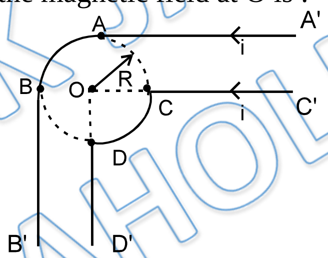
DPP – 1

Q 1. Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that 'O' is their common point for the two. The wires carry I_1 and I_2 currents, respectively. Point P is lying at distance 'd' from 'O' along a direction perpendicular to the plane containing the wires. The magnetic field at the point 'P' will be :

(a) $\frac{\mu_0}{2\pi d}\left(\frac{I_1}{I_2}\right)$ (b) $\frac{\mu_0}{2\pi d}(I_1 + I_2)$

(c) $\frac{\mu_0}{2\pi d}(I_1^2 - I_2^2)$ (d) $\frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{1/2}$

Q 2. All straight wires are very long. Both AB and CD are arcs of the same circle, both subtending right angles at the centre O. Then the magnetic field at O is :



(a) $\frac{\mu_0 i}{4\pi R}$ (b) $\frac{\mu_0 i}{4\pi R}\sqrt{2}$

(c) $\frac{\mu_0 i}{2\pi R}$ (d) $\frac{\mu_0 i}{2\pi R}(\pi + 1)$

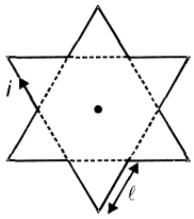
Q 3. A long, straight wire carries a current along the Z-axis. One can find two points in the X-Y plane such that
(a) the magnetic fields are equal
(b) the directions of the magnetic fields are the same
(c) the magnitudes of the magnetic fields are equal
(d) the field at one point is opposite to that at the other point

Q 4. A straight wire carries a current. Assume that all free electrons in the conductor move with the same drift velocity v. A and B are two observers on a straight line xy parallel to the conductor. A is stationary, B moves along xy with a velocity v in the direction of the free electrons. At any point outside wire
(a) A and B observe the same magnetic field
(b) A observes a magnetic field, B does not
(c) A and B observe magnetic fields of the same magnitude but opposite directions
(d) A and B do not observe any electric field

Q 5. A current loop consists of two identical semicircular parts each of radius R, one lying in the x-y plane and the other in x-z plane. If the current in the loop is i. The resultant magnetic field due to the two semicircular parts at their common centre is

(a) $\frac{\mu_0 i}{2\sqrt{2}R}$ (b) $\frac{\mu_0 i}{2R}$ (c) $\frac{\mu_0 i}{4R}$ (d) $\frac{\mu_0 i}{\sqrt{2}R}$

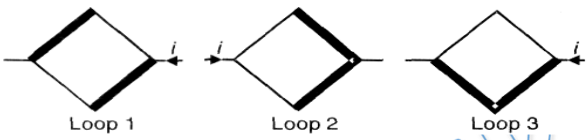
Q 6. A star shaped loop (with l = length of each section) carries current i. Magnetic field at the centroid of the loop is



(a) $\frac{3\mu_0 i}{\pi l}$ (b) $\frac{3\mu_0 i}{2\pi l}$

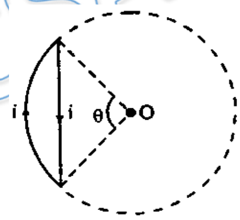
(c) $\frac{\mu_0 i}{\pi l}(3-\sqrt{3})$ (d) $\frac{\mu_0 i}{\pi l}(3+\sqrt{3})$

Q 7. Consider three different square loops made of aluminium wires. Relative thicknesses of the wires used to construct the loops are shown in the figure. Magnetic field



(a) At the centre of only loop 1 is zero
(b) At the centre of loops 1 and 2 is zero
(c) At the centre of all loops is zero
(d) At the centre of loop 3 is directed up

Q 8. Net magnetic field at the centre of the circle O due to a current carrying loop as shown in figure is ($\theta < 180°$):



(a) zero
(b) perpendicular to paper inwards
(c) perpendicular to paper outwards
(d) is perpendicular to paper inwards if $\theta \le 90°$ and perpendicular to paper outwards if $90° \le \theta < 180°$

Q 9. A nonconducting disc of radius R is rotating about an axis passing through its centre and perpendicular to its plane with an angular velocity ω. Charge q is uniformly distributed over its surface. The magnetic field at centre is:

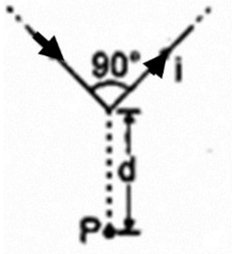
(a) $\frac{\mu_0 q\omega}{2\pi R}$ (b) $\frac{\mu_0 q\omega}{8\pi R}$ (c) $\frac{\mu_0 q\omega}{4R}$ (d) $\frac{\mu_0 q\omega}{8R}$

Q 10. Same current i is flowing in three infinitely long wires along positive x, y and z directions. The magnetic field at a point (0, 0, - a) would be:

(a) $\frac{\mu_0 i}{2\pi a}(\hat{j}-\hat{i})$ (b) $\frac{\mu_0 i}{2\pi a}(\hat{i}+\hat{j})$

