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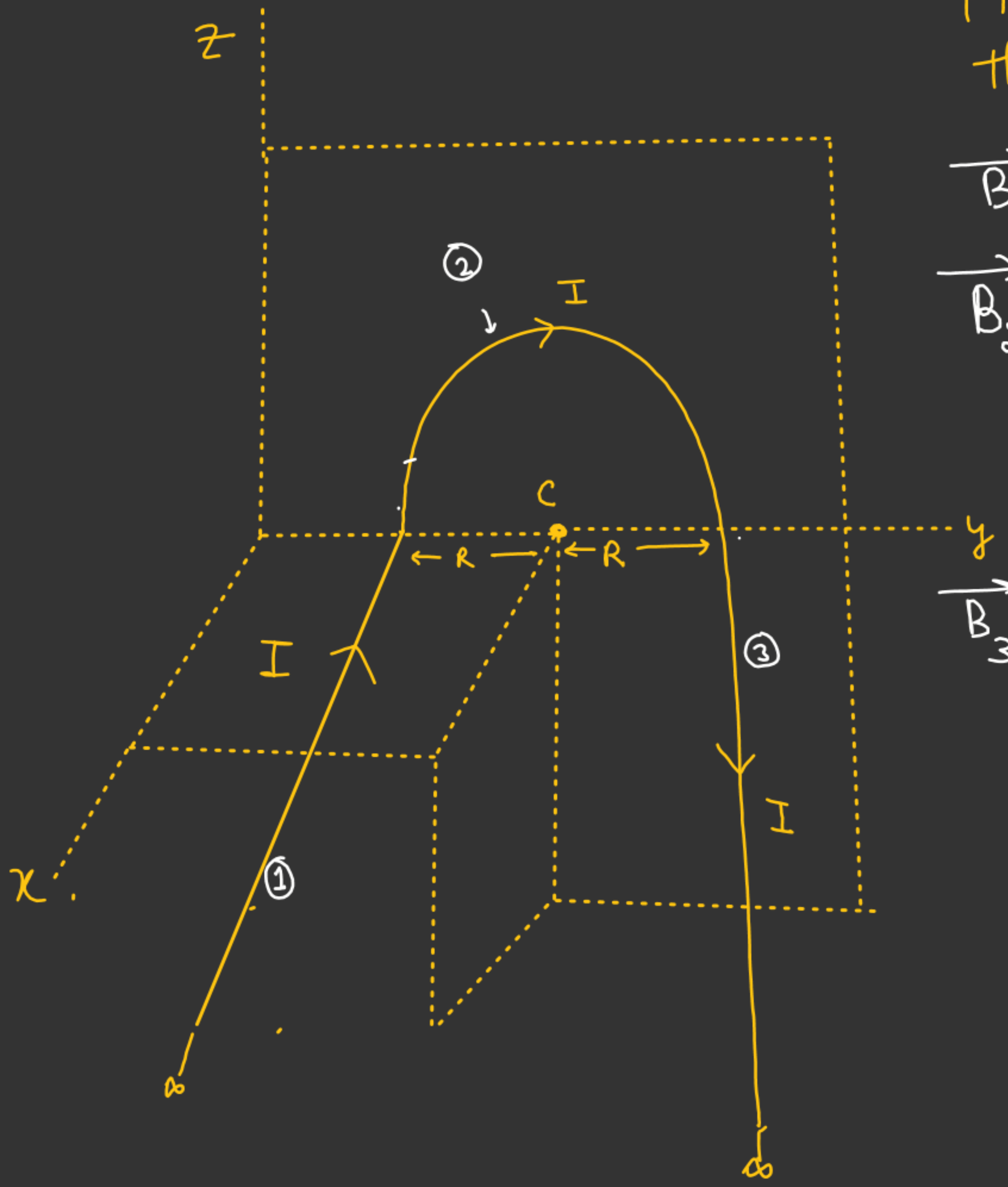


Find net Magnetic field due to the wire at C.

