
PRAYAS
JEE 2025
Lecture - 02
Physics
Magnetism
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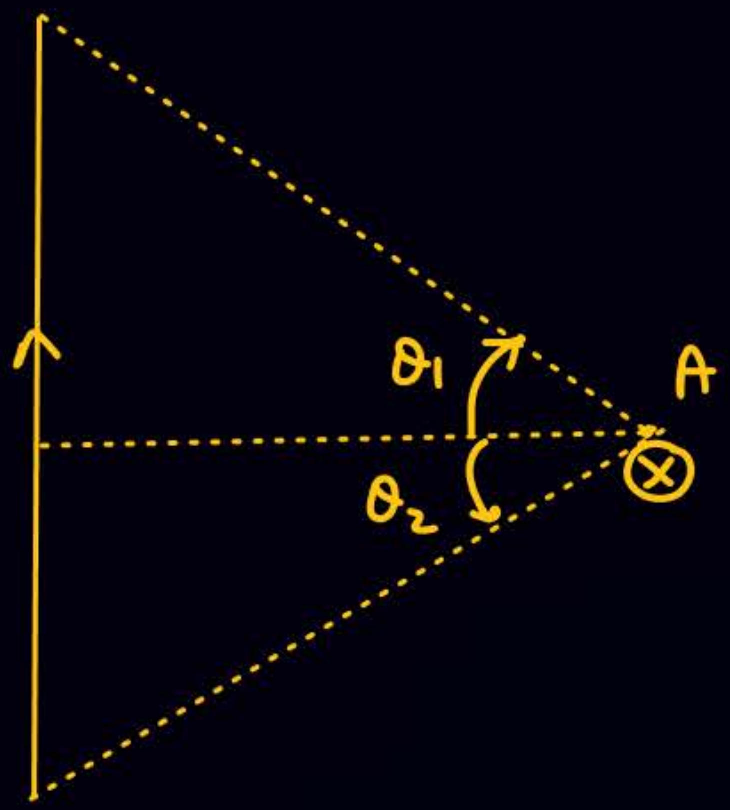
Physics Wallah

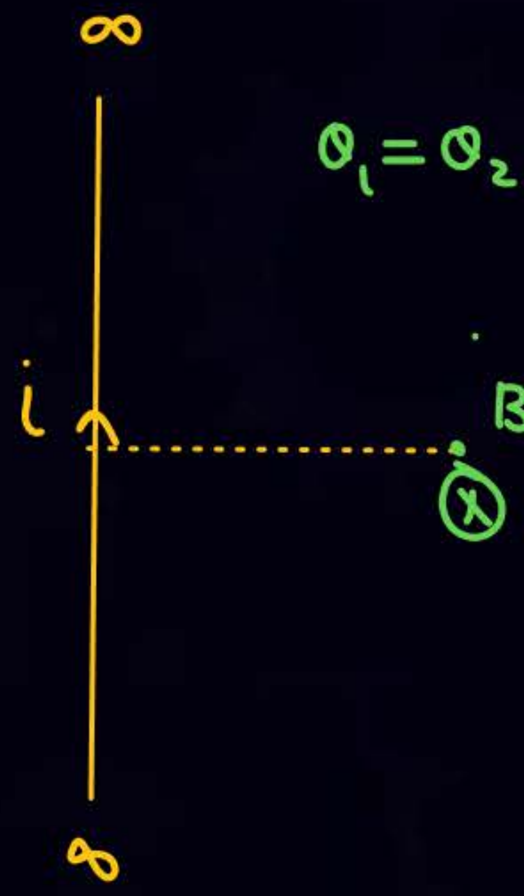
Topics *to be covered*

1. Calculation of B
2.
3.
4.



$$B_A = \frac{Ki}{r}(\sin\theta_1 + \sin\theta_2)$$

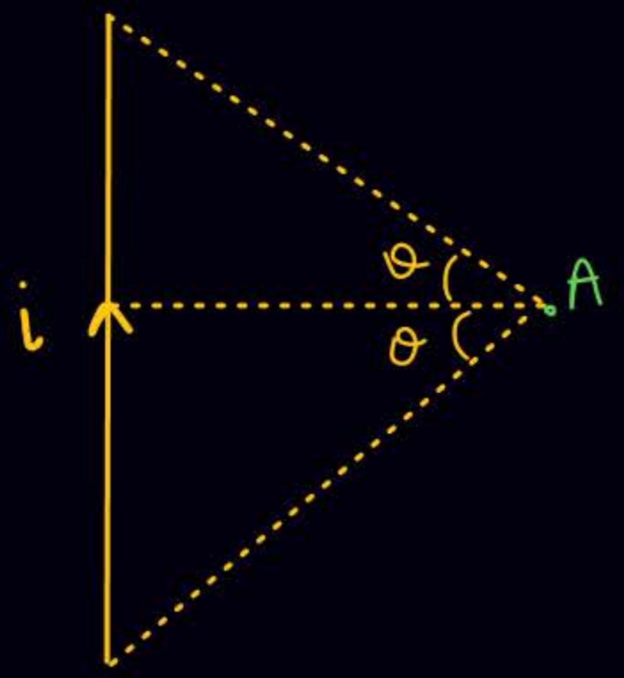
(1)



$$\theta_1 = \theta_2 = 90°$$

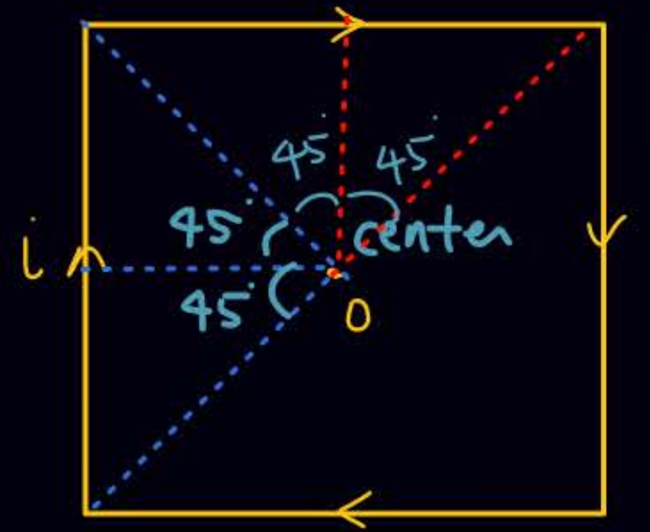
$$B = \frac{2Ki}{r}$$

(2)



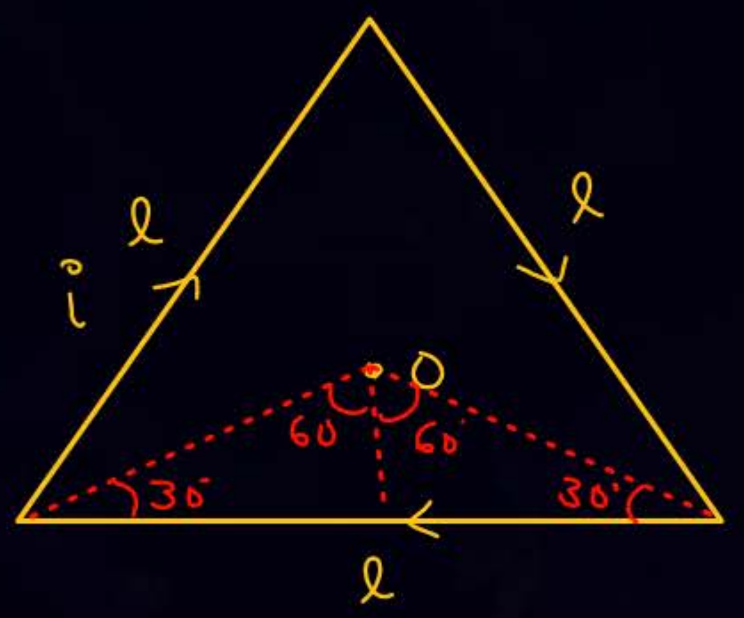
$$B = \frac{2ki}{r}\sin\theta$$

(3) square i



$$(B)_{at\ O} = \frac{ki}{l/2}\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right) \times 4$$

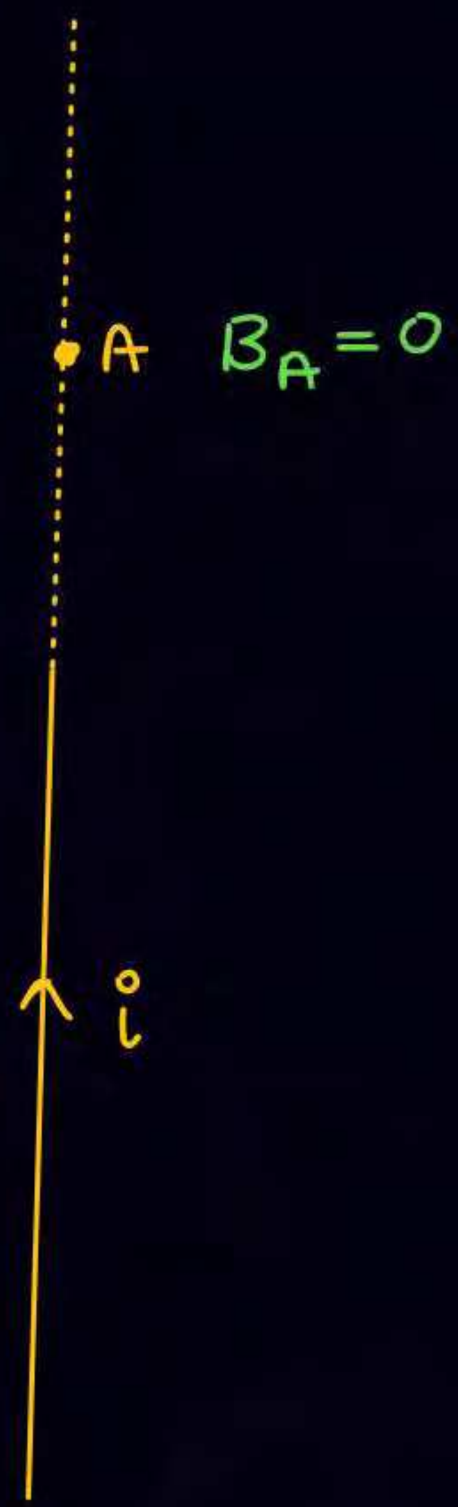
(4)



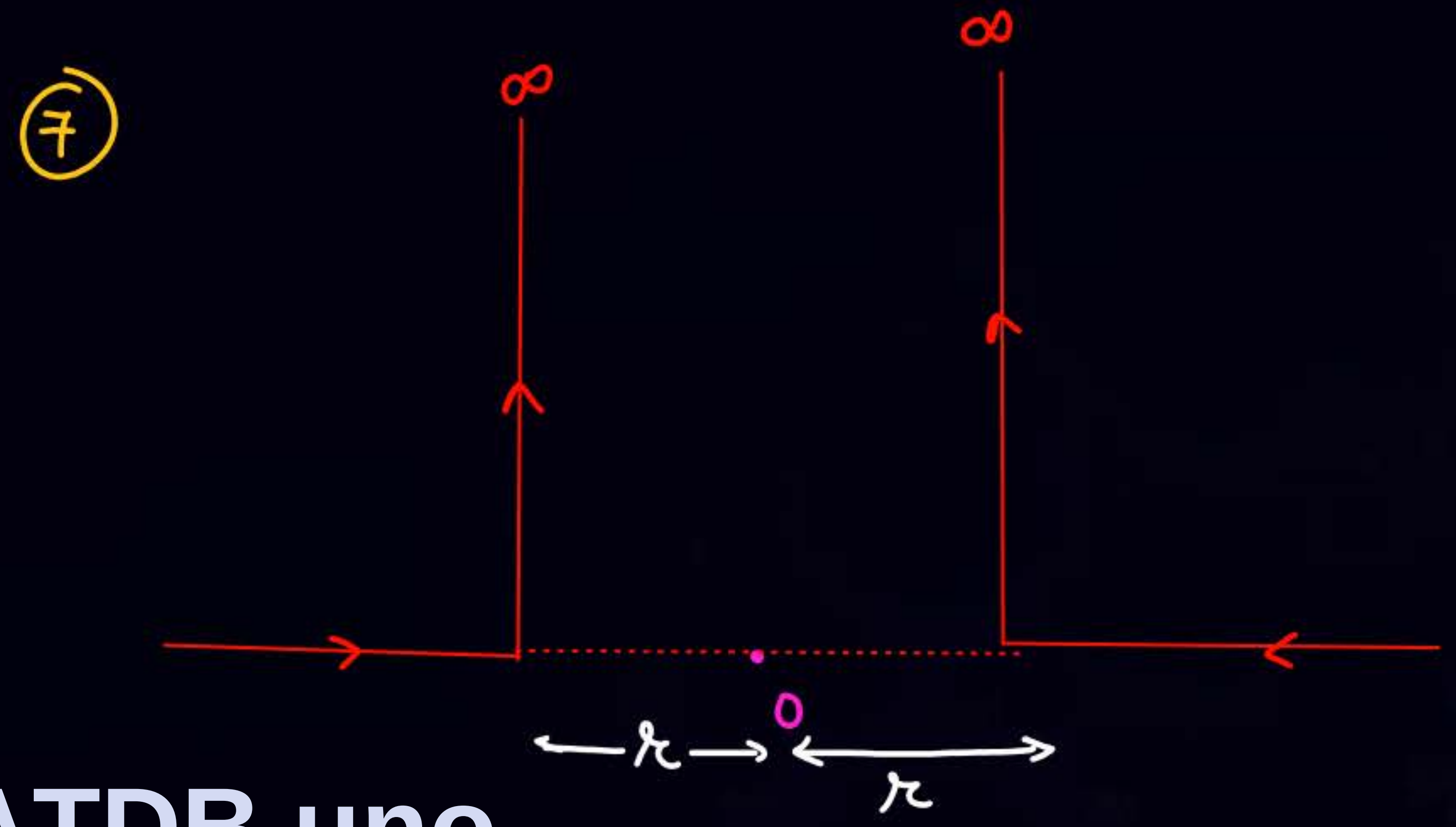
$$B_0 = \frac{ki}{r}(\sin 60 + \sin 60) \times 3$$

