circular loop is kept in that vertical plane which contains the north- south direction. It carries a current that is towards north at the topmost point. Let A be a point on the axis of the circle to the east of it and B a point on this axis to the west of it. The magnetic field due to the loop.

A. is towards west at A and towards west at B

B. is toward west at A and toward east at B

C. is toward east at both A and B

D. is toward west at both A and B

Answer: D

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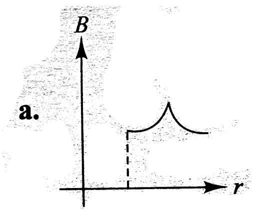
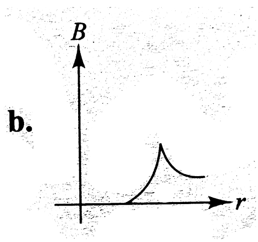
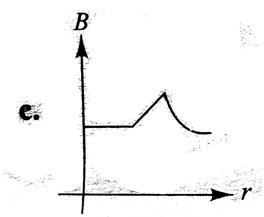
9. A current i is unifromly distributed over the cross section of a long hollow cylindrical wire o finner radius R_1 and outer radius R_2. Magnetic field B varies with distance r from the axis of the cylinder as .

A. 

B. 

C. 

D.

Answer: B

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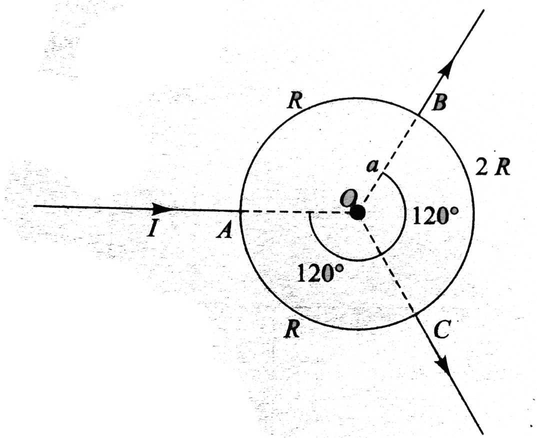
10. The resistances of three parts of a circular loop are as shown in Fig. The magnetic field at the centre O is (current enters at A and leaves at B and C as shown)



A. $\frac{\mu_0 I}{6a}$

B. $\frac{\mu_0 I}{3a}$

C. $\frac{2}{3}\frac{\mu_0 I}{a}$

D. zero.

Answer: D

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11. Five very long, straight insulated wires are closely bound together to form a small cable. Currents carried by the wires are: $I_1 = 20A, I_2 = -6A, I_3 = 12A, I_4 = -7A, I_5 = 18A$

. (Negative currents are opposite in direction to the positve.) The magnetic field induction at a distance of 10cm from the cable is (current enters at A and leaves at B and C as shown)

A. $5\mu T$

B. $15\mu T$

C. $74\mu T$

D. $128\mu T$

Answer: C

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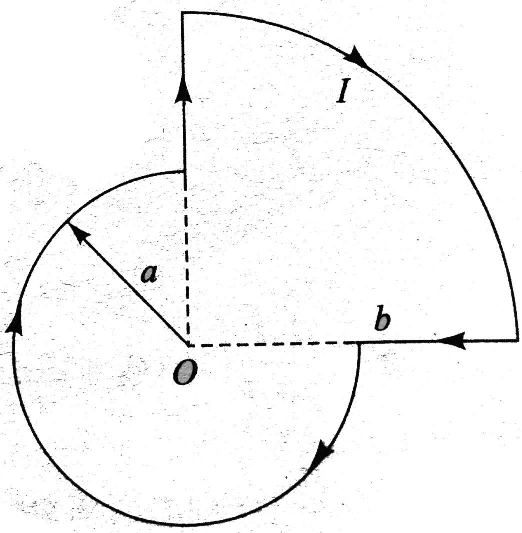
12. The magnetic induction at centre O Fig.



A. $\frac{\mu_0 I}{2a} + \frac{\mu_0 I}{2b} \otimes$

B. $\frac{3\mu_0 I}{8a} + \frac{\mu_0 I}{8b} \otimes$

C. $\frac{3\mu_0 I}{8a} - \frac{\mu_0 I}{8b} \otimes$

D. $\frac{3\mu_0 I}{8a} + \frac{\mu_0 I}{8b} \odot$

Answer: B

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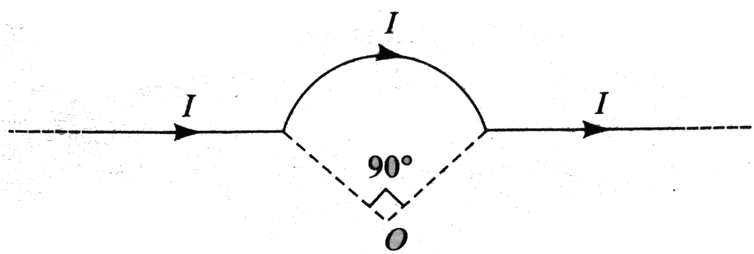
13. The magnetic field at centre O of the arc in Fig.



A. $\frac{\mu_0 I}{4\pi \times r}[\sqrt{2}+\pi]$

B. $\frac{\mu I}{2\pi r}\left[\frac{\pi}{4}+(\sqrt{2}-1)\right]$

C. $\frac{\mu_0}{4\pi} \times \frac{I}{r}[(\sqrt{2}-\pi)]$

D. $\frac{\mu I}{4\pi} \times \frac{I}{r}\left[\sqrt{2}+\frac{\pi}{4}\right]$

Answer: B

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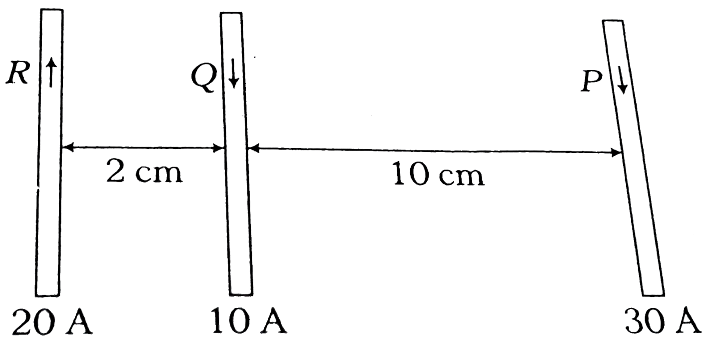
14. Three long, straight and parallel wires carrying currents are arranged as shown in figure. The force experienced by 10 cm length of wire Q is



A. $1.4 \times 10^{-4} N$ towards the right

B. $1.4 \times 10^{-4} N$ towards the left

C. $2.6 \times 10^{-4} N$ towards the right

D. $2.6 \times 10^{-4} N$ towards the left

Answer: A

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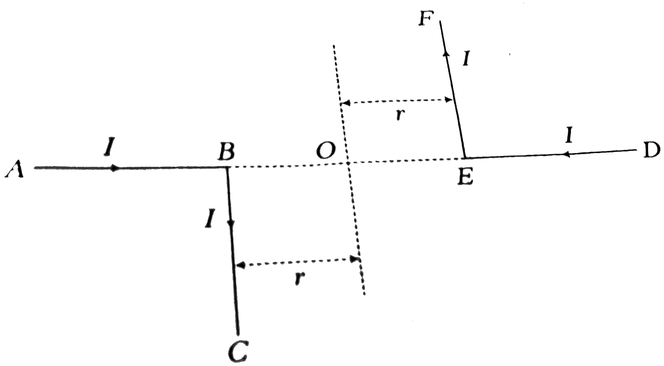
15. Two long thin wires ABC and DEF are arranged as shown in the figure. The magnitude of the magnetic field at O is



A. zero

B. $\mu_0 I / 4\pi a$

C. $\mu_0 I / 2\pi a$

D. $\mu_0 I / 2\sqrt{2}\pi a$

Answer: C

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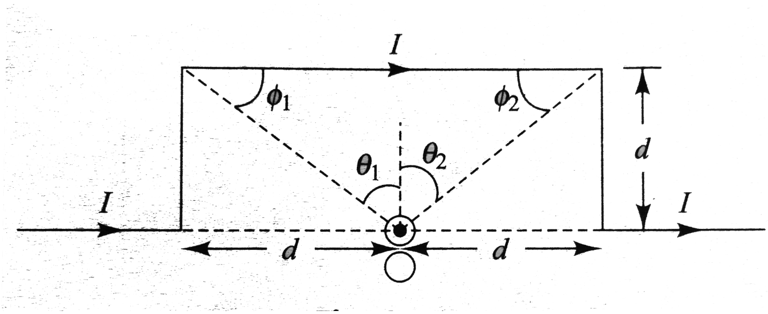
16. The magnetic field at O due to current in the infinite wire forming a loop as a shown in Fig.



A. $\dfrac{\mu_0 I}{2\pi d}(\cos\phi_1 + \cos\phi_2)$

B. $\frac{\mu_0}{4\pi}\frac{2I}{d}(\tan\theta_1 + \tan\theta_2)$

C. $\frac{\mu_0}{4\pi}\frac{I}{d}(\sin\phi_1 + \sin\phi_2)$

D. $\frac{\mu_0}{4\pi}\frac{I}{d}(\cos\theta_1 + \cos\theta_2)$

Answer: A

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17. A current I flows through a thin wire shaped as regular polygon of n sides which can be inscribed in a circle of radius R. The magnetic fidl induction at the center of polygon due to one side of the polygon is

A. $\frac{\mu_0 I}{\pi R}\left(\frac{\tan\pi}{n}\right)$

B. $\frac{\mu_0 I}{4\pi R}\frac{\tan\pi}{n}$

C. $\frac{\mu_0 I}{2\pi R}\left(\frac{\tan\pi}{n}\right)$

D. $\frac{\mu_0 I}{2\pi R}\left(\frac{\cos\pi}{n}\right)$

Answer: C

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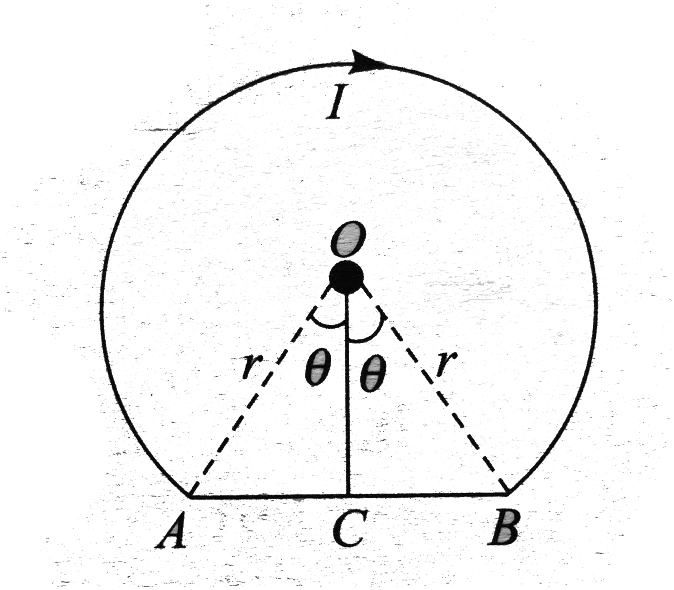
18. A wire is bent in the form of a circular arc with a straight portion AB. Magnetic induction at O when current flowing in the wire, is



A. $\frac{\mu_0}{2r}(\pi - \theta + \tan\theta)$

B. $\frac{\mu_0 I}{2\pi R}(\pi + \theta - \tan\theta)$

C. $\frac{\mu_0 I}{2\pi R}(\pi - \theta + \theta)$

D. $\frac{\mu_0 I}{2\pi R}(-\tan\theta + \pi - \theta)$

Answer: C

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19. The field due to a wire of n turns and radius r which carries a current I is measure on the axis of the coil at a small distance h form the centre of the coil. This is smaller than the field at the centre by the fraction:

A. $\frac{3}{2}\frac{h^2}{r^2}$

B. $\frac{2}{3}\frac{h^2}{r^2}$

C. $\frac{3}{2}\frac{r^2}{h^2}$

D. $\frac{2}{3}\frac{r^2}{h^2}$

Answer: A

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20. Two identical wires A and B , each of length 'l', carry the same current I. Wire A is bent into a circle of radius R and $wire B$ is bent to form a square of side 'a' . If B_A and B_B are the values of magnetic field at the centres of the circle and square respectively , then the ratio $\frac{B_A}{B_B}$ is :

A. $(\pi^2 / 8)$

B. $(\pi^2 / 8\sqrt{2})$

C. $(\pi^2 / 16)$

D. $(\pi^2 / 16\sqrt{2})$

Answer: B

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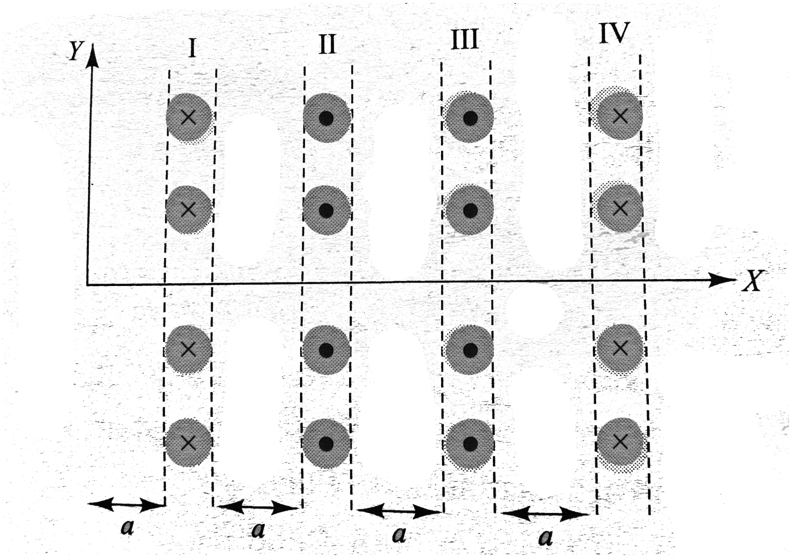
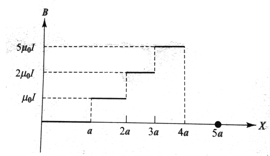
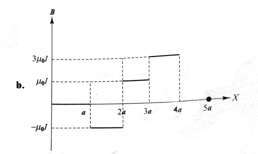
21. Four infinite thin current carrying sheets are placed in Y-Z plane. The 2D view of the arrangement is as shown in Fig. Direction of current has alos been shown in the figure. The linear current density, i.e., current per unit width in the four sheets are I, 2I, 3I, and 4I, respectively.



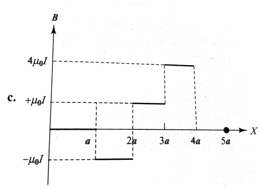
A.

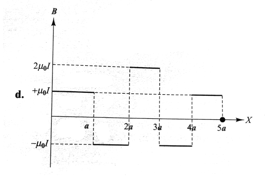


B.



C.



D. 

Answer: C

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22. A steady current is flowing in a circular coil of radius R, made up of a thin conducting wire. The magnetic field at the centre of the loop is B_L. Now, a circular loop of radius R/n is made from the same wire without changing its length, by unfounding and refolding the loop, and the same current is passed through it. If new magnetic field at the centre of the coil is B_C, then the ratio B_L / B_C is

A. $1 : n^2$

B. $n^{1/2}$

C. $n : 1$

D. none of these

Answer: A

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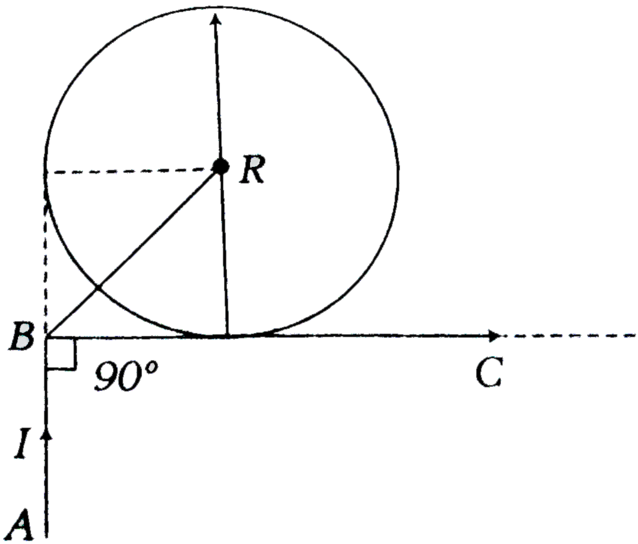
23. What is the magnetic field at the centre of the circular (as shown in figure), when a single wire is bent to form a circular loop and extands to from straight section



A. $\frac{\mu_0 I}{2R}$ $\odot$

B. $\frac{\mu_0 I}{2R}\left(1+\frac{1}{\pi\sqrt{2}}\right)$ $\odot$

C. $\frac{\mu_0 I}{2R}\left(1-\frac{1}{\pi\sqrt{2}}\right)$ $\otimes$

D. $\frac{\mu_0 I}{R}\left(1-\frac{1}{\pi\sqrt{2}}\right)$ $\otimes$

Answer: B

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24. Two parallel wires carrying equal currents in opposite direaction are palced at $x = \pm$ a parallel to y-axis with z= 0. Magnetic field at origin O is equal B_1 and at $P(2a, 0, 0)$ is B_2 . Then the ratio B_1 / B_2 is

A. 3

B. $1/2$

C. $1/3$

D. 2

Answer: A

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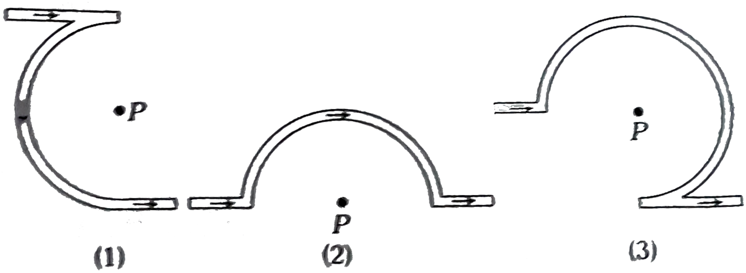
25. Figure here shows three cases, in all cases the circular path has radius r and straight ones are infinitely long. For same current, the magnetic field at the centre P in cases 1, 2 and 3 have the ratio



A. $\left(-\frac{\pi}{2}\right):\left(\frac{\pi}{2}\right):\left(\frac{3\pi}{4}-\frac{1}{2}\right)$

B. $\left(-\frac{\pi}{2}+1\right):\left(\frac{\pi}{2}+1\right):\left(\frac{3\pi}{4}+\frac{1}{2}\right)$

C. $\left(-\frac{\pi}{2}\right):\left(\frac{\pi}{2}\right):\left(\frac{3\pi}{4}\right)$

D. $\left(-\frac{\pi}{2}-1\right):\left(\frac{\pi}{2}-\frac{1}{4}\right):\left(\frac{3\pi}{4}+\frac{1}{2}\right)$

Answer: A

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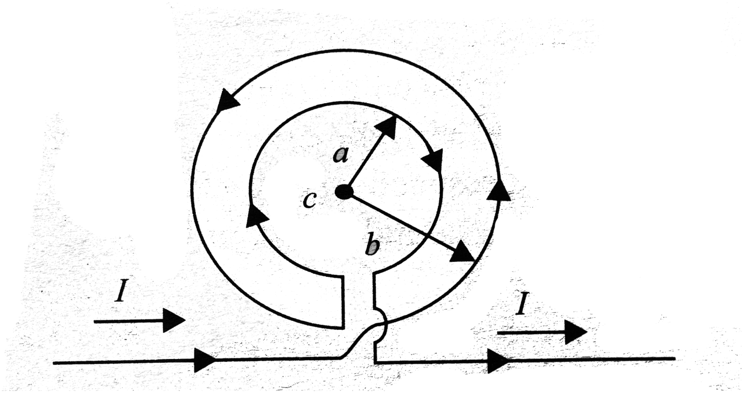
26. An otherwise infinite, straight wire has two concentric loops of radii a and b carrying equal currents in opposite directions as shown in Fig. The magnetic field at the common centre is zero for



A. $\frac{a}{b} = \frac{\pi - 1}{\pi}$

B. $\frac{a}{b} = \frac{\pi}{\pi + 1}$

C. $\frac{a}{b} = \frac{\pi - 1}{\pi + 1}$

D. $\frac{a}{b} = \frac{\pi + 1}{\pi - 1}$

Answer: B

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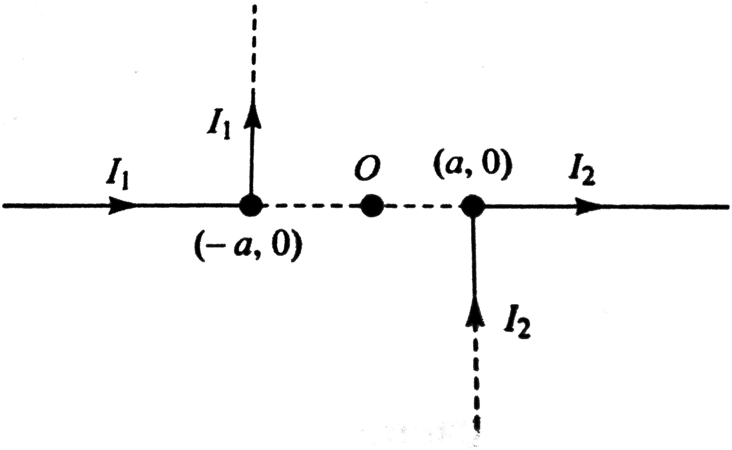
27. Current I_1 and I_2 flow in the wires shown in Fig. The field is zero at distance x to the right of O. Then



A. $x = \left(\frac{I_1}{I_2}\right) a$

B. $x = \left(\frac{I_2}{I_1}\right) a$

C. $x = \left(\frac{I_1 - I_2}{I_1 + I_2}\right) a$

D. $x = \left(\frac{I_1 + I_2}{I_1 - I_2}\right) a$

Answer: C

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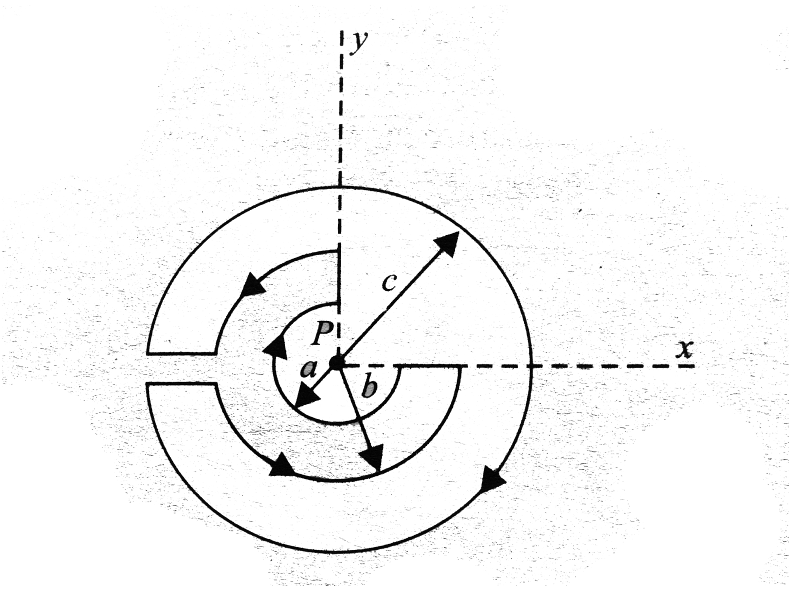
28. For $c = 2a$ if, the magnetic field at point P will be zero when



