DPP – 1 (Magnetic Field & Force)

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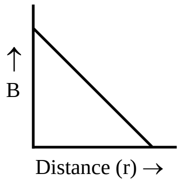
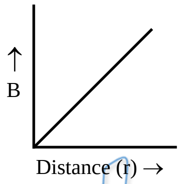
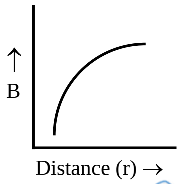
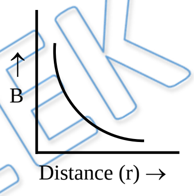
Q 1. Which of the following graphs represent variation of magnetic field B with distance r for a straight long wire carrying current

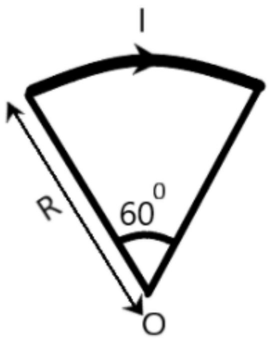
(a) 

(b) 

(c) 

(d) 

Q 2. The magnitude of magnetic field due to current carrying arc of radius R, having a current I subtending an angle of 60° at the center O is

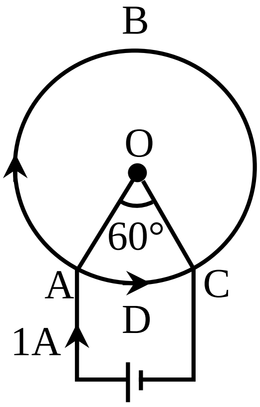


(a) $\frac{\mu_0 I}{8R}$
(b) $\frac{\mu_0 I}{10R}$
(c) $\frac{2\mu_0 I}{4R}$
(d) $\frac{\mu_0 I}{12R}$

Q 3. A cell is connected between two points of a uniformly thick circular conductor. I_1 and I_2 are the currents flowing in two parts of the circular conductor of radius a. What will be the magnetic field at the center of the loop?

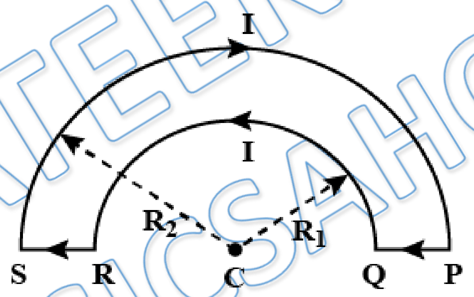
(a) $zero$
(b) $\frac{\mu_0}{4\pi}\frac{(I_1+I_2)\sin 90^0}{r^2}$
(c) $\frac{\mu_0}{4\pi}\frac{(I_1 I_2)\sin 90^0}{r^2}$
(d) $\frac{\mu_0}{4\pi}\frac{2(I_1+I_2)}{r^2}$

Q 4. A cell is connected between the points A and C of a circular conductor ABCD with O as centre and angle AOC = 60° If B_1 and B_2 are the magnitudes of the magnetic fields at O due to the currents in ABC and ADC respectively, then ratio $\frac{B_1}{B_2}$ is



(a) 1 (b)2
(b) 3 (d)4

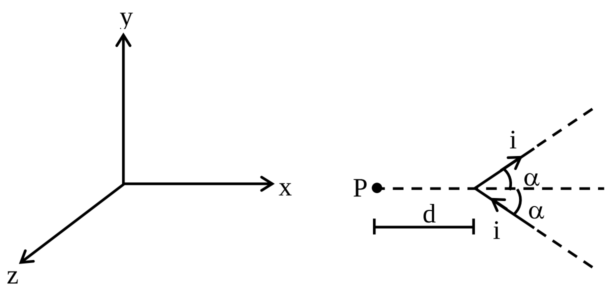
Q 5. A wire loop PQRSP formed by joining two semicircular wires of radii R_1 & R_2 carries a current I as shown in figure below. The magnitude of magnetic induction at center C is