$$\vec{B}_1 = \frac{\mu_0 I}{4\pi R}(-\hat{k})$$

$$\vec{B}_2 = \frac{\mu_0 I}{4\pi R}(\pi)(-\hat{i})$$

$$= \frac{\mu_0 I}{4R}(-\hat{i})$$

$$\vec{B}_3 = \frac{\mu_0 I}{4\pi R}(-\hat{i})$$

$$\vec{B}_{net} = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$$

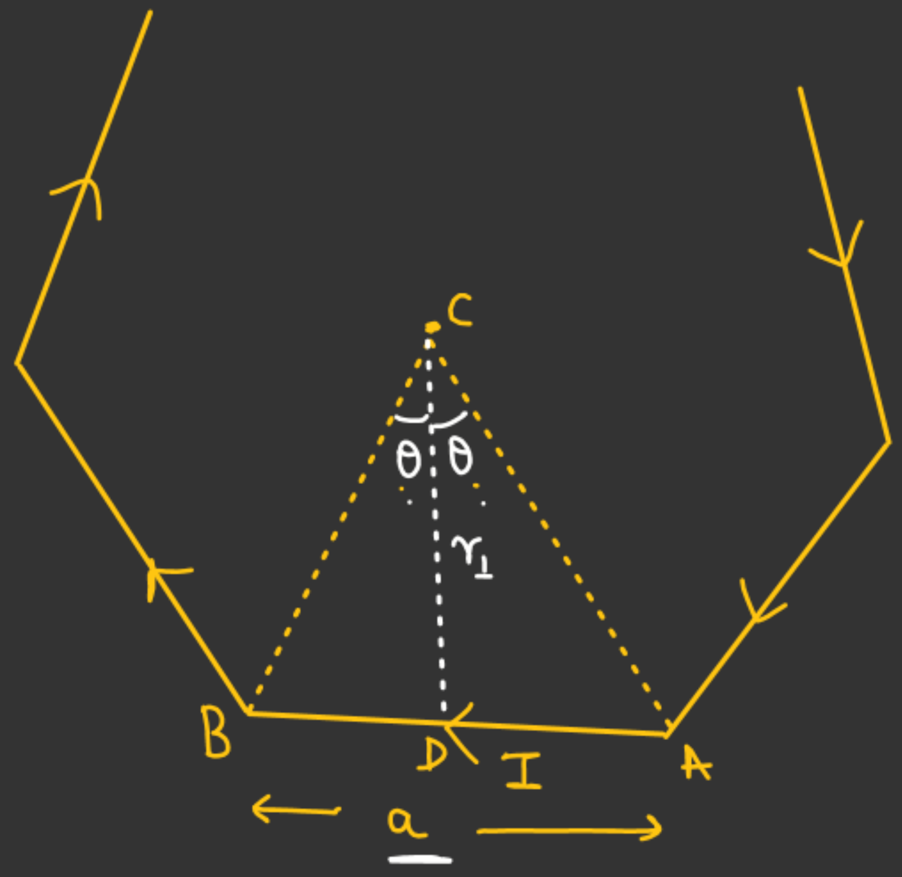
$$\vec{B}_{net} = \frac{\mu_0 I}{4\pi R}(-\hat{k}) - \hat{i}\left[\frac{\mu_0 I}{4R} + \frac{\mu_0 I}{4\pi R}\right]$$

$$\vec{B}_{net} = \frac{\mu_0 I}{4\pi R}\left[-\hat{k} - \hat{i}(1+\pi)\right]$$

$$\vec{B}_{net} = -\frac{\mu_0 I}{4\pi R}\left[(\pi+1)\hat{i} + \hat{k}\right]$$

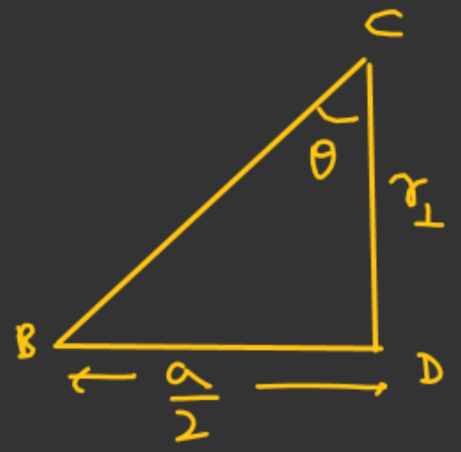
Magnetic field at the Center of n- Sided regular polygon :→