A. $a = b$

B. $a = \frac{3}{5}b$

C. $a = \frac{5}{3}b$

D. $a = \frac{1}{3}b$

Answer: C

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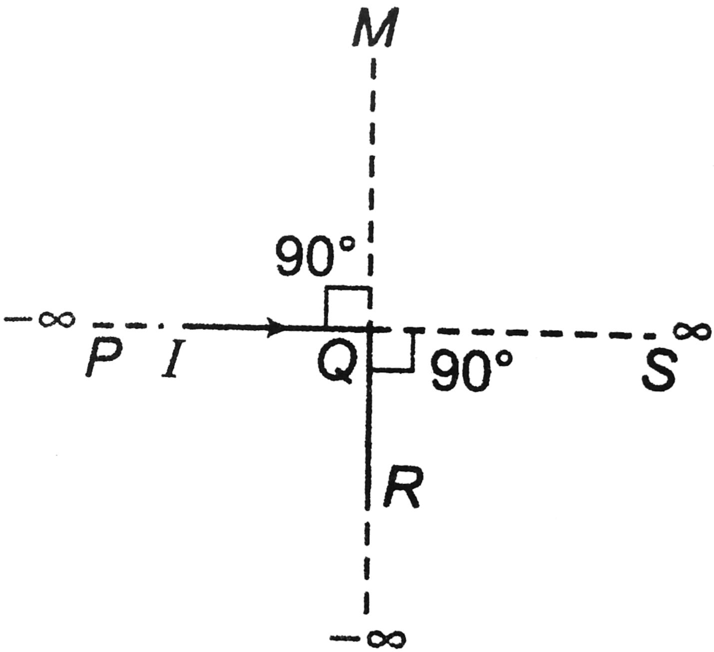
29. An infifnitely long conductor PQR is bent to form a right angle as shown in figure. A current I flows through PQR. The magnetic field due to this current at the point M is H_1 Now, another infinitely long straight conductor QS is connected at Q, so that current is $\frac{I}{2}$ in QR as well as in QS, the current in PQ remaining unchanged. The magnetic field at M is now H_2. The ratio $\frac{H_1}{H_2}$ is given by `



A. $1/2$

B. 1

C. $2/3$

D. 2

Answer: C

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30. Two concentric coil each of radius equal to 2π cm are placed at right angles to each other. 3 A and 4 A are the currents flowing in each coil, respectively. The magnetic induction in Wb/m^2 at the centre of the coils will be $(\mu_0 = 4\pi \times 10^{-7} Wb/A - m)$

A. 5×10^{-5}

B. 7×10^{-5}

C. 12×10^{-5}

D. 10^{-5}

Answer: A

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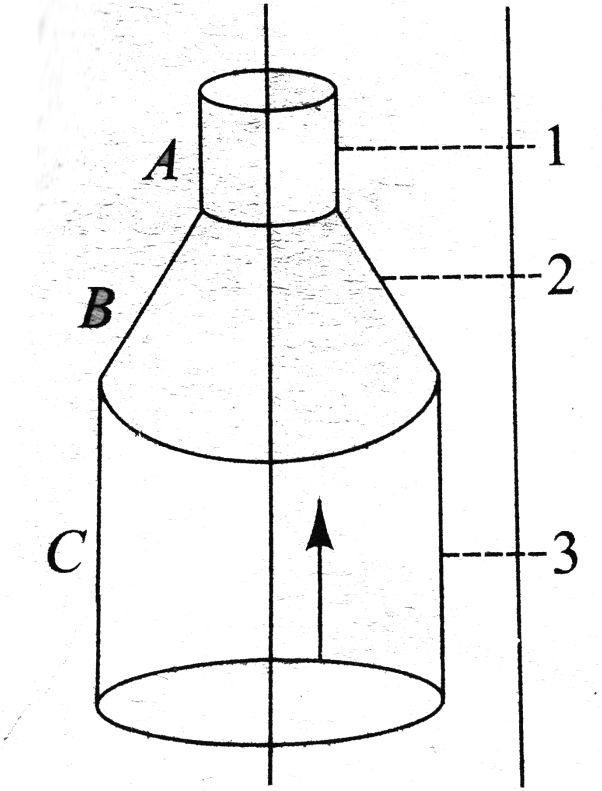
31. A long, straight, hollow conductor (tube) carrying a current has two sections A and C of unequal cross sections joined by a conical section B. 1,2 and 3 are points on a line parallel to the axis of the conductor. The magnetic fields at 1,2 and 3 have magnitudes

B_1, B_2 and B_3. Then,



A. $B_1 = B_2 = B_3$

B. $B_1 = B_2 \neq B_3$

C. $B_1 < B_2 < B_3$

D. B_2 cannot be found unless the dimensions of the section B are known

Answer: A

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32. A coaxial cable consists of a thin inner conductor fixed along the axis of a hollow outer conductor. The two conductor carry equal currents in opposite directions. Let B_1 and B_2 be the magnetic fields in the region between the conductors and outside the conductor, respectively. Then,

A. $B_1 \neq 0, B_2 \neq 0$

B. $B_1 = B_2 = 0$

C. $B_1 \neq 0, B_2 = 0$

D. $B_1 = 0, B_2 \neq 0$

Answer: C

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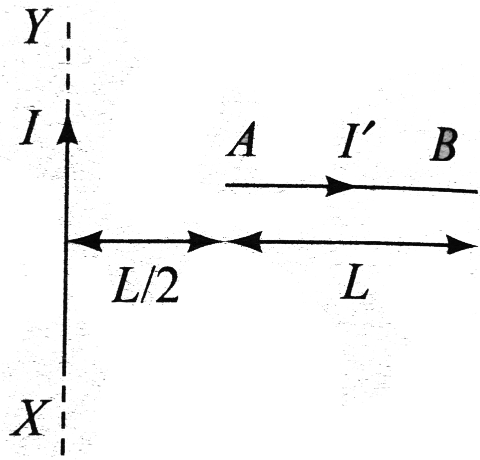
33. A conductor AB of length L carrying a current I', is placed perpendicular to a long straight conductor XY carrying a current I as shown in Fig. The forces on AB has magnitude



A. $\frac{\mu_0 I' I}{2\pi} \log 2$

B. $\frac{\mu_0 I' I}{2\pi} \log 3$

C. $\frac{3\mu_0 I' I}{2\pi} \frac{\log 3}{2}$

D. $\frac{2\mu_0 I' I}{3\pi}$

Answer: B

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34. The magnetic field at the centre of an equilateral triangular loop of side 2L and carrying a current i is

A. $\frac{9\mu_0 i}{4\pi L}$

B. $\frac{3\sqrt{3}\mu_0 i}{4\pi L}$

C. $\frac{2\sqrt{3}\mu_0 i}{\pi L}$

D. $\frac{3\mu_0 i}{4\pi L}$

Answer: A

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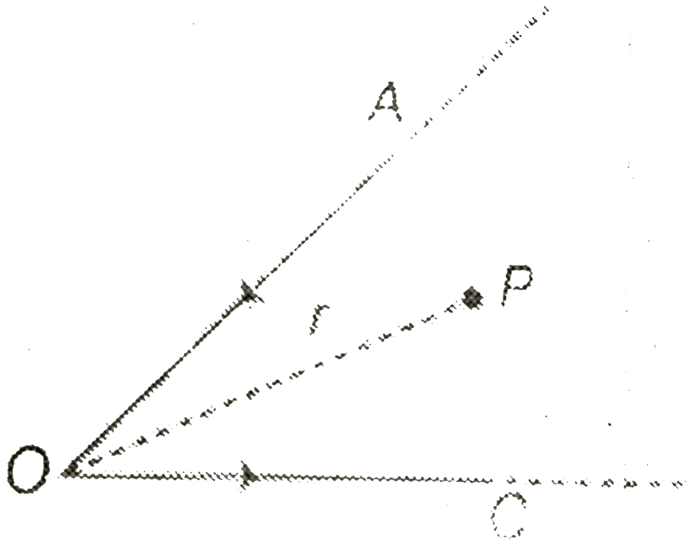
35. Tow wire AO and OC carry euqal current i. as shown in figure . One end of both the wire extends to infinity . Anlge AOC is α . The magnetiude of magnetic fields at a point P on the bisector of these two wirea at a distance r from point O is ltbgt



A. $\frac{\mu_0}{2\pi}\frac{i}{r}\cot\left(\frac{\alpha}{2}\right)$

B. $\frac{\mu_0}{4\pi}\frac{i}{r}\cot\left(\frac{\alpha}{2}\right)$

C. $\frac{\mu_0}{2\pi}\frac{i}{r}\frac{1+\frac{\cos(\alpha)}{2}}{\sin\left(\frac{\alpha}{2}\right)}$

D. $\frac{\mu_0}{4\pi}\frac{i}{r}\left(\frac{\alpha}{2}\right)$

Answer: C

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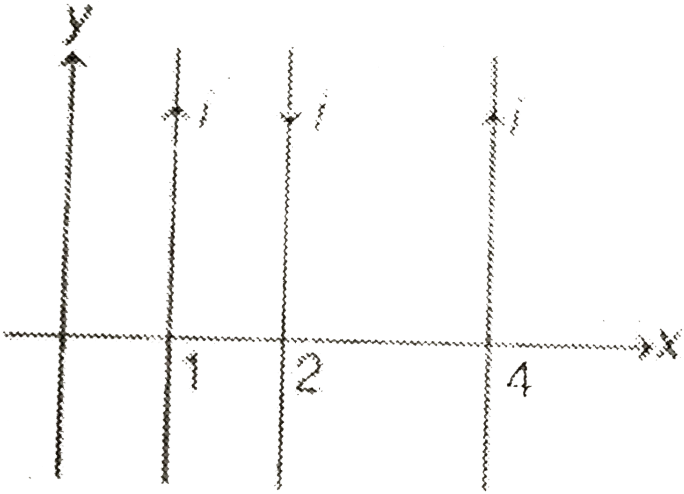
36. Equal currents A are flowing through the wires parallel to y-axis located at etc. but in opposite direction as shows.The magnetic field at origin (in teals) would be



A. $-1.33 \times 10^{-7}\hat{k}$

B. $1.33 \times 10^{-7}\hat{k}$

C. $2.67 \times 10^{-7}\hat{k}$

D. $-2.67 \times 10^{-7}\hat{k}$

Answer: B

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37. Same current i is flowing in three infinitely long wires along positive x,y and z directions. The magnetic field at a point would be

A. $\frac{\mu_0 i}{2\pi a}\left(\hat{j}-\hat{i}\right)$

B. $\frac{\mu_0 i}{2\pi a}\left(\hat{j}+\hat{i}\right)$

C. $\frac{\mu_0 i}{2\pi a}\left(\hat{i}-\hat{j}\right)$

D. $\frac{\mu_0 i}{2\pi a}\left(\hat{i}+\hat{j}+\hat{k}\right)$

Answer: A

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38. Two very long straight parallel wire carry steay currents i. and 2i in opposite directions . The disatance between the waire is d . At a certain instant of time a point charge q is at a point equadistant from the two wires in the plane of the wires . Its instantaneous velocity v is perpendicular to this plane . The magnetude of the magnetic field acting on the charge at this isntant is

A. $\frac{\mu_0 i q v}{2\pi d}$

B. $\frac{\mu_0 i q v}{\pi d}$

C. $\frac{3\mu_0 i q v}{2\pi d}$

D. zero.

Answer: D

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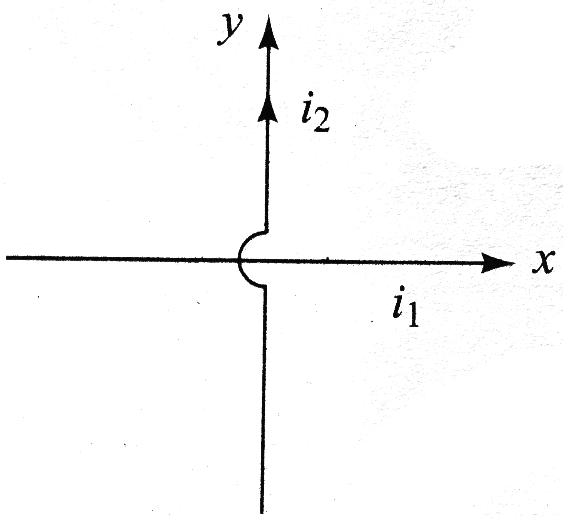
39. two infinite wires, carrying currents i_1 and i_2., are lying along x-and y-axes, as shown in the x-y plane. Then,



A. locus of points where B is zero is a circle

B. locus of points where B is zero is a line

C. B decay heperbolically along any line parallel to x-axis

D. B decay heperbolically along any line parallel to y-axis

Answer: B

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40. A long cylinder of wire of radius 'a' carries a current i distributed uniformly over its cross section.

If the magnetic fields at distances $r < a$ and $R > a$ from the axis have equal magnitude, then

A. $a = \frac{R + r}{2}$

B. $a = \sqrt{Rr}$

C. $a = Rr / (R + r)$

D. $a = R^2 / r$

Answer: B

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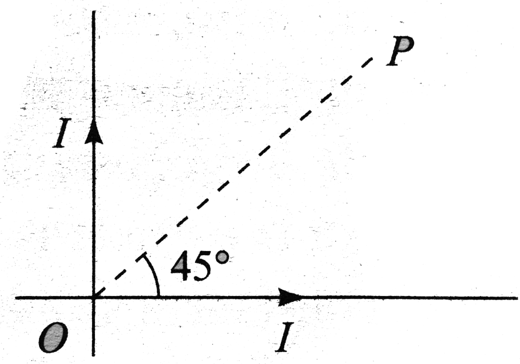
41. Two infinite long wires, each carrying current I, are lying along x- and y-axis, respectively. A charged particle, having a charge q and mass m, is projected with a velocity u along the straight line OP. The path of the particle is (neglect gravity)



A. Straight line

B. circle

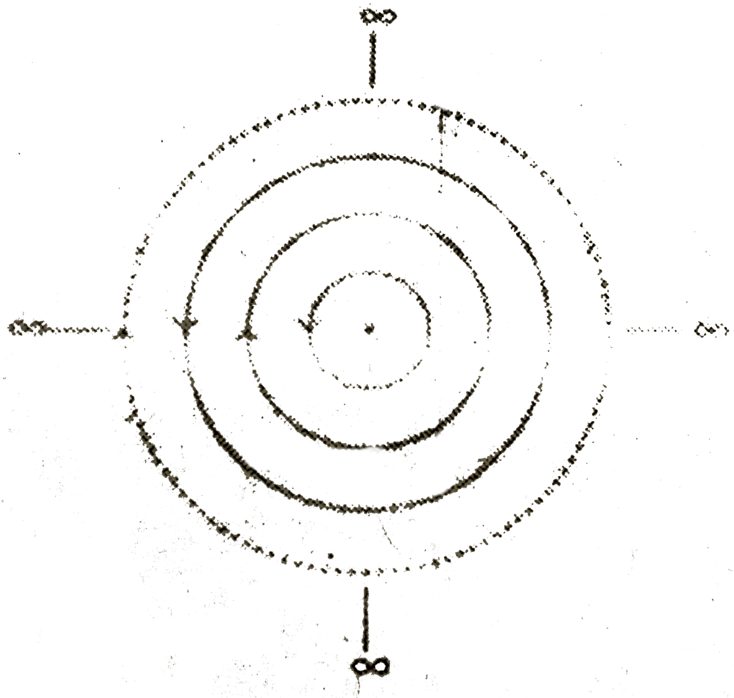
C. helix

D. cycloid

Answer: A

Watch Video Solution

42. In figure, infinite conducting ring each having current i in the direction shown are places concentricallly in the same plane . The radius of ring are $r, 2r, 2^2r, 2^3r.\ldots\infty$. The magnetic field at the centre of ring will be



A. zero

B. $\frac{\mu_i}{r}$

C. $\frac{\mu_i}{2r}$

D. $\frac{\mu_i}{3r}$

Answer: B

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43. A very long straight conducting wire, lying along the z-axis, carries a current of 2A. The integral $\oint \vec{B} . d \vec{l}$ is computed along the straight line PQ, where P has the coordinates $(2cm, 2cm, 0)$ and Q has the coordinates $(2cm, 2cm, 0)$. The integral has the magnitude (in SI units)`

A. $\frac{\pi}{2} \times 10^{-7}$

B. $8\pi \times 10^{-7}$

C. $2\pi \times 10^{-7}$

D. $\pi \times 10^{-7}$

Answer: A

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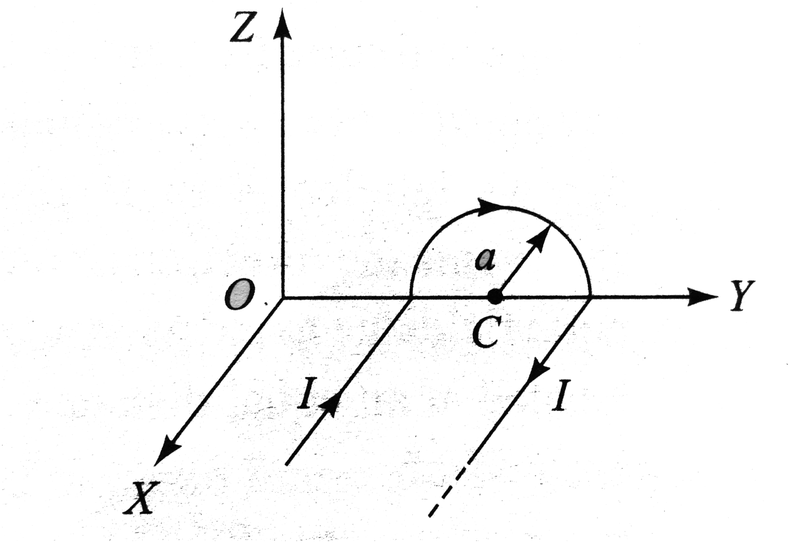
44. A long wire bent as shown in fig. carries current I. If the radius of the semicircular portion is a, the magnetic field at centre C is



A. $\frac{\mu_0 I}{4a}$

B. $\frac{\mu_0 I}{4\pi a}\sqrt{\pi^2+4}$

C. $\frac{\mu_0 I}{4a}+\frac{\mu_0 I}{4\pi a}$

D. $\frac{\mu_0 I}{4\pi a}\sqrt{(\pi^2-4)}$

Answer: B

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45. A long wire carrying a current i is bent to form a plane angle alpha. Find the magnetic field B at a point on the bisector of this angle situated at a distance x from the vertex. `

A. $\frac{2rmv}{q\mu_0 i}$

B. $\frac{2\pi rmv}{q\mu_0 i}$

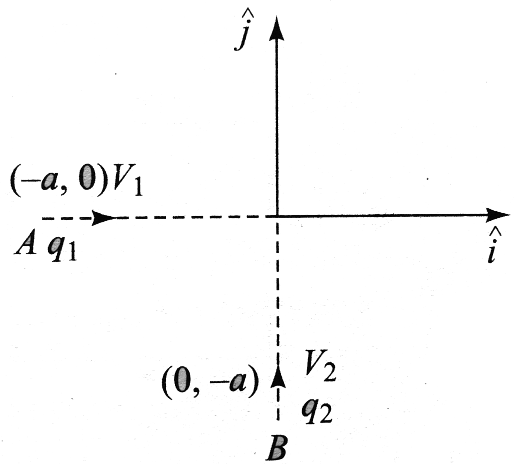
C. r

D. cannot be determine

Answer: B

Watch Video Solution

46. Two positive charges q_1 and q_2 are moving with velocities v_1 and v_2 when they are at points A and B, respectively, as shown in Fig. The magnetic force experienced by charge q_1 due to the other charge q_2 is



A. $\dfrac{\mu_0 q_1 q_2 v_1 v_2}{8\sqrt{2}\pi a^2}$

B. $\frac{\mu_0 q_1 q_2 v_1 v_2}{4\sqrt{2}\pi a^2}$

C. $\frac{\mu_0 q_1 q_2 v_1 v_2}{2\sqrt{2}\pi a^2}$

D. $\frac{\mu_0 q_1 q_2 v_1 v_2}{\sqrt{2}\pi a^2}$

Answer: A

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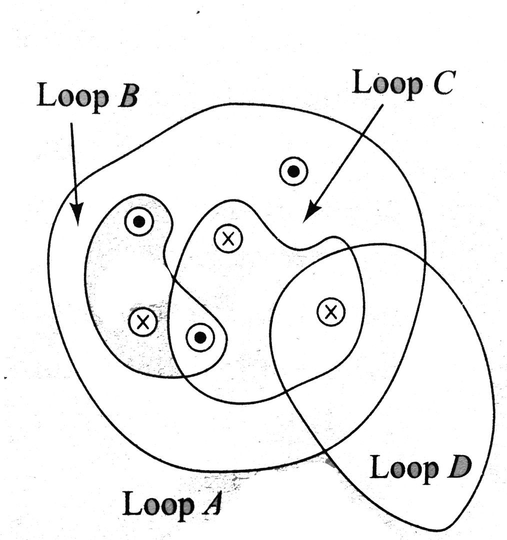
47. Consider six wires coming into or out of the page, all with the same current. Rank the line integral of the magnetic field (from most positive to most negative) taken counterclockwise around each loop shown



A. $B > C > D > A$

B. $B > C = D > A$

C. $B < A > C = D$

D. $C < B = D > A$

Answer: C

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48. A positively charged disk is rotated clockwise as shown in Fig. The direction of hte magnetic field at a point A in the plane of the disk is

A. $\otimes$ (into the page)

B. $3/4 \rightarrow$

C. $\leftarrow 3/4$

D. $\odot$ (out of the page)

Answer: D

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49. Figure. Shows two long wires carrying equal currents I_1 and I_2 flowing in opposite directions. Which of the arrows labeled A to D correctely represents the direction of the magnetic field due to the wires at a point located at an equal distance d from each wire?

A. A

B. B

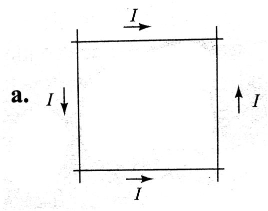
C. C

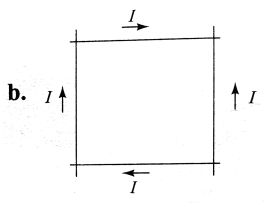
D. D

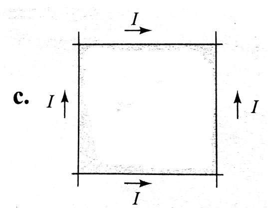
Answer: B

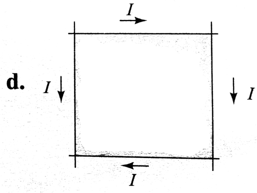
Watch Video Solution

50. Current flows through uniform, square frames as shown in the figure. In which case is the magnetic field at the centre of the frame not zero?