(c) $\frac{\mu_0 i}{2\pi a}(\hat{i}-\hat{j})$ (d) $\frac{\mu_0 i}{2\pi a}(\hat{i}-\hat{j}+\hat{k})$

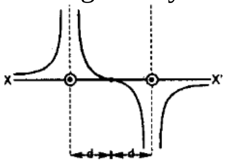
Q 11. Find the magnetic field at P due to the arrangement shown:



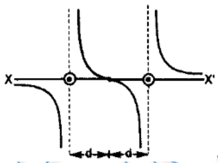
(a) $\frac{\mu_0 i}{\sqrt{2}\pi d}\left(1-\frac{1}{\sqrt{2}}\right)\otimes$ (b) $\frac{2\mu_0 i}{\sqrt{2}\pi d}\otimes$

(c) $\frac{\mu_0 i}{\sqrt{2}\pi d}\otimes$ (d) $\frac{\mu_0 i}{\sqrt{2}\pi d}\left(1+\frac{1}{\sqrt{2}}\right)\otimes$

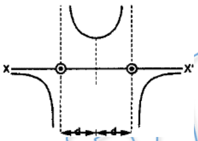
Q 12. Two long parallel wires are at a distance 2d apart. They carry steady equal currents flowing out of the plane of the paper as shown. The variation of the magnetic field B along the line XX is given by:



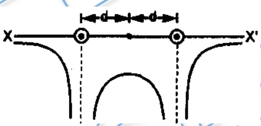
(a)



(b)



(c)



(d)

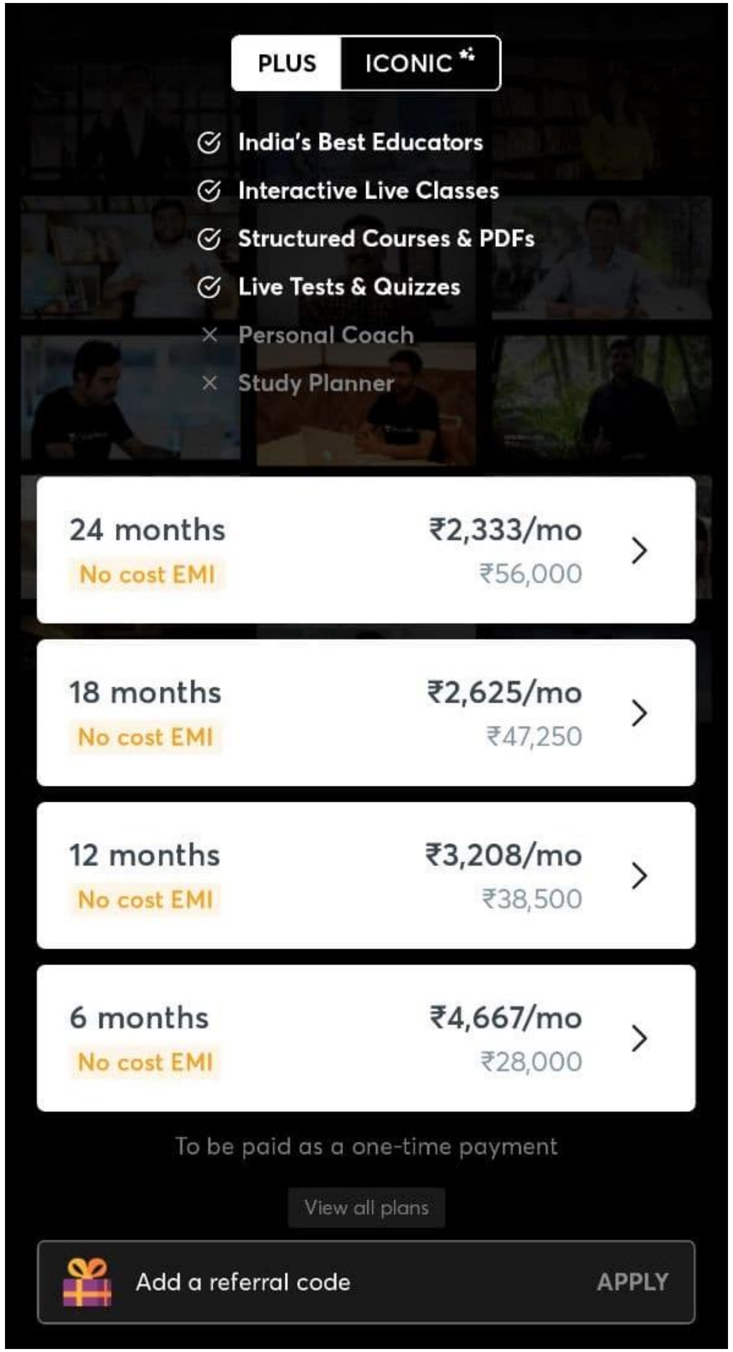
Q 13. A coil having N turns Is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When a current I passes through the coil, the magnetic field at the centre is:

