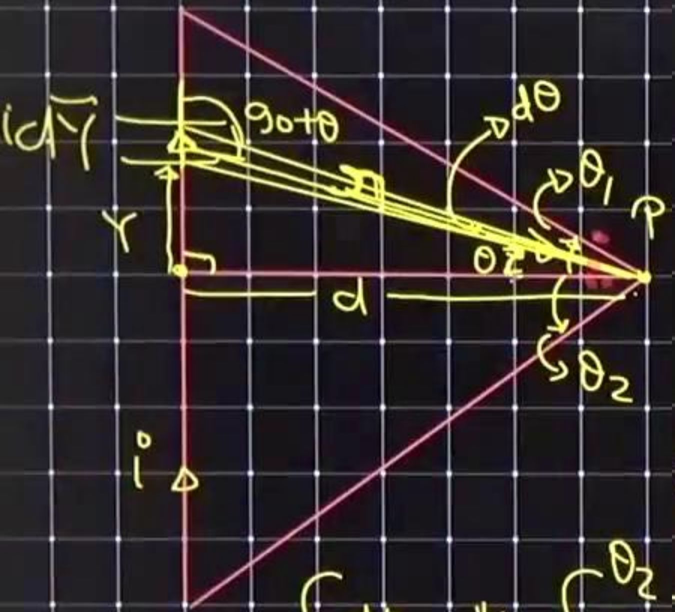
Magnetic field due to finite current carrying wire :



$$dB = \frac{\mu_0 i}{4\pi}\frac{dY \sin(90+\theta)}{r^2}$$

$$dB = \frac{\mu_0 i}{4\pi}\frac{dY \cos\theta}{r^2}$$

$$dB = \frac{\mu_0 i}{4\pi}\frac{[d \sec^2\theta\, d\theta]\cos\theta}{(d\sec\theta)^2}$$

$$dB = \frac{\mu_0 i}{4\pi}\frac{d \sec^2\theta \cos\theta\, d\theta}{d^2 \sec^2\theta}$$

$$\int dB = \frac{\mu_0 i}{4\pi d}\int_{-\theta_2}^{\theta_1} \cos\theta\, d\theta$$

$$\int dB = \frac{\mu_0}{4\pi d}\int_{-\theta_1}^{\theta_2} \cos\theta\, d\theta$$