$$\alpha = \beta = \theta$$



$$2\theta = \frac{2\pi}{n}$$

$$\theta = \left(\frac{\pi}{n}\right)$$



$$\cot\theta = \frac{r_1}{a/2}$$

$$r_1 = \frac{a}{2}\cot\theta$$

$$B = \frac{\mu_0 I}{4\pi\left(\frac{a}{2}\cot\theta\right)} \cdot 2\sin\theta$$

$$B = \left(\frac{\mu_0 I}{\pi a}\right)\frac{\sin\theta}{(\cot\theta)}$$

$$B = \frac{\mu_0 I}{\pi a}\left[\sin\theta . \tan\theta\right]$$

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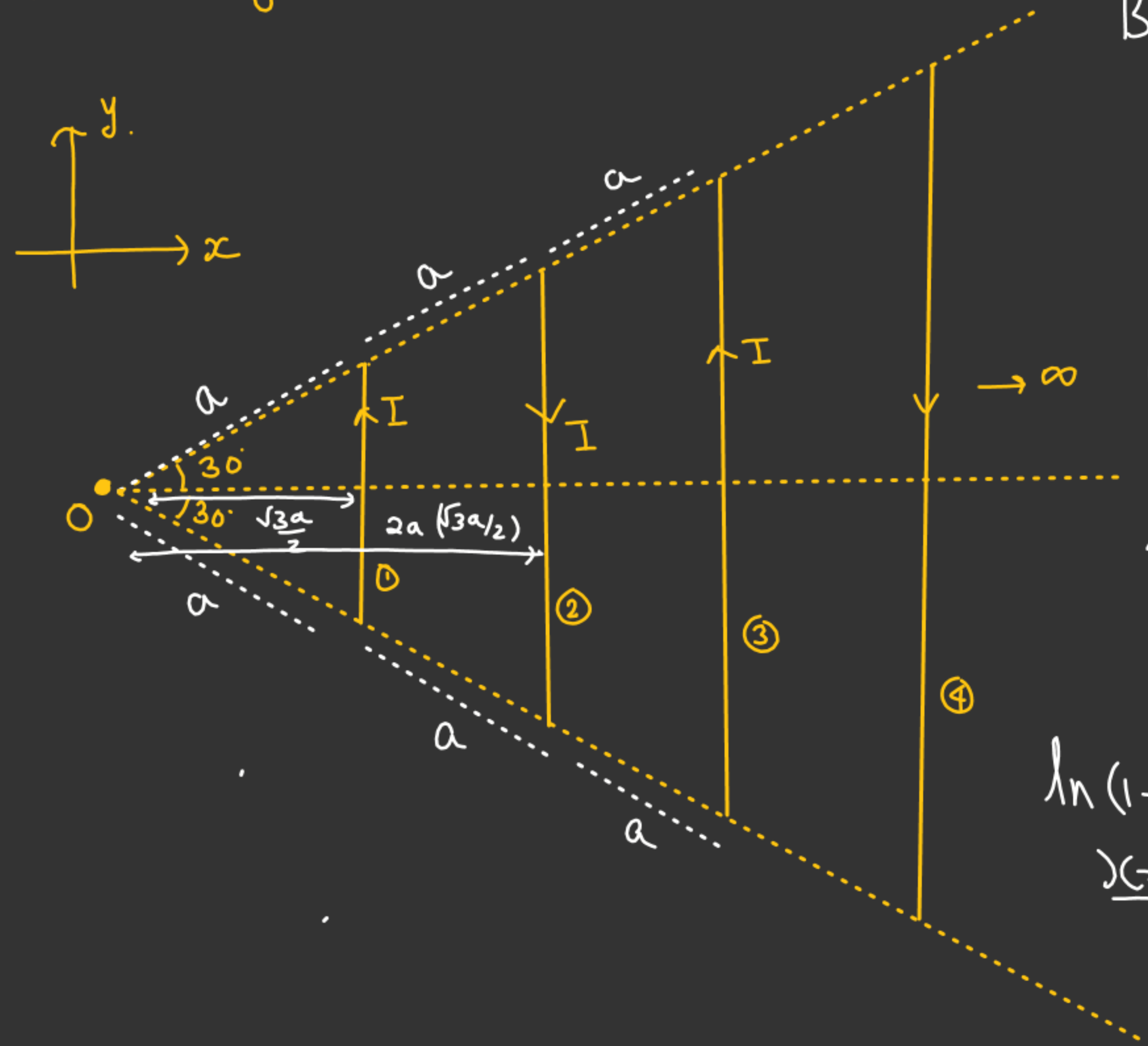
Find Magnetic field at O.



$$B_{net} = \frac{\mu_0 I}{4\pi\left(\frac{\sqrt{3}a}{2}\right)}(2\sin 30^\circ) - \frac{\mu_0 I}{4\pi\, 2a\left(\frac{\sqrt{3}}{2}\right)}\cdot(2\sin 30^\circ)$$

$$+ \frac{\mu_0 I}{4\pi(3a)\frac{\sqrt{3}}{2}}\cdot(2\sin 30^\circ) \ldots$$

$$B_{net} = \frac{\mu_0 I}{4\pi\left(\frac{\sqrt{3}a}{2}\right)} \times \underline{2\sin 30^\circ}\left[1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} \cdots \infty\right]$$

$$\Downarrow$$

$$\ln 2$$

$$B_{net} = \frac{\mu_0 I}{2\pi\sqrt{3}a}\ln 2$$

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5} \ldots$$

$\underline{x = 1}$

$$\ln(2) = \left(1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5}\right)$$