(a) $\frac{\mu_0 NI}{b}$ (b) $\frac{2\mu_0 NI}{a}$

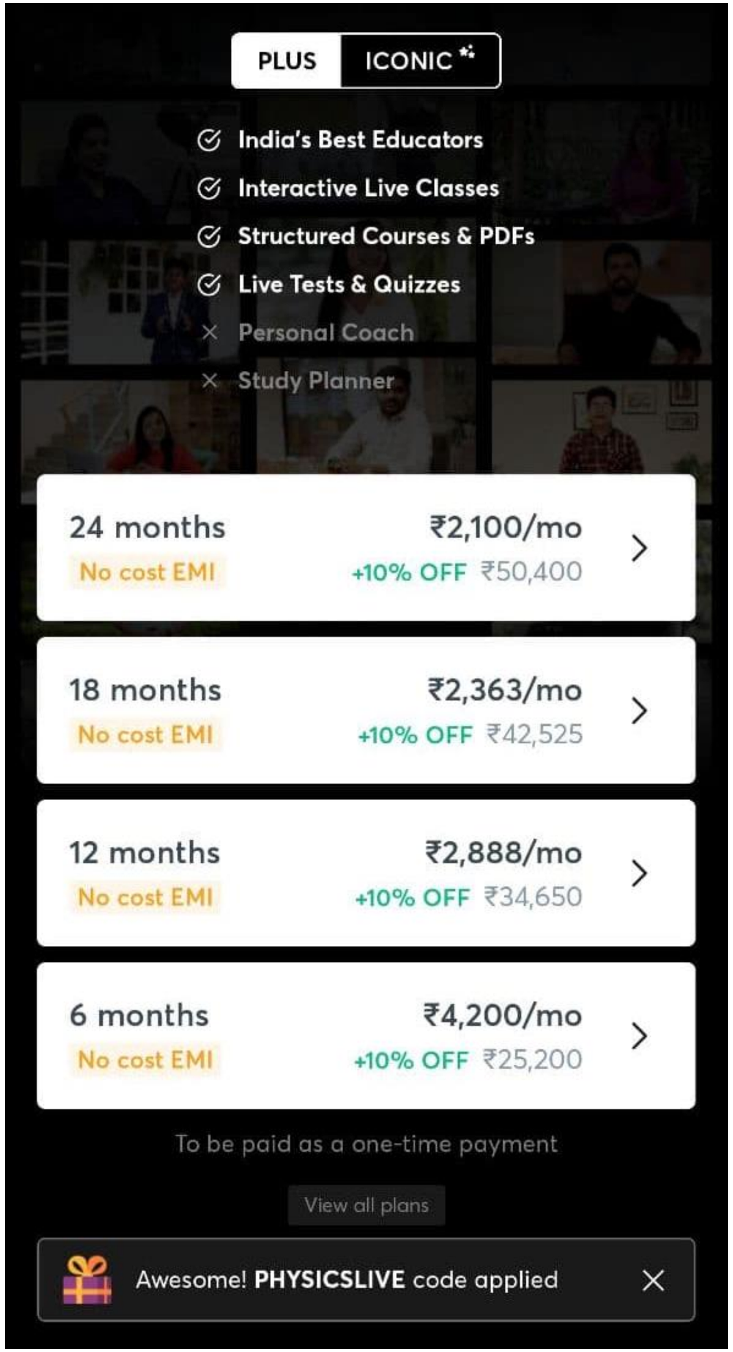
(c) $\frac{\mu_0 NI}{2(b-a)} In\frac{b}{a}$ (d) $\frac{2\mu_0 I^N}{2(b-a)} In\frac{b}{a}$

Answer Key

Q.1 d	**Q.2 c**	**Q.3 b,c,d**	**Q.4 a,d**	**Q.5 a**
Q.6 c	**Q.7 b,d**	**Q.8 c**	**Q.9 a**	**Q.10 a**
Q.11 a	**Q.12 b**	**Q.13 c**		



PHYSICSLIVE



Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.

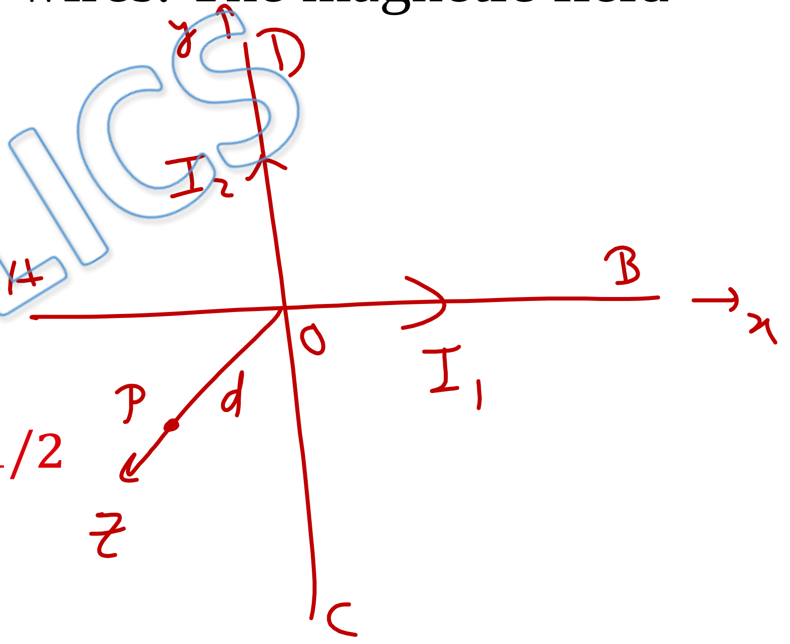
Written Solution

DPP- 1, Magnetic Field and Force : Biot Sevart Law

By Physicsaholics Team

Q 1) Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that 'O' is their common point for the two. The wires carry I_1 and I_2 currents, respectively. Point P is lying at distance 'd' from 'O' along a direction perpendicular to the plane containing the wires. The magnetic field at the point 'P' will be :