A. 

B. 

C. 

D. 

Answer: C

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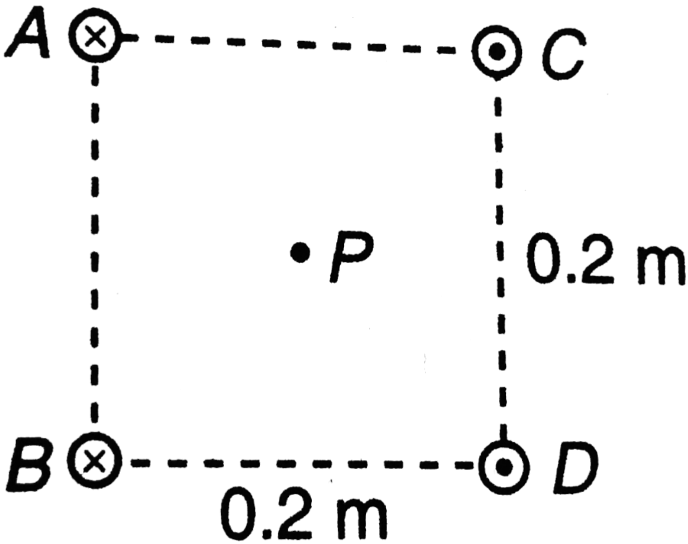
51. Four long, parallel conductors carry equal currents of 5.0. The direction of the currents is into the pge at points. A and B and out of the page at C and D. Calculate the magnitude and directionof the mgnetic field at point P, located at the centre of the square.



A. W and Y X and Z

B. X and Z W and Y

C. W and Z X and Y

D. W and X Y and Z

Answer: D

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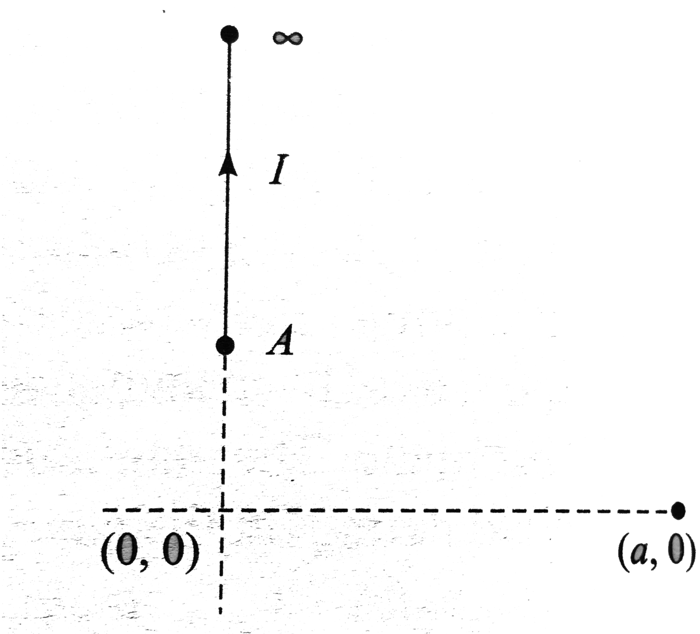
52. An infinitely long wire carrying current I is along Y-axis such taht its one end is at point A(0,b) while the wire extends upto $+\infty$. The magnitude of magnetic field strength at point (a,0) is



A. $\frac{\mu_0 I}{4\pi a}\left(1+\frac{b}{\sqrt{a^2+b^2}}\right)$

B. $\frac{\mu_0 I}{4\pi a}\left(1-\frac{b}{\sqrt{a^2+b^2}}\right)$

C. $\frac{\mu_0 I}{4\pi a}\left(\frac{b}{\sqrt{a^2+b^2}}\right)$

D. none of these

Answer: B

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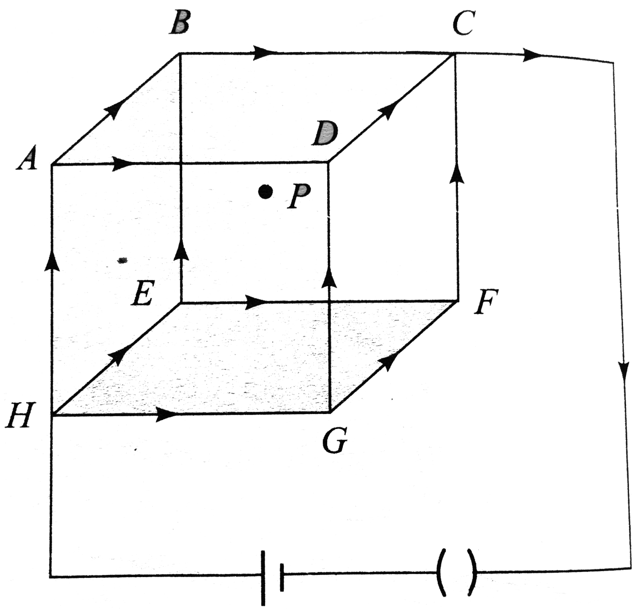
53. A steady current is set up in a cubic network composed of wires of equal resistance and length d as shown in Fig. What is the magnetic field at centre P due to the cubic network?



A. $\frac{\mu_0}{4\pi}\frac{2I}{d}$

B. $\frac{\mu_0}{4\pi}\frac{3I}{\sqrt{2}d}$

C. 0

D. $\frac{\mu_0}{4\pi}\frac{\theta\pi I}{d}$

Answer: C

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54. A point charege is moving in a circle with constant speed . Consider the magnetic field produced by the charge at a fixed point P (not center of the circle) on its axis .

A. it is constant in magnitude only

B. it is constant in direction only

C. it is constant both in direction and magnitude

D. It is constant neither in magnitude nor in direction

Answer: A

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55. An α particle is moving along a circle of radius R with a constant angular velocity ω. Point A lies in the same plane at a distance 2R from the centre. Point A records magnetic field produced by the α particle. If the minimum time interval between two successive times at which A records zero magnetic field is t_1, the angular speed ω in terms of t is

A. $\frac{2\pi}{t}$

B. $\frac{2\pi}{3t}$

C. $\frac{\pi}{3t}$

D. $\frac{\pi}{t}$

Answer: B

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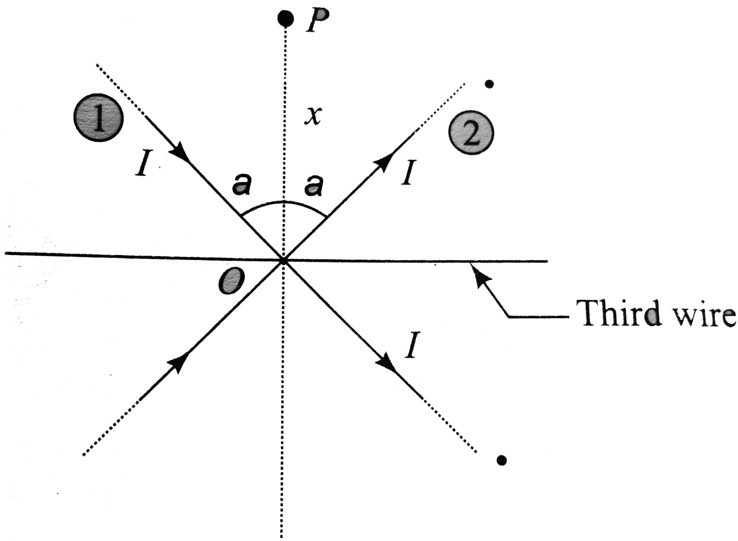
56. Three infinite current carrying conductors are placed as shown in Fig. Two wires carry same current while current in third wire is unknown. The three wires are electrically insulated from each other and all of them are in the plane of paper. Which of the following is correct about point P which is also in the same plane?



A. Magnetic field intensity at P is zero for all values of x, whatever is the current in the third wire.

B. If the current in the third wire is $\frac{2I}{\sin\alpha}$ (left to right), then magnetic field will be zero at P for all values of x.

C. If the current in the third wire is $\frac{2I}{\sin \alpha}$ (right to left), then magnetic field will be zero at P for all values of x.

D. none of these

Answer: C

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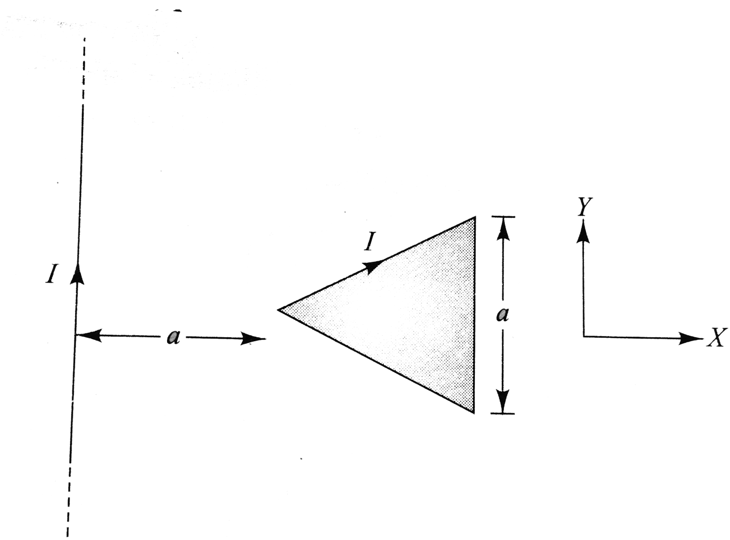
57. An equilateral triangular loop is kept near to a current carrying long wire as shown fig. under the action of magnetic force alone, the loop



A. must move along positive of negative X-axis

B. must move in XY plane and not along X- or Y-axis

C. does not move

D. moves but which way we cannot predict

Answer: A

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58. A particle is moving wirh velocity $\overrightarrow{v} = \hat{i} + 3\hat{j}$ and it produces an electric field at a point given by $\overrightarrow{E} = 2\hat{k}$. It will produce magnetic field at that point equal to (all quantities are in SI units)

A. $\left(6\hat{i} - 2\hat{j}\right)\mu_0\varepsilon_0$

B. $\left(6\hat{i} + 2\hat{j}\right)\mu_0\varepsilon_0$

C. zero

D. cannot be determine

Answer: A

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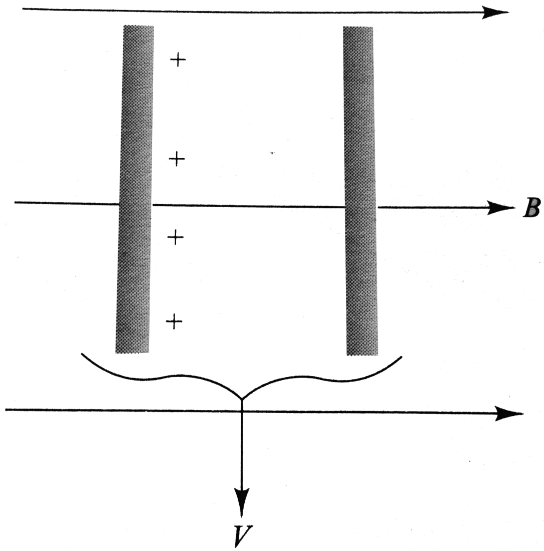
59. A parallel plate capacitor is moving with a velocity of $25ms^{-1}$ through a uniform magnetic field of 4T as shown in Fig. If the electric field within the capacitor plates is $400NC^{-1}$ and the plate area is $25 \times 10^{-7}m^2$, then the magnetic force experienced by the positive charge plate is



A. $8.85 \times 10^{-13} N$ directed out of the plane of the paper

B. zero

C. $8.85 \times 10^{-15} N$ directed out of the plane of the paper

D. none of above

Answer: A

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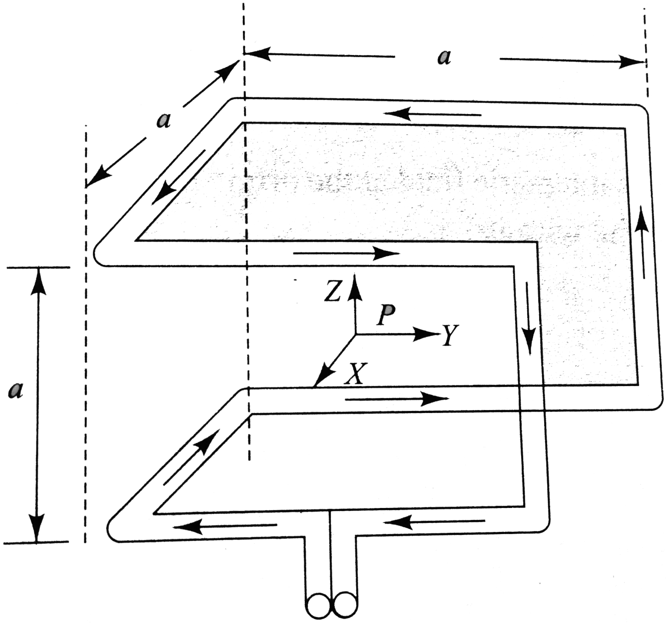
60. Current I flows around the wire frame along the edge of a cube as shown in Fig. Point P is the centre of the cube. The incoming and outgoing wires have orientation toward P. Then,



A. the magnetic field at P is toward +y direction

B. the magnetic field at P is toward -y direction

C. the unit vector of magnetic field at P is

$$-\frac{1}{\sqrt{2}}\left(\hat{\imath}-\hat{\jmath}\right)$$

D. the magnitude of magnetic field at P is

$$\frac{4\sqrt{2}\mu_0 I}{3\pi a}$$

Answer: A

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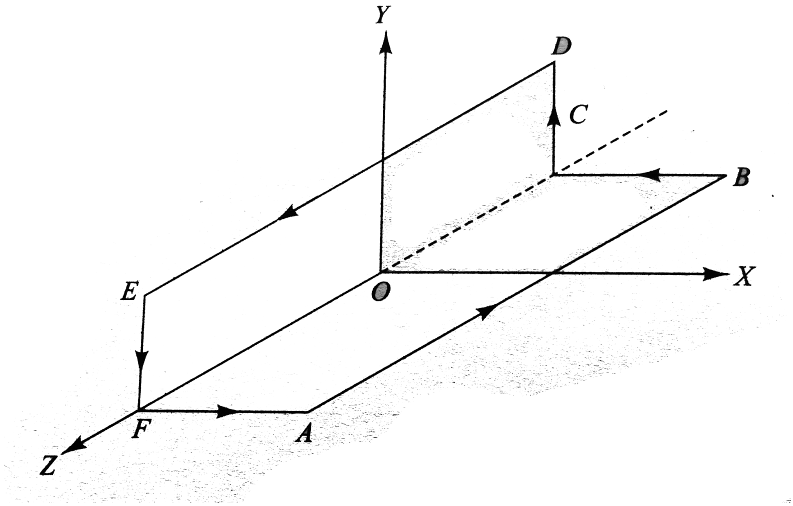
61. In Fig ABCDEFA was a square loop of side l, but is folded in two equal parts so that half of it lies in the x-z plane and the other half lies in the y-z plane. The origin O is centre of the frame also. The loop carries current 'i'. The magnetic field at the centre is



A. $\frac{\mu_0 i}{2\sqrt{2}\pi l}\left(\hat{i}-\hat{j}\right)$

B. $\frac{\mu_0 i}{4\pi l}\left(-\hat{i}-\hat{j}\right)$

C. $\frac{\sqrt{2}\mu_0 i}{\pi l}\left(\hat{i}+\hat{j}\right)$

D. $\frac{\mu_0 i}{\sqrt{2}\pi l}\left(\hat{i}+\hat{j}\right)$

Answer: C

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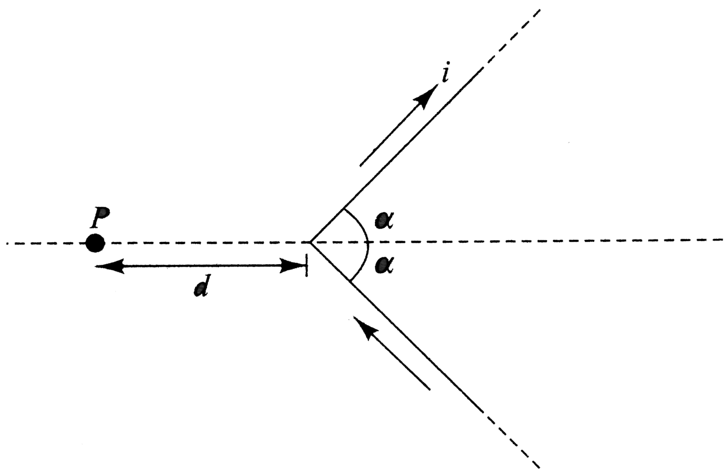
62. If the magnetic field at P can be written as $K \tan\left(\frac{\alpha}{2}\right)$,



A. $\frac{\mu_0 I}{4\pi d}$

B. $\frac{\mu_0 I}{2\pi d}$

C. $\frac{\mu_0 I}{\pi d}$

D. $\frac{2\mu_0 I}{\pi d}$

Answer: B

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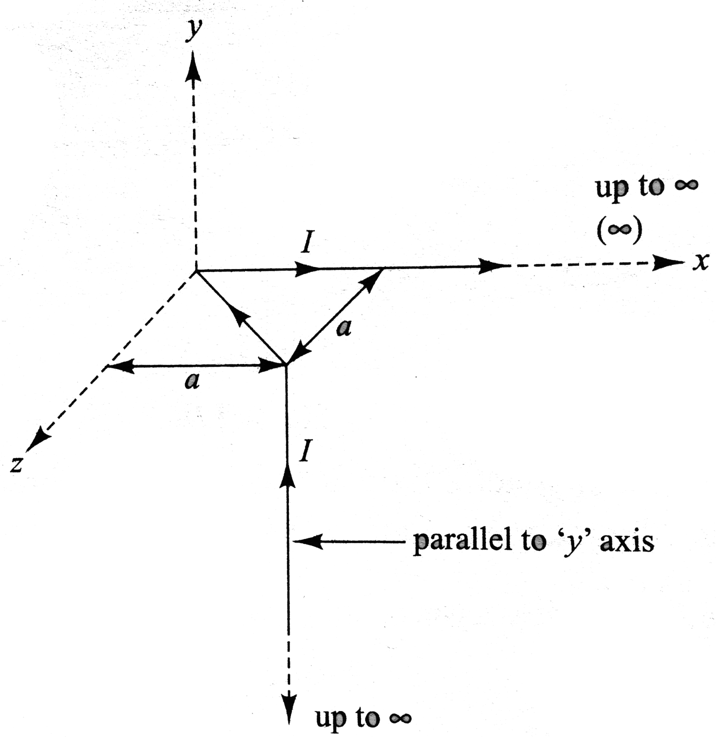
63. The magnetic field at the origin due to the current flowing in the wire is



A. $-\frac{\mu_0 I}{8\pi a}\left(\hat{i}+\hat{k}\right)$

B. $\frac{\mu_0 I}{2\pi a}\left(\hat{i}+\hat{k}\right)$

C. $\frac{\mu_0 I}{8\pi a}\left(-\hat{i}+\hat{k}\right)$

D. $-\frac{\mu_0 I}{4\pi a\sqrt{2}}\left(\hat{i}-\hat{k}\right)$

Answer: C

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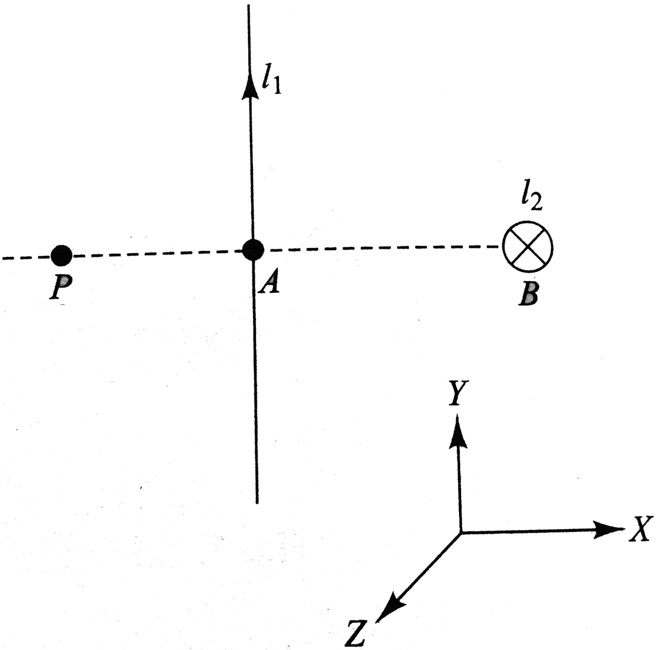
64. Two infinitely long linear conductors are arranged perpendicular to each other and are in mutually perpendicular planes as shown in Fig. If $I_1 = 2A$ along the y-axis, $I_2 = 3A$, along -ve z-axis and

AP=AB=1cm, the value of magnetic field strength $\overrightarrow{B}$ at P is



A. $(3 \times 10^{-5} T)\hat{j} + (-4 \times 10^{-5} T)\hat{k}$

B. $(3 \times 10^{-5} T)\hat{j} + (4 \times 10^{-5} T)\hat{k}$

C. $(4 \times 10^{-5} T)\hat{j} + (-4 \times 10^{-5} T)\hat{k}$

D. $(-3 \times 10^{-5} T)\hat{j} + (4 \times 10^{-5} T)\hat{k}$

Answer: B

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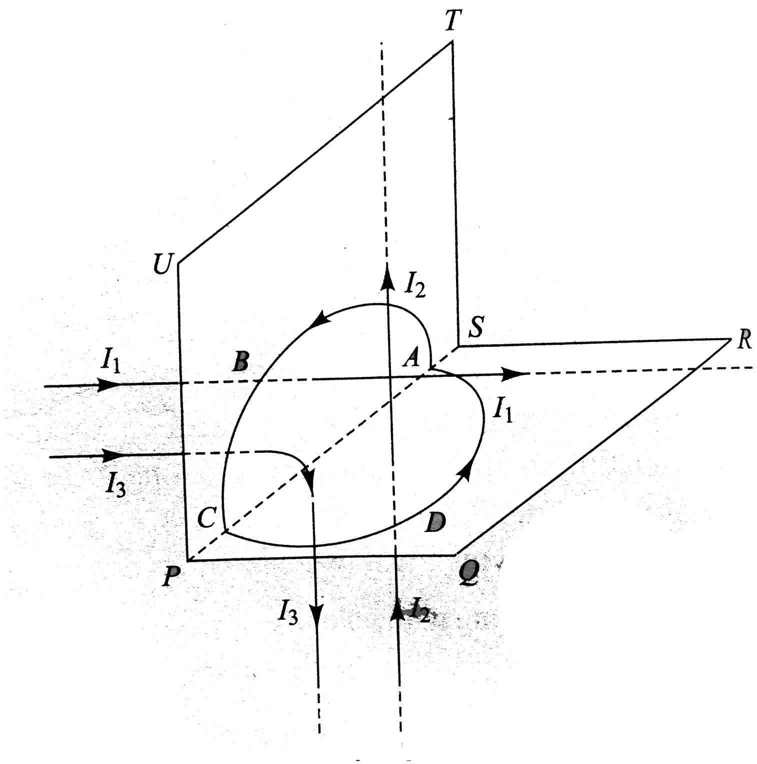
65. Figure shows an Amperian path ABCDA. Part ABC is in vertical plane PSTU while part CDA is in horizontal plane PQRS. Direction of circulation along the path is shown by an arrow near point B and at D. $\oint \overrightarrow{B}.d\overrightarrow{l}$

for this path according to Ampere's law will be



A. $(I_1 - I_2 + I_3)\mu_0$

B. $(-I_1 + I_2)\mu_0$

C. $I_3\mu_0$

D. $(I_1 + I_2)\mu_0$

Answer: D

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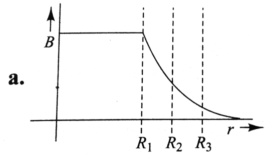
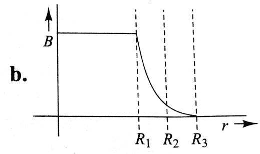
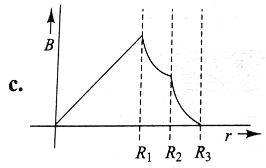
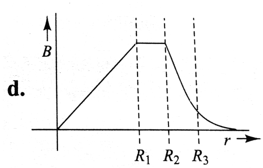
66. A coaxial cable made up of two conductors. The inner conductor is solid and is of radius R_1 and the outer conductor is hollow of inner radius R_2 and outer radius R_3. The space between the conductors is filled with air. The inner and outer conductors are carrying currents of equal magnitudes and in opposite directions. Then the variation of magnetic field with distance from the axis is best plotted as

A. 