$$B = \frac{\mu_0 i}{4\pi d}\left[\sin\theta\right]_{-\theta_2}^{\theta_1}$$

$$B = \frac{\mu_0 i}{4\pi d}\left[\sin\theta_1 - (\sin(-\theta_2))\right]$$

$$\boxed{B = \frac{\mu_0 i}{4\pi d}(\sin\theta_1 + \sin\theta_2)}$$

$$\tan\theta = \frac{Y}{d}$$

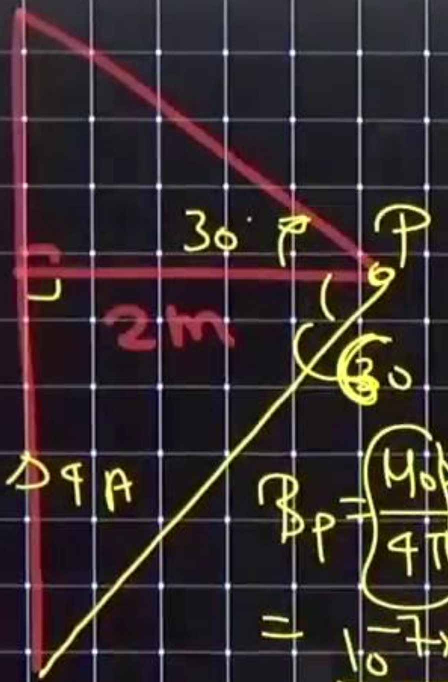
$$Y = d\tan\theta$$

$$dY = d\sec^2\theta\, d\theta$$

$$\cos\theta = \frac{d}{r}$$

$$r = \frac{d}{\cos\theta}$$

$$r = d\sec\theta$$



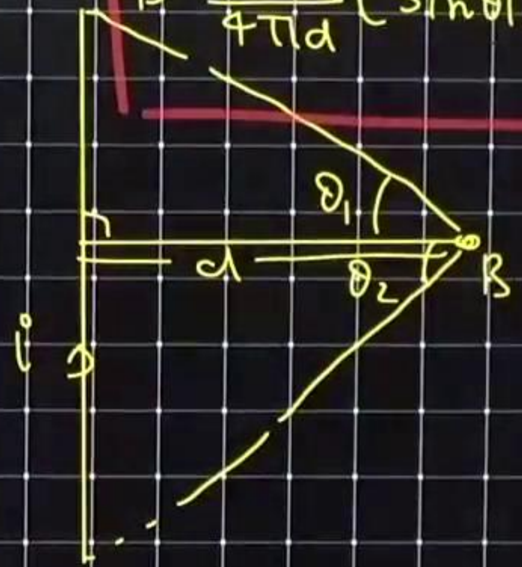
$$B_P = \frac{\mu_0 \times 4}{4\pi \times 2}\left[\sin 30 + \sin 60\right]$$

$$= \frac{10^{-7}\times 4}{2}\left[\frac{1}{2} + \frac{\sqrt{3}}{2}\right]$$

$$= \frac{10^{-7}\times 4\,(1+\sqrt{3})}{2 \times 2}$$

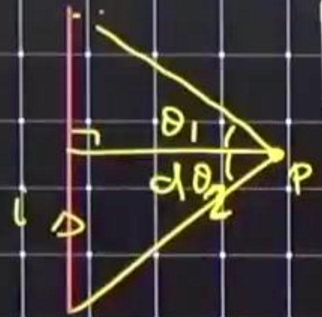
$$= (1+\sqrt{3})\times 10^{-7}\,T$$

$$B = \frac{\mu_0 i}{4\pi d}\left[\sin\theta_1 + \sin\theta_2\right]$$

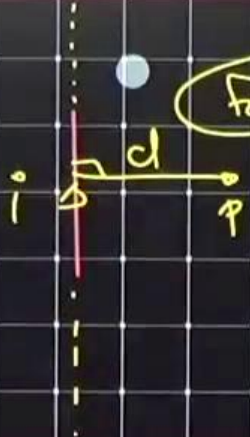


$$B = 2.732\times 10^{-7}\,T$$

Finite wire



$$B_P = \frac{\mu_0 i}{4\pi d}(\sin\theta_1 + \sin\theta_2)$$



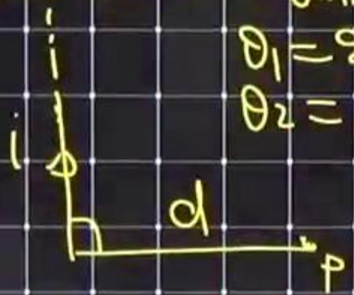
$\theta_1 = 90$, $\theta_2 = 90$

For infinite wire

$$B_P = \frac{\mu_0 i}{4\pi d}(\sin 90 + \sin 90)$$

$$B_P = \frac{\mu_0 i}{2\pi d}$$

For Semi-Infinite wire



$\theta_1 = 90$

$\theta_2 = 0$

$$B_P = \frac{\mu_0 i}{4\pi d}(\sin\theta_1 + \sin\theta_2)$$

$$B_P = \frac{\mu_0 i}{4\pi d}$$

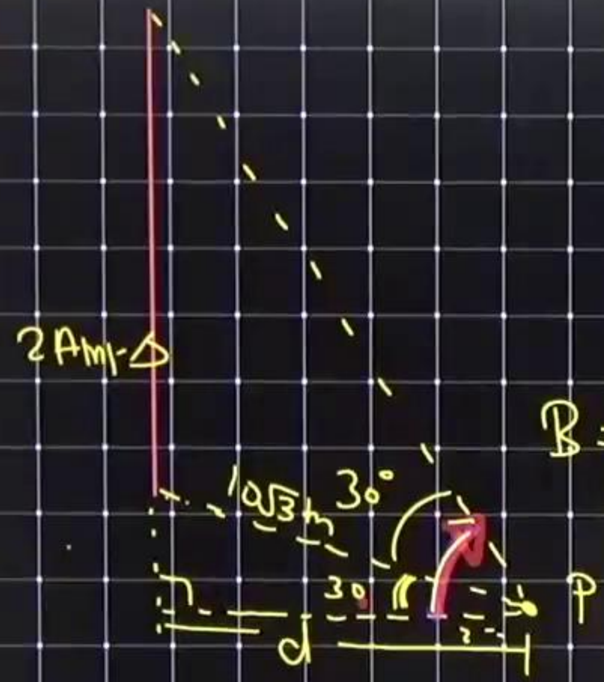
$d \rightarrow$ Perpendicular distance from point [where magnetic field obtain)