$$\vec{B}_{AB} = \frac{\mu_0 I_1}{2\pi d}(-\hat{k})$$



(a) $\frac{\mu_0}{2\pi d}\left(\frac{I_1}{I_2}\right)$

(b) $\frac{\mu_0}{2\pi d}(I_1 + I_2)$

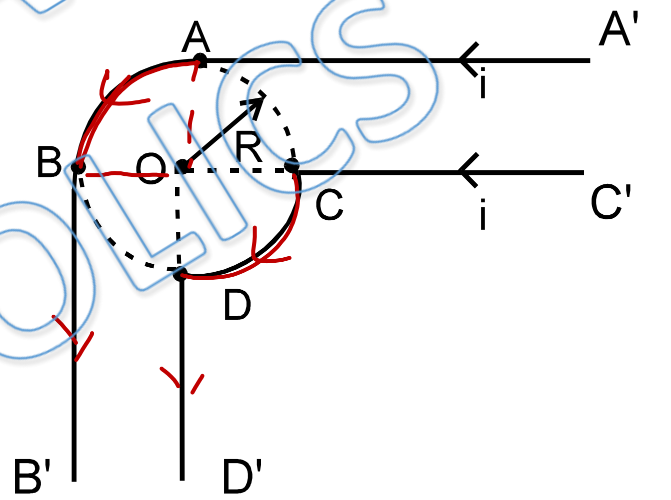
(c) $\frac{\mu_0}{2\pi d}(I_1^2 - I_2^2)$

(d) $\frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{1/2}$

$$\vec{B}_{CD} = \frac{\mu_0 I_2}{2\pi d}(\hat{i})$$

$$\vec{B} = \frac{\mu_0}{2\pi d}\left[I_2\hat{i} - I_1\hat{k}\right] = \frac{\mu_0}{2\pi d}\sqrt{I_2^2 + I_1^2}$$

Q 2) All straight wires are very long. Both AB and CD are arcs of the same circle, both subtending right angles at the centre O. Then the magnetic field at O is :



Net field due to Circular wires = 0

(a) $\frac{\mu_0 i}{4\pi R}$

(b) $\frac{\mu_0 i}{4\pi R}\sqrt{2}$

(c) $\frac{\mu_0 i}{2\pi R}$

(d) $\frac{\mu_0 i}{2\pi R}(\pi+1)$

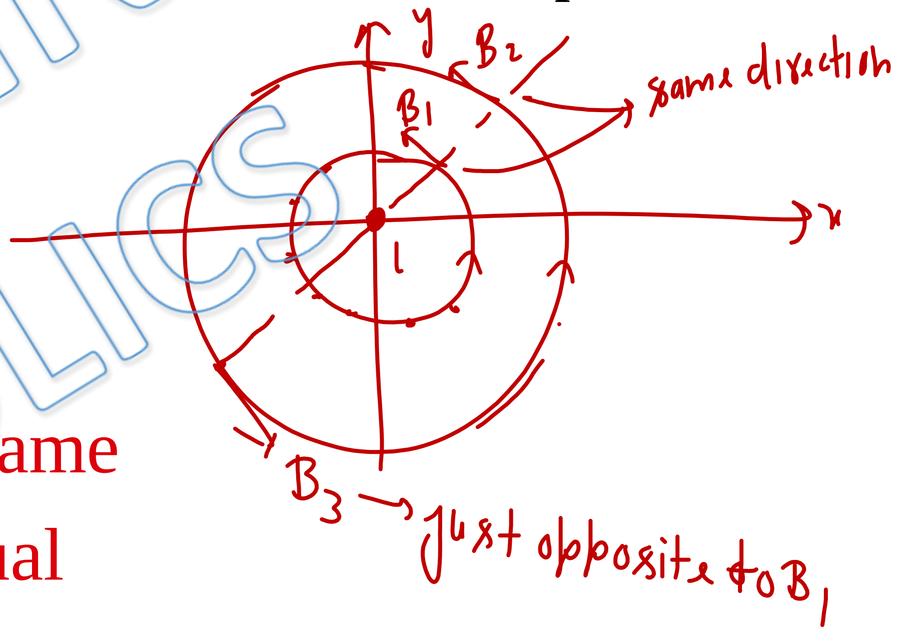
$B_{AA'} = \frac{\mu_0 i}{4\pi R} \odot$, $B_{BB'} = \frac{\mu_0 i}{4\pi R} \odot$

$B_{CC'} = B_{DD'} = 0$

$B_{net} = \frac{\mu_0 i}{2\pi R} \odot$

Q 3) A long, straight wire carries a current along the Z-axis. One can find two points in the X-Y plane such that

$B = \frac{\mu_0 I}{2\pi r}$



(a) the magnetic fields are equal

(b) the directions of the magnetic fields are the same

(c) the magnitudes of the magnetic fields are equal

(d) the field at one point is opposite to that at the other point

Q 4) A straight wire carries a current. Assume that all free electrons in the conductor move with the same drift velocity v. A and B are two observers on a straight line xy parallel to the conductor. A is stationary, B moves along xy with a velocity v in the direction of the free electrons. At any point outside wire