$$\tan 30 = \frac{r}{l/2}$$

** (5)

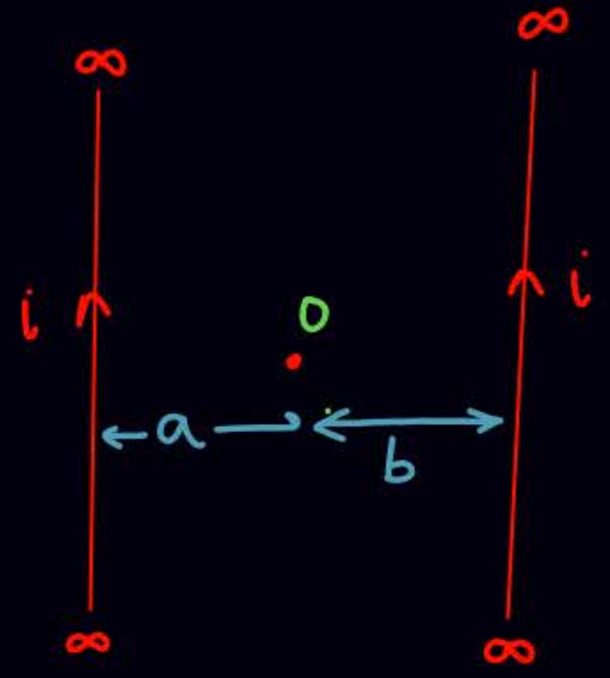


$$\vec{B}_A = 0 + \frac{ki}{r}(\sin 90 + 0)$$



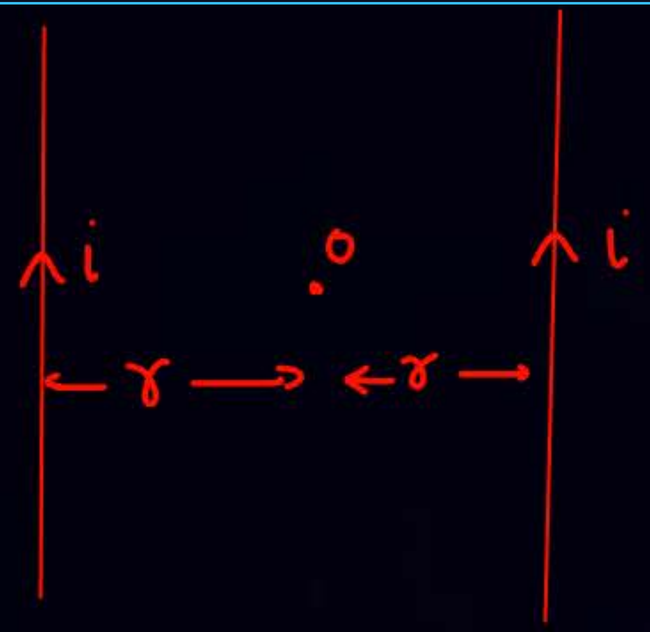
$$\vec{B}_0 = 0$$

8



$$B_0 = \frac{2ki}{a}(-\hat{k}) + \frac{2ki}{b}(+\hat{k})$$

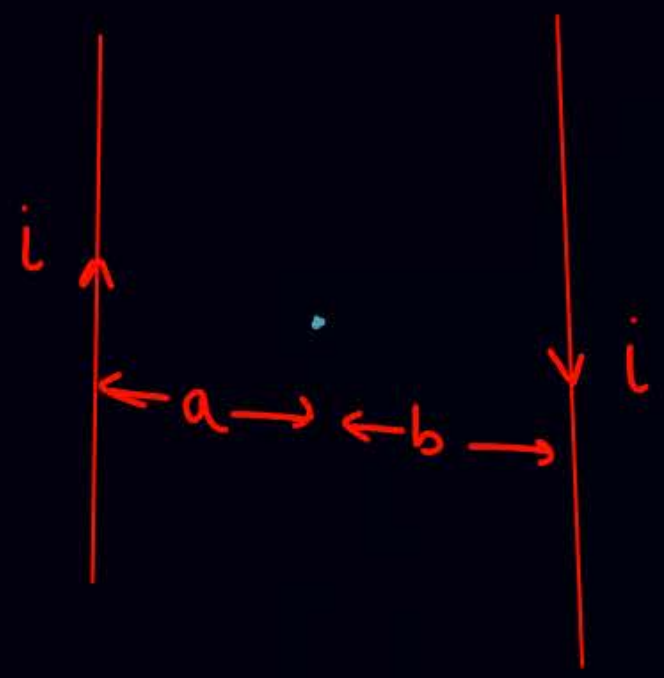
10



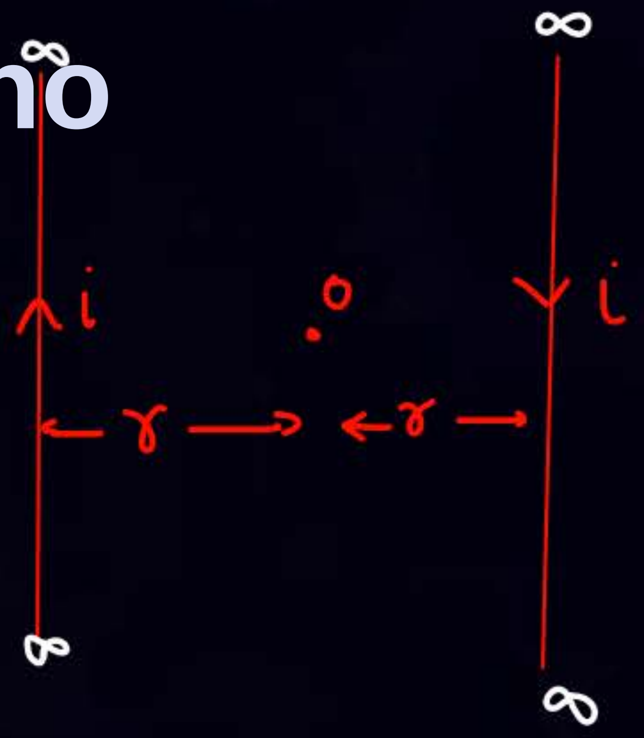
$$B_0 = 0$$

11

9

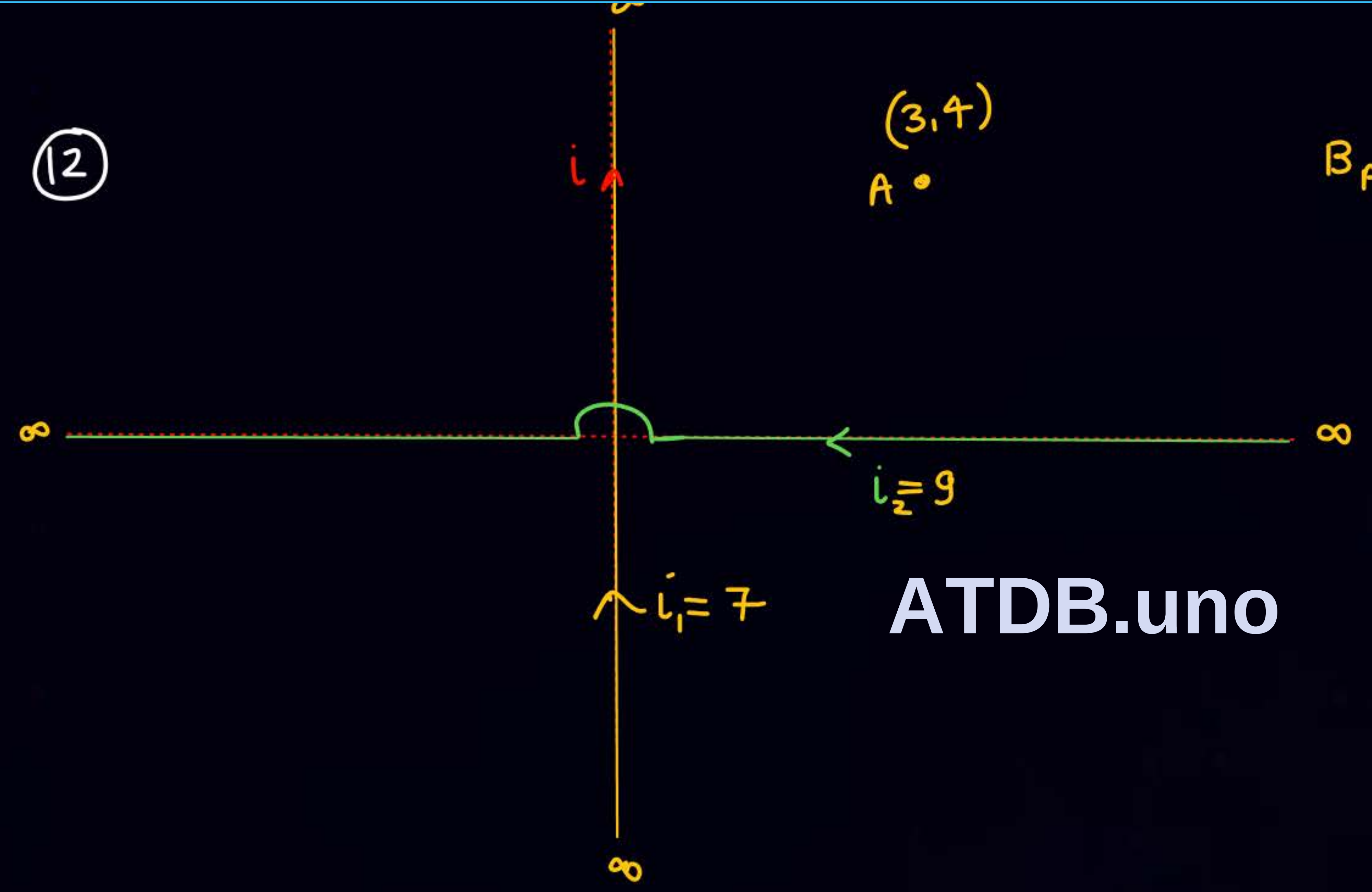


$$B_0 = \frac{2ki}{a}(-\hat{k}) + \frac{2ki}{b}(-\hat{k})$$



$$B_0 = \frac{2ki}{r} \times 2$$

(12)



$$B_A = \frac{2Ki_1}{3} + \frac{2Ki_2}{4}$$

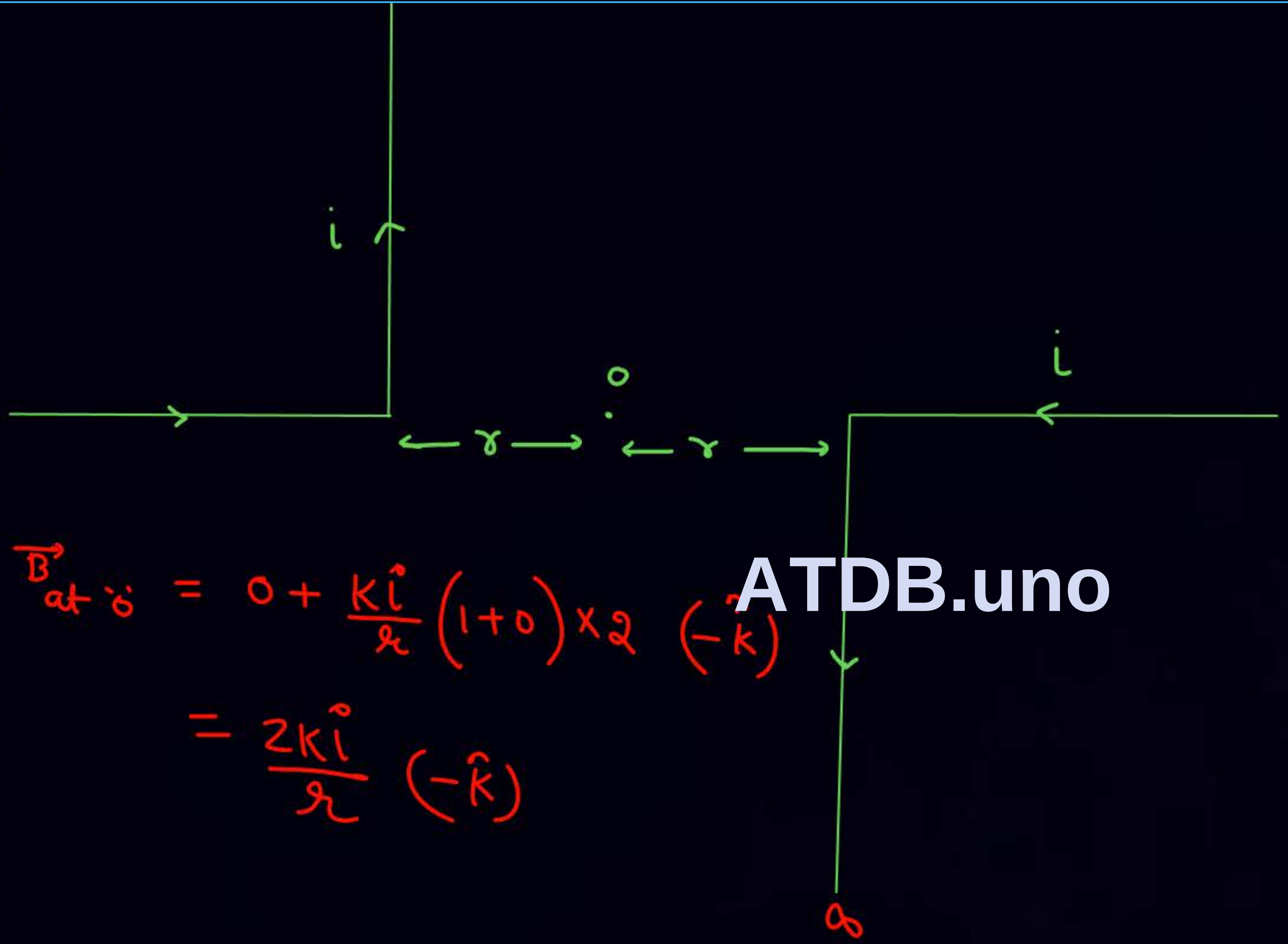
$$= \left(\frac{14}{3} + \frac{9}{2}\right)K$$

$$= \left(\frac{28+27}{6}\right)K = \frac{55}{6}K$$

(13)

$$\vec{B}_A = \left(\frac{2ki_2}{b} - \frac{2ki_1}{a}\right)\hat{k}$$

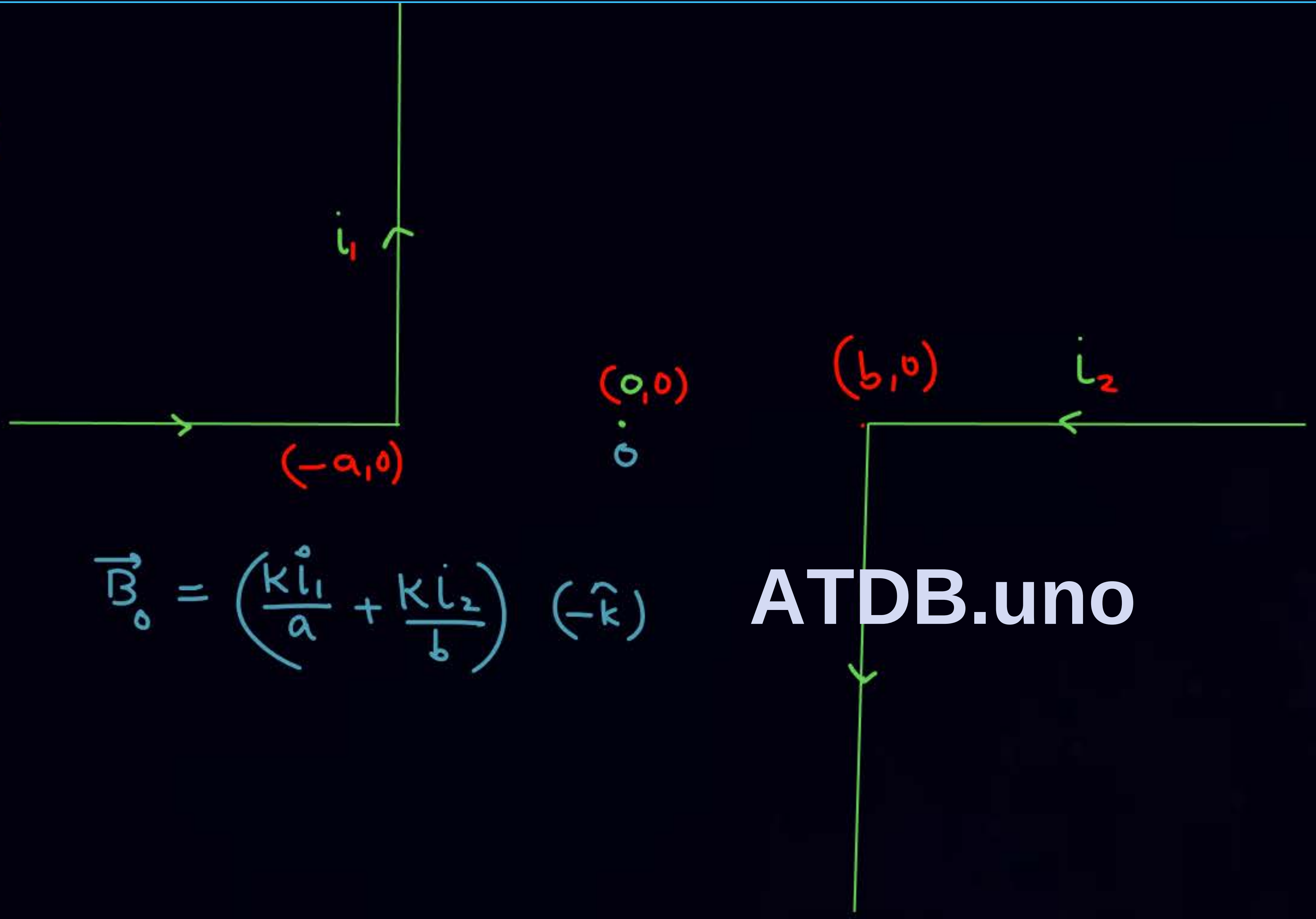
(14)