On line

$\theta_1 \rightarrow$ Angle b/w Perpendicular dista
line to upper point of wire.

$\theta_2 \rightarrow$ Angle b/w Perpendicular distance
to lower point of wire

Q2)



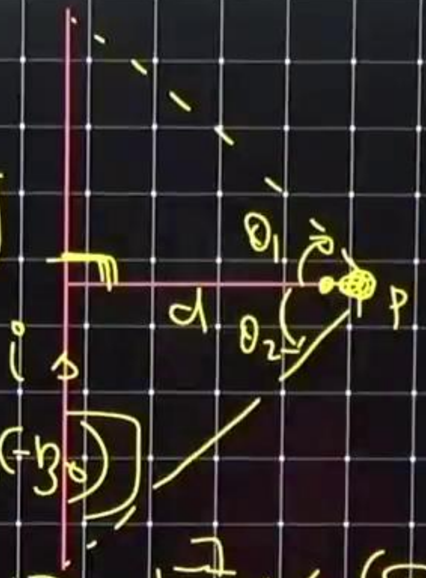
$\theta_1 = ? = 60°$

$\theta_2 = ?$ [$-30°$]

$\theta_2 = -30°$

$i = ?$

$d = ?$ 15 m



$$B = \frac{\mu_0 \times 2}{4\pi \times 15}\left[\sin 60 + \sin(-30)\right]$$

$$= \frac{10^{-7} \times 2}{15} \times \left[\frac{\sqrt{3}}{2} - \frac{1}{2}\right] = \frac{10^{-7} \times 2}{15} \times \left(\frac{\sqrt{3}-1}{2}\right)$$

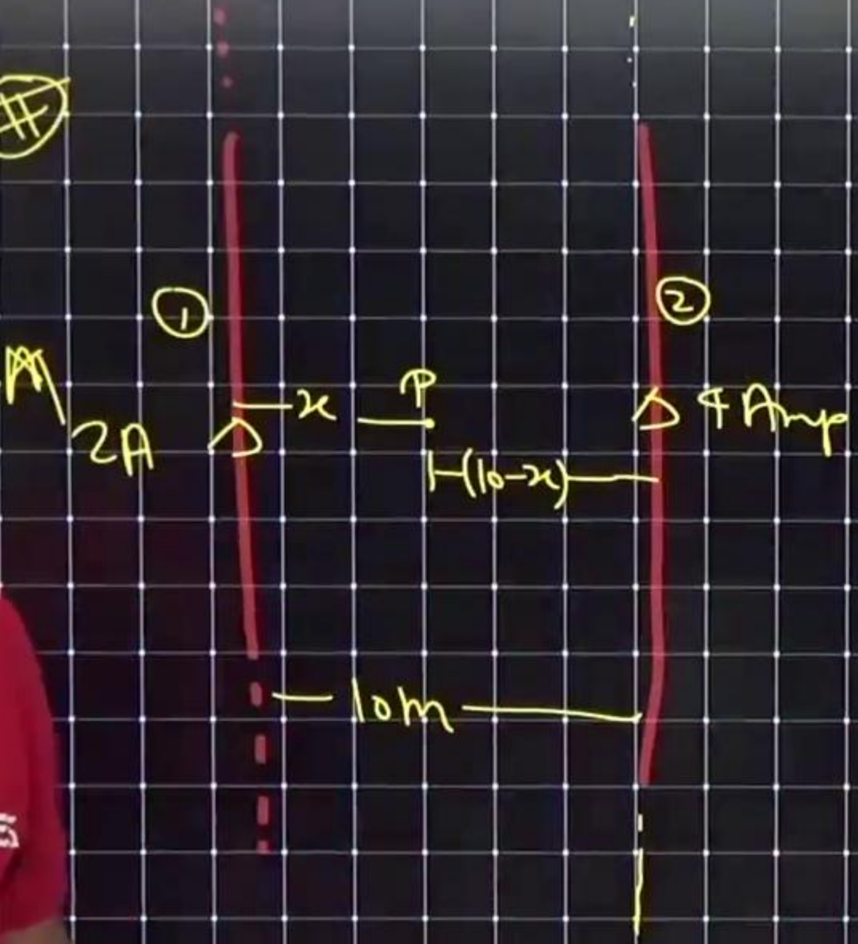
$$= \frac{10^{-7} \times (\sqrt{3}-1)}{15} \text{ Tesla}$$