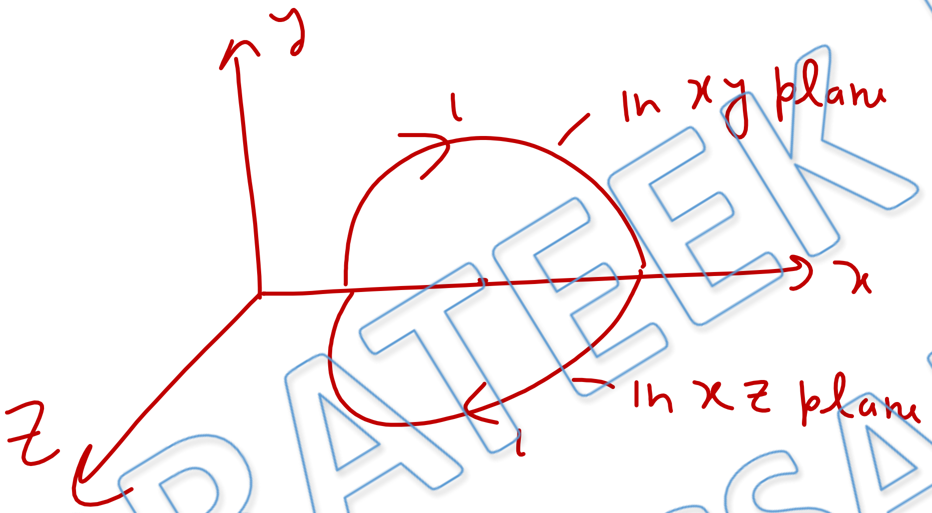
(a) A and B observe the same magnetic field

(b) A observes a magnetic field, B does not

(c) A and B observe magnetic fields of the same magnitude but opposite directions

(d) A and B do not observe any electric field

Q 5) A current loop consists of two identical semicircular parts each of radius R, one lying in the x-y plane and the other in x-z plane. If the current in the loop is i. The resultant magnetic field due to the two semicircular parts at their common centre is



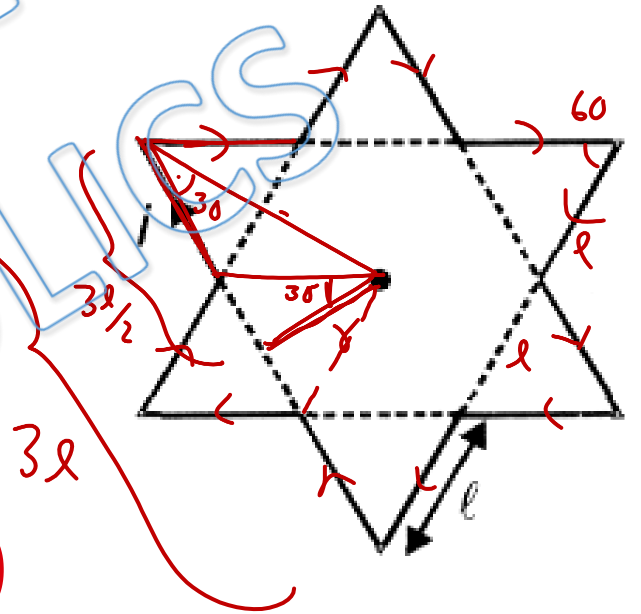
field due to semicircular loop

$$B = \frac{\mu_0 i}{4\pi R}$$

$$\vec{B} = \frac{\mu_0 i}{4\pi R}(-\hat{k} - \hat{j})$$

(a) $\frac{\mu_0 i}{2\sqrt{2}R}$ ✓ (b) $\frac{\mu_0 i}{2R}$ (c) $\frac{\mu_0 i}{4R}$ (d) $\frac{\mu_0 i}{\sqrt{2}R}$

Q 6) A star shaped loop (with l = length of each section) carries current i. Magnetic field at the centroid of the loop is



$\tan 60 = \sqrt{3} = \frac{3l}{2r}$

$r = \frac{3l}{2\sqrt{3}} = \frac{\sqrt{3}}{2} l$

$B = \frac{\mu_0 I}{4\pi\left(\frac{\sqrt{3}}{2} l\right)}\left(\frac{\sqrt{3}}{2} - \frac{1}{2}\right) \times 12$