(a) $\left(\frac{\mu_0}{4}\right) I \left[\frac{1}{R_2} - \frac{1}{R_1}\right]$ (b) $\left(\frac{\mu_0}{4}\right) I \left[\frac{1}{R_1} - \frac{1}{R_2}\right]$
(c) $(\mu_0) I \left[\frac{1}{R_2} - \frac{1}{R_1}\right]$ (d) $(\mu_0) I \left[\frac{1}{R_1}\right]$

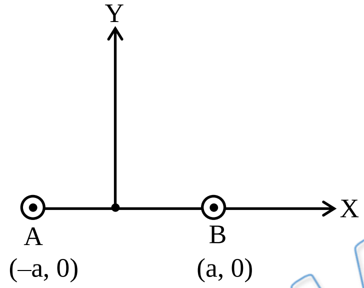
Q 6. A straight section PQ of a circuit lies along the x-axis from x = – (a/2) to x = + (a/2) and carries a steady current I. The magnetic field due to the section PQ at a point x = +a will be -
(a) proportional to a (b) proportional to a^2
(c) proportional to (1/a) (d) equal to zero

Q 7. V shaped wire is in x-y plane. The direction of the field B at P is –



(a) along + x axis (b) along + z axis
(c) along – x axis (d) along + y axis

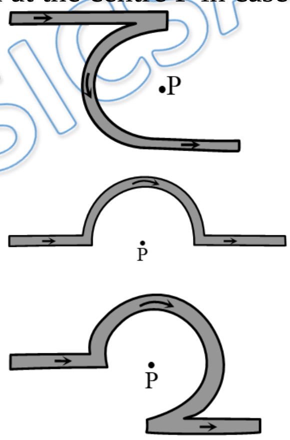
Q 8. Two very long current carrying wires A and B carrying current I_0 (along Z-axis) are placed at (– a, 0) and (a, 0) as shown. Find the value of magnetic field at (0, a) –



(a) $\frac{\mu_0 I_0}{\sqrt{2}\pi a}$ (b) $\frac{\mu_0 I_0}{2\pi a}$

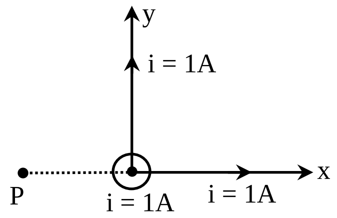
(c) $\frac{\mu_0 I_0}{4\pi a}$ (d) $\frac{\mu_0 I_0}{2\sqrt{2}\pi a}$

Q 9. The magnetic field at the center of a circular coil of radius r is π times that due to a long straight wire at a distance r from it, for equal currents. Figure here shows three cases: in all cases the circular part has radius r and straight ones are infinitely long. For same current the B field at the centre P in cases 1, 2, 3, have the ratio:



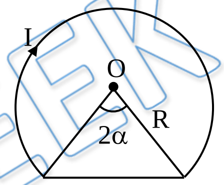
(a) $-\frac{\pi}{2}:\frac{\pi}{2}:\frac{3\pi}{4}-\frac{1}{2}$
(b) $-\frac{\pi}{2}-1:\frac{\pi}{2}:\frac{3\pi}{4}+\frac{1}{2}$
(c) $-\frac{\pi}{2}:\frac{\pi}{2}:3\frac{\pi}{4}$
(D) $-\frac{\pi}{2}-1:\frac{\pi}{2}-\frac{1}{4}:\frac{3\pi}{4}+\frac{1}{2}$

Q 10. Three infinitely long wires each carrying a current 1 A are placed such that one end of each wire is at origin and one of these wires are along x-axis, y-axis and z-axis. Magnetic induction at point P (–2,0,0) is –



(a) $\frac{\mu_0}{4\pi}(\hat{j}+\hat{k})$
(b) $\frac{\mu_0}{4\pi}(\hat{j}-\hat{k})$
(c) $\frac{\mu_0}{8\pi}(-\hat{j}+\hat{k})$
(d) $\frac{\mu_0}{8\pi}(\hat{j}+\hat{k})$

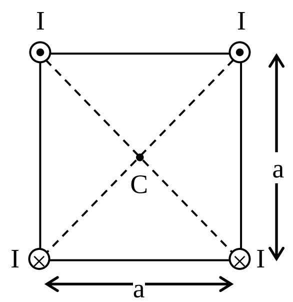
Q 11. The magnetic field intensity due to a thin wire carrying current I in the fig is $\frac{\mu_0 i}{k\pi R}(\pi - \alpha + \tan\alpha)$ find the value of k is