B. 

C. 

D. 

Answer: C

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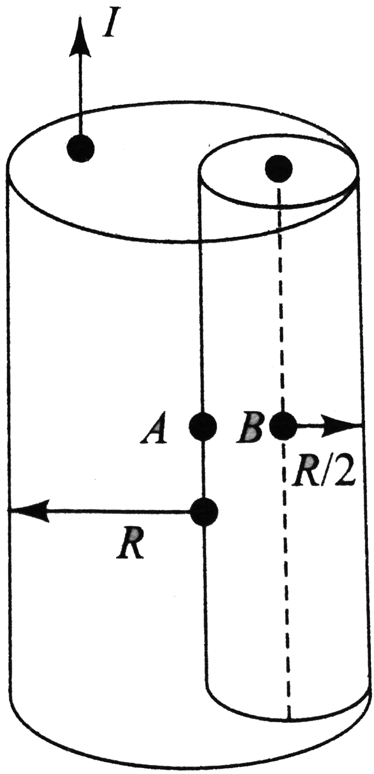
67. From a cylinder of radius R, a cylider of radius $R/2$ is removed, as shown in Fig. Current flowing in the remaining cylinder is I. Then, magnetic field strength is



A. $\frac{\mu_0 I}{3\pi R}$ at point B

B. $\frac{\mu_0 I}{2\pi R}$ at point A

C. zero at point B

D. zero at point A

Answer: D

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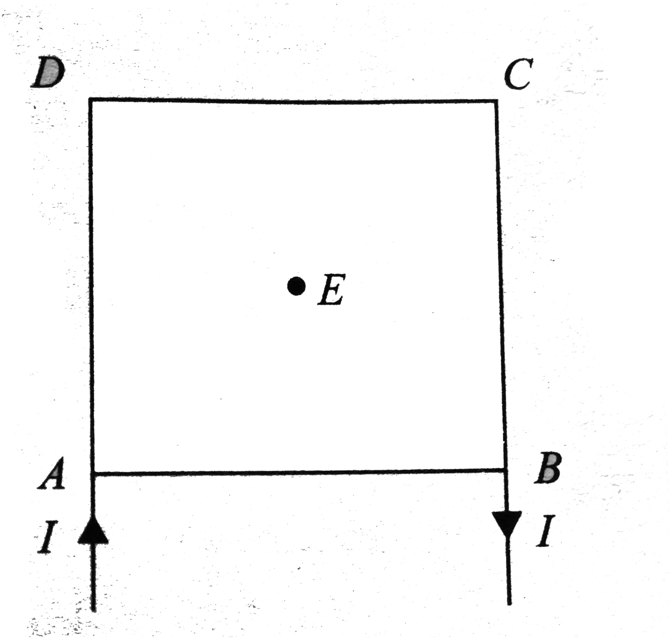
68. Current I enters at A in a square loop of uniform resistance and leaves at B. The ratio of magnetic field at E, the centre of square, due to segment AB to that due to DC is



A. 1

B. 2

C. 3

D. 4

Answer: C

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69. A wire of length l is used to form a coil. The magnetic field at its centre for a given current in it is minimum if the coil has

A. $4turn$

B. $2turn$

C. $1turn$

D. data is not sufficient

Answer: C

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70. The value of the electric field strength in vacuum if the energy density is same as that due to a magnetic field of induction 1T in vacuum is

A. $3 \times 10^8 NC^{-1}$

B. $1.5 \times 10^8 NC^{-1}$

C. $2.0 \times 10^8 NC^{-1}$

D. $1.0 \times 10^8 NC^{-1}$

Answer: A

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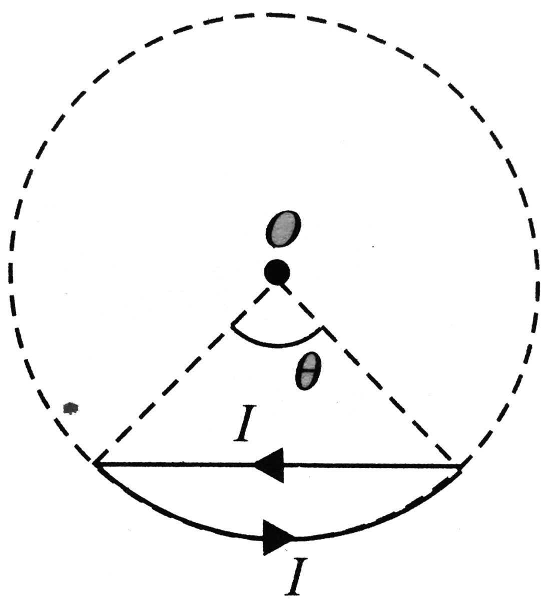
71. Figure. Shows a small loop carrying a current I. The curved portion is an arc of a circle of radius R and the straight portion is a chord to the same circle subtending an angle θ. The magnetic induction at centor O is



A. zero

B. always inward irrespective of the value θ

C. inward as long as θ is less than π

D. always outward irrespective of the value of θ

Answer: C

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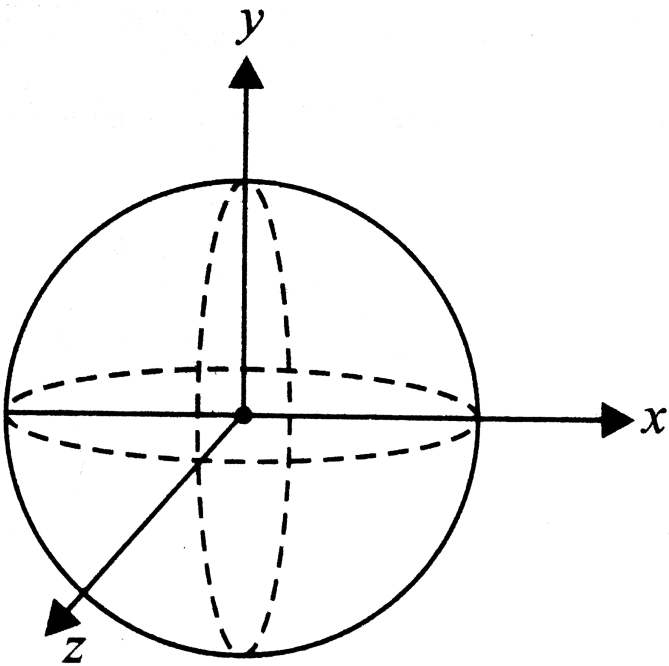
72. Three rings, each having equal radius R, are placed mutually perpendicular to each other and each having its centre at the origin of coordinate system. If current I is flowing through each ring, then the magnitude of the magnetic field at the common centre is



A. $\sqrt{3}\frac{\mu_0 I}{2R}$

B. zero

C. $\left(\sqrt{2}-1\right)\frac{\mu_0 I}{2R}$

D. $\left(\sqrt{3}-\sqrt{2}\right)\frac{\mu_0 I}{2R}$

Answer: A

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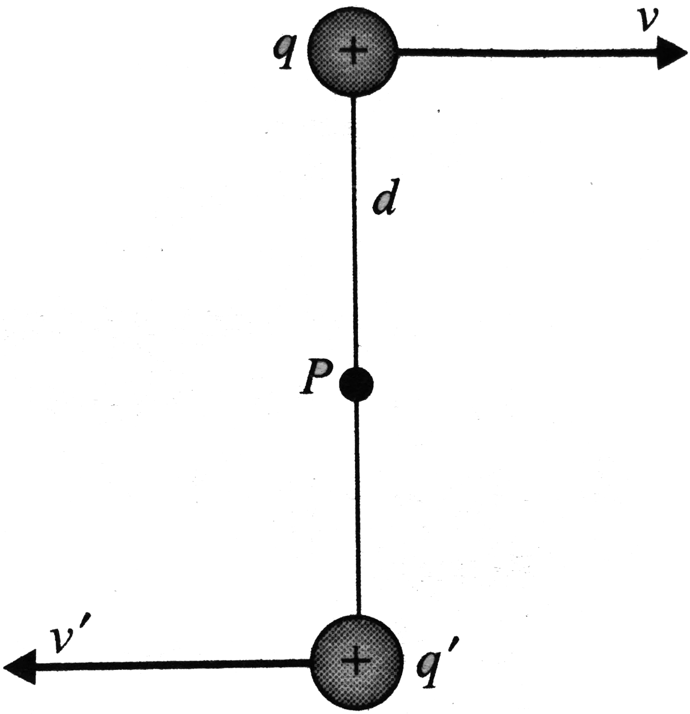
73. Positive point charge $q = +8.00\mu C$ and $q' = +3.00\mu C$ are moving relative to an observer in Fig. The distance d is 0.120m. When the two charges are at the locations shown in the figure, what are the magnitude and direction of the net magnetic field they produce at point P?

$(Take v = 4.50 \times 10^6 ms^{-1}$ and $v' = 9.00 \times 10^6 ms^1)$



A. $4.38 \times 10^{-4} T$, into the page

B. $4.38 \times 10^{-4} T$, out of the page

C. $2.16 \times 10^{-4} T$, into the page

D. $2.16 \times 10^{-4} T$, out of the page

Answer: A

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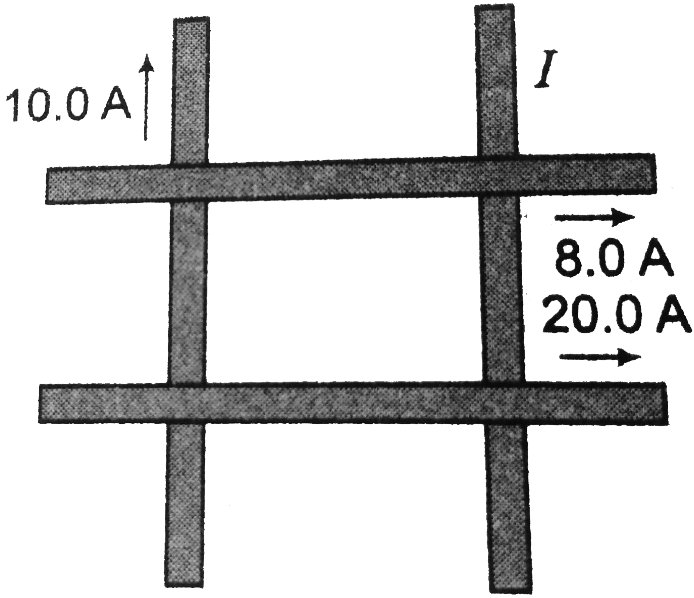
74. Four very long, current carrying wires in the same plane intersect to form a square $40.0cm$ on each side as shown in figure. Find the magnitude and direction of the current I so that the magnetic field at the centre of square is zero. Wires are insulated from each other.



A. $4.0A$ toward the bottom

B. $2.0A$ toward the bottom

C. $2.5A$ toward the bottom

D. $2.6A$ toward the bottom

Answer: B

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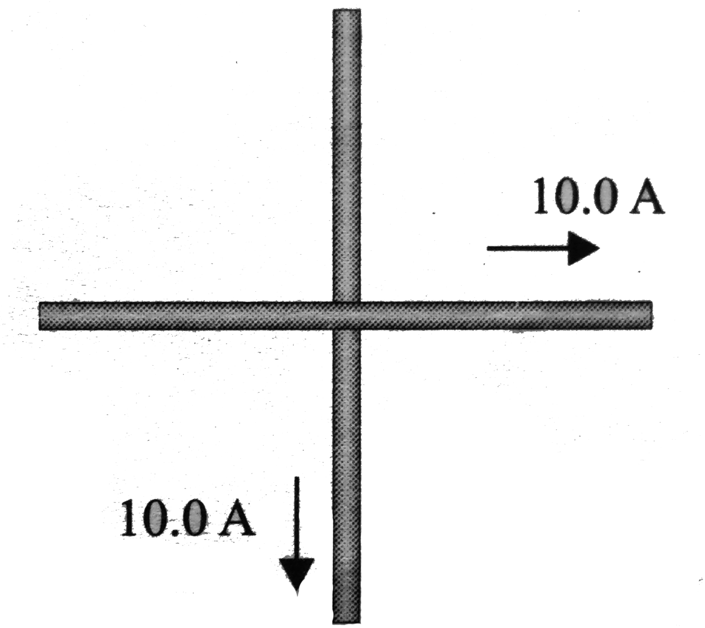
75. Two very long, straight wires carrying, currents as shown in Fig. Find all locations where the net magnetic field is zero.



A. $y = \sqrt{2}x$

B. $y = x$

C. $y = -x$

D. $y = -\left(\frac{x}{2}\right)$

Answer: C

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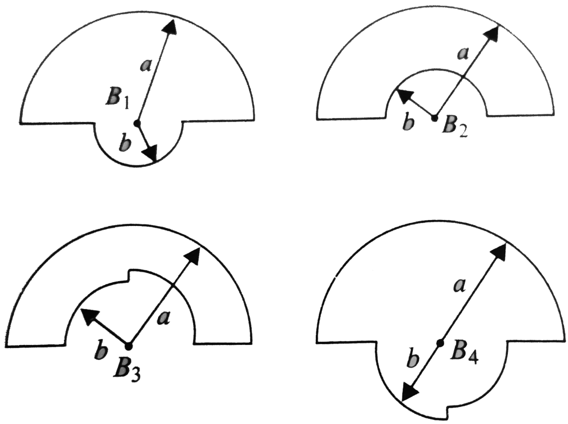
Exercise (multiple Currect)

1. In the loops shown in fig. all curved section are either semicircles or quarter circles. All the loops carry same current. The magnetic fields at the centre have magnitudes B_1, B_2, B_3 and B_4. Then,



A. B_4 is maximum

B. B_3 is minimum

C. $B_4 > B_1 > B_2 > B_3$

D. $B_1 > B_4 > B_3 > B_2$

Answer: A::B::C

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2. A steady electric current is flowing through a cylindrical conductor. Then,

A. the electric field at the axis of the conductor is zero

B. the magnetic field at the axis of the conductor is zero

C. the electric field in the vicinity of the conductor is zero

D. the magnetic field in the vicinity of the conductor is zero

Answer: B::C

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3. Two circular coils of radii 5.0 cm and 10 cm carry equal currents of 2.0 A. The coils have 50 and 100 turns respectively and are placed in such a way that their planes as well as the centres coincide. Find the magnitude of the magnetic field B at the common centre of the coils if the currents in the coils are (a) in the same sense (b) in the opposite sense.

A. $8\pi \times 10^{-4}T$ if current in the coils are in same sense

B. $4\pi \times 10^{-4} T$ if current in the coils are in opposite sense

C. zero if current in the coils are in opposite sense

D. $8\pi \times 10^{-4} T$ if current in the coils are in opposite sense

Answer: A::C

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4. A long straight wire carries the current along +ve x-direction. Consider four points in space $A(0, 1, 0)$, $B(0, 1, 1)$, $C(1, 0, 1)$, and $D(1, 1, 1)$.

Which of the pairs will have the same magnitude of magnetic field?

A. A and B

B. A and C

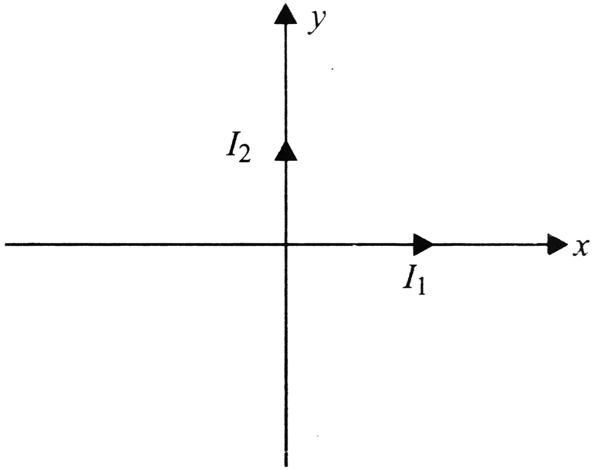
C. B and C

D. B and D

Answer: B::D

Watch Video Solution

5. Two thin long wires carry currents I_1 and I_2 along x- and y-axes, respectively, as shown in Fig. Consider the points only in x-y plane.



A. Magnetic field is zero at last at one point in each quadrant

B. Magnetic field can be zero somewhere in the first quadrant

C. Magnetic field can be zero somewhere in the second quadrant

D. Magnetic field in non-zero in second quadrant

Answer: B::D

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Exercise (assertion-reasioning)

1. Statement 1: A direct current flows through a metallic rod. It produces magnetic field only outside the rod.

Statement 2: The charge carries flow through whole of the cross section.

A. If both Statement 1 and Statement 2 are true, the Statement 2 is the correct explanation of Statement1.

B. If both Statement 1 and Statement 2 are true, Statement 2 is not the correct explanation of Statement 1.

C. If Statement 1 is true, Statement 2 is false.

D. If Statement 1 is false, Statement 2 is true.

Answer: D

Watch Video Solution

2. Statement1: The magnetic filed at the ends of very long current carrying solenoid is half of that at the centre.

Statement2: If the solenoid is sufficiently long, the field within it is uniform.

A. If both Statement 1 and Statement 2 are true, the Statement 2 is the correct explanation of Statement1.

B. If both Statement 1 and Statement 2 are true, Statement 2 is not the correct explanation of Statement 1.

C. If Statement 1 is true, Statement 2 is false.

D. If Statement 1 is false, Statement 2 is true.

Answer: B

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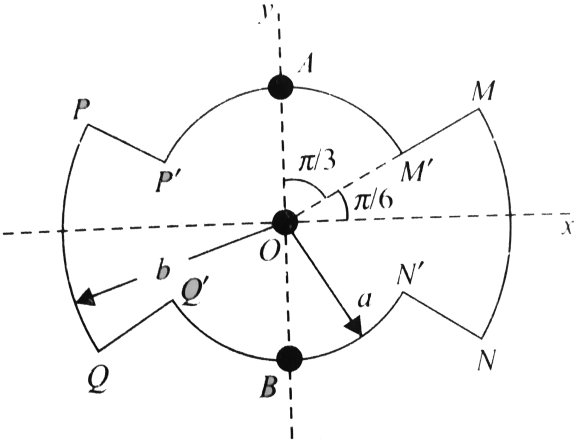
Exercise (linked Comprehension)

1. There exists a long conductor along z-axis carrying a current I_0 along positive z-direction. A loop having total resistance R is placed symmetrical about x-axis and y-axes in x-y plane as shown in Fig. potential difference $V_{BA} = V$ is applied. Radii of arcs are a and b, respectively, as shown in the figure.



The magnitude of force experienced by the arc MN is

A. $zero$

B. $\dfrac{\mu_0 V I_0}{\pi R b}$

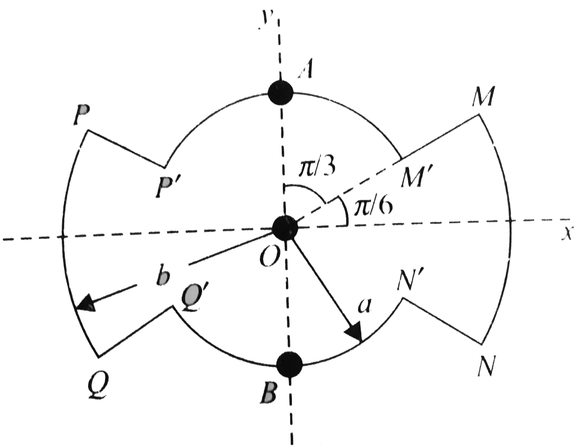
C. $\dfrac{\mu_0 V I_0}{2\pi R b}$

D. none of these

Answer: A

Watch Video Solution

2. There exists a long conductor along z-axis carrying a current I_0 along positive z-direction. A loop having total resistance R is placed symmetrical about x-axis and y-axes in x-y plane as shown in Fig. potential difference $V_{BA} = V$ is applied. Radii of arcs are a and b, respectively, as shown in the figure.



The total torque acting on the loop is nearly

A. $\dfrac{\mu_0 V I_0}{\pi R}(b - a)\hat{i}$

B. $-2\frac{\mu_0 V I_0}{\pi R}(b-a)\hat{i}$

C. $\frac{\mu_0 V I_0}{2\pi R}(b-a)\hat{i}$

D. none of these

Answer: B

Watch Video Solution

3. Curves in the graph shown in Fig. give, as function of radius distance r, the magnitude B of the magnetic field inside and outside four long wire a,b,c and d, carrying currents that are uniformly distributed across the cross sections of the wires. Overlapping portions of the plots are indicated by double labels.

Which wire has the greatest radius?

A. a

B. b

C. c

D. d

Answer: C

Watch Video Solution

4. Curves in the graph shown in Fig. give, as function of radius distance r, the magnitude B of the magnetic field inside and outside four long wire a,b,c and d, carrying currents that are uniformly distributed across the cross sections of the wires. Overlapping portions of the plots are indicated by double labels.

which wire has the greatest magnitude of the magnetic field on the surface?

A. a

B. b

C. c

D. d

Answer: A

Watch Video Solution

5. Curves in the graph shown in Fig. give, as function of radius distance r, the magnitude B of the magnetic field inside and outside four long wire a,b,c and d, carrying currents that are uniformly distributed across the cross sections of the wires. Overlapping portions of the plots are indicated by double labels.

The current density in wire a is

A. greater than in wire c

B. less than in wire c

C. equal to that in wire c

D. not comparable to that of in wire c due to lack of information

Answer: A

Watch Video Solution

6. Ampere's law provides us an easy way to calculate the magnetic field due to a symmetrical distribution of current. Its mathemfield expression is $\oint \overrightarrow{B} . dl = \mu_0 I_{\text{in}}$.