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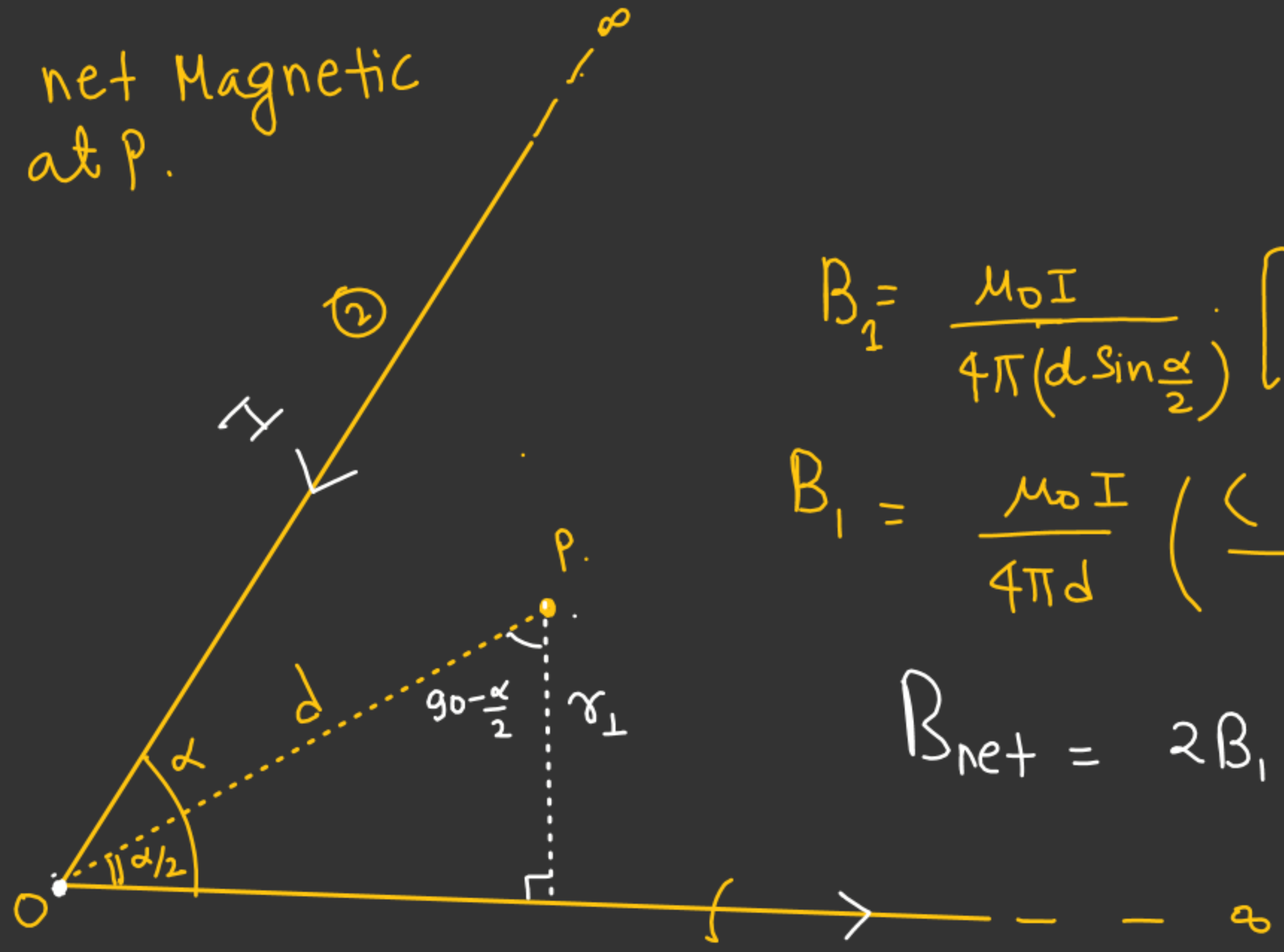
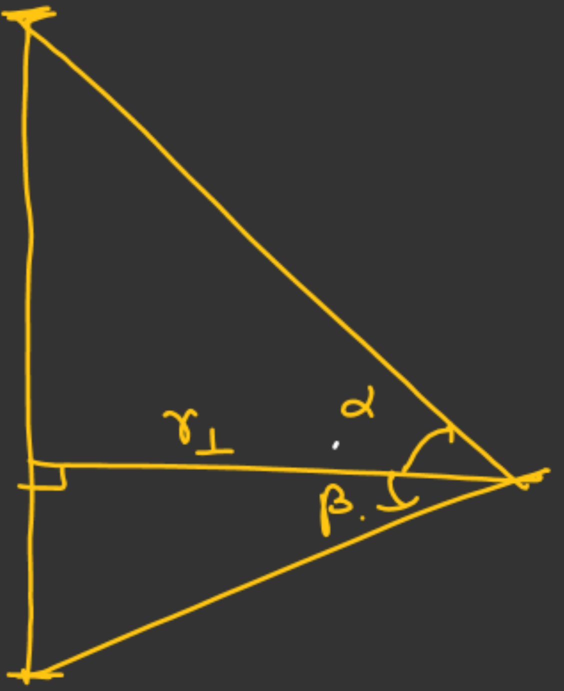
Find net Magnetic field at P.