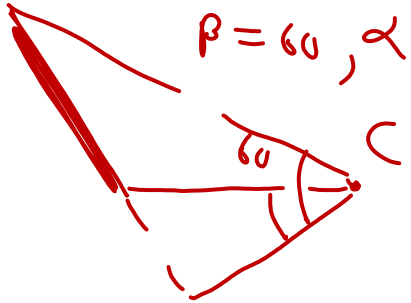
(a) $\frac{3\mu_0 i}{\pi l}$

(b) $\frac{3\mu_0 i}{2\pi l}$

(c) $\frac{\mu_0 i}{\pi l}(3-\sqrt{3})$ ✓

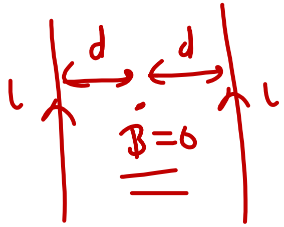
(d) $\frac{\mu_0 i}{\pi l}(3+\sqrt{3})$

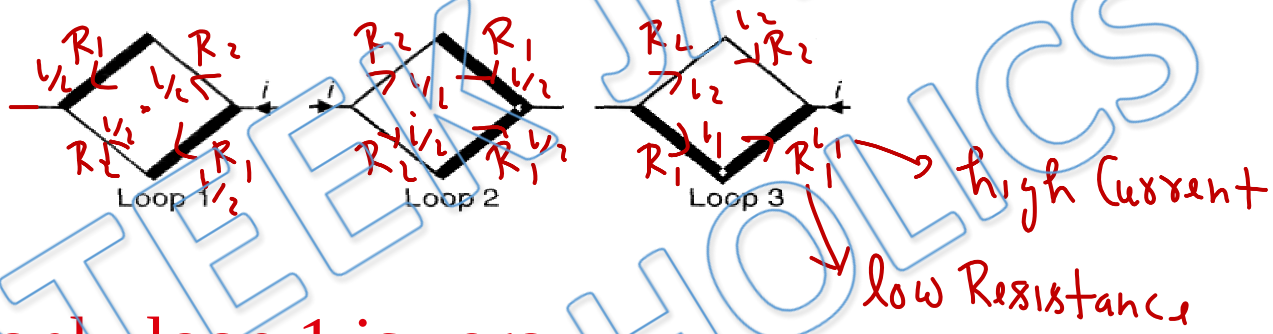
$= \frac{\mu_0 I}{4\pi \times 3l}(3-\sqrt{3}) \times 12$



$\beta = 60, \alpha = -30$

Q 7) Consider three different square loops made of aluminium wires. Relative thicknesses of the wires used to construct the loops are shown in the figure. Magnetic field





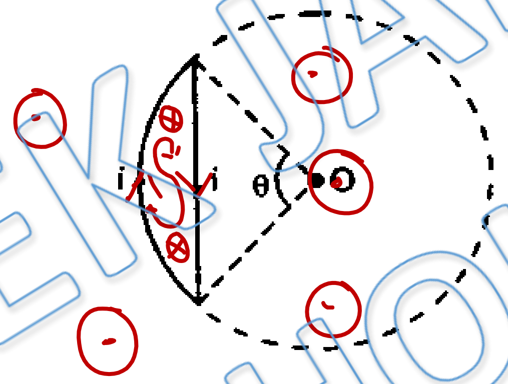
(a) At the centre of only loop 1 is zero

(b) At the centre of loops 1 and 2 is zero

(c) At the centre of all loops is zero

(d) At the centre of loop 3 is directed up

Q 8) Net magnetic field at the centre of the circle O due to a current carrying loop as shown in figure is (θ < 180°):



(a) zero

(b) perpendicular to paper inwards

(c) perpendicular to paper outwards

(d) is perpendicular to paper inwards if $\theta \leq 90°$ and perpendicular to paper outwards if $90° \leq \theta < 180°$

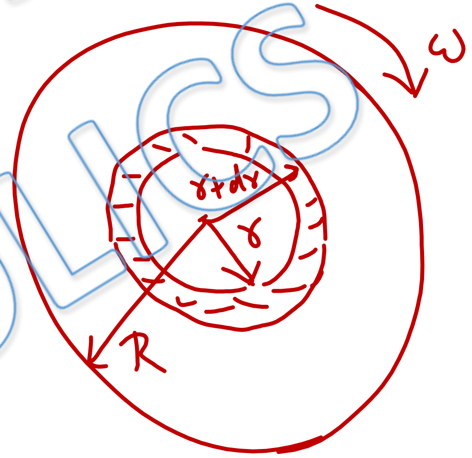
Q 9) A nonconducting disc of radius R is rotating about an axis passing through its centre and perpendicular to its plane with an angular velocity ω. Charge q is uniformly distributed over its surface. The magnetic field at centre is:

surface charge density $= \frac{q}{\pi R^2}$

dq = charge on differential ring $= \frac{q}{\pi R^2} \times 2\pi r\,dr$

effective current in ring $= \frac{dq\,\omega}{2\pi} = di$

$= \frac{q\omega r\,dr}{\pi R^2}$

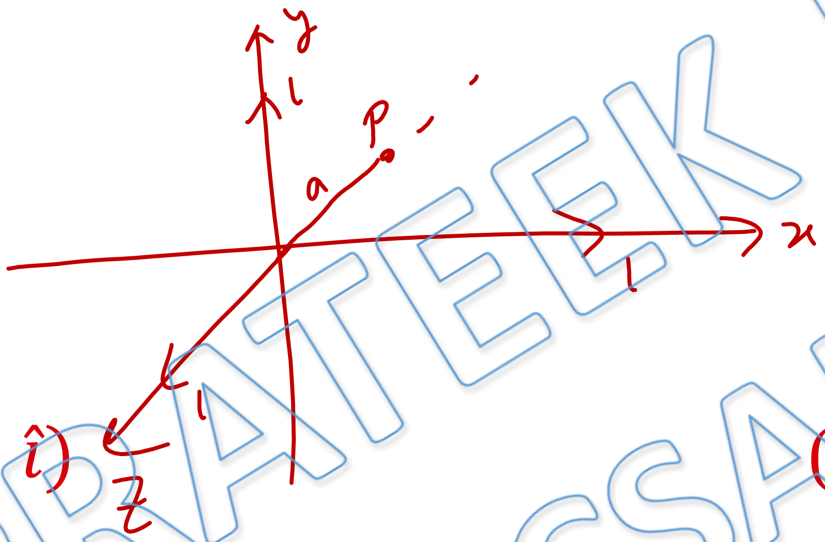


(a) $\frac{\mu_0 q\omega}{2\pi R}$ ✓ (b) $\frac{\mu_0 q\omega}{8\pi R}$ (c) $\frac{\mu_0 q\omega}{4R}$ (d) $\frac{\mu_0 q\omega}{8R}$