$$\vec{B}_{at\ o} = 0 + \frac{ki}{r}(1+0)\times 2\,(-\hat{k})$$

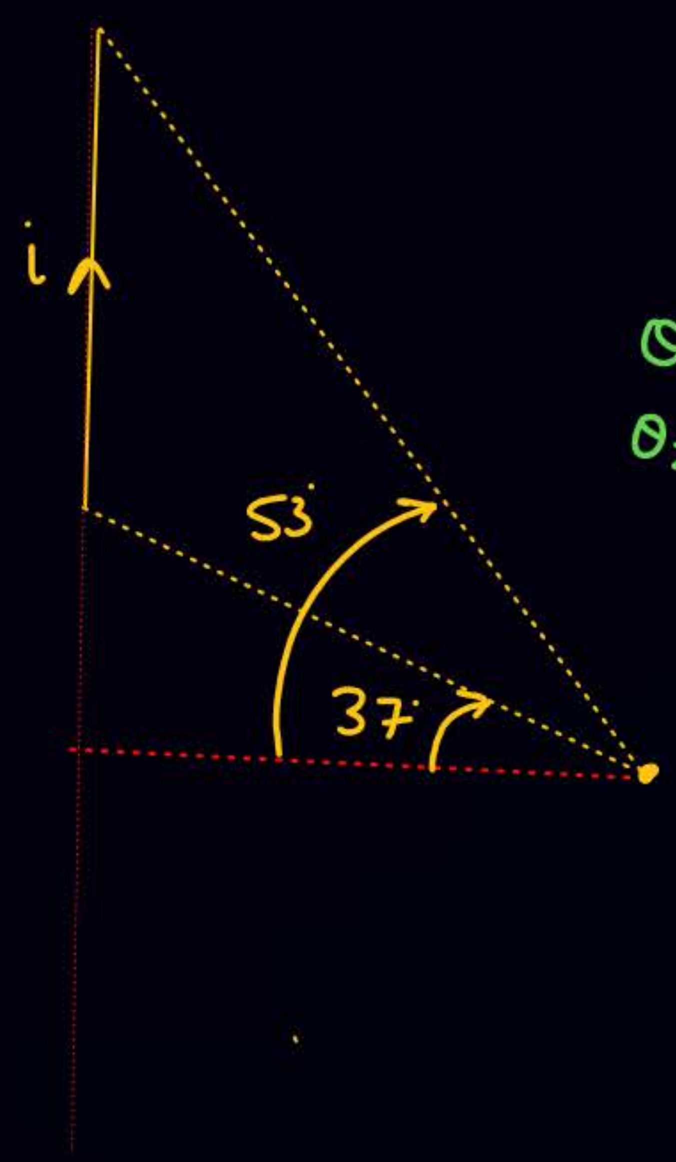
$$= \frac{2ki}{r}(-\hat{k})$$

15



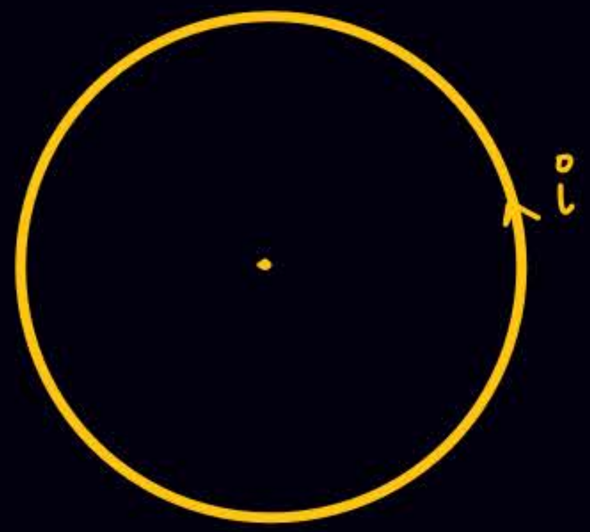
$$\vec{B}_O = \left(\frac{k i_1}{a} + \frac{k i_2}{b}\right)(-\hat{k})$$

(16)

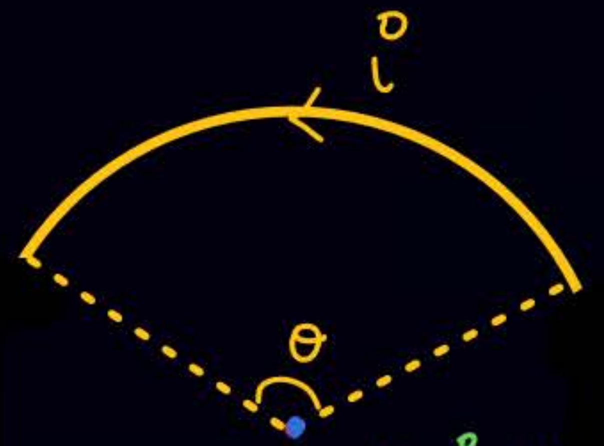


$\theta_1 = 53°$

$\theta_2 = -37$



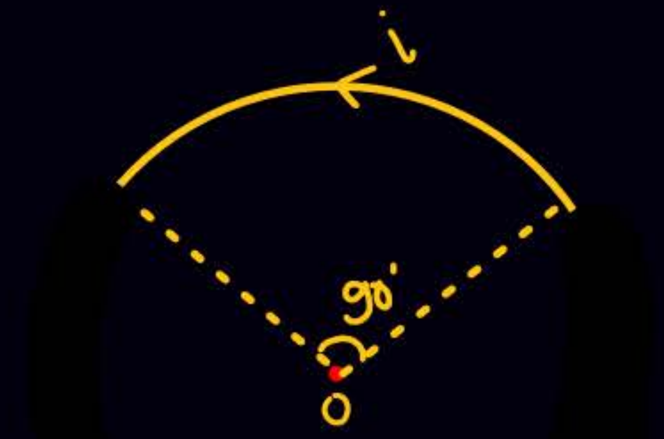
$$B_{center} = \frac{\mu_0 i}{2R}$$



$$B_0 = \frac{k i}{R} \theta \quad \odot$$

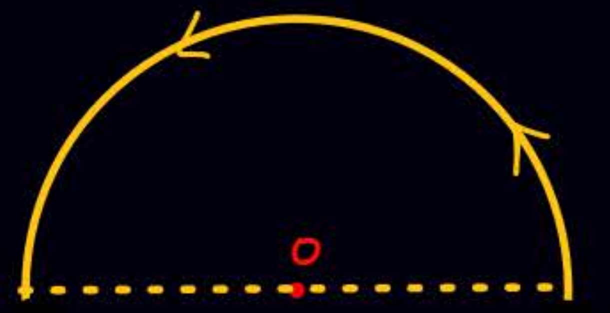
θ → radian

(17)



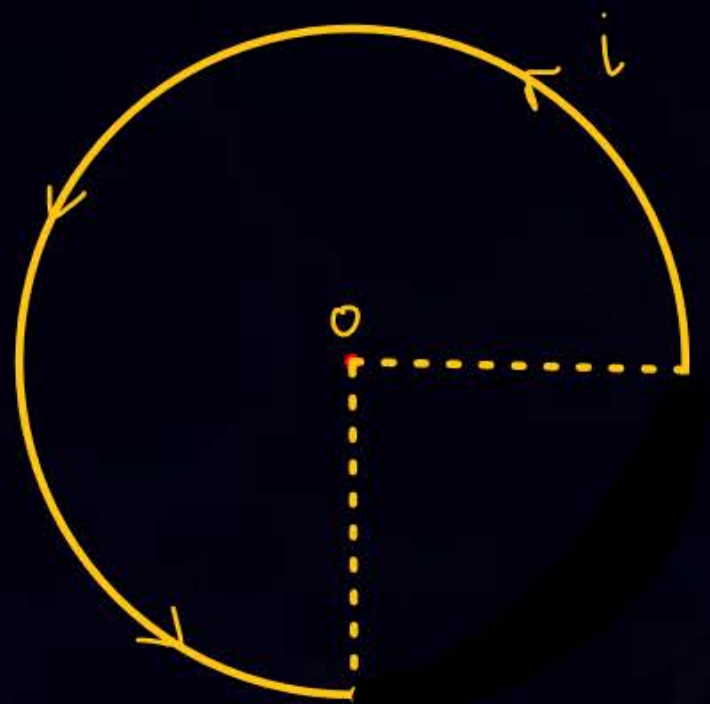
$$B_0 = \frac{ki}{R}\frac{\pi}{2} \odot$$

(18)



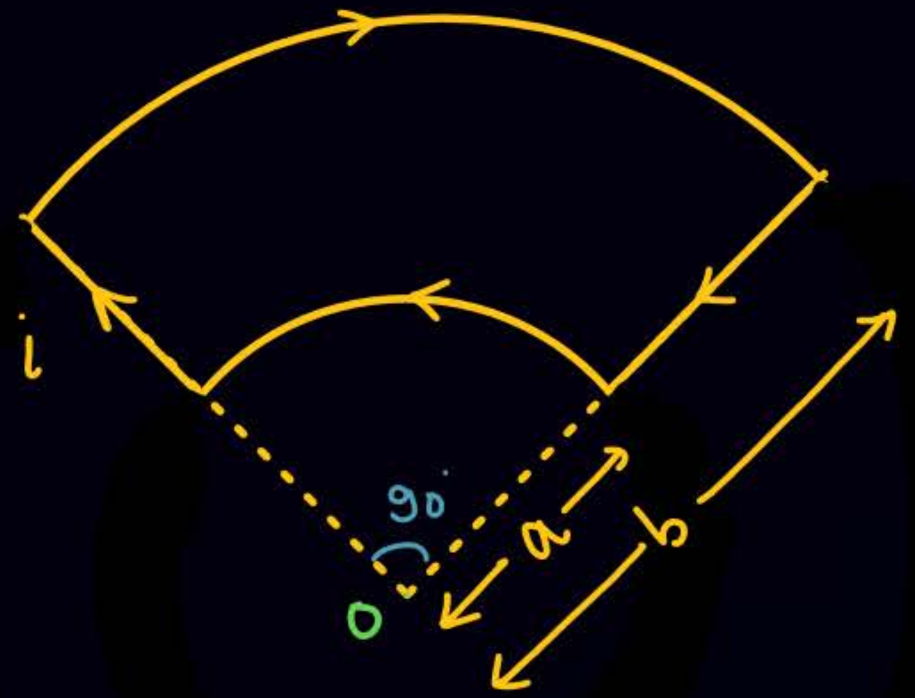
$$B_0 = \frac{ki}{R}\pi \odot$$

(19)



$$B_0 = \frac{ki}{R}\left(\frac{3\pi}{2}\right) \odot$$

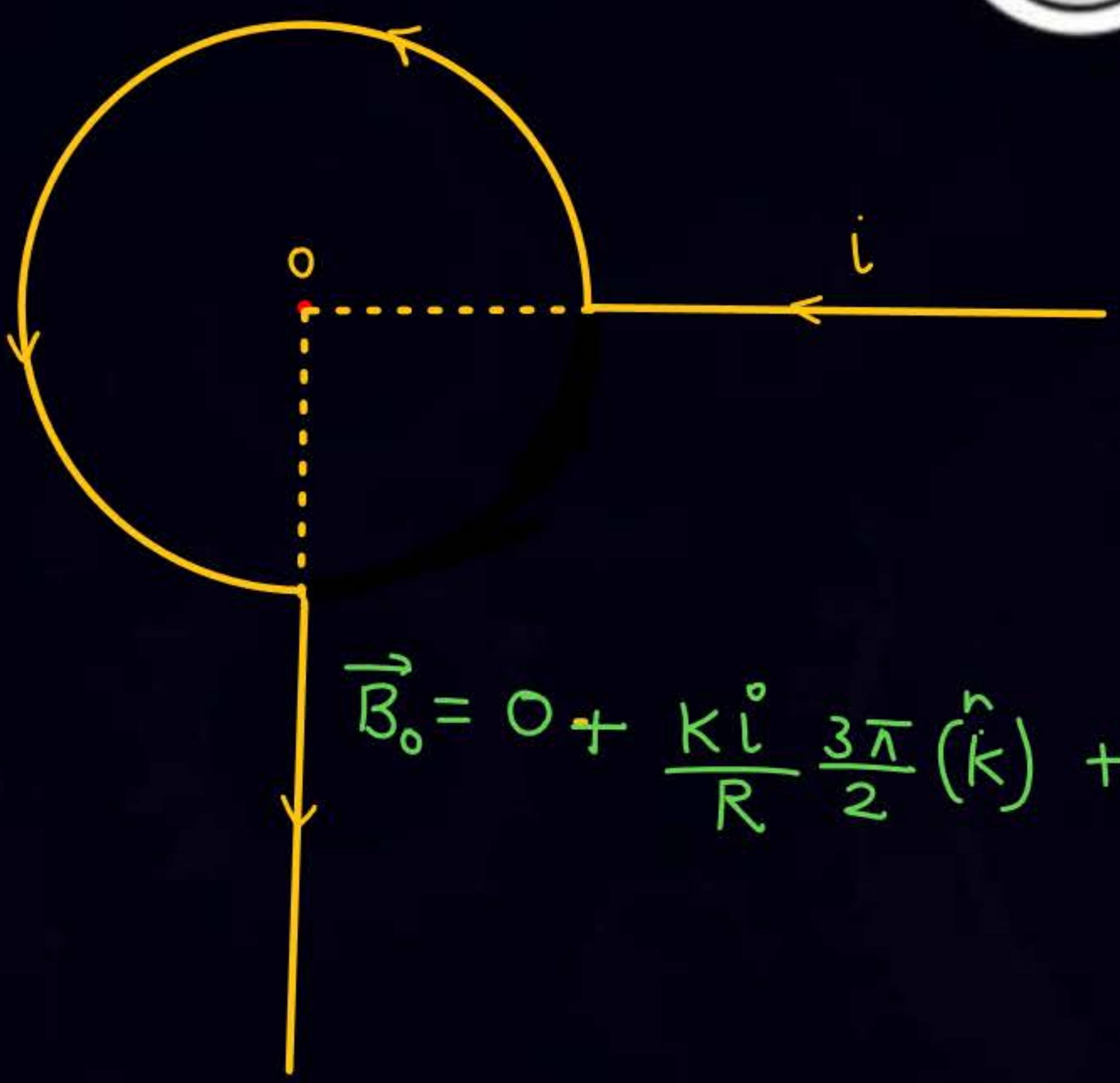
(20)



$$\vec{B}_o = \left(\frac{ki}{a}\frac{\pi}{2}\right)\hat{k} + 0 - \left(\frac{ki}{b}\frac{\pi}{2}\right)\hat{k} + 0$$