(a) 1 (b) 3
(c) 2 (d) 4

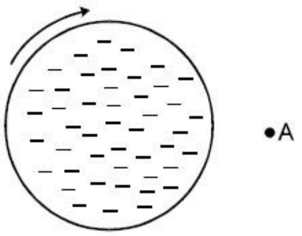
Q 12. Ratio of magnetic field at the center of a current carrying coil of radius R and at a distance of 3R on its axis is -
(a) $10\sqrt{10}$ (b) $20\sqrt{10}$
(c) $2\sqrt{10}$ (d) $\sqrt{10}$

Q 13. Four long and parallel wires each carrying current I are kept at the corners of a square having side a. Magnetic field produced at centre C is k $\frac{\mu_0 I}{\pi a}$. find the k



(a) 2 (b) $\sqrt{2}$
(c) 1 (d) $1/\sqrt{2}$

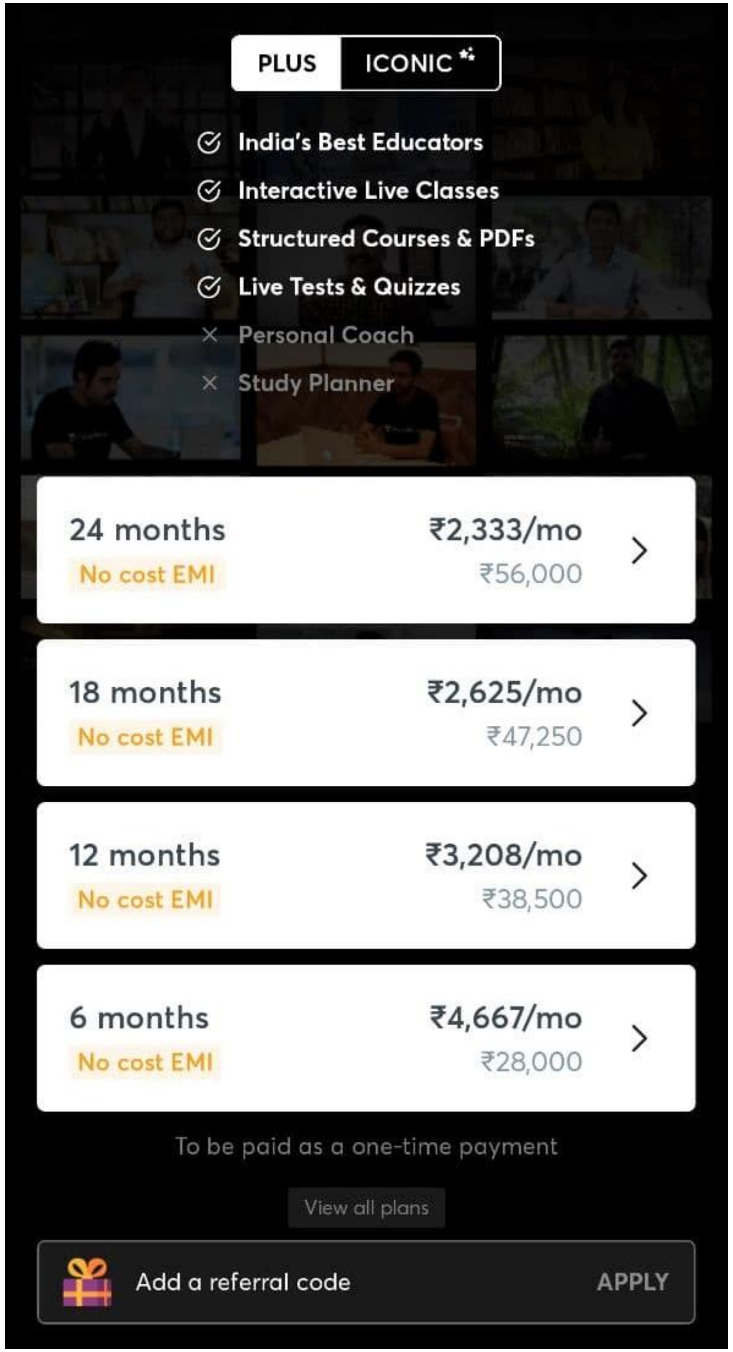
Q 14. The negatively and uniformly charged nonconducting disc as shown is rotated clockwise. The direction of the magnetic field at point A in the plane of the disc is –