field at centre due to ring $= \frac{\mu_0\,di}{2r} = \frac{\mu_0}{2r} \times \frac{q\omega r\,dr}{\pi R^2}$

Net field $B = \frac{\mu_0 q\omega}{2\pi R^2}\int_0^R dr = \frac{\mu_0 q\omega}{2\pi R}$

Q 10) Same current i is flowing in three infinitely long wires along positive x, y and z directions. The magnetic field at a point (0, 0, - a) would be:



$\vec{B}$ due to current along x axis

$= \frac{\mu_0 i}{2\pi a}(\hat{j})$

$\vec{B}$ due to current along y axis

$= \frac{\mu_0 i}{2\pi a}(-\hat{i})$

(a) $\frac{\mu_0 i}{2\pi a}(\hat{j}-\hat{i})$ (b) $\frac{\mu_0 i}{2\pi a}(\hat{i}+\hat{j})$

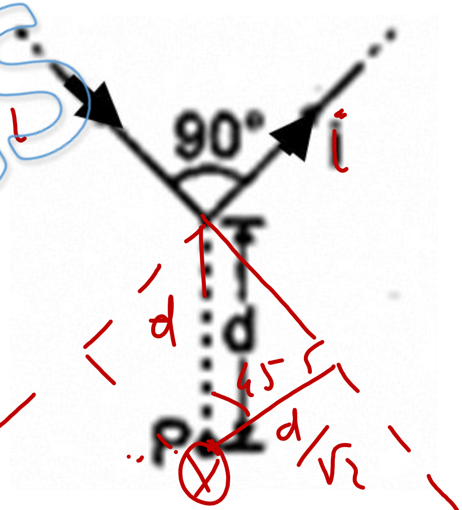
(c) $\frac{\mu_0 i}{2\pi a}(\hat{i}-\hat{j})$ (d) $\frac{\mu_0 i}{2\pi a}(\hat{i}-\hat{j}+\hat{k})$

Q 11) Find the magnetic field at P due to the arrangement shown:

$$B = \frac{\mu_0 i}{4\pi(d/\sqrt{2})}(\sin 90 - \sin 45^\circ) \times 2$$

$$= \frac{\mu_0 i}{4\pi d}\sqrt{2}\left(1 - \frac{1}{\sqrt{2}}\right) \times 2$$

$$= \frac{\mu_0 i}{\sqrt{2}\pi d}\left(1 - \frac{1}{\sqrt{2}}\right) \otimes$$

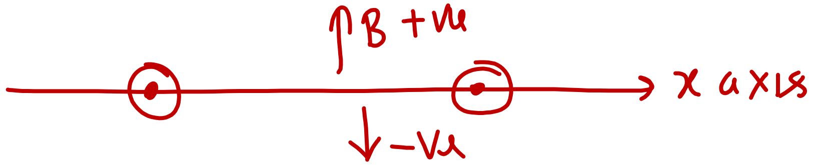


(a) $\frac{\mu_0 i}{\sqrt{2}\pi d}\left(1 - \frac{1}{\sqrt{2}}\right) \otimes$

(b) $\frac{2\mu_0 i}{\sqrt{2}\pi d} \otimes$

(c) $\frac{\mu_0 i}{\sqrt{2}\pi d} \otimes$

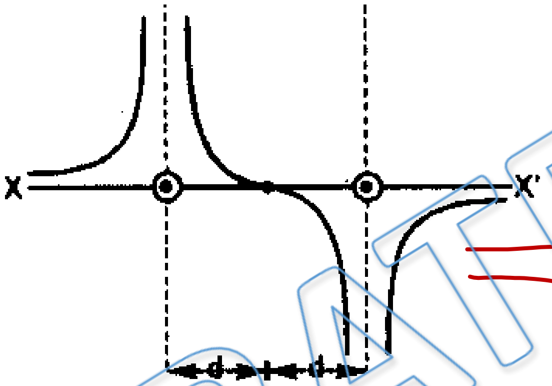
(d) $\frac{\mu_0 i}{\sqrt{2}\pi d}\left(1 + \frac{1}{\sqrt{2}}\right) \otimes$