The quantity on the left hand side is known as line as integral of magnetic field over a closed Ampere's loop.

Only the current inside the Amperian loop contributes in

A. finding magnetic field at any point on the Ampere's loop

B. line integral of magnetic field

C. in both of the above

D. in neither of them

Answer: B

Watch Video Solution

7. Ampere's law provides us an easy way to calculate the magnetic field due to a symmetrical distribution of current. Its mathemfield expression is $\oint \vec{B} \, . \, dl = \mu_0 I_{\text{in}}.$

The quantity on the left hand side is known as line as integral of magnetic field over a closed Ampere's loop. If the current density in a linear conductor of radius a varies with r according to relation $J = kr^2$, where k is a constant and r is the distance of a point from the axis of conductor, find the magnetic field induction at a point distance r from the axis when rlta. Assume relative permeability of the conductor to be unity.

A. $\dfrac{\mu_0 k a^4}{4r}$

B. $\dfrac{\mu_0 k r^3}{2}$

C. $\dfrac{\mu_0 k \pi a^4}{2r}$

D. $\dfrac{\mu_0 k a^3}{4}$

Answer: D

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8. Ampere's law provides us an easy way to calculate the magnetic field due to a symmetrical distribution of current. Its mathemfield expression is $\oint \overrightarrow{B} \,.\, dl = \mu_0 I_{\text{in}}.$

The quantity on the left hand side is known as line as integral of magnetic field over a closed Ampere's loop.

In the above question, find the magnetic field induction at a point distance r from the axis when rgta. Assume relative permeability of the medium surrounding the conductor to be unity.

A. $\frac{\mu_0 k a^4}{4r}$

B. $\frac{\mu_0 k r^3}{2}$

C. $\frac{\mu_0 k \pi a^4}{2r}$

D. $\frac{\mu_0 k a^3}{4}$

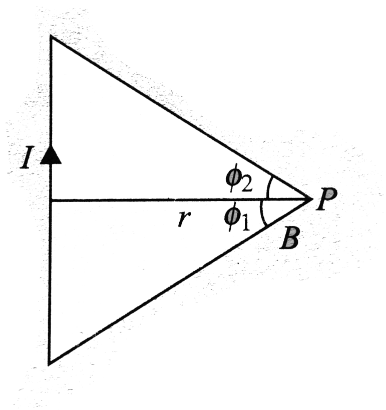
Answer: A

Watch Video Solution

9. According to Biot-Savarat's law, magentic field due to a straight current carrying wire at a point at a distance r form it is given by

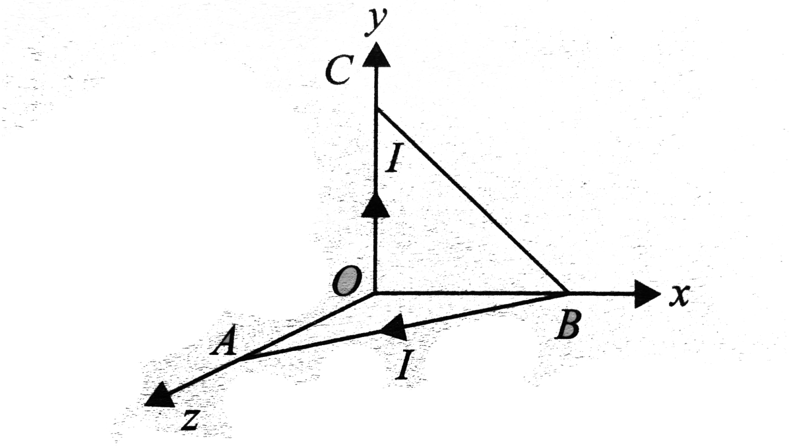
$$B = \frac{\mu_0 I}{4\pi r}(\sin\phi_1 + \sin\phi_2)$$

The direction of magnetic field being perpendicular to the plane containing the wire and the point.



Figure, shows a closed loop AOCBA in which current I is flowing as shown. Given $OA = OB = OC = a$.

Find the magnetic field at point B due to this loop.



A. $-\dfrac{\mu_0 I}{4\pi\left(\sqrt{2}a\right)}\left(\hat{i}+\hat{j}\right)$

B. $-\dfrac{\mu_0 I}{4\pi\left(\sqrt{2}a\right)}\left(\hat{j}+\hat{i}\right)$

C. $\dfrac{-\mu_0 I}{2\left(\sqrt{2}\pi\right)}\left(\hat{j}+\hat{i}\right)$

D. none of these

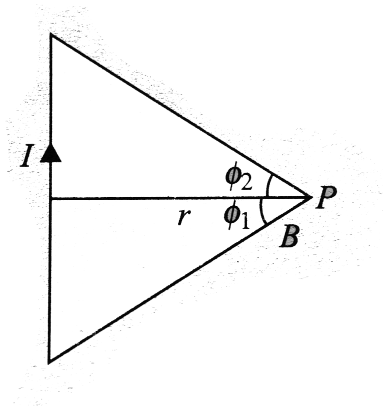
Answer: B

Watch Video Solution

10. According to Biot-Savarat's law, magentic field due to a straight current carrying wire at a point at a distance r form it is given by

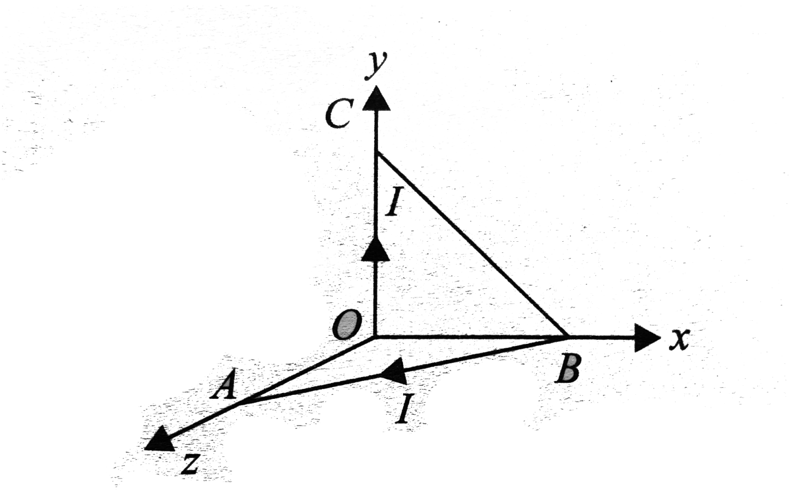
$$B = \frac{\mu_0 I}{4\pi r}(\sin\phi_1 + \sin\phi_2)$$

The direction of magnetic field being perpendicular to the plane containing the wire and the point.



Figure, shows a closed loop AOCBA in which current I is flowing as shown. Given $OA = OB = OC = a$.

Find the magnetic field at point B due to this loop.



A. $-\dfrac{\mu_0 I}{4\pi a}\left(\hat{i}+\hat{k}\right)$

B. $-\dfrac{\mu_0 I}{4\pi a}\left(\hat{j}+\hat{k}\right)$

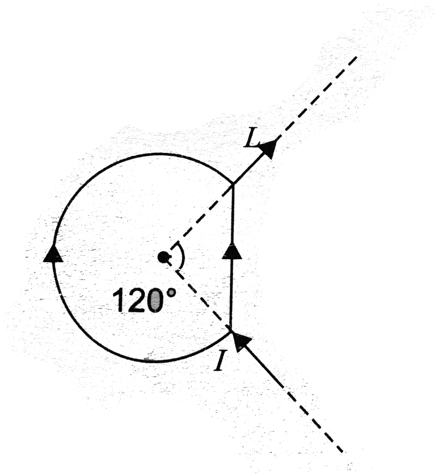
C. $-\dfrac{-\mu_0 I}{2\pi a}\left(\hat{j}+\hat{k}\right)$

D. $\dfrac{-\mu_0 I}{2\sqrt{2}\pi a}\left(\hat{j}+\hat{k}\right)$

Answer: C

Watch Video Solution

11. In Fig. the circular and the straight parts of the wire are made of same material but have different diameters. The magnetic field at the centre is zero.



Ratio of the currents I_1 and I_2 flowing through the circular and straight parts is

A. $\frac{\sqrt{3}}{2\pi}$

B. $\frac{2\sqrt{2}}{\pi}$

C. $\frac{3\sqrt{3}}{2\pi}$

D. $\frac{3\sqrt{3}}{2\sqrt{2}\pi}$

Answer: C

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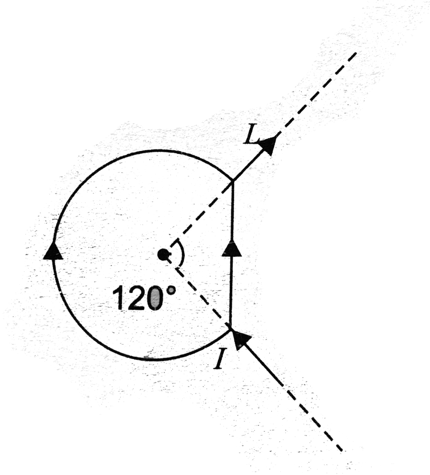
12. In Fig. the circular and the straight parts of the wire are made of same material but have different diameters. The magnetic field at the centre is zero.



The ratio of the diameters of wires of circular and straight parts is

A. $\frac{1}{\sqrt{2}}$

B. $\frac{2\sqrt{3}}{\pi}$

C. $\frac{3\sqrt{3}}{2\pi}$

D. $\sqrt{2}$

Answer: D

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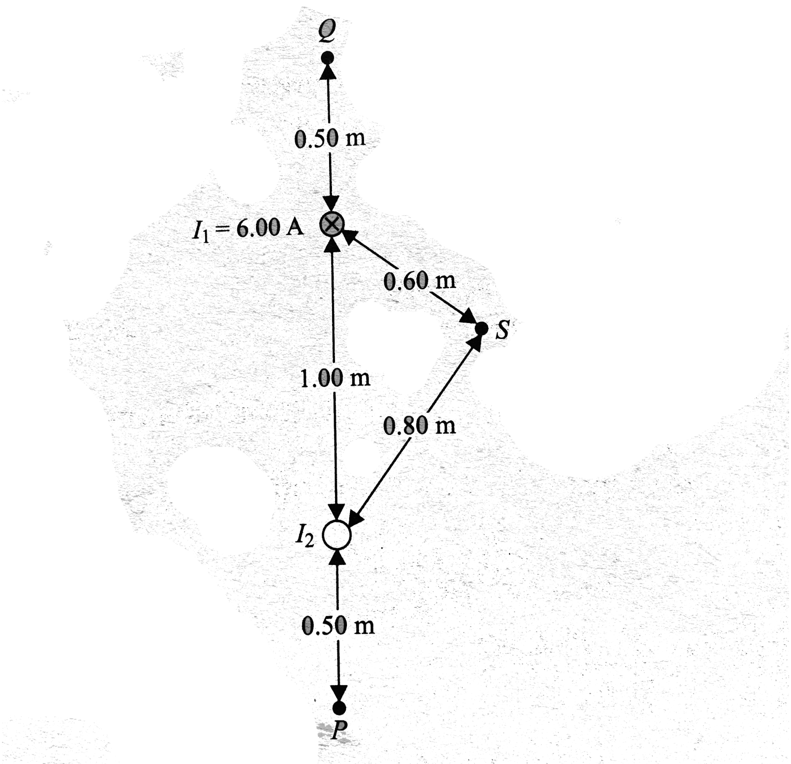
13. Two long, straight, parallel wires are 1.00m apart (as shown in Fig). The upper wire carries a current I_1 of 6.00A into the plane of the paper.



What must the magnitude of the current I_2 be for the net field at point P to be zero?

A. $3.00A$

B. $\sqrt{3}A$

C. $2.00A$

D. $1.00A$

Answer: C

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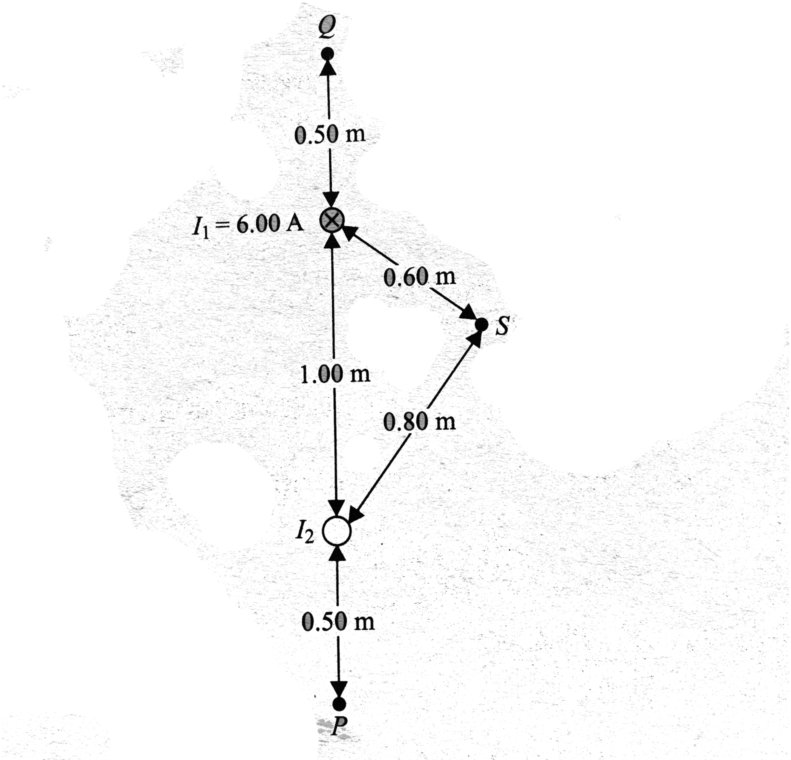
14. Two long, straight, parallel wires are 1.00m apart (as shown in Fig). The upper wire carries a current I_1

of 6.00A into the plane of the paper.



What is the magnitude of the net field at Q?

A. $2.13 \times 10^{-6} T$

B. $4.26 \times 10^{-6} T$

C. $1.21 \times 10^{-6} T$

D. $5.30 \times 10^{-6} T$

Answer: A

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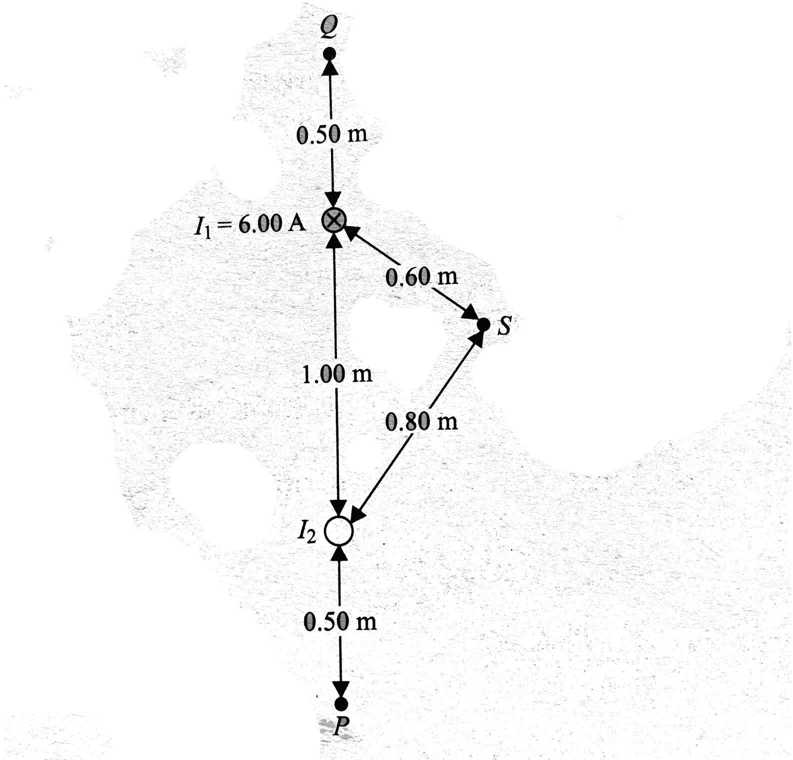
15. Two long, straight, parallel wires are 1.00m apart (as shown in Fig). The upper wire carries a current I_1 of 6.00A into the plane of the paper.



What is the magnitude of the net field at S?

A. $4.1 \times 10^{-6} T$

B. $1.6 \times 10^{-6} T$

C. $3.2 \times 10^{-6} T$

D. $2.1 \times 10^{-6} T$

Answer: D

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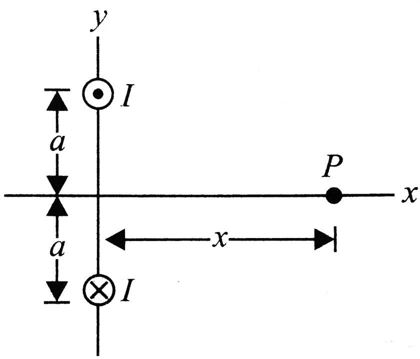
16. Figure shows an end view of two long, parallel wires perpendicular to the xy plane, each carrying a current I, but in opposite directions.



Derive an expression for the magnitude of $\overrightarrow{B}$ at any point on the x-axis in terms of the x-coordinate of the point. What is the direction of $\vec{B}$?

A. $\frac{\sqrt{2}\mu_0 Ia}{\pi(x^2 + a^2)}$

B. $\frac{3\mu_0 Ia}{\pi(x^2 + a^2)}$

C. $\frac{\mu_0 Ia}{2\pi(x^2 + a^2)}$

D. $\frac{\mu_0 Ia}{\pi(x^2 + a^2)}$

Answer: D

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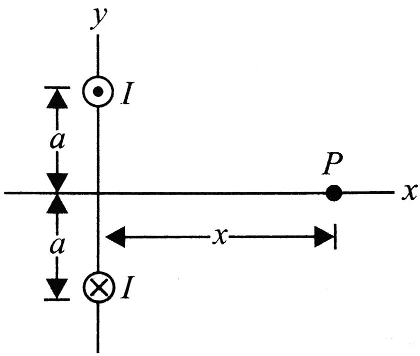
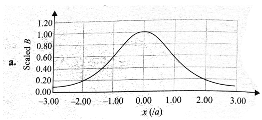
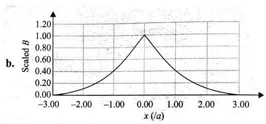
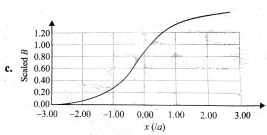
17. Figure shows an end view of two long, parallel wires perpendicular to the xy plane, each carrying a current I, but in opposite directions.

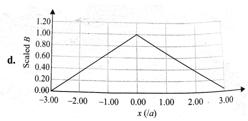


Graph the magnitude of $\vec{B}$ at point on the x-axis.

A. 

B. 

C. 

D. 

Answer: A

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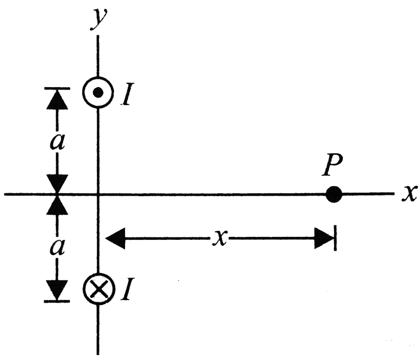
18. Figure shows an end view of two long, parallel wires perpendicular to the xy plane, each carrying a current I, but in opposite directions.



At what value of x, the magnitude of $\overrightarrow{B}$ is maxismum?

A. $x = 0$

B. $x = \sqrt{2}a$

C. $x = 1/\sqrt{2}a$

D. $x = a/2$

Answer: A

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19. Repeat the above problem, but with the current in both wires shown in fig. directed into the plane of the figure.

Derive the expression for the magnitude of $\overrightarrow{B}$ at any point on the x-axis in terms of the x-coordinate of the point. What is the direciton of $\overrightarrow{B}$?

A. $\dfrac{\sqrt{2}\mu_0 I a}{\pi(x^2 + a^2)}$

B. $\dfrac{3\mu_0 I a}{\pi(x^2 + a^2)}$

C. $\dfrac{\mu_0 I a}{2\pi(x^2 + a^2)}$

D. $\dfrac{\mu_0 I x}{\pi(x^2 + a^2)}$

Answer: D

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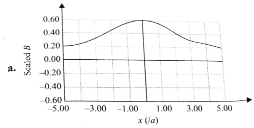
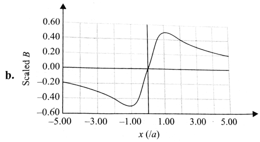
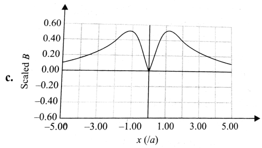
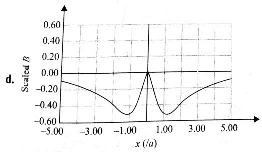
20. Repeat the above problem, but with the current in both wires shown in fig. directed into the plane of the figure.

Graph the magnitude of $\overrightarrow{B}$ at points on the x-axis.

A. 

B. 

C. 

D. 

Answer: B

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21. Repeat the above problem, but with the current in both wires shown in fig. directed into the plane of the figure.

At what value of x is the magnitude of $\vec{B}$ is maximum?

A. $x = 0$

B. $x = \sqrt{2}a$

C. $x = \pm a/2$

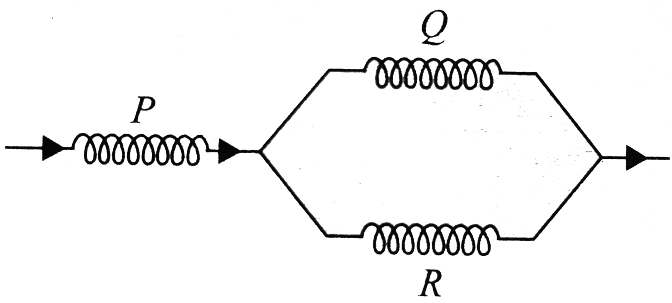
D. $x = \pm a$

Answer: D

Watch Video Solution

Exercise (integer)

1. Three identical long solenoid P,Q and R are connected to each other as shown in fig. If the magnetic field at the centre of P is 2.0T, what would be the field (inT) at the centre of Q? Assume that the field due to any solenoid is confined within the volume of that solenoid only.



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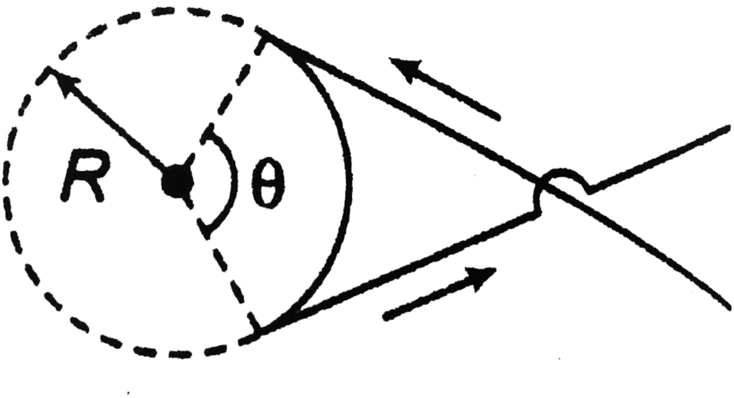
2. A wire carrying current i has the configuration as shown in figure. Two semi-infinite straight sections, both tangent to the same circle, are connected by a circular arc of central angle theta, along the circumference of the circle, with all sections lying in the same plane. What must be for B to be zero at the centre of the circle?