(a) into the page
(b) out of the page
(c) up to the page
(d) down the page

Answer Key

Q.1 d	Q.2 d	Q.3 a	Q.4 a	Q.5 b
Q.6 d	Q.7 b	Q.8 b	Q.9 a	Q.10 c
Q.11 c	Q.12 a	Q.13 a	Q.14 a	



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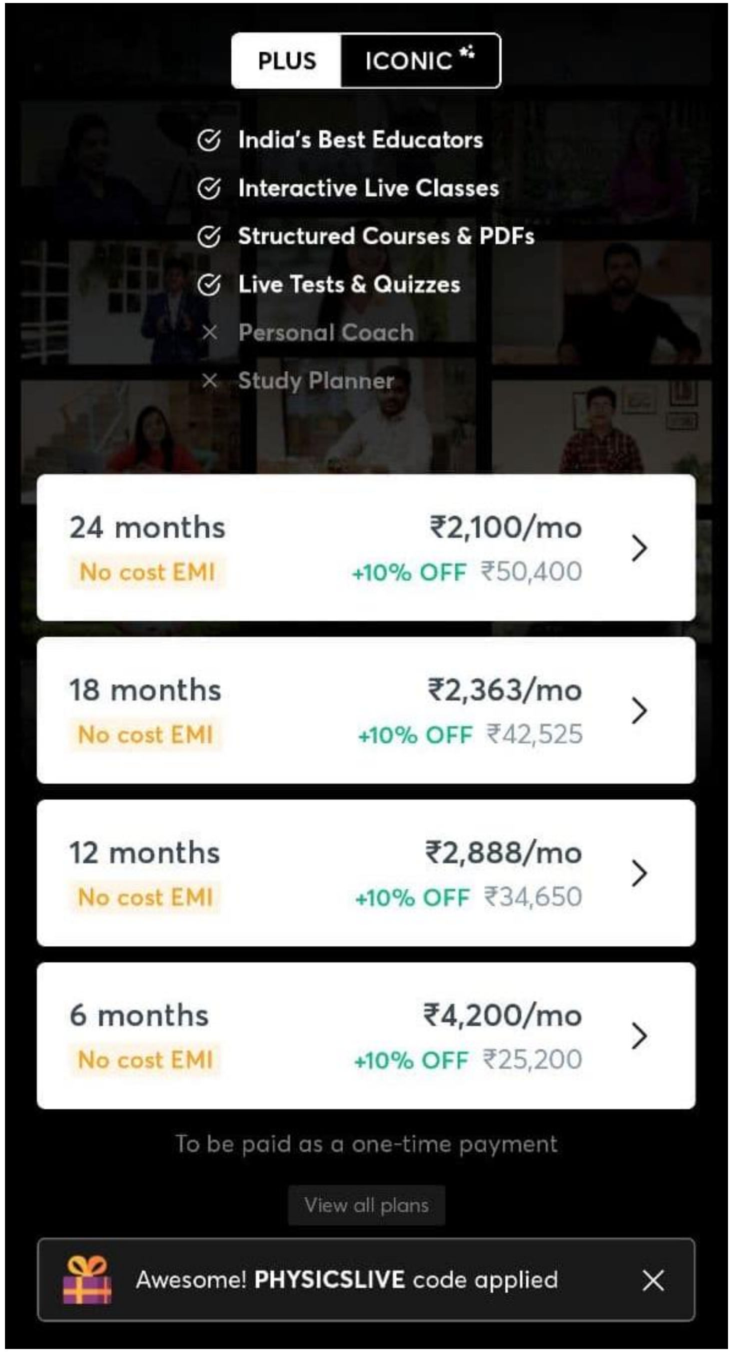