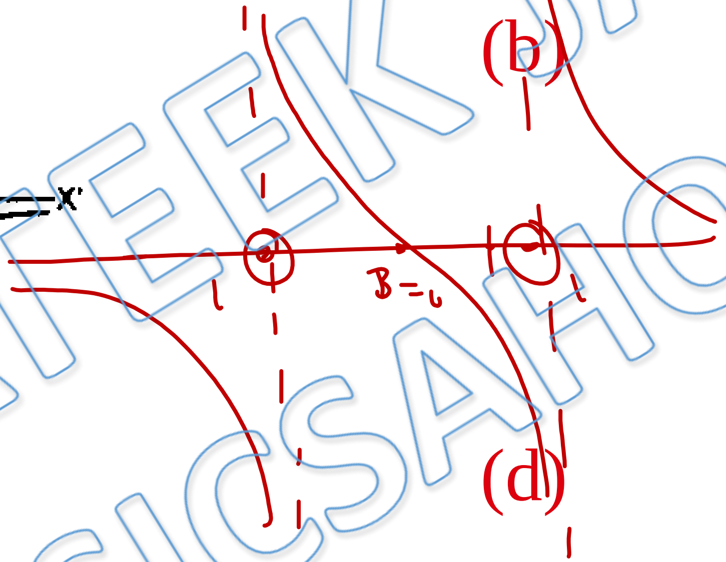


B due to one wire $= \frac{\mu_0 I}{2\pi r}$

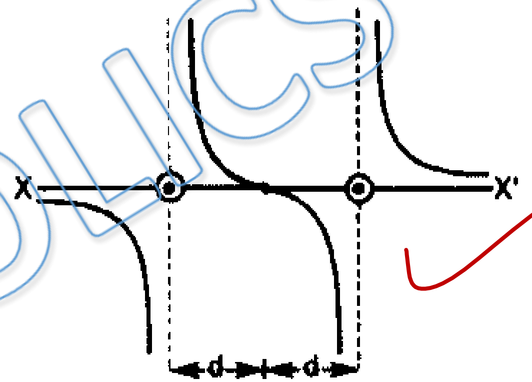
Q 12) Two long parallel wires are at a distance 2d apart. They carry steady equal currents flowing out of the plane of the paper as shown. The variation of the magnetic field B along the line XX is given by:

(a)

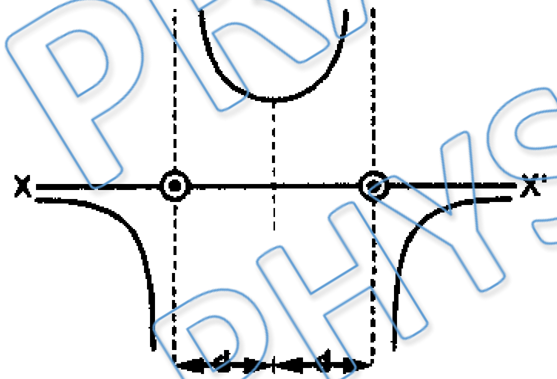




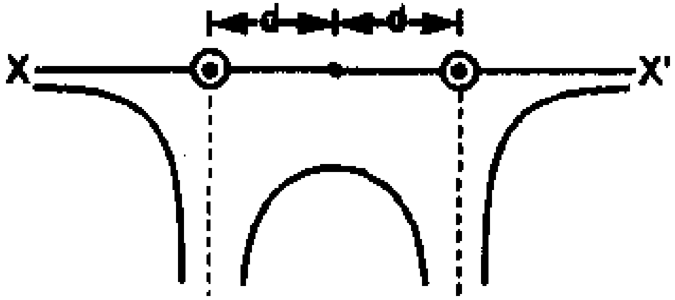
(b)



(c)



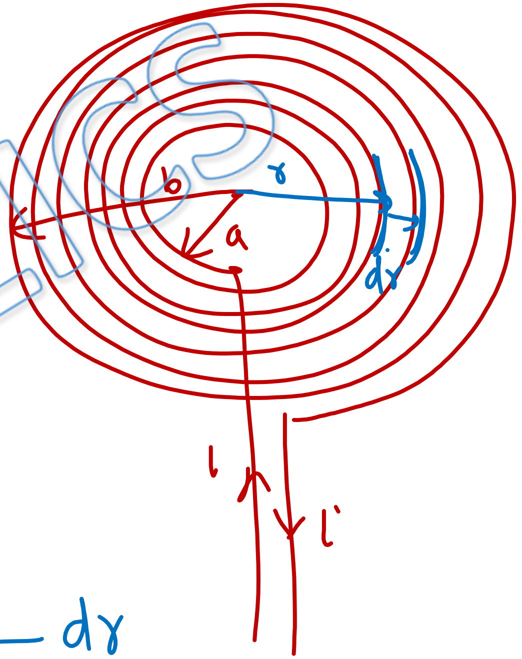
(d)



Q 13) A coil having N turns Is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When a current I passes through the coil, the magnetic field at the centre is:

no of turns in thickness dr

$$= \frac{N}{b-a} dr$$



(a) $\frac{\mu_0 NI}{b}$

(b) $\frac{2\mu_0 NI}{a}$

(c) $\frac{\mu_0 NI}{2(b-a)} In\frac{b}{a}$ ✓

(d) $\frac{2\mu_0 I^N}{2(b-a)} In\frac{b}{a}$

field due to ring dr $= \frac{\mu_0 I}{2r} \frac{N}{(b-a)} dr$

net field $= \frac{\mu_0 I N}{2(b-a)} \int_a^b \frac{dr}{r} = \frac{\mu_0 I N \ln(b/a)}{2(b-a)}$

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/97

Video Solution on YouTube:- https://youtu.be/uUEIIBlNgkA

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/51

Chalo Niklo