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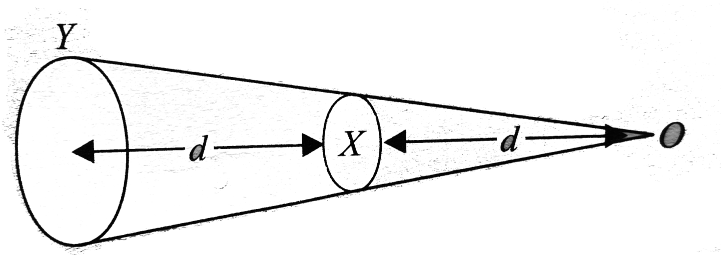
3. Two circular coils X and Y, having equal number of turns and carrying currents in the same sense, subtend same solid angle at point O. If the smaller coil X is midway between O and Y and if we represent the magnetic induction due to bigger coil Y at O as B_y and the due to smaller coil X at O as B_x,then find the ratio B_x / B_y.



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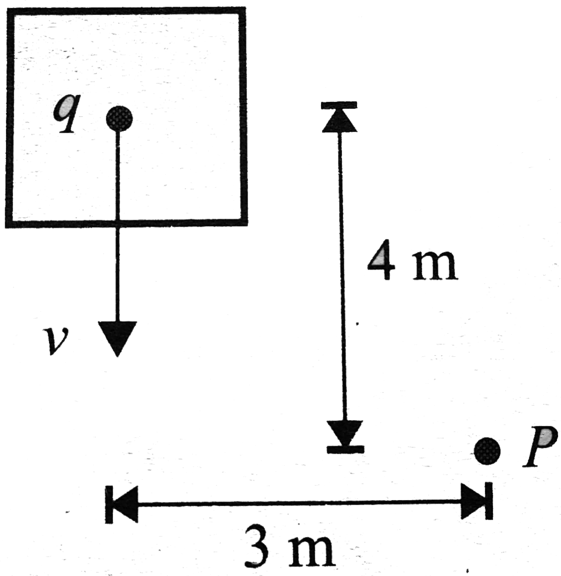
4. Two circular coils made of similar wires but of radii 20 and 40cm are connected in parallel. Find the ratio of the magnetic fields at their centers.

Watch Video Solution

5. An elevator carrying a charge of 0.5C is moving down with a velocity of $5 \times 10^3 ms^{-1}$. The elevator is 4m from the bottom and 3m horizontally from P as shown in Fig. What magnetic field (μT) does it produce at point P



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6. A square loop of side $6cm$ carries a current of $30A$.

Calculate the magnitude of magnetic field B at a point P lying on the axis of the loop and a distance $\sqrt{7}$ cm from centre of the loop.

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7. A system consists of two parallel plane carrying currents producing a uniform magnetic field of induction B between the planes. Outside this space there is no magnetic field. The magnetic force acting per unit area of each plane is found to be $B^2 / N\mu_0$. Find N.

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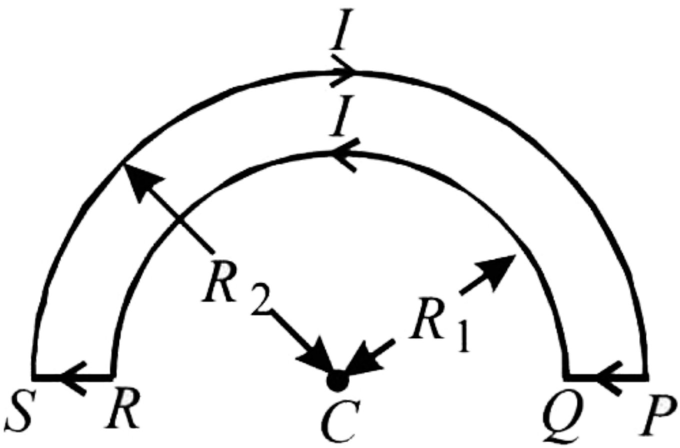
Archives (fill In The Blanks)

1. The wire loop $PQRSP$ formed by joining two semicircular wires of radii R_1 and R_2 carries a current I as shown . The magnitude of the magnetic induction at the center C is ....



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Archives (single Correct Anser)

1. A current i flows along the length of an infinitely long, straight, thin-walled pipe. Then,

(a) the magnetic field at all points inside the pipe is the same, but not zero

(b) the magnetic field at any point inside the pipe is zero

(c) the magnetic field is zero only on the axis of the pipe

(d) the magnetic field is different at different points inside the pipe

A. The magnetic field at all point inside the pipe is same, but not zero

B. The magnetic field at any point inside the pipe is zero

C. the magnetic field is zero only on the axis of the pipe

D. the magnetic field is different at different points inside the pipe

Answer: B

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2. A battery is connected between two points A and B on the circumference of a uniform conducting ring of radius r and resistance R. One of the arc AB of the ring subtends an angle θ at the centre. The value of the magnetic field produced at the centre due to the current in the ring is

A. proportional to $2(180^{\circ} - \theta)$

B. inversely proportional to r

C. zero, only if $\theta = 180^{\circ}$

D. zero for all values θ

Answer: D

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3. Two very long, straight , parallel wires carry steady currents $I \& - I$ respectively . The distance between the wires is d. At a certain instant of time, a point charge q is at a point equidistant from the wires , in the plane of the wires. Its instantaneous vel,ocity v is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on the charge at this instant is

A. $\frac{\mu_0 I q v}{2\pi d}$

B. $\frac{\mu_0 I q v}{\pi d}$

C. $\frac{2\mu_0 I q v}{\pi d}$

D. 0

Answer: D

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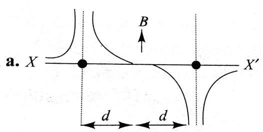
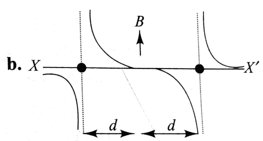
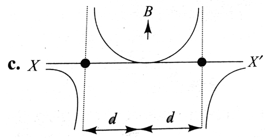
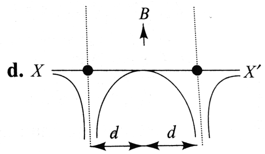
4. Two long parallel wires are at a distance $2d$ apart. They carry steady equal currents flowing out of the plane of the paper , as shown. The variation of the magnetic field B along the line XX is given by

A. 

B. 

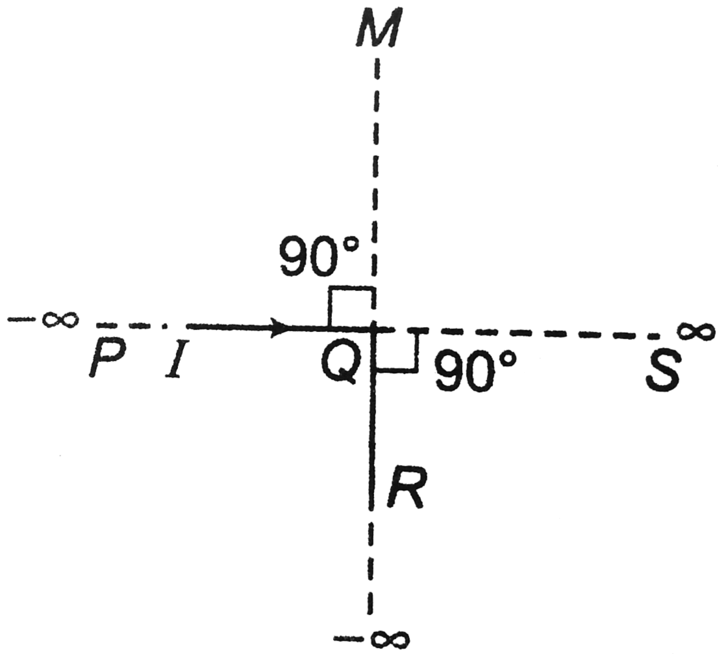
C. 

D. 

Answer: B

Watch Video Solution

5. An infifnitely long conductor PQR is bent to form a right angle as shown in figure. A current I flows through PQR. The magnetic field due to this current at the point M is H_1 Now, another infinitely long straight conductor QS is connected at Q, so that current is $\frac{I}{2}$ in QR as well as in QS, the current in PQ remaining unchanged. The magnetic field at M is now H_2. The ratio $\frac{H_1}{H_2}$ is given by `



A. $1/2$

B. 1

C. $2/3$

D. 2

Answer: C

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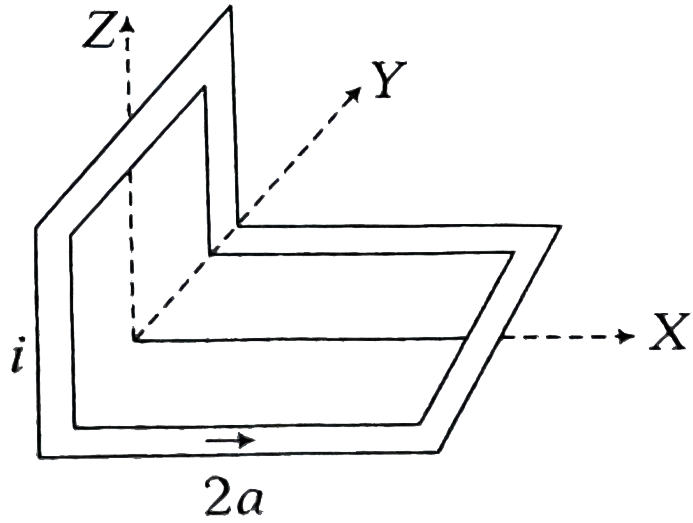
6. A non-planar loop of conducting wire carrying a current I is placed as shown in the figure. Each of the straight sections of the loop is of length 2a. The magnetic field due to this loop at the point P (a, 0, a) in the direction



A. $\frac{1}{\sqrt{2}}\left(-\hat{j}+\hat{k}\right)$

B. $\frac{1}{\sqrt{3}}\left(-\hat{j}+\hat{k}+\hat{i}\right)$

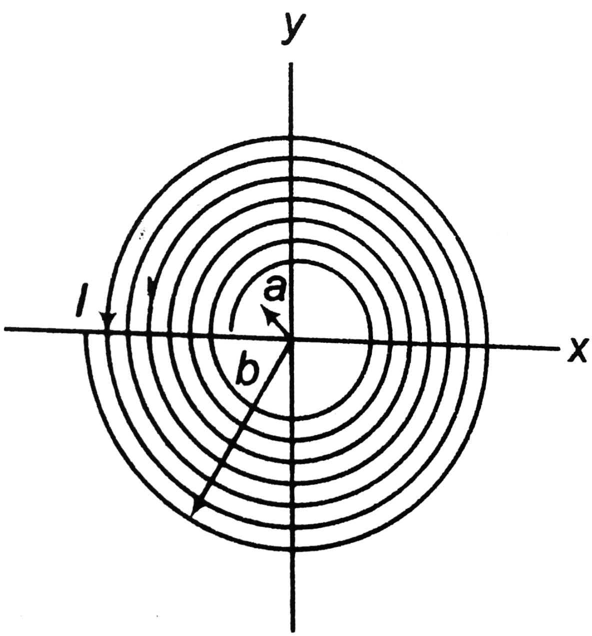
C. $\frac{1}{\sqrt{3}}\left(\hat{j}+\hat{k}+\hat{i}\right)$

D. $\frac{1}{\sqrt{2}}\left(\hat{i}+\hat{k}\right)$

Answer: D

Watch Video Solution

7. A long insulated copper wire is closely wound as a spiral of N turns. The spiral has inner radius a and outer radius b. The spiral lies in the xy-plane and a steady current I flows through the wire. The$z$-component of the magetic field at the centre of the spiral is



A. $\dfrac{\mu_0 NI}{b}$

B. $\dfrac{2\mu_0 NI}{a}$

C. $\dfrac{\mu_0 NI}{2(b-a)} In \dfrac{b}{a}$

D. $\dfrac{\mu_0 IN}{2(b-a)} In \dfrac{b}{a}$

Answer: C

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8. A long straight wire along the Z-axis carries a current I in the negative z-direction. The magnetic vector field B at a point having coodinates (x, y) in the z = 0 plane is

A. $\dfrac{\mu_0 I\left(y\hat{i} - x\hat{j}\right)}{2\pi(x^2 + y^2)}$

B. $\dfrac{\mu_0 I\left(x\hat{i} + y\hat{j}\right)}{2\pi(x^2 + y^2)}$

C. $\dfrac{\mu_0 I\left(x\hat{j} - y\hat{i}\right)}{2\pi(x^2 + y^2)}$

D. $\dfrac{\mu_0 I\left(x\hat{i} - y\hat{j}\right)}{2\pi(x^2 + y^2)}$

Answer: A

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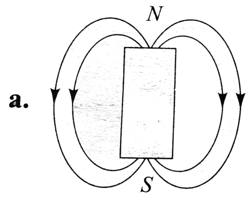
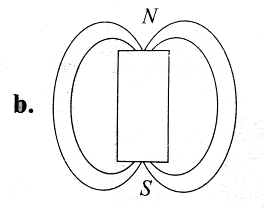
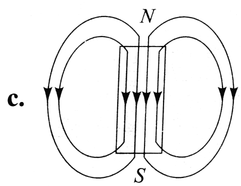
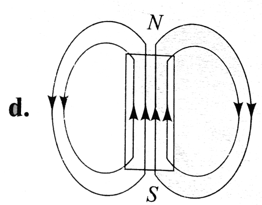
9. The magnet field lines due to a bar magnet are correctly shown in

A. 

B. 

C. 

D. 

Answer: D

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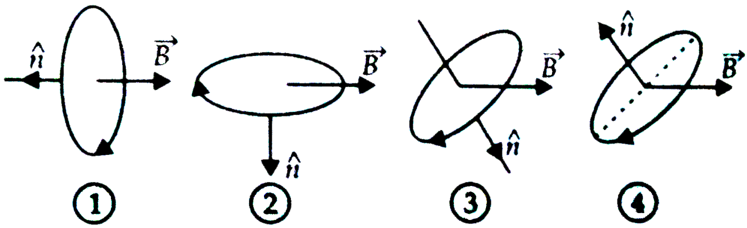
10. A current carrying loop is placed in a uniform magnetic field in four different orientations as shown in figure. Arrange them in the decreasing order of potential energy.



A. $I > III > II > IV$

B. $I > II > III > IV$

C. $I > IV > II > III$

D. $III > IV > I > II$

Answer: C

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11. A steady current I goes through a wire loop PQR having shape of a right angle triangle with PQ = 3x, PR = 4x and QR = 5x. If the magnitude of the magnetic field at P due to this loop is k find the value of k. $\left(\frac{\mu_0 I}{48\pi x}\right)$ find the value of k.

A. 5

B. 8

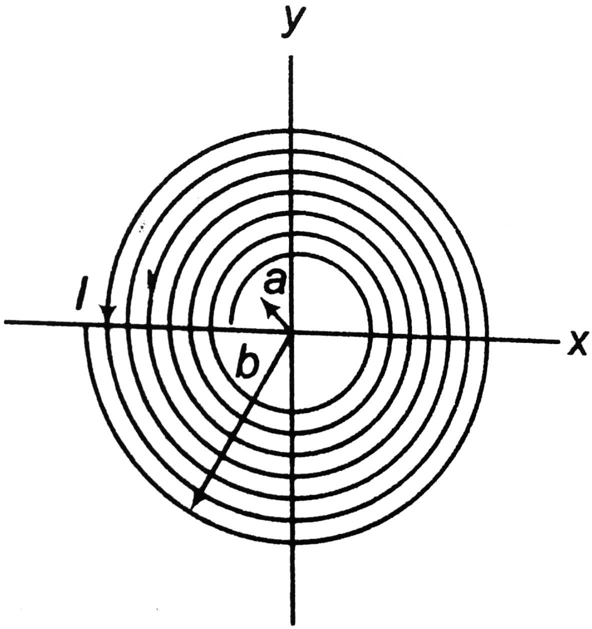
C. 7

D. 10

Answer: C

Watch Video Solution

12. A long insulated copper wire is closely wound as a spiral of N turns. The spiral has inner radius a and outer radius b. The spiral lies in the xy-plane and a steady current I flows through the wire. The$z$-component of the magetic field at the centre of the spiral is



A. $\dfrac{\mu_0 NI}{2(b-a)} In\left(\dfrac{b}{a}\right)$

B. $\dfrac{\mu_0 NI}{2(b-a)} In\left(\dfrac{b+a}{b-a}\right)$

C. $\dfrac{\mu_0 NI}{2b} In\left(\dfrac{b}{a}\right)$

D. $\dfrac{\mu_0 NI}{2b} In\left(\dfrac{b+a}{b-a}\right)$

Answer: A

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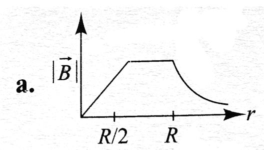
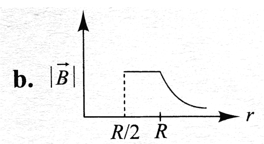
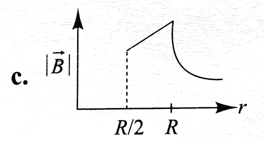
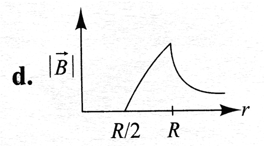
13. An infinitely long hollow conducting cylinder with inner radius $\frac{R}{2}$ and outer radius R carries a uniform current density along its length . The magnitude of the magnetic field , $\left|\overrightarrow{B}\right|$ as a function of the radial distance r from the axis is best represented by

A. 

B. 

C. 

D. 

Answer: D

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Archives (multiple Correct)

1. A steady current I flows along an infinitely long hollow cylindrical conductor of radius R. This cylinder is placed coaxially inside an infinite solenoid of radius

$2R$. The solenoid has a n turns per unit length and carries a steady current I. Consider a point p at a distance r from the common axis . The correct statement(s) is (are)

A. In the region $0 < r < R$, the magnetic field is non-zero

B. In the region $R < r < 2R$, the magnetic field is along the common axis.

C. In the region $R < r < 2R$, the magnetic field is tangential to the circle of radius r, centred on the axis.

D. In the region $r > 2R$, the magnetic field in non-zero.

Answer: A::D

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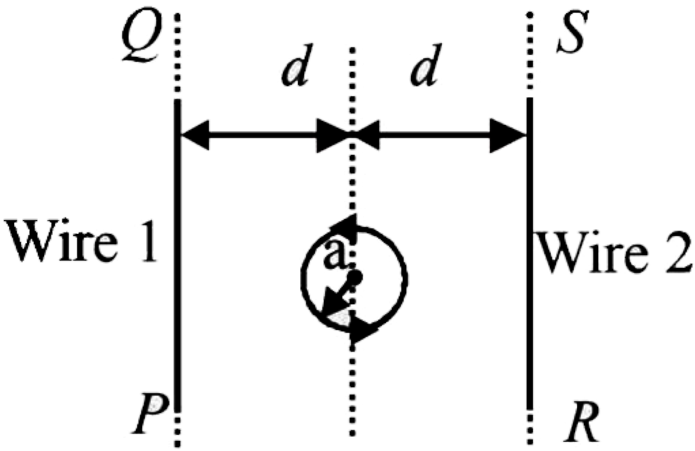
Archives (linked Comprehension)

1. The figure shows a circular loop of radius a with two long parallel wires $(\nu mbered 1 \text{ and } 2)$ all in the plane of the paper . The distance of each wire from the centre of the loop is d. The loop and the wire are carrying the same current I. The current in the loop is in the counterclockwise direction if seen from above.

(q) The magnetic fields(B) at P due to the currents in the wires are in opposite directions.

(r) There is no magnetic field at P.

(s) The wires repel each other.



(4) When $d \approx a$ but wires are not touching the loop , it is found that the net magnetic field on the axis of the loop at a height h above the loop is zero. In that case

A. current in wire 1 and wire 2 is the direction PQ and SR, respectively and $h \approx a$

B. current in wire 1 and wire 2 is the direction PQ and SR, respectively and $h \approx a$

C. current in wire 1 and wire 2 is the direction PQ and SR, respectively and $h \approx 1.2a$

D. current in wire 1 and wire 2 is the direction PQ and RS, respectively and $h \approx 1.2a$

Answer: C

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2. The figure shows a circular loop of radius a with two long parallel wires $(\nu mbered 1 \text{ and } 2)$ all in the plane of the paper . The distance of each wire from the centre of the loop is d. The loop and the wire are carrying the same current I. The current in the loop is in the counterclockwise direction if seen from above.

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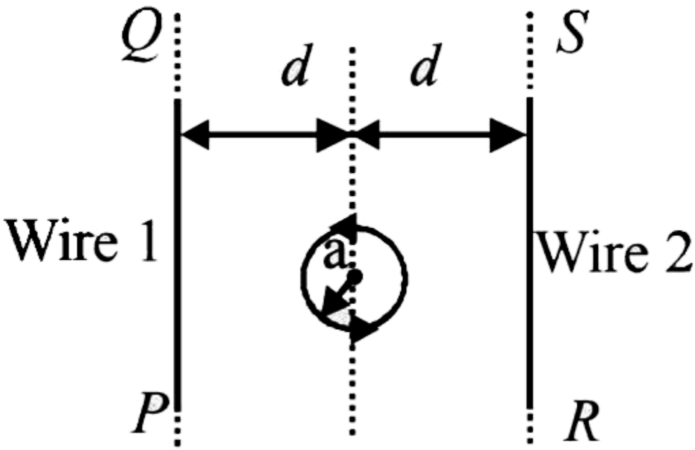


(5) Consider $d >> a$, and the loop is rotated about its diameter parallel to the wires by 30° from the

position shown in the figure. If the currents in the wire are in the opposite directions, the torque on the loop at its new position will be (assume that the net field due to the wires is constant over the loop).

A. $\frac{\mu_0 I^2 a^2}{d}$

B. $\frac{\mu_0 I^2 a^2}{2d}$

C. $\frac{\sqrt{3}\mu_0 I^2 a^2}{d}$

D. $\frac{\sqrt{3}\mu_0 I^2 a^2}{2d}$

Answer: B

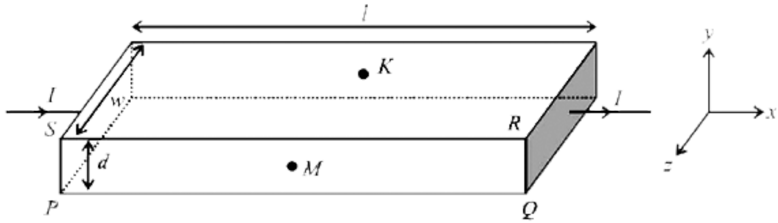
Watch Video Solution

3. In a thin rectangular metallic strip a constant current I flows along the positive $x-direction$, as shown in the figure. The length , width and thickness of the strip are l, w and d, respectively.