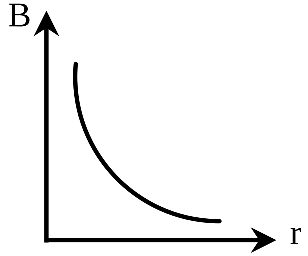
Written Solution

DPP-1 Biot-Savart law

By Physicsaholics Team

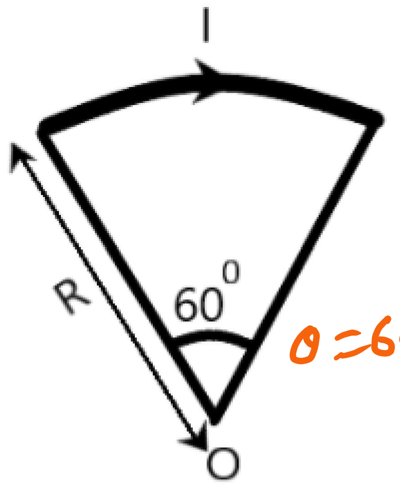
Solution: 1

$$B \propto \frac{1}{r}$$



Ans. d

Solution: 2



$\theta = 60^\circ = \frac{\pi}{3}$

$$B = \frac{\mu_0 I}{2R}\left(\frac{\theta}{2\pi}\right)$$

$$= \frac{\mu_0 I}{2R}\left(\frac{\pi/3}{2\pi}\right)$$

$$= \frac{\mu_0 I}{2R}\left(\frac{1}{6}\right)$$

$$\boxed{B = \frac{\mu_0 I}{12R}}$$ Ans.

Ans. d

Solution: 3

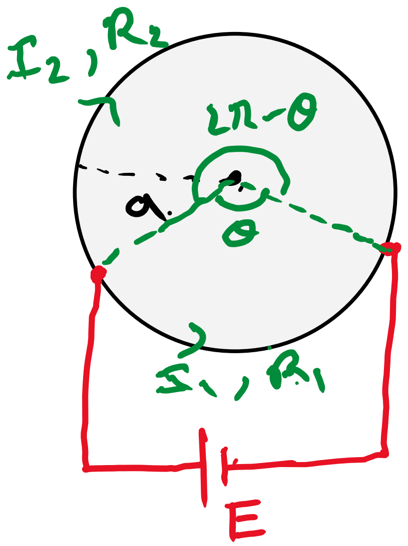
$\therefore$ Net magnetic field at centre is zero

$\therefore$ $B_1 = B_2$

$$\therefore \quad \frac{B_1}{B_2} = 1$$

Ans. a

Solution: 4



let, Resistance in unit length of wire = k

then; $R_1 = k(a\theta)$

$R_2 = k(a(2\pi-\theta))$

$I_1 = \frac{E}{R_1}, \; I_2 = \frac{E}{R_2}$

$$B_1 = \frac{\mu_0 I_1}{2a}\left(\frac{\theta}{2\pi}\right) \odot$$

$$B_2 = \frac{\mu_0 I_2}{2a}\left(\frac{2\pi-\theta}{2\pi}\right) \otimes$$

$$B = B_1 - B_2 = \frac{\mu_0 E}{2aR_1}\left(\frac{\theta}{2\pi}\right) - \frac{\mu_0 E}{2aR_2}\left(\frac{2\pi-\theta}{2\pi}\right)$$

$$= \frac{\mu_0 E}{4\pi a}\left[\frac{\theta}{R_1} - \frac{2\pi-\theta}{R_2}\right]$$

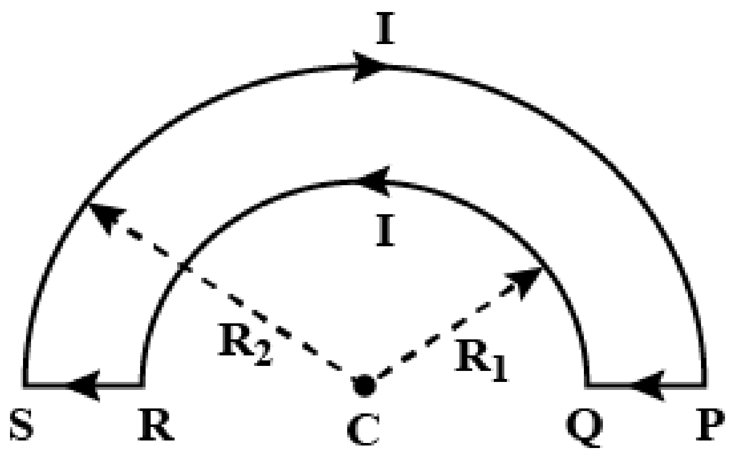
$$= \frac{\mu_0 E}{4\pi}\left[\frac{\theta}{(ka\theta)} - \frac{2\pi-\theta}{(ka(2\pi-\theta))}\right]$$