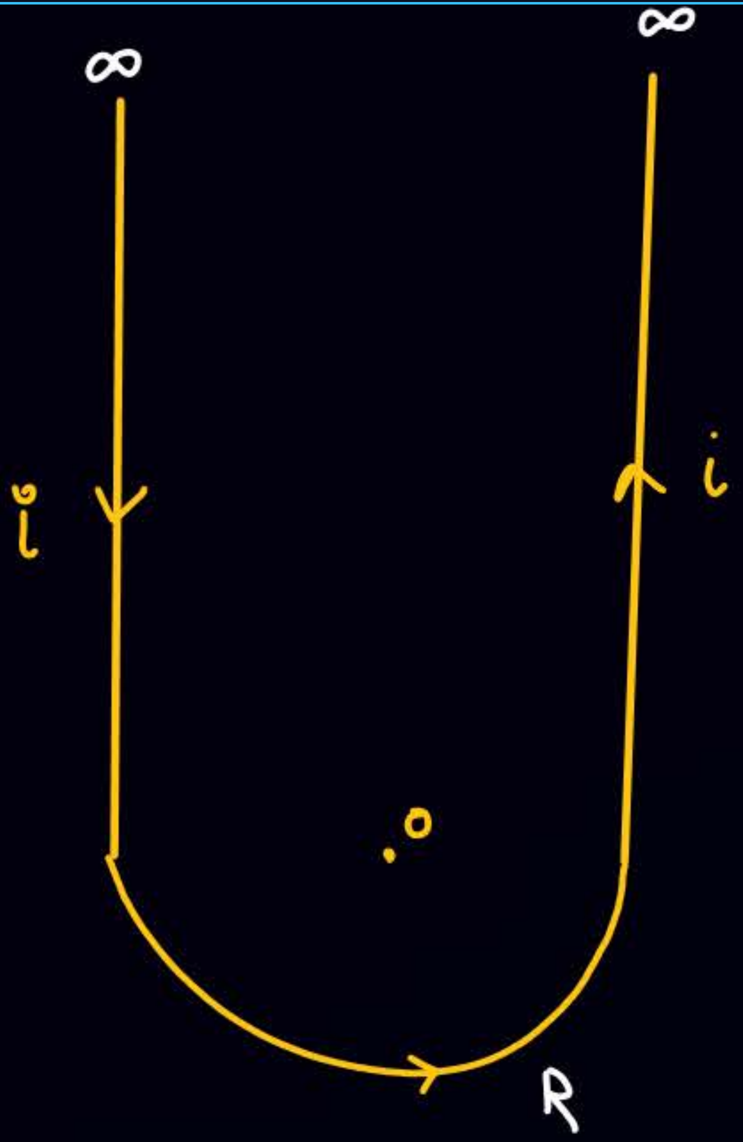
$$B = ki\frac{\pi}{2}\left(\frac{1}{a} - \frac{1}{b}\right)$$

(21)



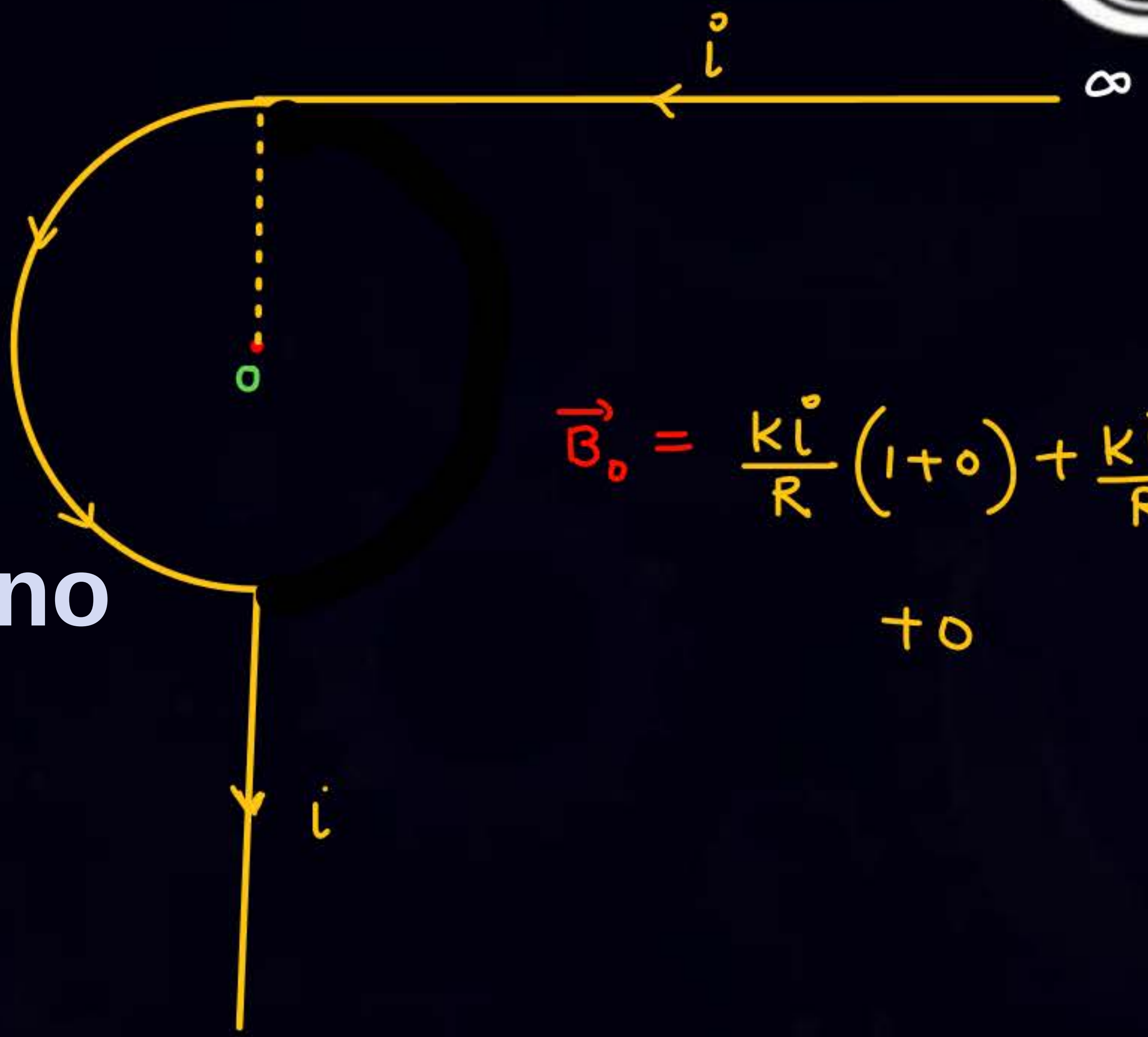
$$\vec{B}_o = 0 + \frac{ki}{R}\frac{3\pi}{2}(\hat{k}) + 0$$

22



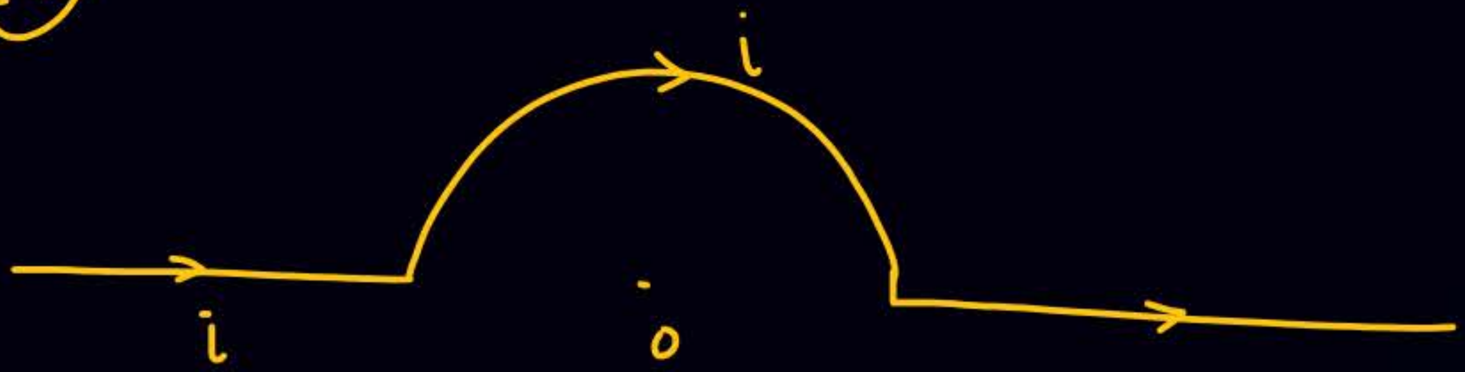
$$B_0 = \frac{ki}{R}\times 2 + \frac{ki}{R}\pi$$

23



$$\vec{B}_0 = \frac{ki}{R}(1+0) + \frac{ki}{R}\pi + 0$$

(24)



$$B_0 = \frac{ki}{R} \odot$$

(25)

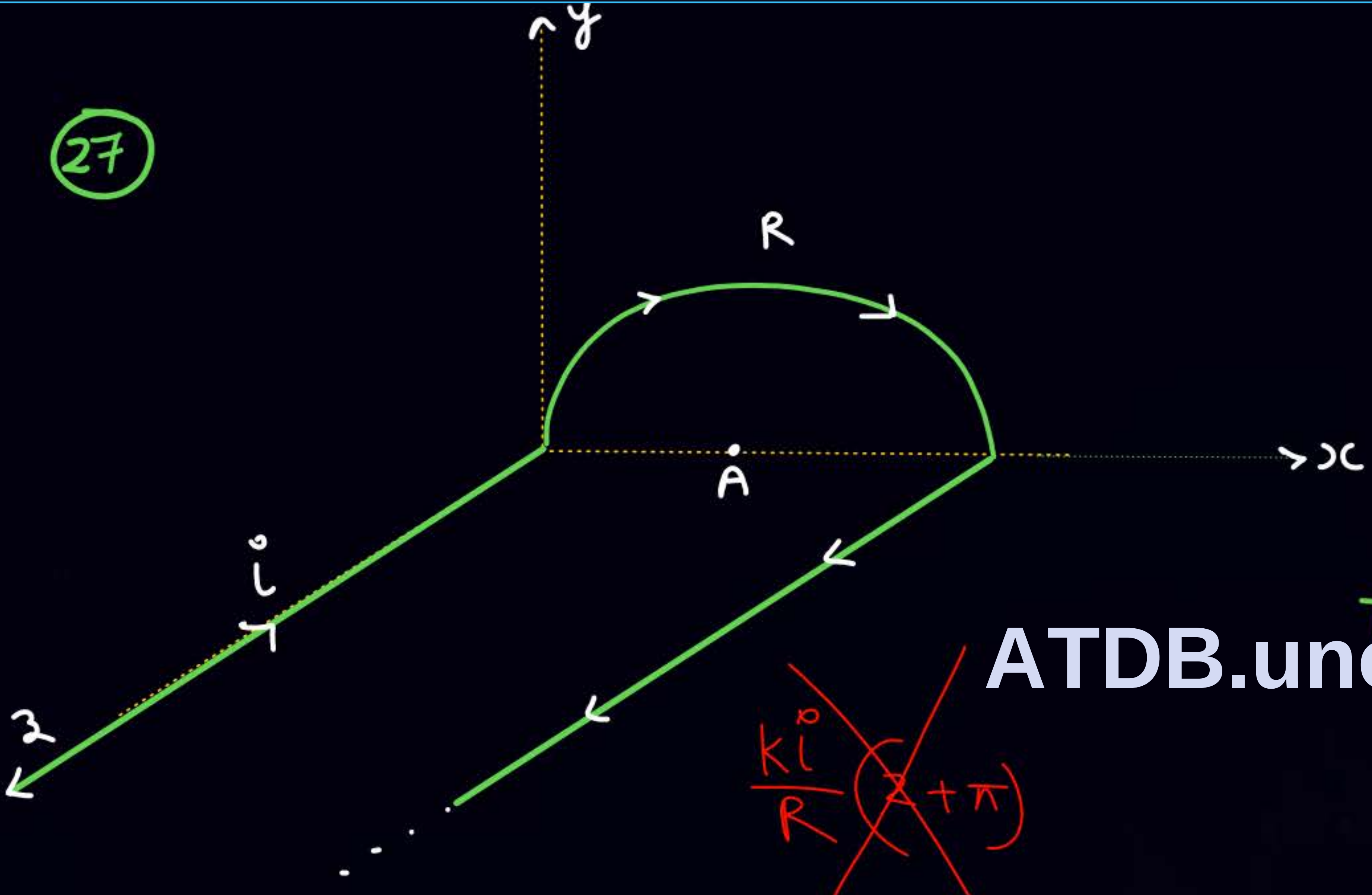
$$B_0 = \frac{ki}{R_1} \odot - \frac{ki}{R_2} \odot$$

26

$$B_0 = \frac{k i}{l/2}\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right) \times 3$$

27
y
$B_1 \equiv -\hat{j}$
$-\hat{k}$
x
A
i
1
z
A
$B_1 + B_3$
i
B
i

27



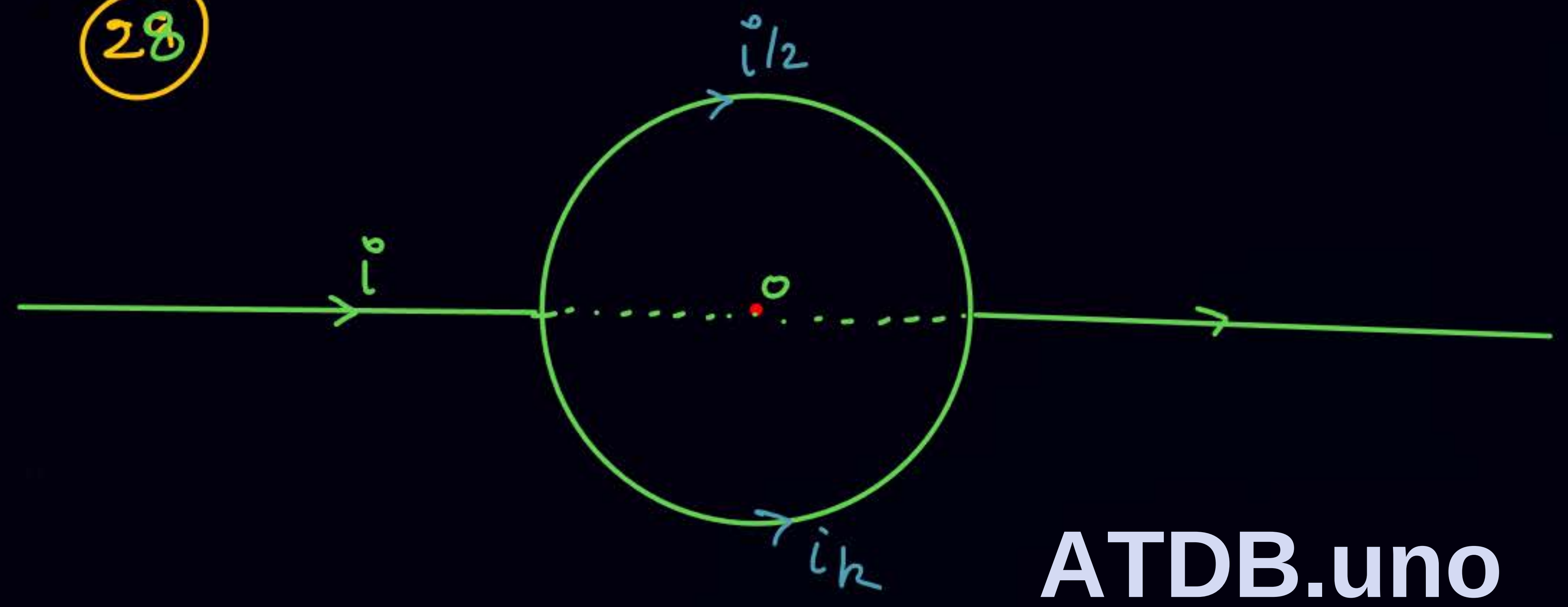
~~$\frac{ki}{R}(2+\pi)$~~

$$\vec{B}_A = \frac{ki}{R}(-\hat{j}) + \frac{ki}{R}\pi(-\hat{k}) + \frac{ki}{R}(-\hat{j})$$