$$\sin\frac{\alpha}{2} = \frac{r_\perp}{d}$$

$$r_\perp = d\sin(\alpha/2)$$

$$B = \frac{\mu_0 I}{4\pi d}(\sin\alpha + \sin\beta)$$



$$B_1 = \frac{\mu_0 I}{4\pi\left(d\sin\frac{\alpha}{2}\right)}\left[\sin(90 - \alpha/2) + \sin 90\right]$$

$$B_1 = \frac{\mu_0 I}{4\pi d}\left(\frac{(1+\cos\alpha/2)}{(\sin\alpha/2)}\right)$$

$$B_{net} = 2B_1 = \frac{\mu_0 I}{2\pi d}\left[\frac{1+\cos\alpha/2}{\sin\alpha/2}\right] \text{ Ans.}$$

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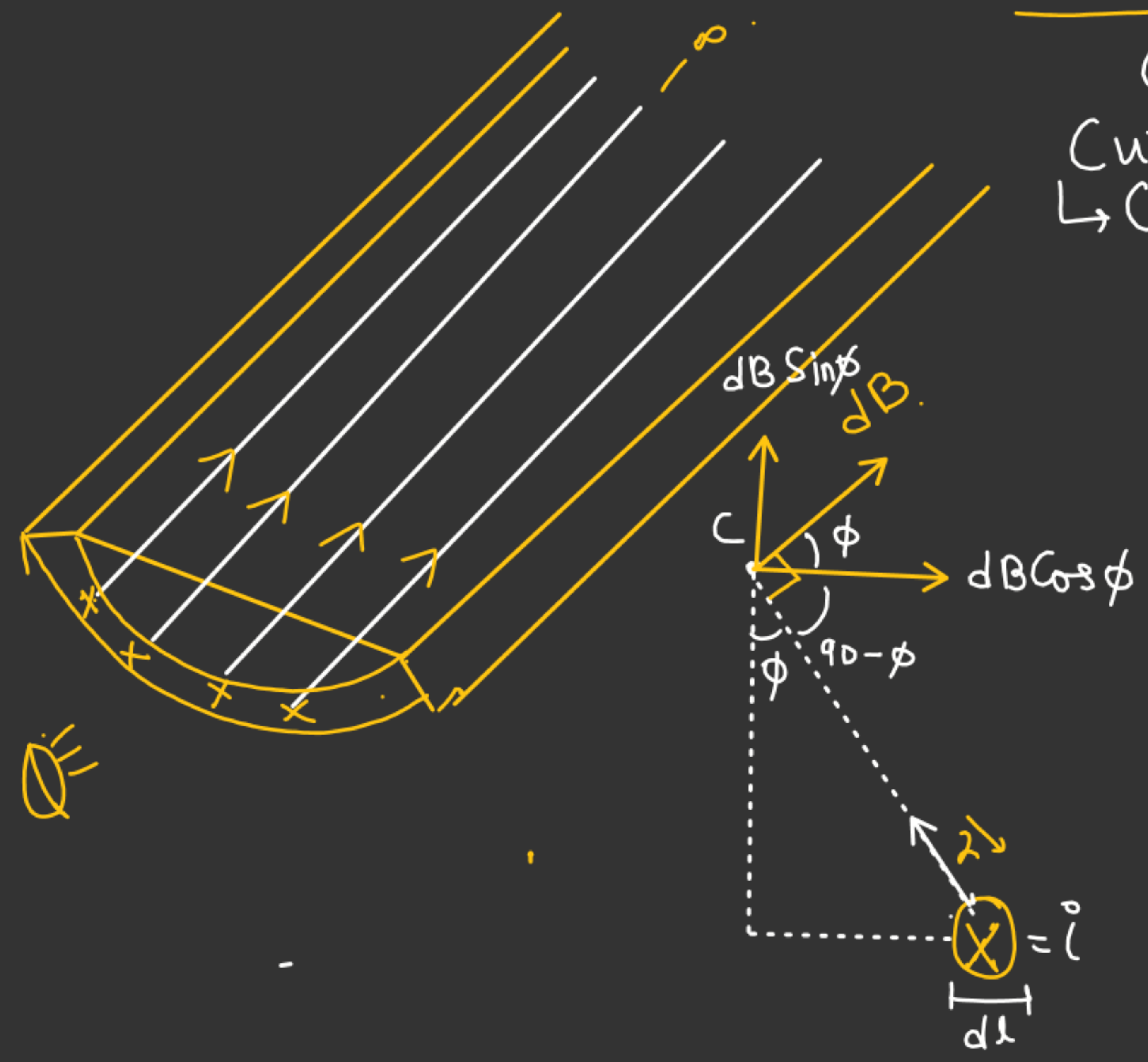
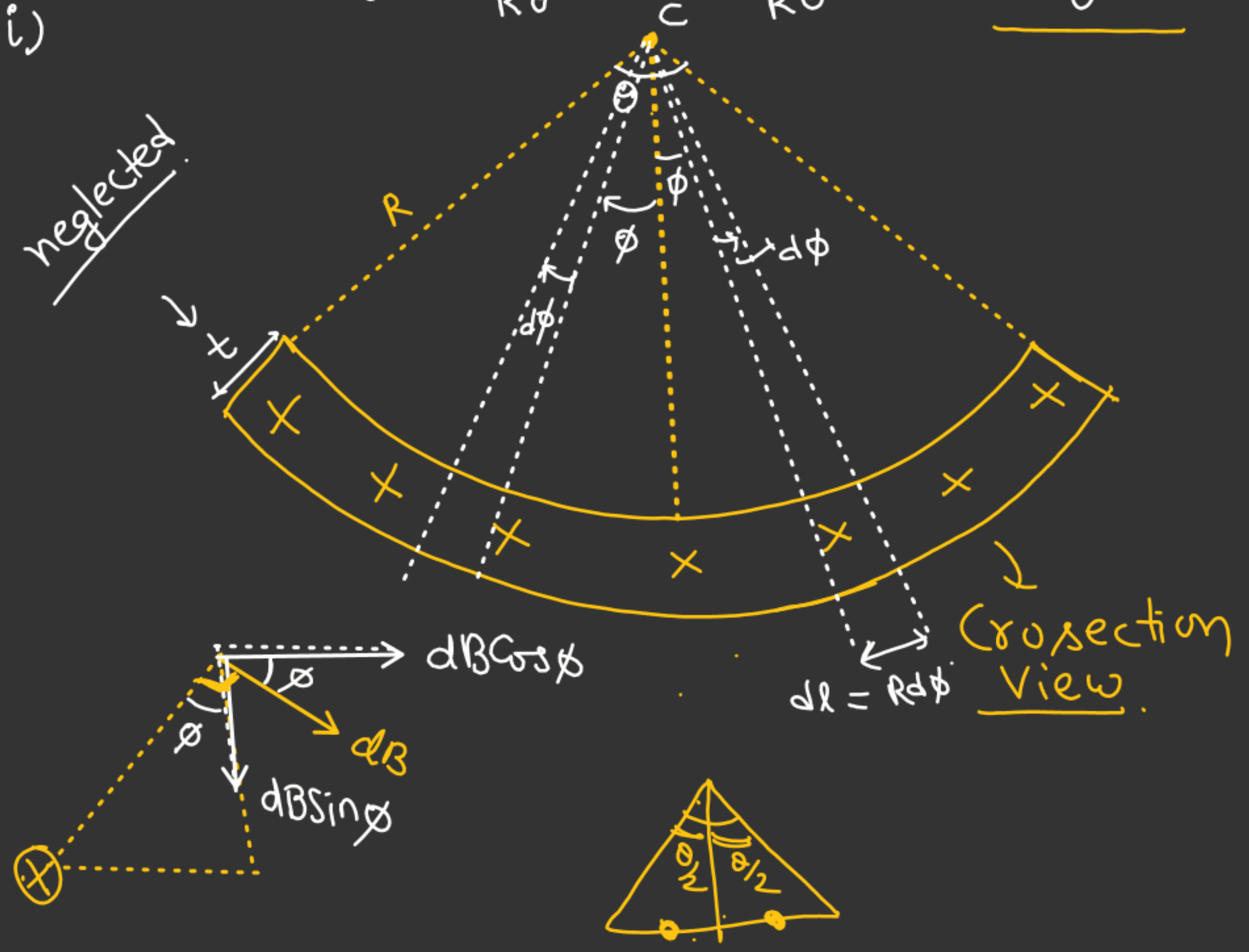
Total Current = I.