$$= \frac{\mu_0 E}{4\pi}\left[\frac{1}{ka} - \frac{1}{ka}\right]$$

$$\boxed{B = 0}$$ Ans

Ans. a

Solution: 5



$$B = \frac{\mu_0 I}{4}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \odot$$

$$B_1 = \frac{\mu_0 I}{2R_1}\left(\frac{\pi}{2\pi}\right) = \frac{\mu_0 I}{4R_1} \odot$$

$$B_2 = \frac{\mu_0 I}{2R_2}\left(\frac{\pi}{2\pi}\right) = \frac{\mu_0 I}{4R_2} \otimes$$

$$B = B_1 - B_2$$

Ans. b

Solution: 6

Sol.[D] Along the wire $\vec{d\ell} \times \vec{r} = 0$

$$\therefore \quad dB = 0$$

Ans. d

Solution: 7

By Right hand thumb rule the field by both the segments are out of the plane is along +ve z axis.

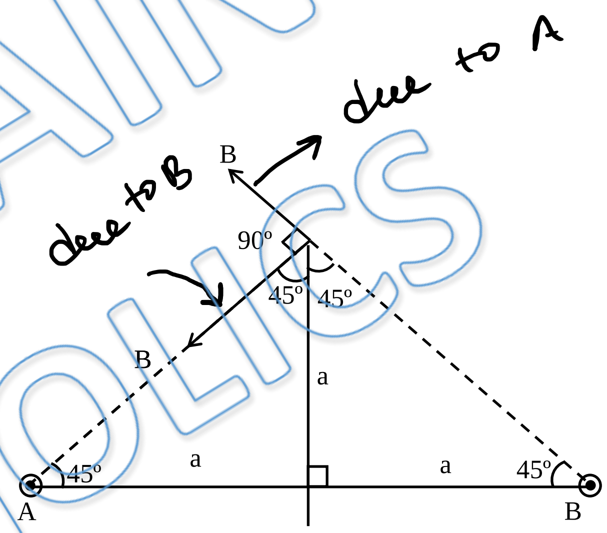
Ans. b

Solution: 8

Sol. **[B]**

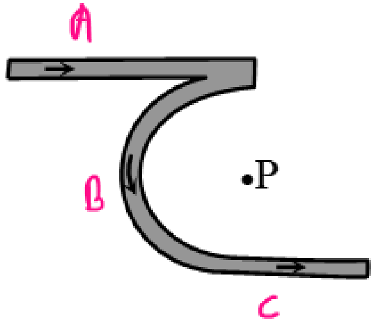
$B_{Net} = \sqrt{2}\,B$

where $B = \dfrac{\mu_0 I_0}{2\pi\cdot\sqrt{2}a} \Rightarrow B_{Net} = \dfrac{\mu_0 I_0}{2\pi a}$

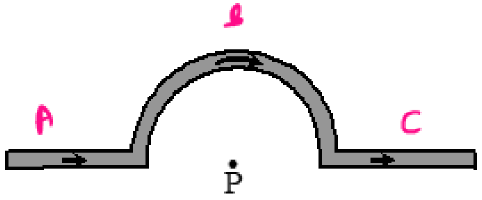


Ans. b

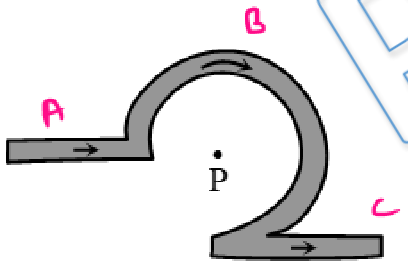
Solution: 9



$$\Rightarrow \frac{\mu_0 i}{4\pi R} \otimes + \frac{\mu_0 i}{4R} \odot + \frac{\mu_0 i}{4\pi R} \odot = \frac{\mu_0 i}{4R} \odot = B_1$$



$$\Rightarrow 0 + \frac{\mu_0 i}{4R} \otimes + 0 = -\frac{\mu_0 i}{4R} \otimes = B_2$$



$$\Rightarrow 0 + \frac{\mu_0 i}{2R} \times \frac{3}{4} \otimes + \frac{\mu_0 i}{4\pi R} \odot = B_3$$