A uniform magnetic field $\overrightarrow{B}$ is applied on the strip along the positive $y-direction$. Due to this, the charge carriers experience a net deflection along the $z-direction$. This results in accumulation of charge carriers on the surface $PQRS$ ansd apperance of equal and opposite charges on the face opposite to $PQRS$. A potential difference along the $z-direction$ is thus developed. Charge accumulation contiues untill the magnetic force is balanced by the electric force. The current is assumed to be uniformly distributed on the cross- section of the strip and carried by electrons.

Consider two different metallic strips $(1 \text{ and } 2)$ of the same material . Their lengths are the same,widths are $w_1 \text{ and } w_2$ and thickness are $d_1 \text{ and } d_2$ respectively. Two points $K \text{ and } M$ are symmetrically located on the opposite faces parallel to the $x-y$ plane (see figure) . $V_1 \text{ and } V_2$ are the potential differences between $K \text{ and } M$ in strips $1 \text{ and } 2,$ respectively . Then, for a given current I flowing through them in a given magnetic field strength $B,$

the correct statement(s) is (are)



A. If $w_1 = w_2$ and $d_1 = 2d_2$, $then V_2 = 2V_1$

B. If $w_1 = w_2$ and $d_1 = 2d_2$, $then V_2 = V_1$

C. If $w_1 = 2w_2$ and $d_1 = d_2$, $then V_2 = 2V_1$

D. If $w_1 = 2w_2$ and $d_1 = d_2$, $then V_2 = V_1$

Answer: A::D

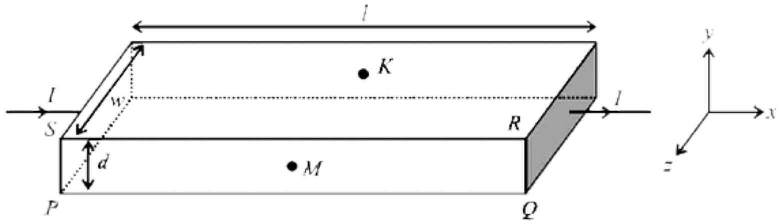
Watch Video Solution

4. In a thin rectangular metallic strip a constant current I flows along the positive x-direction , as shown in the figure. The length , width and thickness of the strip are l, w and d, respectively.

A uniform magnetic field $\overrightarrow{B}$ is applied on the strip along the positive $y-direction$. Due to this, the charge carriers experience a net deflection along the $z-direction$. This results in accumulation of charge carriers on the surface $PQRS$ ansd apperance of equal and opposite charges on the face opposite to $PQRS.$ A potential difference along the $z-direction$ is thus developed. Charge accumulation contiues untill the magnetic force is balanced by the electric force. The current is assumed to be uniformly distributed on the cross- section of the strip and carried by electrons.

Consider two different metallic strips $(1 \text{ and } 2)$ of same dimensions n_1 and n_2, repectrively . Strip 1 is placed in magnetic field B_1 and strip 2 is placed in magnetic field B_2 , both along positive $y - directions$. Then V_1 and V_2 are the potential differences developed between K and M in strips 1 and 2 , respectively . Assuming that the current I is the same for both the strips, the correct option(s) is

(are)



A. If $B_1 = B_2$ and $n_1 = 2n_2, then V_2 = 2V_1$

B. If $B_1 = B_2$ and $n_1 = 2n_2, then V_2 = V_1$

C. If $B_1 = 2B_2$ and $n_1 = 2n_2, then V_2 = 0.5V_1$

D. If $B_1 = 2B_2$ and $n_1 = 2n_2, then V_2 = V_1$

Answer: A::C

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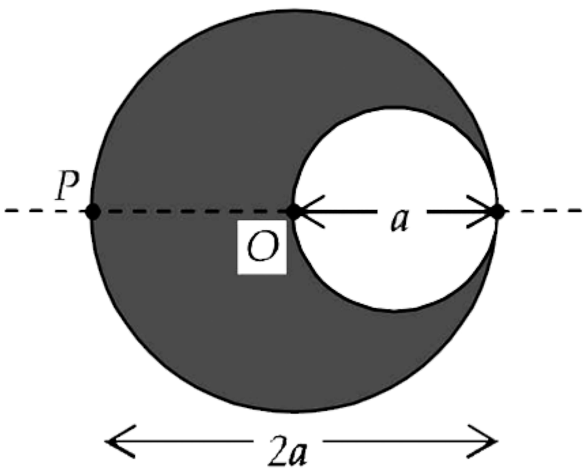
Archives (integer)

1. A cylindrical cavity of diameter a exists inside a cylinder of diameter $2a$ as shown in the figure. Both the cylinder and the cavity are infinitity long. A uniform current density j flows along the length . If the magnitude of the magnetic field at the point P is given by $\frac{N}{12}\mu_0 Ja$, then the value of N is



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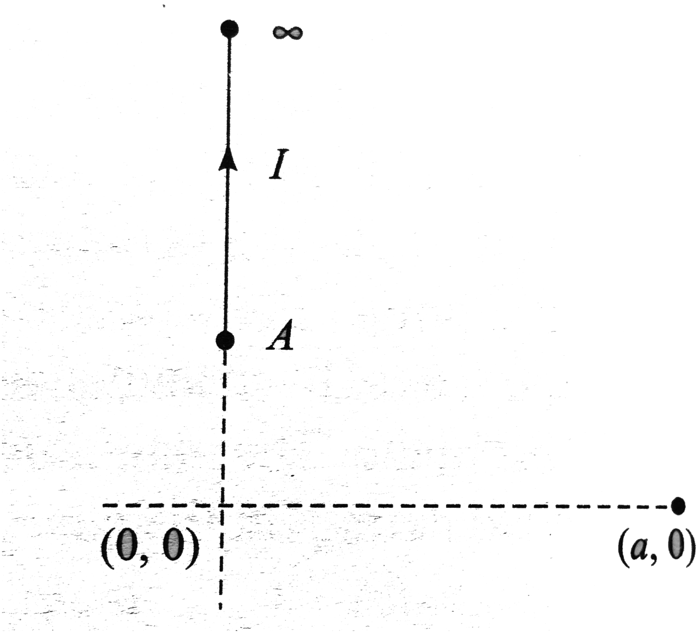
Subjective type

1. An infinitely long wire carrying current I is along Y-axis such taht its one end is at point A(0,b) while the wire extends upto $+\infty$. The magnitude of magnetic field strength at point (a,0) is



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2. Two long wires PQR and MNP carry equal current I as shown such that QR and NP are parallel. Find the magnetic field at origin O.

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3. Figure shows two current segment . The lower segment carries a current of $i_1 = 0.40A$ and includes a semicircular arc with radius 5.0 cm, angle 180° , and center point P The upper segment carries current $i_2 = 2i_1$ and includes a circular arc with radius 4.0 cm, angle 120° and the same center point P. What are the (a) magnitude and (b) direction of the net magnetic field $\vec{B}$ at P for the indicated current directions?

A.

B.

C.

D.

Answer: $1.7 \times 10^{-6} T$ **(b) into the page. (c)** 6.7×10^{-6}**T (d) into the page.**

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4. A current is set up in a wire loop consiting of a semicircle of radius 4.00 cm, a smaller concentric semicircle, and two radial straight lengths , all in the plane . Figure (a) shows the arrangment but is not drawn to scale. The magnitude of the magnetic field produced at the center of curvature si 74.25 μT . The smaller semicircle is then flipped over (rotated) until the loop is again entirely in the same plane figure (b). The magnetic field produced at the (same) center of curvature now has magnitude 15.75 μT and its direction is reversed from the initial magnetic field. What is the radius of the smaller semicircle?

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5. In the figure two inifinitely long wires carry equal currents i. Each follows a 90° arc on the circumference of the same circle of radius R. Show that the magnetic field $\overrightarrow{B}$ at the center of the same as the field $\overrightarrow{B}$ a distance R below on infinite straight wire carrying a current i to the left.

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6. The current-carrying wire loop in Fig (a) lies all in one plane and consists of a semicle of radius 10.0 cm, a smaller semicicle is rotated out of that plkane by angle θ until it is perpendicular to the plane [Fig.(b)]. Figure (c) gives the magnitude of the net magnetic field at the center of curvature versus angle θ . what os the radius of the smaller semicircle ?

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7. A circular coil is in $y - z$ plane with centre at origin. The coil is carrying a constant current. Assuming direction of magnetic field at $x = -25cm$ to be positive direction of magnetic field, which of the following graphs shows variation of magnetic field along x-axis

A.

B.

C.

D.

Answer: (a) -2.5×10^{-6} **T.m. (b) The value of** $\oint \vec{B} . dx$ **depends only on the current enclosed ,and not the shape of the Amperian loop.**

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8. The current density $\bar{J}$ inside a long, solid cylindrical wire of radius $a = 12mm$ is in the direction of the central axis, and its magnitude varies linearly with radial distance r from the axis according to $J = \frac{J_0 r}{a}$, where $J_0 = \frac{10^5}{4\pi} A/m^2$. Find the magnitude of the magnetic field at $r = \frac{a}{2}$ in μT

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9. the below figure shown two closed paths wrapped around two conducting loops carrying currents $i_1 - 5.0A$ and $i_2 = 3.0A$. Whar is the value of the integal $\oint \vec{B} . d \vec{s}$ for (a) path a 1and d(b) path (2) ?

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10. Each of the eight conductors in the below figure carries 2.0 A of current into or out of the page . Two paths are indicated for the line integal $\oint \vec{B} . d \vec{s}$. What is the value of the integal for (a) path 1 and (b) path 2 ?

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single correct Answer Type

1. A and B are two conductors carrying a currwnt i in same direction x and y are two electron beams moving in the same direction .there will be

A. AB

B. CD

C. Segment OB only of line AB

D. Segment OC only of line CD

Answer: A

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2. Two parallel beams of protons and electrons, carrying equal currents are fixed at a separation d. The protons and electrons move in opposite directions. P is a point on a line joining the beams , at a distacne x from any one beam. The magnetic field at P is B . If B is plotted against x, which of the following best represents the resulting curve

A.

B. `##DPP_PHY_MEI_2_1_E01_099_O02.png"

width="30%">

C.

D.

Answer: C

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3. A straight section PQ of a circuit lies along the x-axis from $x = -\frac{a}{2}$ to $x = \frac{a}{2}$ and carries a steady current i. The magnetic field due to the section PQ at a point x =+a will be

A. proportional to a

B. proportional to a^2

C. proportional to 1/a

D. zero

Answer: D

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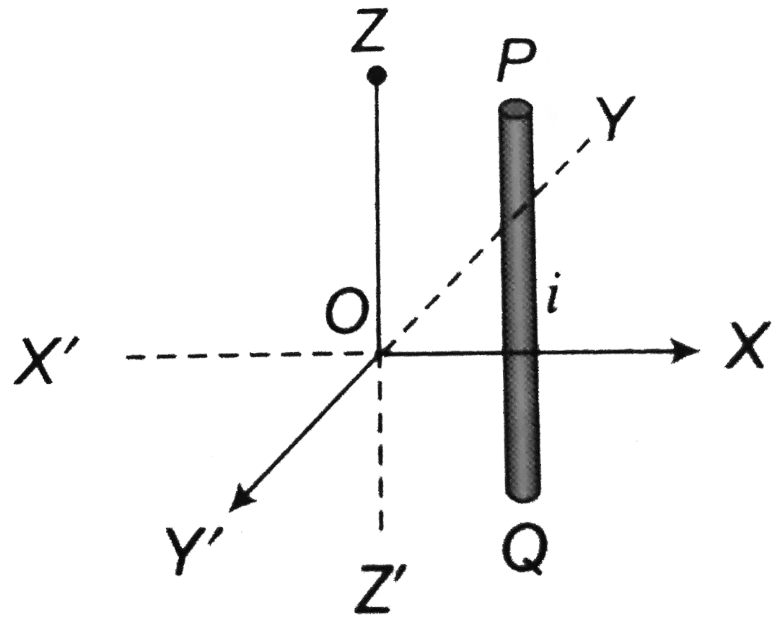
4. A vertical wire kept in $Z-X$ plane carries a current from Q to P (see figure). The magnetic field due to current will have the direction at the origin O

along



A. OX

B. OX'

C. OY

D. OY'

Answer: D

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5. A long straight wire carrying current of $30A$ is placed in an external unifrom magnetic field of induction $4 \times 10^4 T$. The magnetic field is acting parallel to the direction of current. The maggnetic of the resultant magnetic inuduction in tesla at a point $2.0cm$ away form the wire is

A. 10^4

B. 3×10^{-4}

C. 5×10^{-4}

D. 6×10^{-4}

Answer: C

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6. A current i is flowing in a straight conductor of length L. The magnetic induction at a point distant $\frac{L}{4}$ from its centre will be-

A. $\frac{4\mu_0 i}{\sqrt{5}\pi L}$

B. $\frac{\mu_0 i}{2\pi L}$

C. $\frac{\mu_0 i}{\sqrt{2}L}$

D. zero

Answer: A

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7. Two parallel long wire carry currents i_1 and i_2 with $i_1 > i_2$. When the currents are in the same direction , the magnetic field midway between the wires is $10\mu T$. When the direction of i_2 is reversed, it becomes $40\mu T$. The ratio i_1 / i_2 is

A. $3:4$

B. $11:7$

C. $7:11$

D. $5:3$

Answer: D

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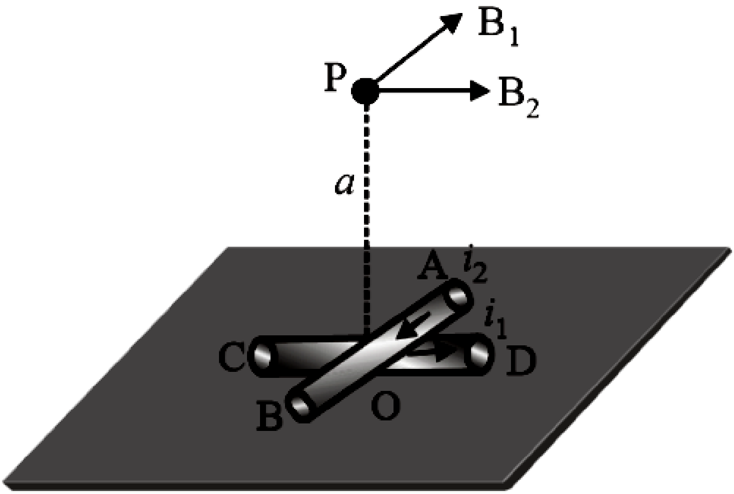
8. The straight long conductors AOB and COD are perpendicular to each other and carry current i_1 and i_2. The magnitude of the magnetic induction at point P at a distance a from the point O in a direction perpendicular to the plane ACBD is



A. $\frac{\mu_0}{2\pi a}(i_1 + i_2)$

B. $\frac{\mu_0}{2\pi a}(i_1 - i_2)$

C. $\frac{\mu_0}{2\pi a}\left(l_1^2 + i_2^2\right)^{1/2}$

D. $\frac{\mu_0}{2\pi a}\frac{i_1 i_2}{i_1 + i_2}$

Answer: C

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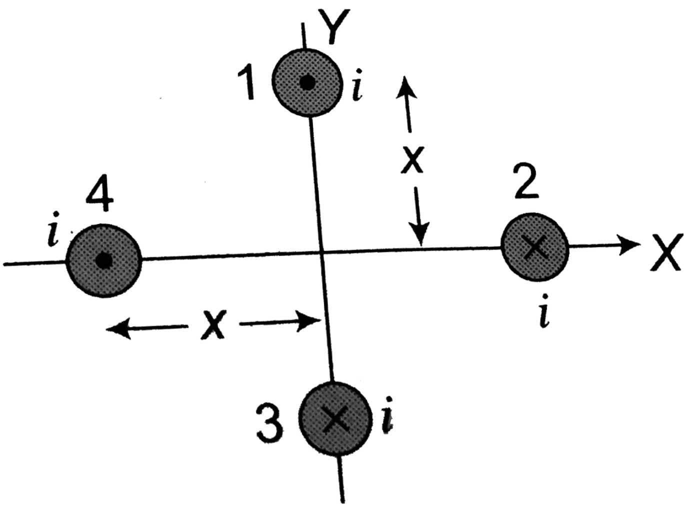
9. What will be the resulatant field at the origin due to the four indinite length wires if each wire produces magnetic field B at origin ?



A. 4 B

B. $\sqrt{2}B$

C. $2\sqrt{2}B$

D. zero

Answer: C

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10. AB and CD are long straight conductor, distance d apart, carrying a current I. The magnetic field at the midpoint of BC is

A. $\frac{-\mu_0 I}{2\pi d}\hat{k}$

B. $\frac{-\mu_0 I}{\pi d}\hat{k}$

C. $\frac{-\mu_0 I}{4\pi d}\hat{k}$

D. $\frac{-\mu_0 I}{8\pi d}\hat{k}$

Answer: B

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11. Consider the following figure in which ABCD is a square of edge a .Resistance of the wires ABC is R_0 and that of ADC $2R_0$.Find magnitude and direction of magnetic field at the centre O of the square

A. $\frac{\sqrt{2}\mu_0 i}{3\pi a}\odot$

B. $\frac{\sqrt{2}\mu_0 i}{3\pi a}\otimes$

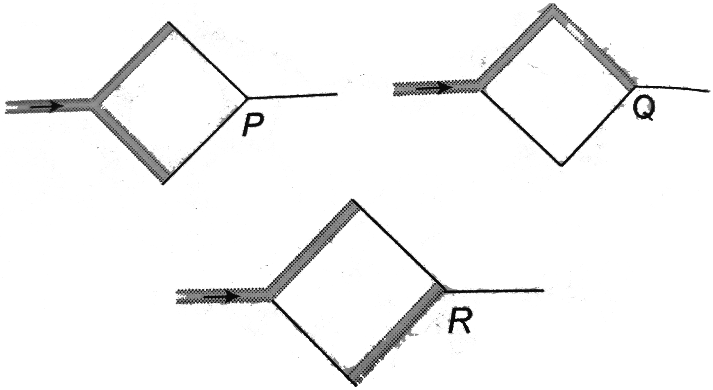
C. $\dfrac{\sqrt{2}\mu_0 i}{\pi a} \odot$

D. $\dfrac{\sqrt{2}\mu_0 i}{\pi a} \otimes$

Answer: B

Watch Video Solution

12. Two thick wires and two thin wires, all of the same materais and same length from a square in the three differenct ways, P, Q and R as shwon in figure with current connection shown, the magneitc feidl at the centre of the square is zero in cases.



A. In p only

B. In P and Q only

C. In Q and R only

D. P and R only

Answer: D

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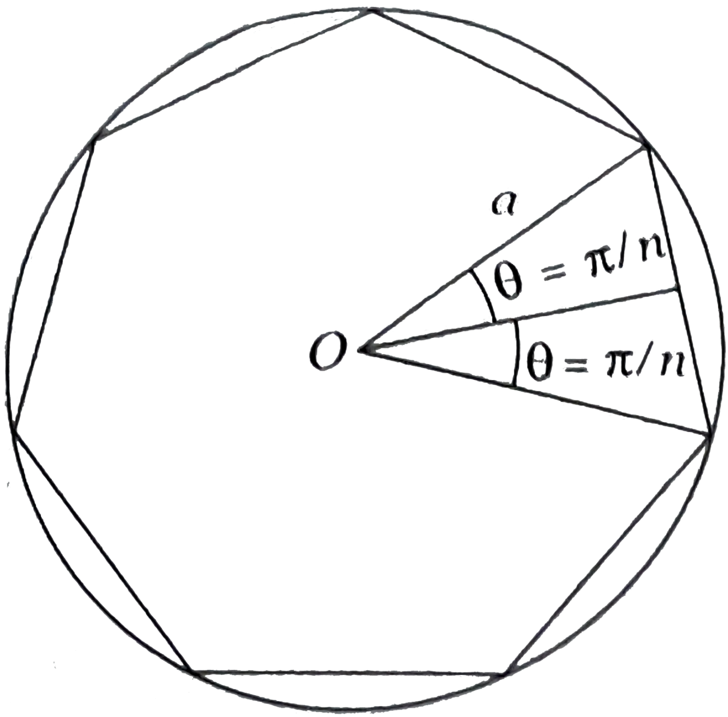
13. A wire bent in the form of a regular polygon of n sides, is inscribed in a circle of radius a. If I ampere is the current flowing in the wire, then the magnetic field at the centre of the circle is



A. $\frac{\mu_0 i}{2\pi a} \tan \frac{\pi}{n}$

B. $\dfrac{\mu_0 ni}{2\pi a}\tan\dfrac{\pi}{n}$

C. $\dfrac{2}{\pi}\dfrac{ni}{a}\mu_0\tan\dfrac{\pi}{n}$

D. $\dfrac{ni}{2a}\mu_0\tan\dfrac{\pi}{n}$

Answer: B

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14. A coil carrying a heavy current and having large number of turns mounted in a N-S vertical plane and current flow in clockwise direction. A small magnetic needle at its center will have its north pole in

A. East -north direction

B. West-north direction

C. East-south direction

D. West-south direction

Answer: B

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15. An electron is revolving round a proton, producing a magnetic field of $16 weber / m^2$ in a circular orbit of radius 1 Å. Its angular velocity will be

A. 10^{17} rad/sec

B. $1/2\pi \times 10^{12}$ rad/sec

C. $2\pi \times 10^{12}$ rad/sec

D. $4\pi \times 10^{12}$ rad/sec

Answer: A

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16. A thin wire of length l is carrying a constant current. The wire is bent to form a circular coil. If radius of the coil, thus formed, is equal to R and number of turns in it is equal to n, then which of the following graphs represent (s) variation of magnetic field induction (B) at centre of the coil

A.

B.

C.

D.