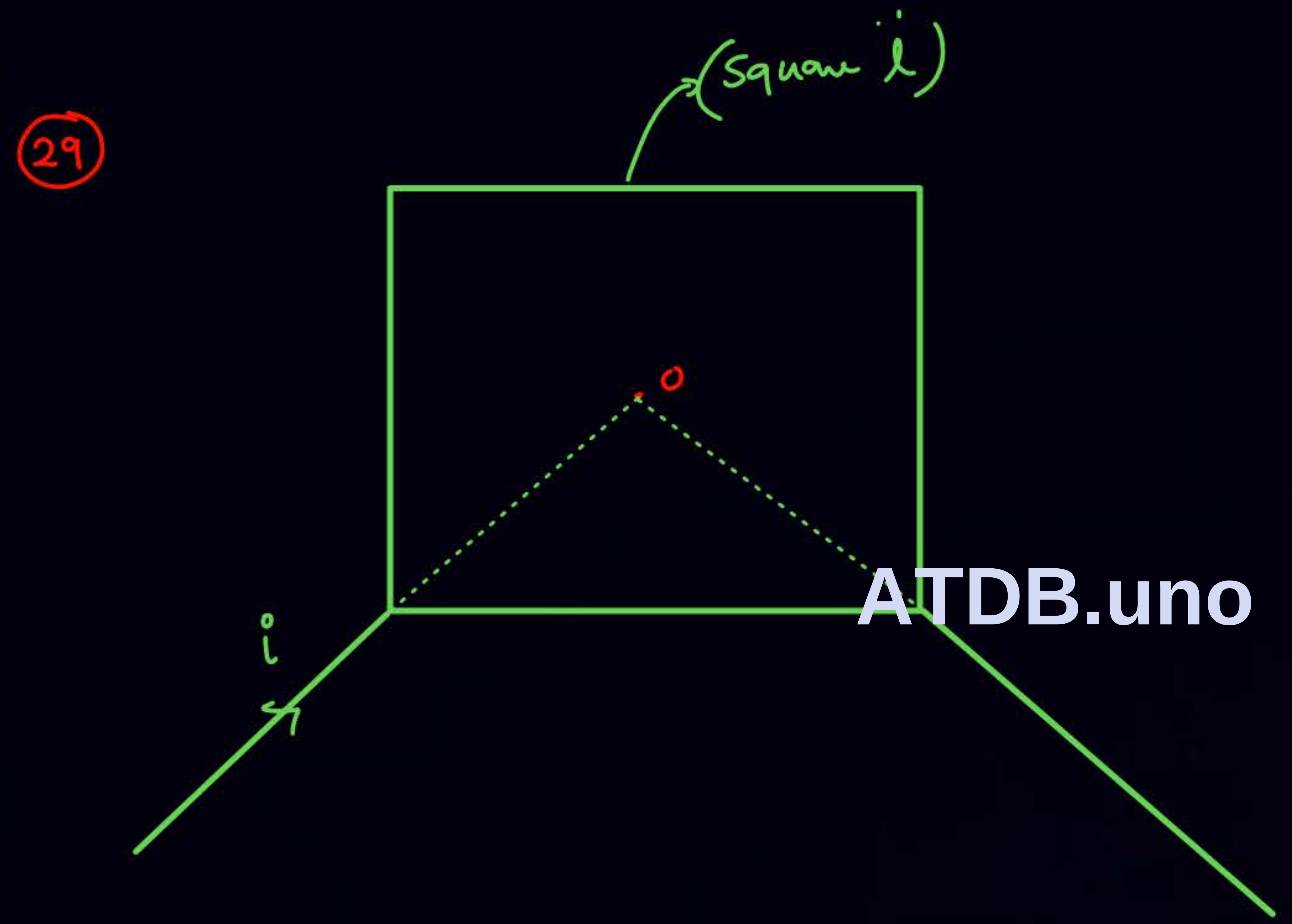
$$\vec{B}_A = \frac{ki}{R}(-2\hat{j} - \pi\hat{k})$$

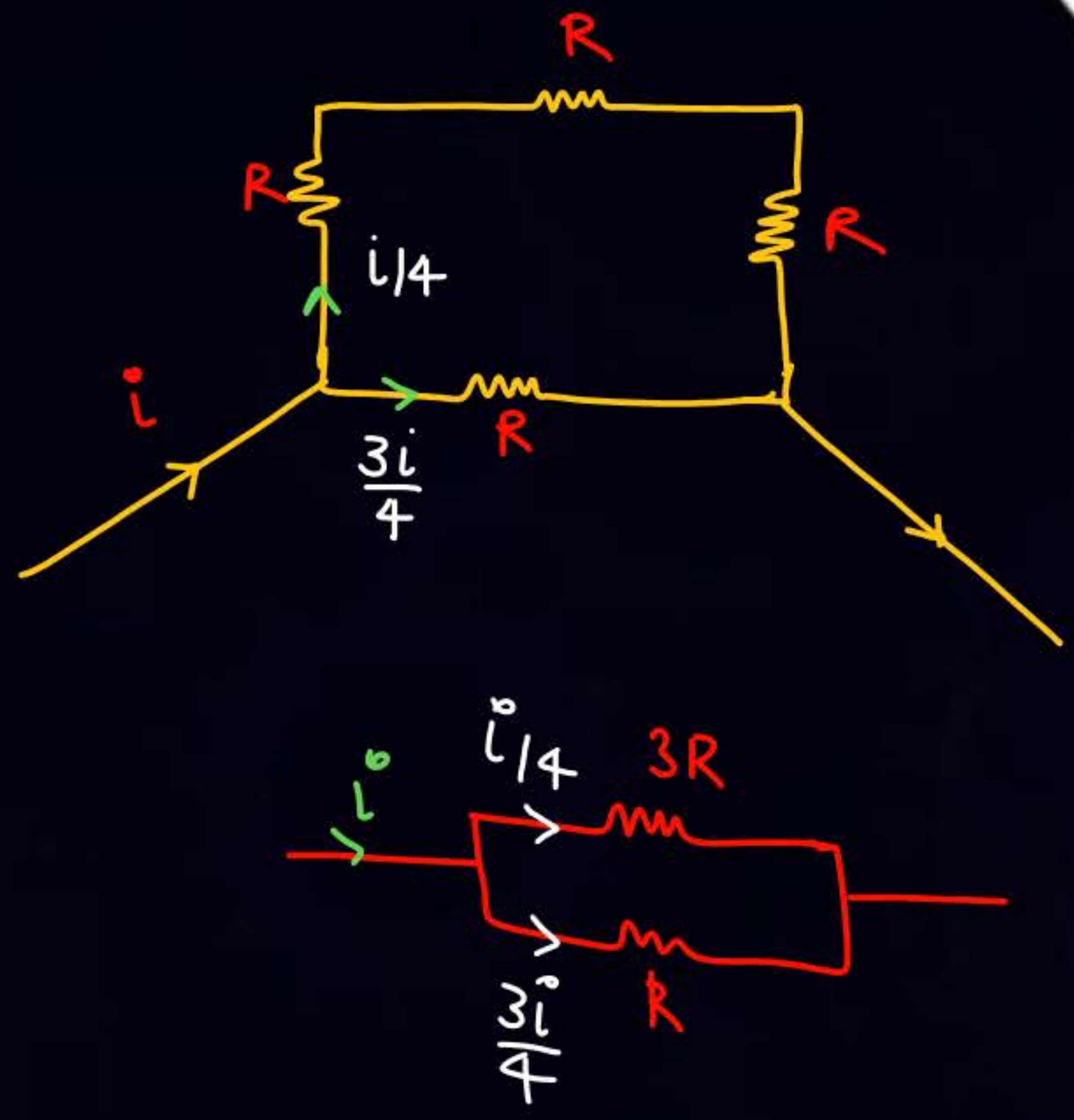
$$B_A = \frac{ki}{R}\sqrt{4+\pi^2}$$

28

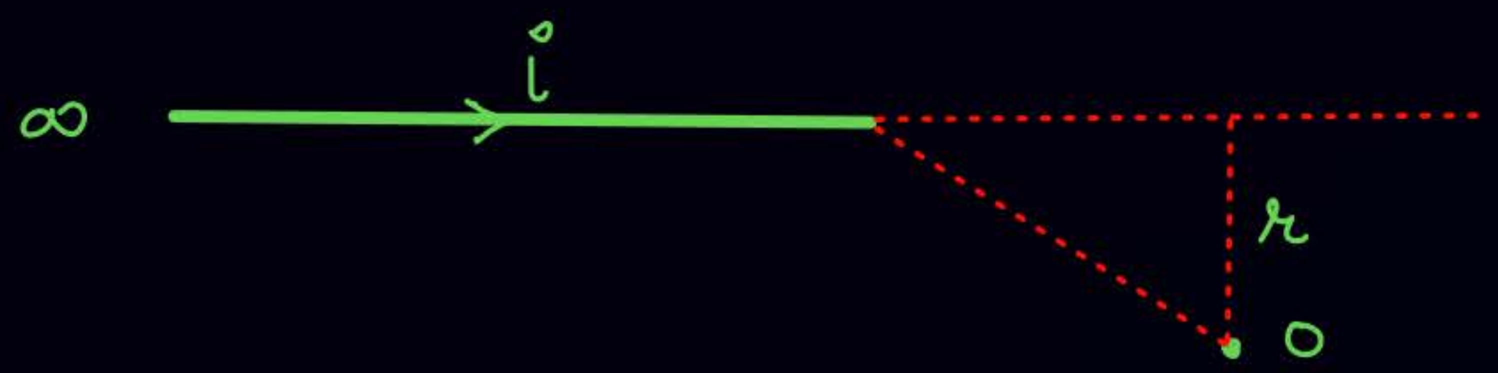


$B_0 = 0$


29
(square l)
O
i


R
R
R
i/4
i
R
3i/4
i
i/4
3R
3i/4
R

Q



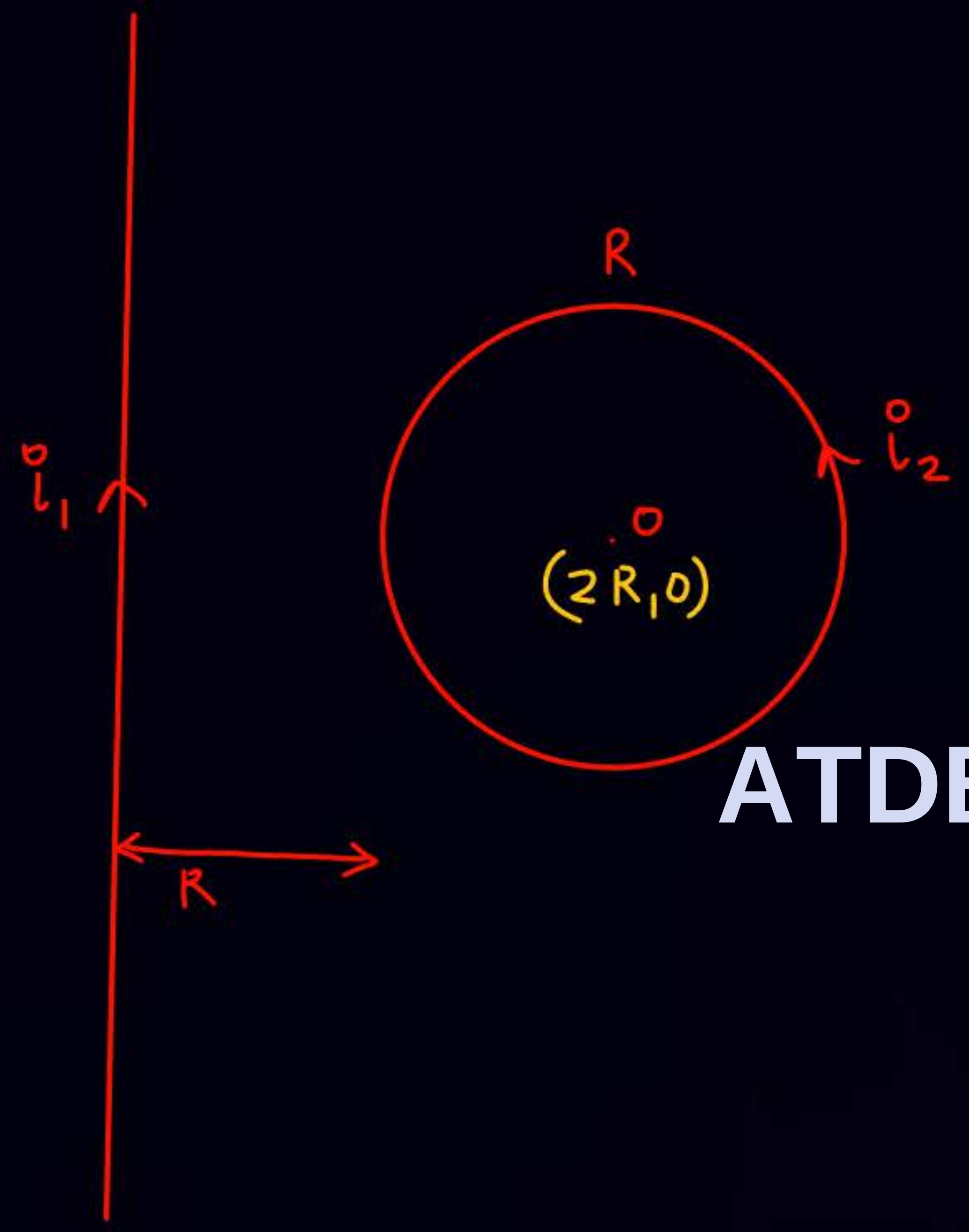
$\theta_1 = 90$

$\theta_2 = -45$

$$\vec{B}_{at\ 'O'} = \frac{ki}{r}\left[\sin 90 + \sin(-45)\right]$$

$$= \frac{ki}{r}\left(1 - \frac{1}{\sqrt{2}}\right)$$

(31)



If magnetic field at 'O' is zero.

find $\frac{i_1}{i_2} = ?$

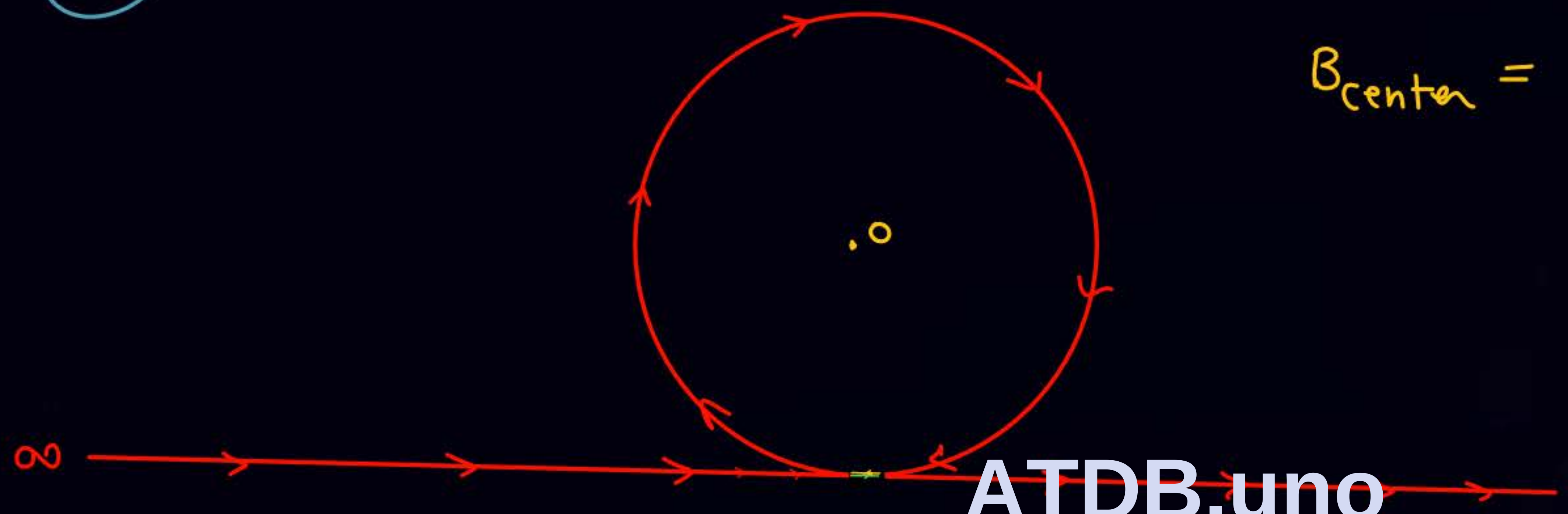
Sol^n

$$\frac{2Ki_1}{2R} = \frac{\mu_0 i_2}{2(R)}$$

$$2 \cdot \frac{\mu_0}{4\pi} i_1 = \mu_0 i_2$$

$$\frac{i_1}{i_2} = 2\pi$$

32



$$B_{center} = \frac{\mu_0 i}{2R}(-\hat{k}) + \frac{2ki}{R}(\hat{k})$$

(33) Suppose we have long wire in air in which current is flowing from west to east. find dir^n of magnetic field at a point just below the wire.