Current per Unit length $= \left(\frac{I}{R\theta}\right)$

Current in dl length $= \frac{I}{R\theta} \times dl = \frac{I}{R\theta} \times R\,d\phi = \left(\frac{I}{\theta} \cdot d\phi\right)$

↳ (i)





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for infinite wires.

$$dB = \frac{\mu_0 i}{2\pi R} \qquad i = \left(\frac{I}{\theta}\,d\phi\right)$$

$$dB_{net} = 2\,dB\cos\phi$$

$$dB_{net} = \cancel{2} \times \frac{\mu_0}{\cancel{2}\pi R}\left(\frac{I}{\theta}\right)\cos\phi\,d\phi$$

$$\int_0^{B_{net}} dB_{net} = \left(\frac{\mu_0 I}{\pi R}\right)\frac{1}{\theta}\int_0^{\theta/2}\cos\phi\,d\phi$$

$$B_{net} = \frac{\mu_0 I}{\pi R}\,\frac{[\sin\theta]_0^{\theta/2}}{\theta}$$

$$\boxed{B_{net} = \frac{\mu_0 I}{\pi R}\,\frac{\sin(\theta/2)}{\theta}}$$

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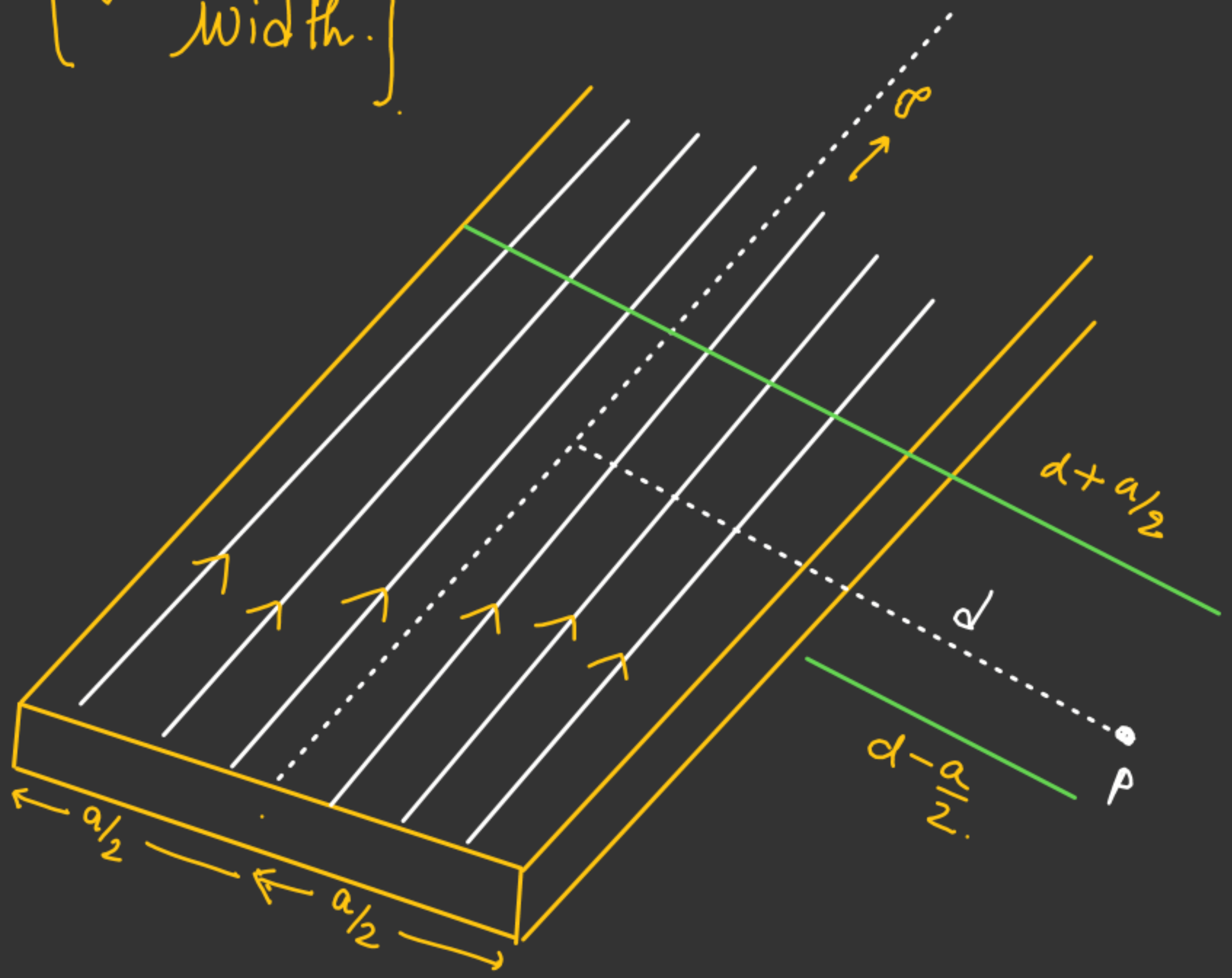
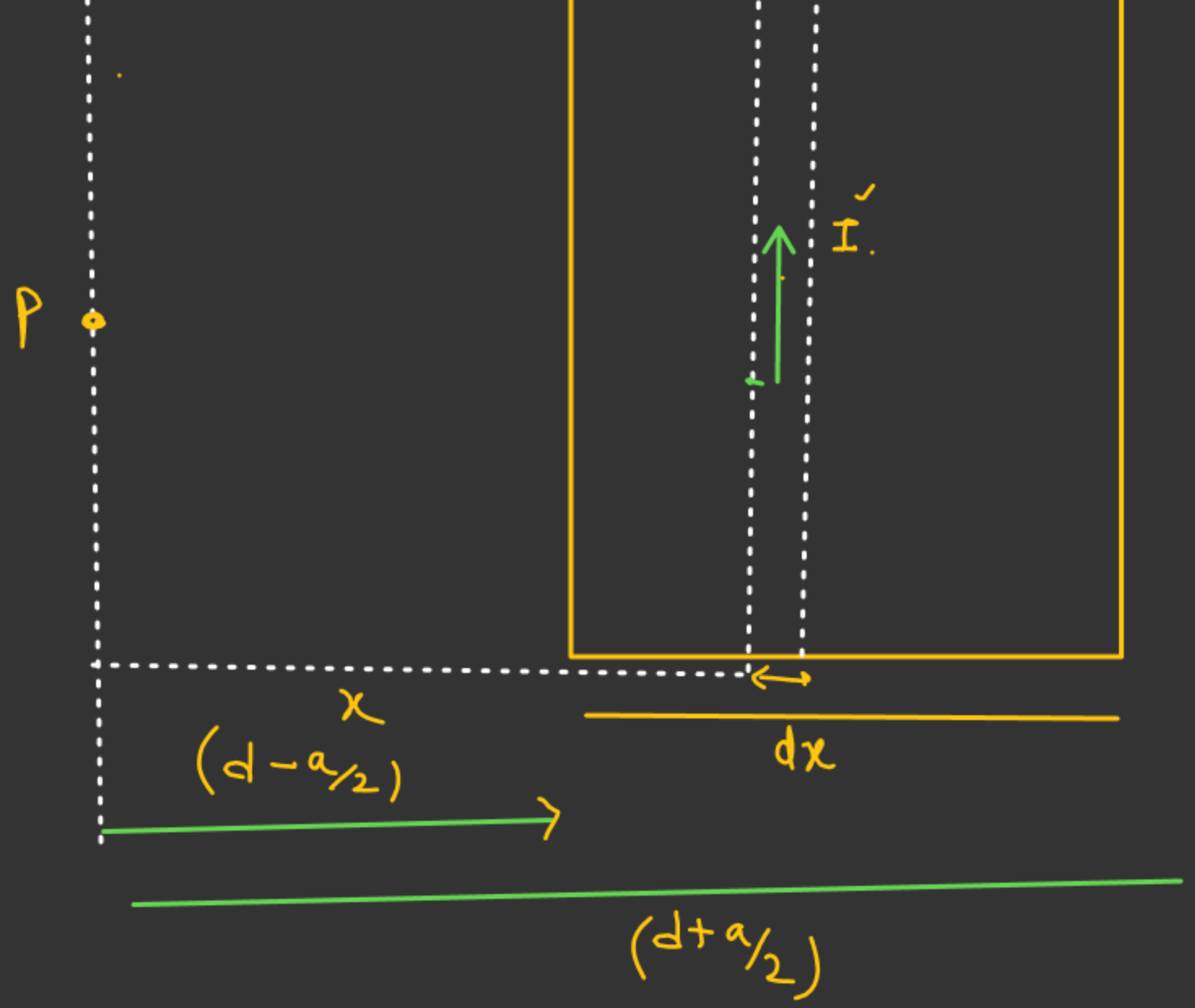
[J = Current per Unit Width.]



$I = J\,dx$

$$\int_0^B dB = \int_{d-\frac{a}{2}}^{d+a/2} \frac{\mu_0 J\,dx}{2\pi x} \Rightarrow B = \frac{\mu_0 J}{2\pi} \ln\left(\frac{d+a/2}{d-a/2}\right)$$



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Homework.

Module/Sheet (

✓ Ex-1 1, 2, 3, 5, 9, 10, 11, 13, 14, 15, 17,

✓ Ex-2 → 14, 15, 16, 17, 23, 24, 25, 26, 28