Answer: B::C

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17. A neutral point is obtained at the centre of a vertical circular coil carrying current. The angle between the plane of the coil and the magnetic meridian is

A. 0

B. 45°

C. 60°

D. 90°

Answer: D

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18. Two concentric coplanar circular loops of radii r_1 and r_2 carry currents of respectively i_1 and i_2 in opposite direction (one clockwise and the other anticlockwise). The magnetic induction at the centre of the loops is half that due to i_1 alone at the centre.

if $r_2 = 2r_1$. the value of i_2 / i_1 is

A. 2

B. $1/2$

C. $1/4$

D. 1

Answer: D

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19. Two similar coils are kept mutually perpendicular such that their centres coincide. At the centre, find the ratio of the magnetic field due to one coil and the resultant magnetic field by both coils, if the same current is flown

A. $1:\sqrt{2}$

B. $1:2$

C. $2:1$

D. $\sqrt{3}:1$

Answer: A

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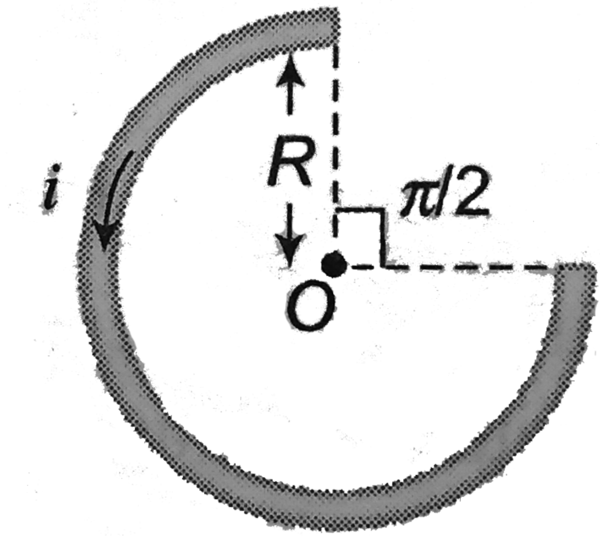
20. A current i ampere flows in a circular arc of wire whose radius is R, which subtend an angle $3\pi/2$ radian at its centre. The magnetic induction B at the centre is



A. $\dfrac{\mu_0 i}{R}$

B. $\dfrac{\mu_0 i}{2R}$

C. $\frac{2\mu_0 i}{R}$

D. $\frac{3\mu_0 i}{8R}$

Answer: D

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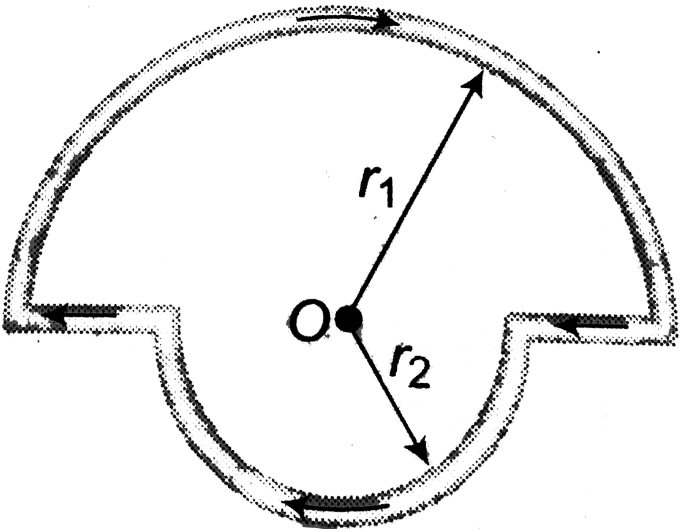
21. In the figure shown there are two semicircles of radii r_1 and r_2 in which a current i is flowing. The magnetic induction at the centre O will be



A. $\frac{\mu_0 i}{r}(r_1 + r_2)$

B. $\frac{\mu_0 i}{4}(r_1 - r_2)$

C. $\frac{\mu_0 i}{4}\left(\frac{r_1 + r_2}{r_1 r_2}\right)$

D. $\frac{\mu_0 i}{4}\left(\frac{r_2 - r_1}{r_1 r_2}\right)$

Answer: C

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22. Find magneitc field at O

A. $\frac{5\mu_0 i\theta}{24\pi r}$

B. $\frac{\mu_0 i\theta}{24\pi r}$

C. $\frac{11\mu_0 i\theta}{24\pi r}$

D. zero

Answer: A

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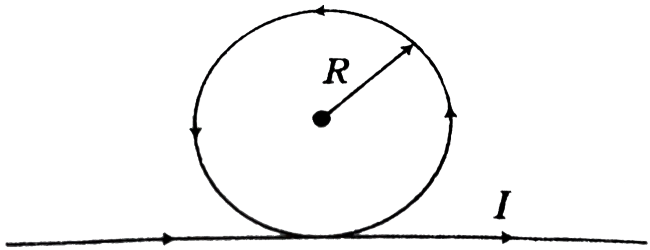
23. An infinitely long conductor is bent into a circle as shown in figure. It carries a current I ampere and the radius of loop is R metre. The magnetic induction at the centre of loop is



A. $\frac{\mu_0}{4\pi}\frac{2i}{r}(\pi+1)$

B. $\frac{\mu_0}{4\pi}\frac{2i}{r}(\pi-1)$

C. zero

D. Infinite

Answer: B

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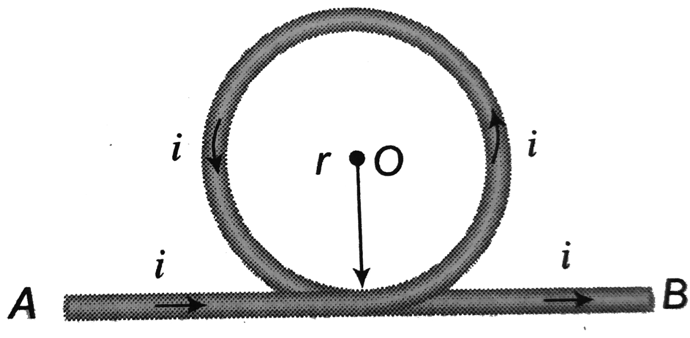
24. A part of a long wire carrying a current i is bent into a circle of radius r as shown in figure. The net magnetic field at the centre O of the circular loop is



A. $\frac{\mu_0 i}{4r}$

B. $\frac{\mu_0 i}{2r}$

C. $\frac{\mu_0 i}{2\pi r}(\pi + 1)$

D. $\frac{\mu_0 i}{2\pi r}(\pi - 1)$

Answer: C

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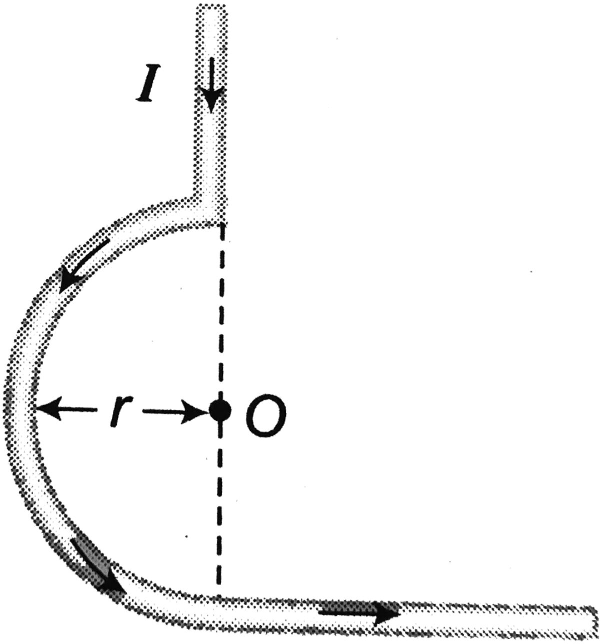
25. In the figure, what is the magnetic field at the point O?



A. $\frac{\mu_0 I}{4\pi r}$

B. $\frac{\mu_0 I}{4\pi r} + \frac{\mu_0 I}{2\pi r}$

C. $\frac{\mu_0 I}{4r} + \frac{\mu_0 I}{4\pi r}$

D. $\frac{\mu_0 I}{4\pi} - \frac{\mu_0 I}{4\pi r}$

Answer: C

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26. A circular current carrying coil has a radius R. The distance from the centre of the coil on the axis where the magnetic induction will be $\frac{1}{8}$ th to its value at the centre of the coil, is

A. $\frac{R}{\sqrt{3}}$

B. $R\sqrt{3}$

C. $2\sqrt{3}R$

D. $\frac{2}{\sqrt{3}}R$

Answer: C

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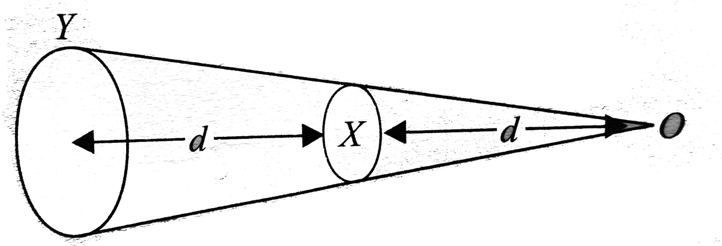
27. Two circular coils X and Y, having equal number of turns and carrying currents in the same sense, subtend same solid angle at point O. If the smaller coil X is midway between O and Y and if we represent the magnetic induction due to bigger coil Y at O as B_y and the due to smaller coil X at O as B_x,then find the ratio $B_x \,/\, B_y$.



A. $\dfrac{B_y}{B_x} = 1$

B. $\frac{b_y}{B_x} = 2$

C. $\frac{B_y}{B_x} = \frac{1}{2}$

D. $\frac{B_y}{B_x} = \frac{1}{4}$

Answer: B

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28. The field normal to the plane of a wire of n turns and radis r which carriers i is measured on the axis of the coil at a small distance h from the centre of the coil. This is smaller than the field at the centre by the fraction.

A. $\frac{3h^2}{2r^2}$

B. $\frac{2h^2}{3r^2}$

C. $\frac{3r^2}{3h^2}$

D. $\frac{2r^2}{3h^2}$

Answer: A

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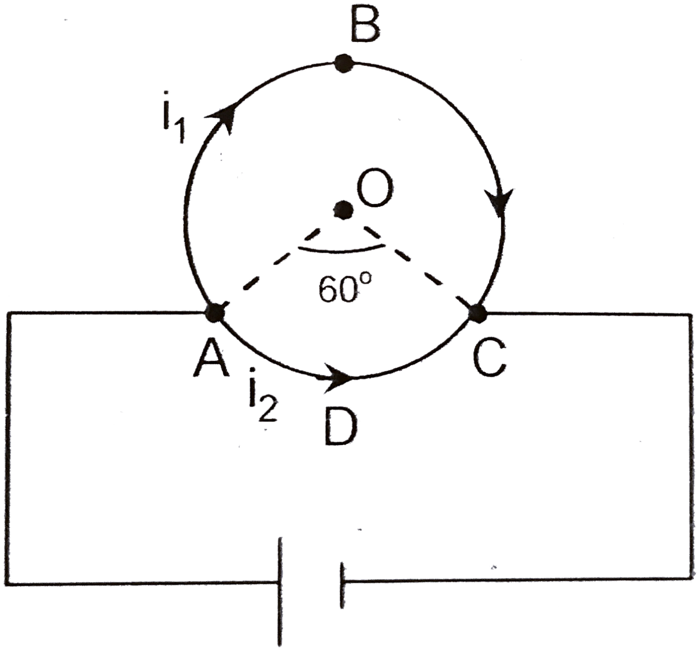
29. A cell is connected between the point A and C of a circular conductor ABCD of centre O, $\angle AOC = 60^\circ$. If B_1 and B_2 are the magnitude of magnetic fields at O due to the currents in ABC and ADC respectively, the ratio of B_1 / B_2 is.



A. 0.2

B. 6

C. 1

D. 5

Answer: C

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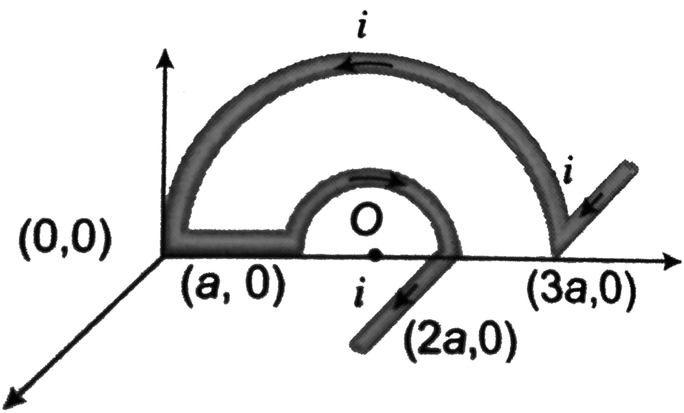
30. In the given figure net magnetic at O will be



A. $\dfrac{2\mu_0 i}{3\pi a}\sqrt{4-\pi^2}$

B. $\dfrac{\mu_0 i}{3\pi a}\sqrt{4+\pi^2}$

C. $\dfrac{2\mu_0 i}{3\pi a}\sqrt{4+\pi^2}$

D. $\frac{2\mu_0 i}{3\pi a}\sqrt{(4+\pi^2)}$

Answer: D

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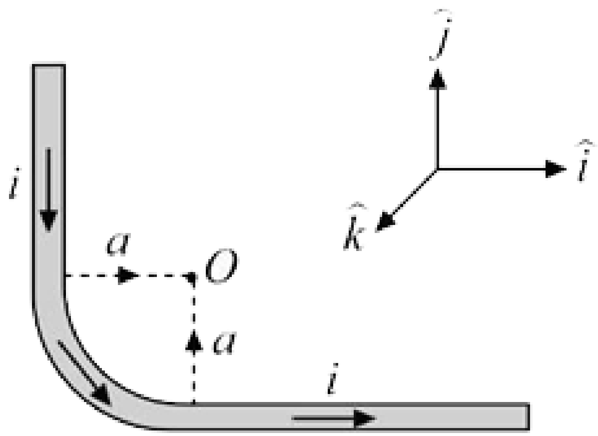
31. The unit vectors $\hat{i}$, $\hat{j}$ and $\hat{k}$ are as shown below.

What will be the magnetic field at O in the following



figure?

A. $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2-\frac{\pi}{2}\right)\hat{j}$

B. $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{j}$

C. $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{i}$

D. $\frac{\mu_0}{4\pi}\frac{i}{a}\left(2+\frac{\pi}{2}\right)\hat{k}$

Answer: B

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32. A staright wire of length (π^2) meter is carrying a current of $2A$ and the magnetic field due to it is measured at a point distant $1cm$ from it. If the wire is to be bent into a circles and is to carry the same current as before, the ratio of the magnetic field at its centre to that obtained in the first case would be

A. $50 : 1$

B. $1 : 50$

C. $100 : 1$

D. $1 : 100$

Answer: D

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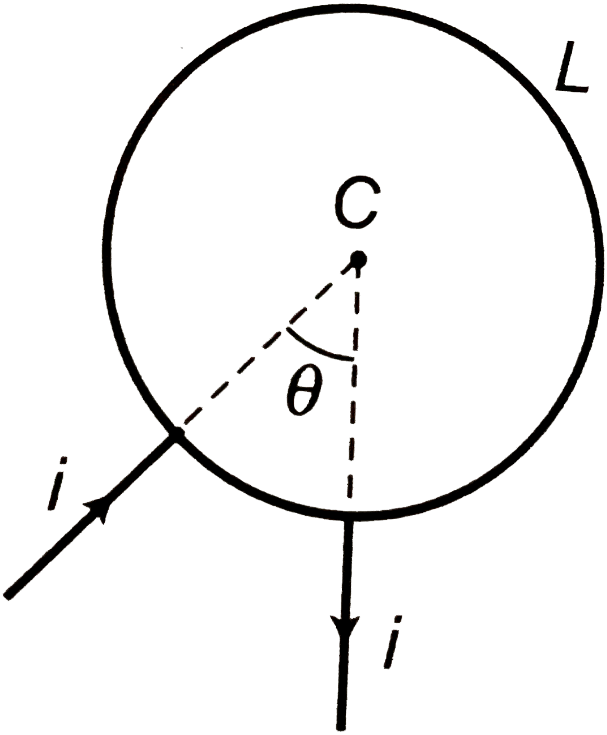
33. L is a circular ring made of a uniform wire, currents enters and leaves the ring through straight conductors which, if produces, would have passed through the centre C of ring. The magnetic field at C



(i) due to the straight conductors is zero

(ii) due to the loop is zero

(iii) due to the loop is proportional to θ

(iv) due to loop is proportional to $(\pi - \theta)$

A. due to the straight conductors is zero

B. due to the loop is zero

C. due to path II is proportional to θ.

D. due to the path I is proportional $(\pi - \theta)$

Answer: B

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34. Two circular coils X and Y, having equal number of turns, carry equal currents in the same sence and subtent same solid angle at point O if the smaller coil, X is midway between O and Y then if we represent the magnetic iduction due to bigger coil Y as B_y and that due to smaller coil X at O as B_x then

A. $B_1 > B_2$

B. $B_1 < B_2$

C. $\frac{B_1}{B_2} = 2$

D. $\frac{B_1}{B_2} = \frac{1}{2}$

Answer: C::D

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35. Figure shows a long wire bent at the middle to from a right angle

A. The magnitude of magnetic field at the points P, Q, R and S are same.

B. The direction of magneitc field at points P and S are same

C. The magnitude of magnetic field at points P and S is zero

D. The direction of magnetic field at points R and S are opposite to each other.

Answer: B::C

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single correct Ansewer type

1. Three distinct current wires intersect a finite rectangular plane ABCD. The current is left wire and the loop is l_1 . The direction of current in left most wire and righy most loop is downards as shown in the figure. The current $l_2$through middle wire is adjusted so that the path integal of the total magnetic field along the perimeter of the rectangle is zero , that is ,

$$\oint_{ABCDA} \vec{B} . d\vec{s} = 0$$ then the current I_2 is

A. $2l_1$ and upwards

B. $2l_1$ and downwards

C. $4l_1$ and upwords

D. $3l_1$ and downwards

Answer: C

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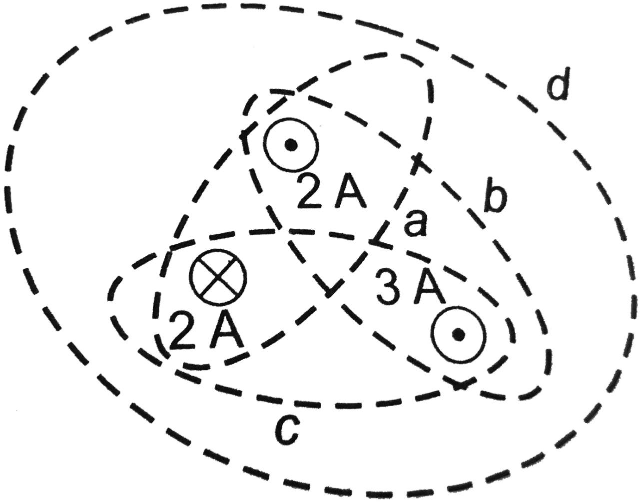
2. Rank the value of $\oint \vec{B} \vec{dl}$ for the closed paths shown in figure from the smallest to largest.



A. a,b,c,d

B. a,c,b,d,

C. a,d,c,d

D. a,c,b,d

Answer: B

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3. Eight wires cut the page perpendicularly at the points shown in figure . A wire labeled with the integer k(k=1.2.....80 carries the current ki, where i=2A . For those wires with odd k, the current is out of the page . For those with even k, it is into the page. the value of $\oint \vec{B} \, . \, d\vec{s} = 0$ along the closed path indicated and in the direaction shown.

A. $10\mu_0$

B. $5\mu_0$

C. $15\mu_0$

D. $20\mu_0$

Answer: A

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4. A long thin hollow metallic cylinder of radius R has a current I ampere. The magnetic induction B away from the axis at a distance r from the axis varies as shown in

A.

B.

C.

D.

Answer: A

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5. A coaxial cable made up of two conductors. The inner conductor is solid and is of radius R_1 and the outer conductor is hollow of inner radius R_2 and outer radius R_3. The space between the conductors is filled with air. The inner and outer conductors are carrying currents of equal magnitudes and in opposite directions. Then the variation of magnetic field with distance from the axis is best plotted as

A.

B.

C.

D.

Answer: C

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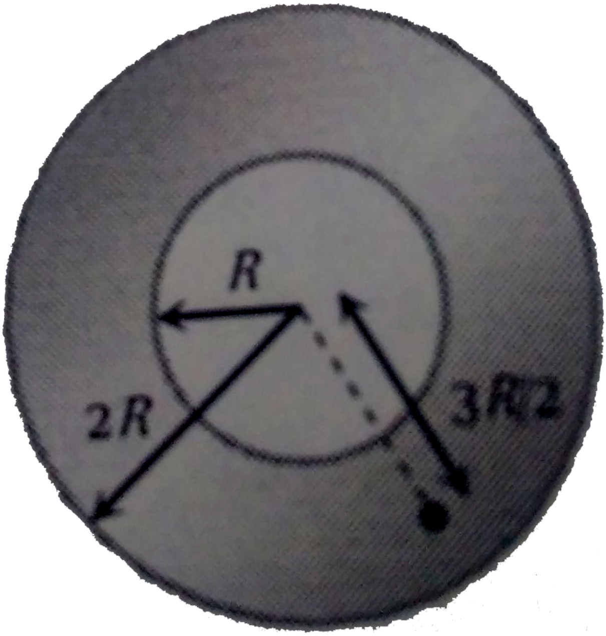
6. Figure shows the cross-sectional view of the hollow cylindrical conductor with inner radius $'R'$ and outer radius $'2R'$, cylinder carrying uniformly distributed current along it's axis. The magnetic induction at point $'P'$ at a distance $\frac{3R}{2}$ from the axis of the cylinder will be



A. zero

B. $\dfrac{5\mu_0 i}{72\pi R}$

C. $\dfrac{7\mu_0 i}{18\pi R}$

D. $\dfrac{5\mu_0 i}{36\pi R}$

Answer: D

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7. A current I ampere flows along the inner conductor of a co-axial cable and returns along the outer conductor of the cable , then the magnetic induction at any point outside the conductor at a distance r metre from the axis is

A. ∞

B. zero

C. $\frac{\mu_0}{4\pi}\frac{2i}{r}$

D. $\frac{\mu_0}{4\pi}\frac{2\pi i}{r}$

Answer: B

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8. From a cylinder of radius R, a cyclinder of radius R/2 is removed, as shown . Current flowing in the remaning cylinder is I. magnetic field strength is :

A. zero at point A

B. zero at point B

C. $\frac{\mu_0 I}{3\pi R}$ at point A

D. $\frac{\mu_0 I}{3\pi R}$ at point B

Answer: D

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9. A winding wire which is used to frame a solenoid can bear a maximum 10 A. current If length of solenoid is 80 cm and its corss sectional raedius is 3 cm , then required length of winding wire is (B =0.2T)

A. 1.2×10^2m

B. $4.8 \times 10^2 m$

C. $2.4 \times 10^3 m$

D. $6 \times 10^3 m$

Answer: C

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10. A cylindrical conductor of radius $'R'$ carries a current $'i'$. The value of magnetic field at a point which is $R/4$ distance inside from the surface is $10T$. Find the value of magnetic field at point which is $4R$ distance outside from the surface

A. $\frac{4}{3}T$

B. $\frac{8}{3}T$

C. $\frac{40}{3}T$

D. $\frac{80}{3}T$

Answer: B

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11. Two coaxil solenoids 1 and 2 of the same length are set so that one is inside the other. The number of turns per unit length are n_1 and n_2. The current i_1 and i_2 are flowing in opposite directions. The magnetic field inside the inner coil is zero. This is possible when

A. $i_1 \neq i_2$ and $n_1 n_2$

B. $i_1 = i_2$ and $n_1 \neq n_2$

C. $i_1 = i_2$ and $n_1 = n_2$

D. $i_1 = n_2$ and $i_1 n_2$

Answer: C::D

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12. Two identical current carrying coaxial hoops, carry current I in an opposite sense. A simple amperian loop passes through both of them once. Calling the loop as C,

A. $\oint B.\,dl = \mu_0 I$

B. the value of $\oint B.\,dl = \pm 2\mu_0 I$ is independent of sense of C.

C. there mat be a point on C where, B and dI are perpendicular

D. B vanishes everywhere on C.

Answer: B::C

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