North

(34) Suppose we have long wire in air in which current is flowing from South to north. find dir^n of magnetic field at a point just below the wire.

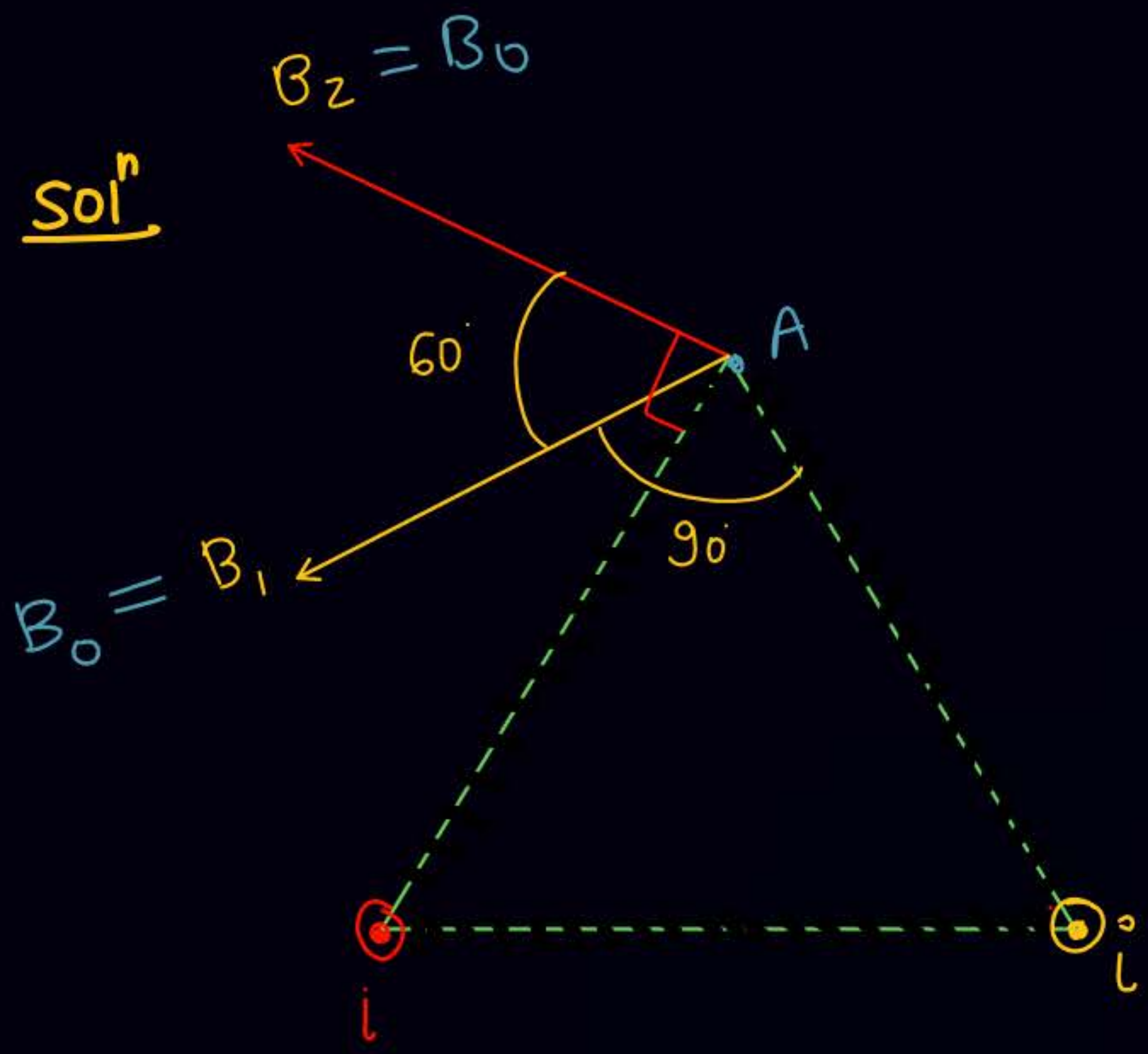
West

35

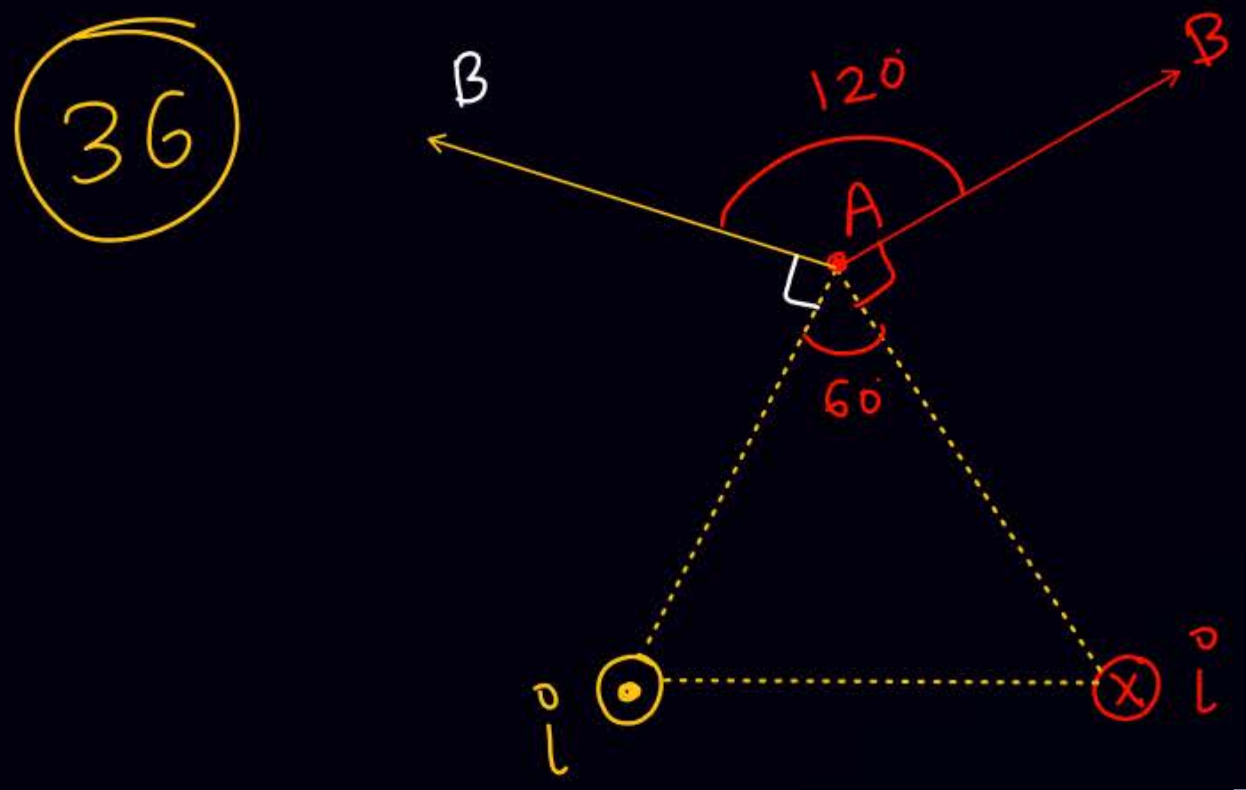
Q Two long wire having same current in same direction are parallel to each other having separation 'l'. find magnetic field at a point which is equidistance from both the wire. and Distance of point from wire is 'l'.

Sol

Sol^n



$$(B_A)_{net} = B_0\sqrt{3} = \frac{2ki\sqrt{3}}{l}$$



$$B_{net} = B = \frac{2ki}{l}$$

$$B_{center} = \frac{\mu_0 i}{2R}\sqrt{2}$$

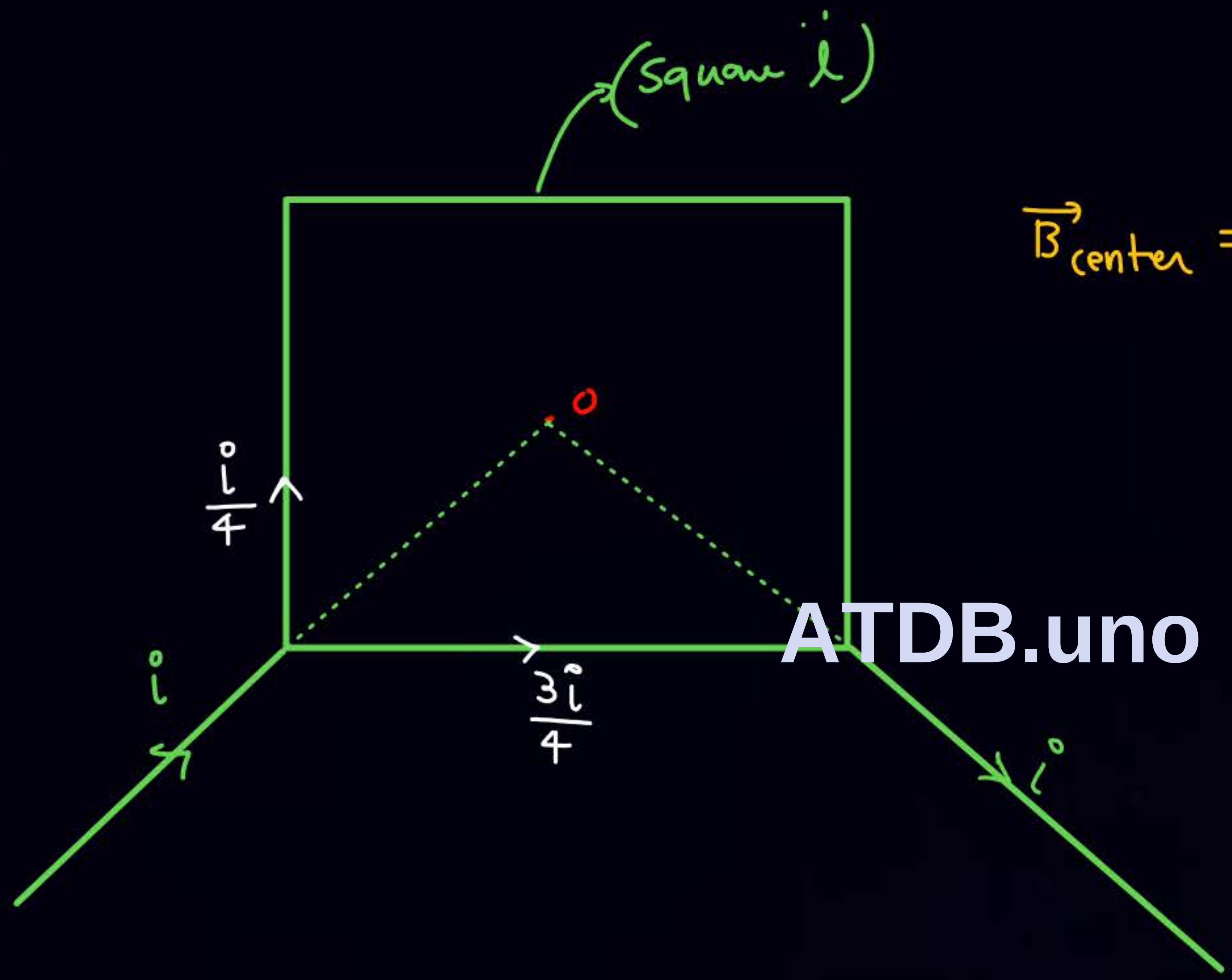
(36)

3 ring ≡ plane $\perp^{r}$ to each other

Center same at origin

$$B_{net} = \frac{\mu_0 i}{2R}\sqrt{3}$$

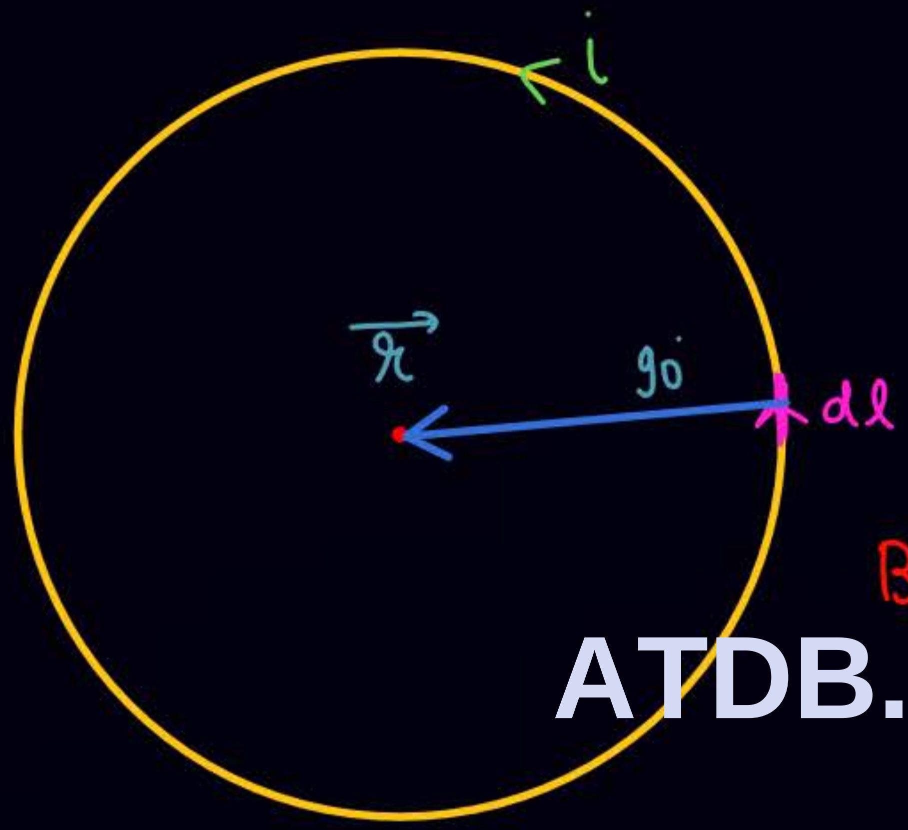
29



$$\vec{B}_{center} = \frac{K\,i/4}{l/2}\left(\frac{1}{\sqrt{2}}+\frac{1}{\sqrt{2}}\right)\times 3 \quad \otimes$$

$$+\ \frac{K\,3i/4}{l/2}\left(\frac{1}{\sqrt{2}}+\frac{1}{\sqrt{2}}\right) \quad \odot$$

$$= 0$$



$$d\vec{B} = \frac{k\, i\,(d\vec{l} \times \vec{r})}{r^3}$$

$$B_{net} = \int dB = \int \frac{k\, i\, dl\, r \sin 90}{r^3}$$

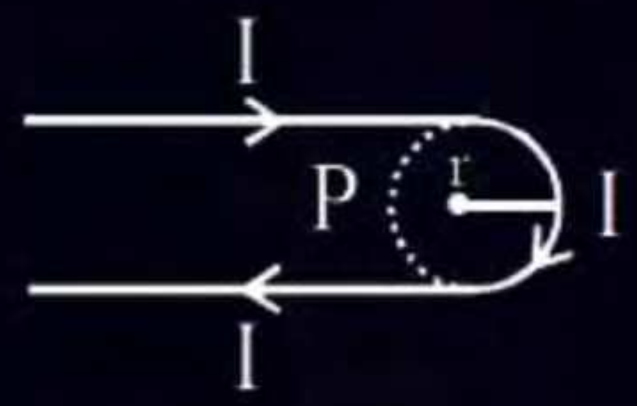
$$= \frac{k i}{r^2} \int dl = \frac{k i}{r^2} 2\pi r$$

$$= \frac{\mu_0}{4\pi} \frac{i}{r^2} 2\pi r = \frac{\mu_0 i}{2r}$$

QUESTION

A hairpin like shape as shown in figure is made by bending a long current carrying wire. What is the magnitude of a magnetic field at point P which lies on the centre of the semicircle?