$B_1 : B_2 : B_3$

$$= \frac{1}{4} : -\frac{1}{4} : \left(-\frac{3}{8} + \frac{1}{4\pi}\right)$$

(multiply by 2π)

$$= \frac{\pi}{2} : -\frac{\pi}{2} : -\frac{3\pi}{4} + 1$$

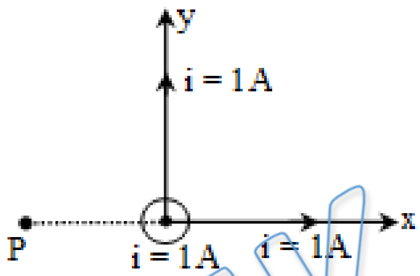
$$= -\pi/2 : \pi/2 : \frac{3\pi}{4} - 1$$

Option (A)

Ans. a

Solution: 10

[C]



No magnetic field at P due to wire in x-axis

$$\vec{B}_P \text{ (due to wire in y-axis)} = \frac{\mu_0 I}{4\pi a}\hat{k}$$

$$\vec{B}_P \text{ (due to wire in z-axis)} = \frac{\mu_0 I}{4\pi a} - \hat{j}$$

$$\therefore \vec{B}_P = \frac{\mu_0 I}{4\pi a}(-\hat{j}+\hat{k})$$

$$= \frac{\mu_0 I}{8\pi}(-\hat{j}+\hat{k}) = \frac{\mu_0}{8\pi}(-\hat{j}+\hat{k})$$

Ans. c

Solution: 11

Sol. **[c]** $B_{arc} = \frac{\mu_0 I}{4\pi R}(2\pi - 2\alpha)$,

$$B_{line} = \frac{\mu_0 I(\sin\alpha + \sin\alpha)}{4\pi R\cos\alpha}$$

$$B_{net} = \frac{\mu_0 I}{2\pi R}(\pi - \alpha + \tan\alpha)$$

Ans. c

Solution: 12

[A] $$\frac{B_{axis}}{B_{centre}} = \left(\frac{R^2 + x^2}{R^2}\right)^{3/2}$$

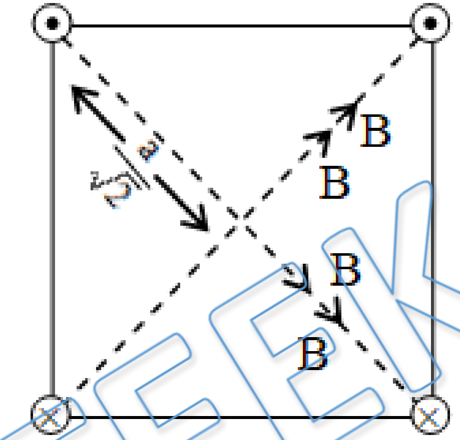
$$= \left(\frac{R^2 + (3R)^2}{R^2}\right)^{3/2} = \left(\frac{10\,R^2}{R^2}\right)^{3/2} = 10^{3/2} = 10^1 \times 10^{1/2}$$

$$= 10\sqrt{10} \text{ (A)}$$

Ans. a

Solution: 13

Sol. [A] Resultant magnetic field



$$B = \sqrt{(2B)^2 + (2B)^2}$$

$$= 2B\sqrt{2}$$

$$= 2\sqrt{2}\,\frac{\mu_0 I}{2\pi\left(\frac{a}{\sqrt{2}}\right)}$$

$$= \frac{2\mu_0 I}{\pi a}$$

Ans. a

Solution: 14

Sol.[A]

The field at A is directed into the page.

Ans. a

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Chalo Niklo