[JEE Main-2021]



(1) $\frac{\mu_0 I}{4\pi r}(2-\pi)$

(2) $\frac{\mu_0 I}{4\pi r}(2+\pi)$

(3) $\frac{\mu_0 I}{2\pi r}(2+\pi)$

(4) $\frac{\mu_0 I}{2\pi r}(2-\pi)$

Ans : (2)

QUESTION

A current of 1.5 A is flowing through a triangle, of side 9 cm each. The magnetic field at the centroid of the triangle is: (Assume that the current is flowing in the clockwise direction). [JEE Main-2021]

(1) 3×10^{-7} T, outside the plane of triangle

(2) 23×10^{-7} T, outside the plane of triangle

(3) 23×10^{-5} T, inside the plane of triangle

(4) 3×10^{-5} T, inside the plane of triangle

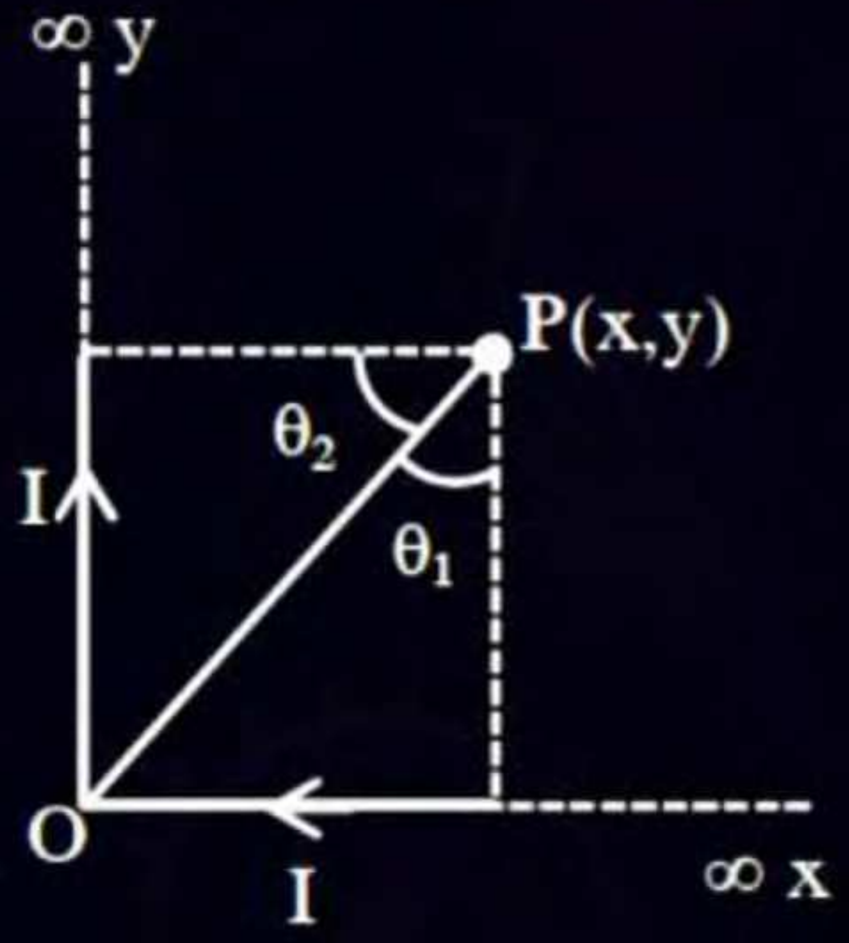
Ans : (4)

QUESTION

There are two infinitely long straight current carrying conductors and they are held at right angles to each other so that their common ends meet at the origin as shown in the figure given below. The ratio of current in both conductor is 1 : 1. The magnetic field at point P is ______.

[JEE Main-2021]

1. $\frac{\mu_0 I}{4\pi xy}\left[\sqrt{x^2+y^2}+(x+y)\right]$
2. $\frac{\mu_0 I}{4\pi xy}\left[\sqrt{x^2+y^2}-(x+y)\right]$
3. $\frac{\mu_0 Ixy}{4\pi}\left[\sqrt{x^2+y^2}-(x+y)\right]$
4. $\frac{\mu_0 Ixy}{4\pi}\left[\sqrt{x^2+y^2}+(x+y)\right]$



Ans : (1)

QUESTION

The electric current in a circular coil of 2 turns produces a magnetic induction B_1 at its centre. The coil is unwound and is rewound into a circular coil of 5 turns and the same current produces a magnetic induction B_2 at its centre. The ratio of B_2/B_1 is:

[JEE Main-2022]

(1) 5/2

(2) 25/4

(3) 5/4

(4) 25/2

Ans : (2)

QUESTION

B_X and B_Y are the magnetic field at the centre of two coils of two coils X and Y respectively, each carrying equal current. If coil X has 200 turns and 20 cm radius and coil Y has 400 turns and 20 cm radius, the ratio of B_X and B_Y is: [JEE Main-2022]

(1) 1 : 1

(2) 1 : 2

(3) 2 : 1

(4) 4 : 1

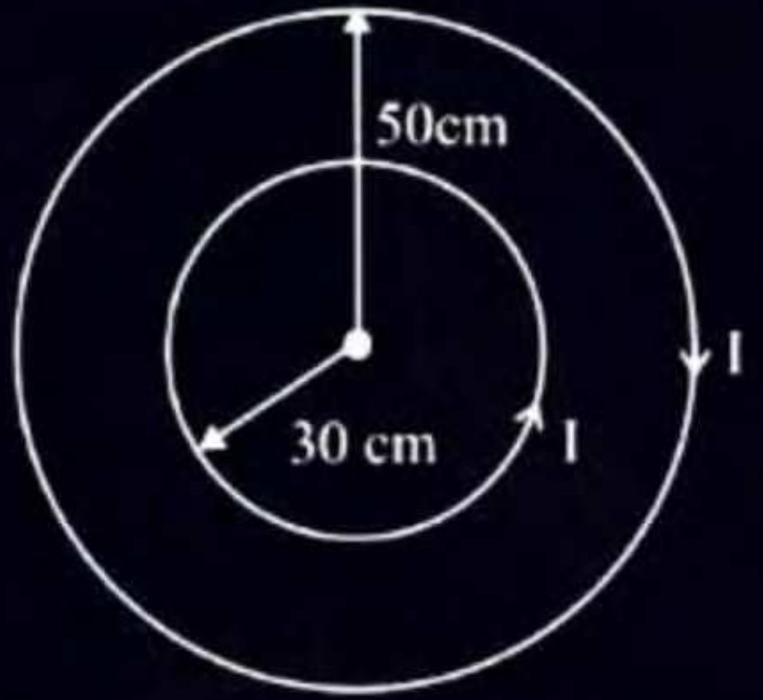
Ans : (2)

QUESTION

Two concentric circular loops of radii $r_1 = 30$ cm and $r_2 = 50$ cm are placed in X-Y plane as shown in the figure. A current $I = 7$A is flowing through them in the direction as shown in figure. The net magnetic moment of this system of two circular loops is approximately:

[JEE Main-2022]

1. $\frac{7}{2}\hat{k}Am^2$
2. $-\frac{7}{2}\hat{k}Am^2$
3. $7\hat{k}Am^2$
4. $-7\hat{k}Am^2$



Ans : (2)

QUESTION

Two long current carrying conductors are placed parallel to each other at a distance of 8 cm between them. The magnitude of magnetic field produced at mid-point between the two conductors due to current flowing in them is 300 μT. The equal current flowing in the two conductors is: [JEE Main-2022]

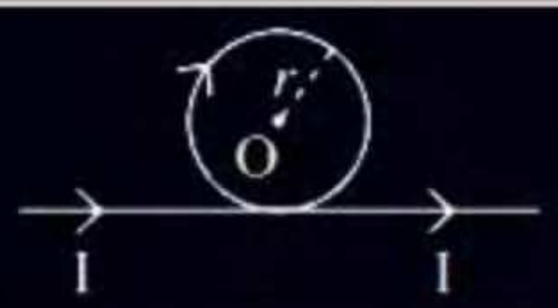
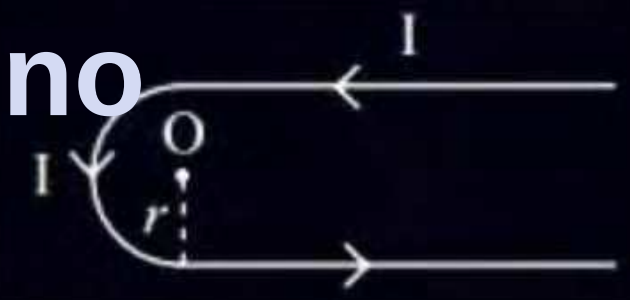
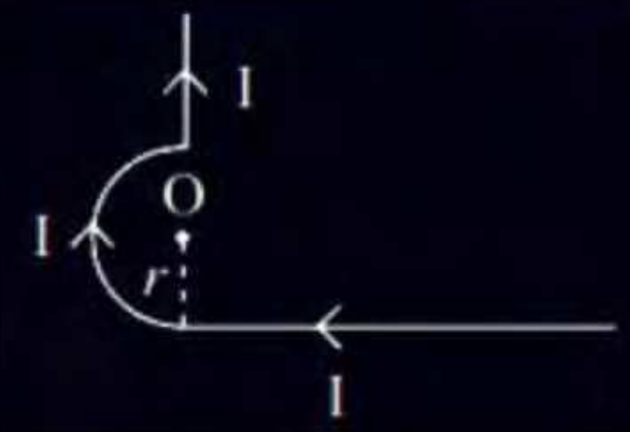
1. 30A in the same direction
2. 30A in the opposite direction
3. 60A in the opposite direction.
4. 300A in the opposite direction

Ans : (2)

QUESTION

Match List I with List II

Choose the correct answer from the option given below: **[25 January 2023 - Shift 1]**

	List - I (Current configuration)		List - II (Magnetic field at point O)
A		I.	$B_0 = \frac{\mu_0 I}{4\pi r}[\pi + 2]$
B		II.	$B_0 = \frac{\mu_0}{4}\frac{I}{r}$
C		III.	$B_0 = \frac{\mu_0 I}{2\pi r}[\pi - 1]$
D		IV.	$B_0 = \frac{\mu_0 I}{4\pi r}[\pi + 1]$

1. A–III, B–IV, C–I, D–II
2. A–I, B–III, C–IV, D–II
3. A–III, B–I, C–IV, D–II
4. A–II, B–I, C–IV, D–III

Ans : (3)

QUESTION

The magnitude of magnetic induction at mid-point O due to current arrangement as shown in Fig will be:

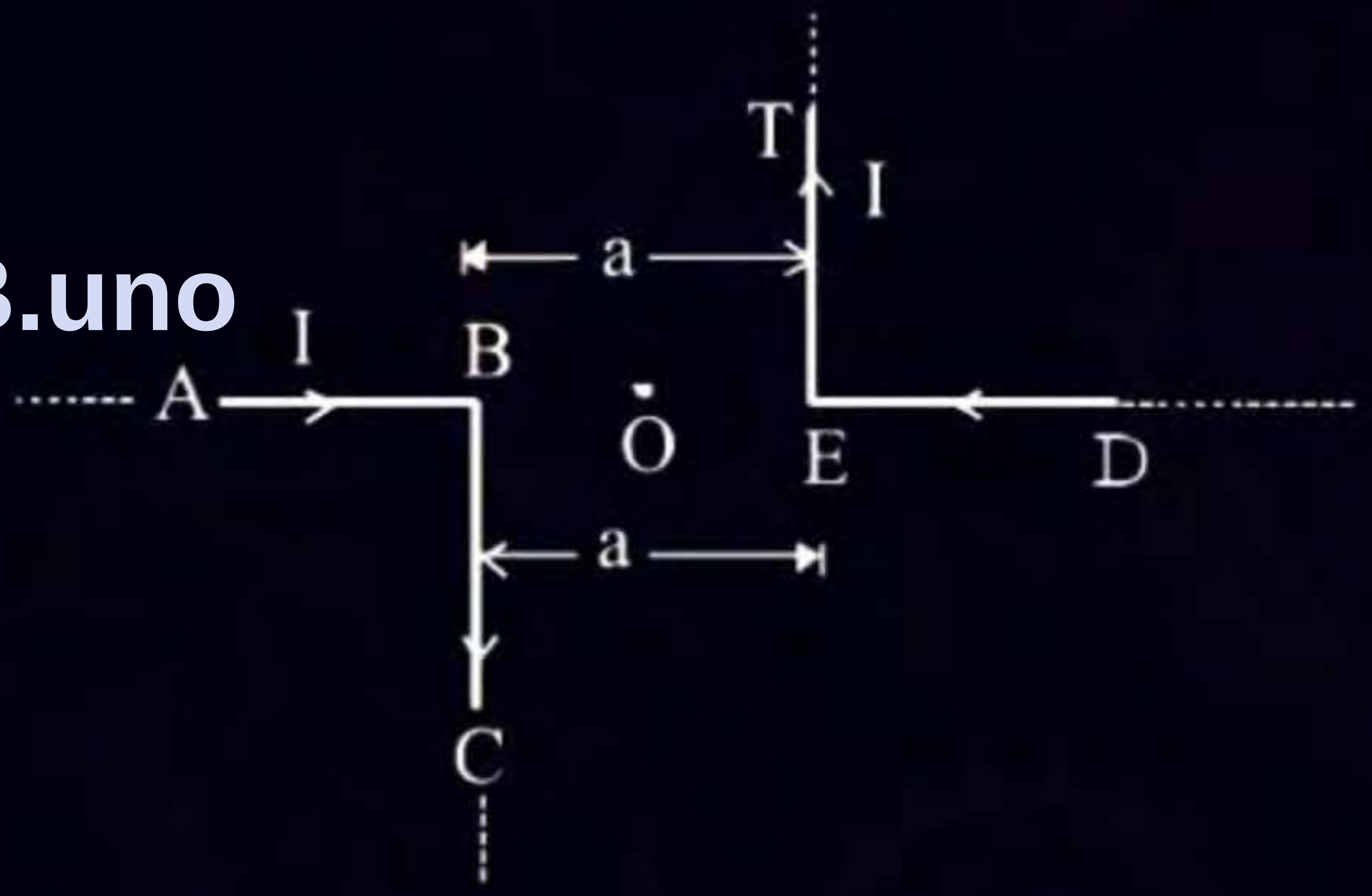
[29 January 2023 - Shift 1]

(1) $\frac{\mu_0 I}{2\pi a}$

(2) 0

(3) $\frac{\mu_0 I}{4\pi a}$

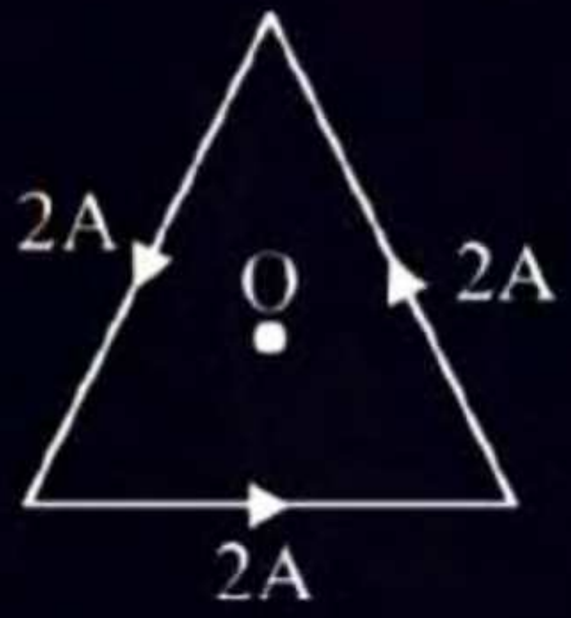
(4) $\frac{\mu_0 I}{\pi a}$



Ans : (4)

QUESTION

As shown in the figure, a current of 2A flowing in an equilateral triangle of side $4\sqrt{3}$ cm. The magnetic field at the centroid O of the triangle is:
(Neglect the effect of earth's magnetic field). [30 January 2023 - Shift 2]



1. $4\sqrt{3} \times 10^{-4}$ T
2. $4\sqrt{3} \times 10^{-5}$ T
3. $\sqrt{3} \times 10^{-4}$ T
4. $3\sqrt{3} \times 10^{-5}$ T

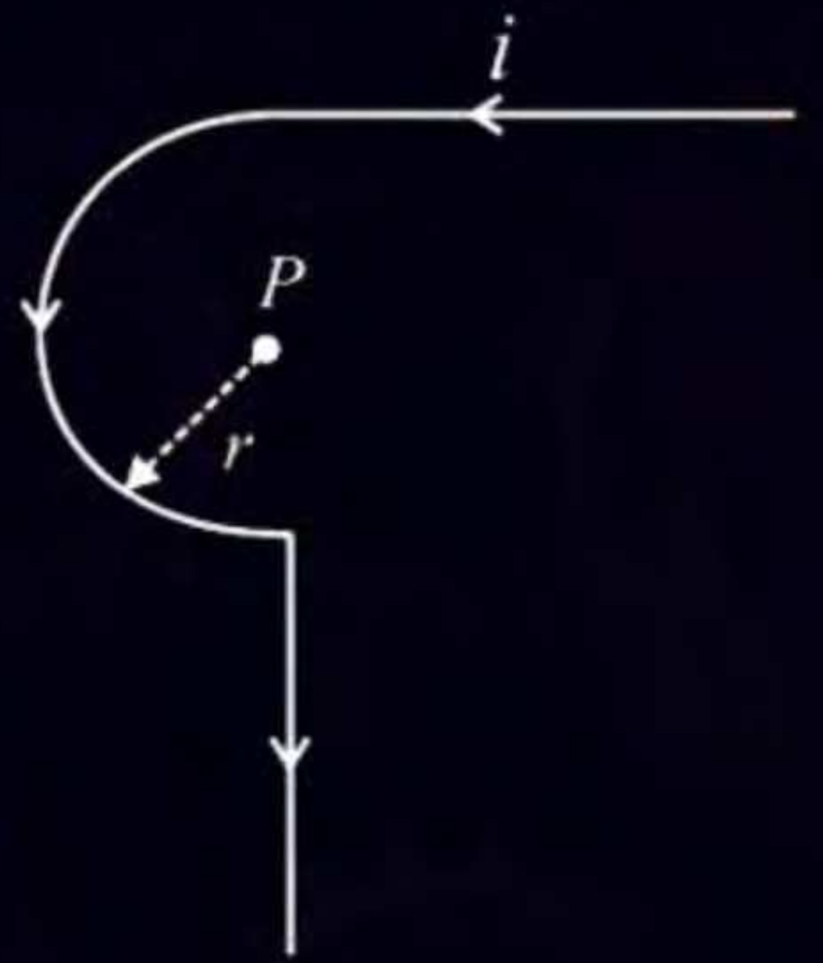
Ans : (4)

QUESTION

Find the magnetic field at the point P in figure. The curved portion is a semicircle connected to two long straight wires.

[01 February 2023 - Shift 1]

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



Ans : (3)

QUESTION

As shown in the figure, a long straight conductor with semicircular arc of radius $\frac{\pi}{10}$ m is carrying current I = 3 A. The magnitude of the magnetic field. at the center O of the arc is: (The permeability of the vacuum = $4\pi \times 10^{-7}$ NA^{-2}) **[01 February 2023 - Shift 2]**

(1) 6 μT

(2) 1 μT

(3) 4 μT

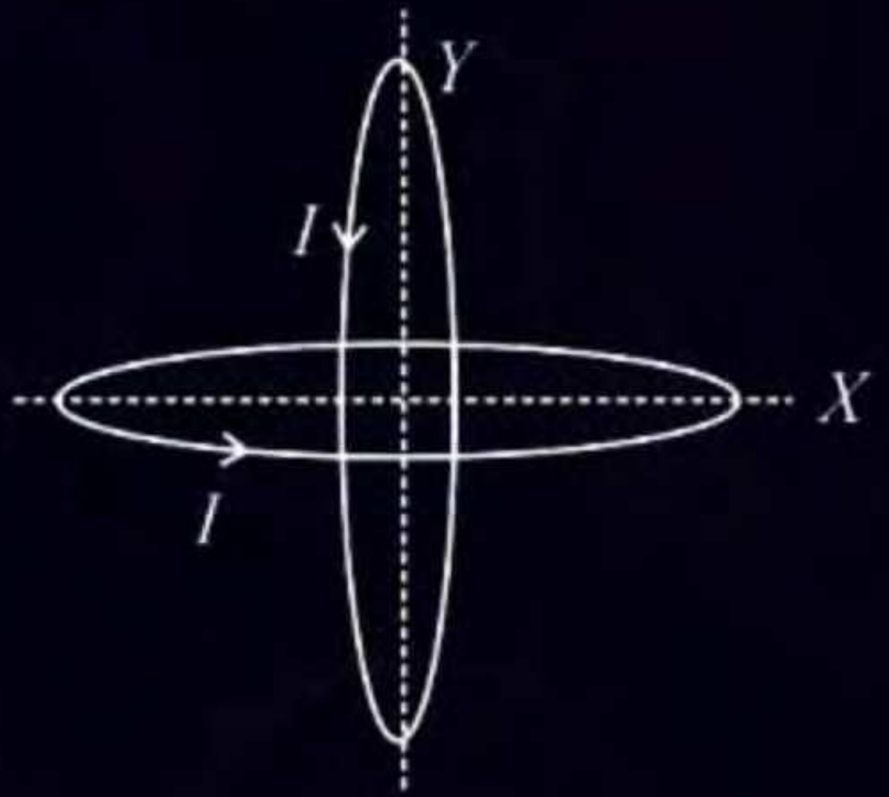
(4) 3 μT

Ans : (4)

QUESTION

Two identical circular wires of radius 20 cm and carrying current $\sqrt{2}$ A are placed in perpendicular planes as shown in figure. The net magnetic field at the centre of the circular wires is ________ $\times 10^{-8}$ T.

(Take $\pi = 3.14$) **[06 April 2023 - Shift 1]**



Ans : (628)

QUESTION

A straight wire carrying a current of 14 A is bent into a semicircular arc of radius 2.2 cm as shown in the figure. The magnetic field produced by the current at the centre O of the arc is ______ $\times 10^{-4}$ T.

[10 April 2023 - Shift 2]

Ans : (2)

QUESTION

A regular polygon of 6 sides is formed by bending a wire of length 4π meter. If an electric current of $4\pi\sqrt{3}$ A is flowing through the sides of the polygon, the magnetic field at the centre of the polygon would be $x \times 10^{-7}$ T. The value of x is ______.

[01 Feb. 2024 - Shift 1]

Ans : (72)

QUESTION

A wire A, bent in the shape of an arc of a circle, carrying a current of 2A and having radius 2 cm and another wire B, also bent in the shape of arc of a circle, carrying a current of $3A$ and having radius of 4 cm, are placed as shown in the figure. The ratio of the magnetic fields due to the wires A and B at the common centre O is:

[JEE Main-2020]

(1) 4 : 6

(2) 6 : 4

(3) 6 : 5

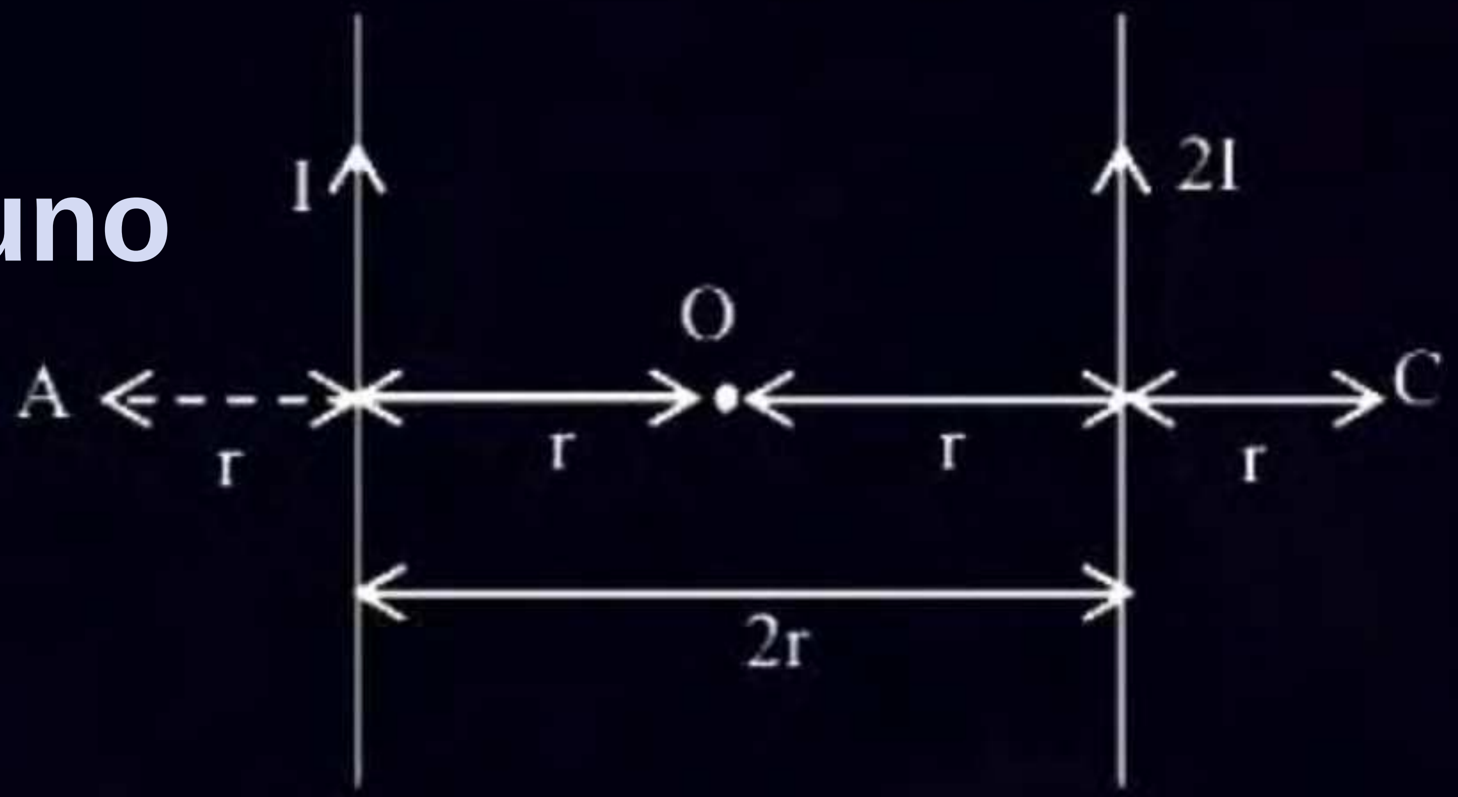
(4) 2 : 5

Ans : (3)

QUESTION

Two parallel long current carrying wire separated by a distance 2r are shown in the figure. The ratio of magnetic field at A to the magnetic field produced at C is x/7. The value of x is _____.

[04 Apr. 2024 - Shift 2]



Ans : (5)

QUESTION

Two long, straight wires carry equal currents in opposite directions as shown in figure. The separation between the wires is 5.0 cm. The magnitude of the magnetic field at a point P midway between the wires is _______ μT.

(Given : $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}). [27 Jan. 2024 - Shift 1]

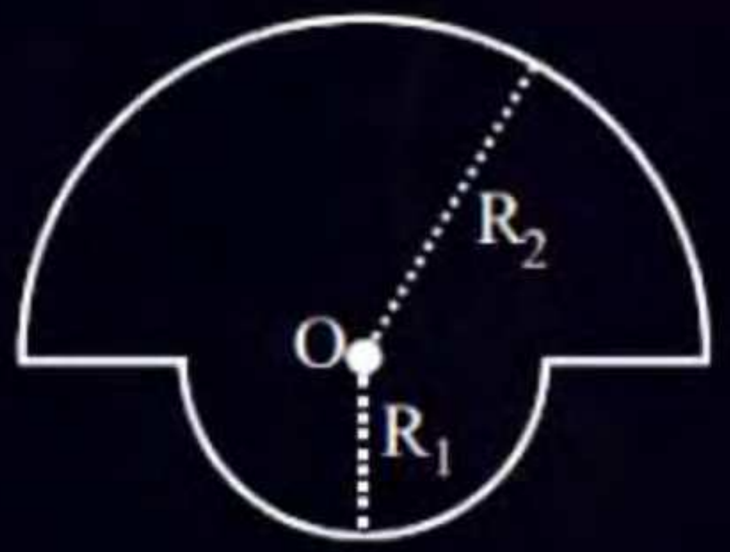
Ans : (160)

QUESTION

The magnetic field at the centre of a wire loop formed by two semicircular wires of radii $R_1 = 2\pi$ m and $R_2 = 4\pi$ m carrying current I = 4A as per figure given below is $\alpha \times 10^{-7}$ T. The value of α is ______.

(Centre O is common for all segments).

[27 Jan. 2024 - Shift 2]



Ans : (3)

QUESTION

The current of 5 A flows in a square loop of sides 1 m is placed in air. The magnetic field at the centre of the loop is $X\sqrt{2} \times 10^{-7}$ T. The value of X is ________.

[30 Jan. 2024 - Shift 2]

Ans : (40)

QUESTION

Two circular coils P and Q of 100 turns each have same radius of π cm. The currents in and are 1 A and 2 A respectively. P and Q are placed with their planes mutually perpendicular with their centers coincide. The resultant magnetic field induction at the center of the coils is $\sqrt{x}$ mT, where x = _____.

(Use $\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1}) [31 Jan. 2024 - Shift 2]

Ans : (20)

Home Work

- HCV (magnetism) → (page 249), (2–8), 10, 11, 13, 15, 14, 17, 18, 19, 21, 22, 23, (24)*,
- Grav. Jm PYQ
- magnetism Jm PYQ Attached.


THANK
YOU
ATDB.uno