$$\cos 30 = \frac{d}{10\sqrt{3}}$$

$$d = 10\sqrt{3}\cos 30 = 10\sqrt{3} \times \frac{\sqrt{3}}{2}$$

$d = 5 \times 3$

$d = 15$ m



find Point where magnetic field is zero.

(wire)

$$B_1 = B_2$$

$$\frac{\mu_0 \times 2}{2\pi \times x} = \frac{\mu_0 \times 4}{2\pi (10-x)}$$

$$\frac{2}{x} = \frac{4}{10-x}$$

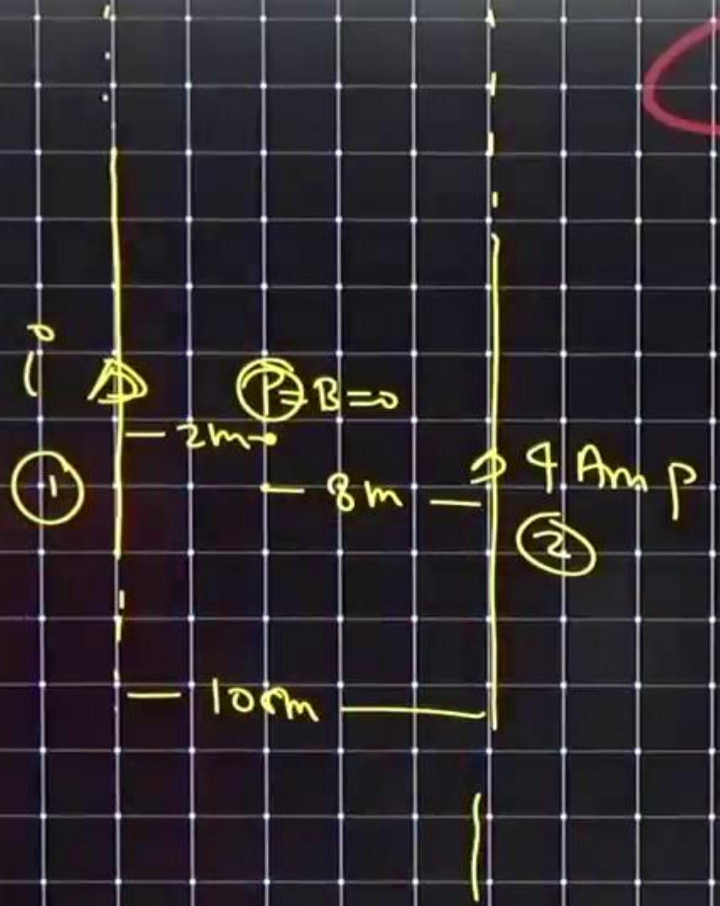
$$20 - 2x = 4x$$

$$6x = 20$$

$$x = \frac{20}{6} = \frac{10}{3}\ m$$

$$\left(10 - \frac{10}{3}\right) = \frac{20}{3}\ m$$

find value of i



$$B_1 = B_2$$

$$\frac{\mu_0 i}{2\pi(2)} = \frac{\mu_0 4}{2\pi(8)}$$

$$\frac{i}{2} = \frac{4}{8} = \frac{1}{2}$$

$$\frac{i}{2} = \frac{1}{2}$$

$$i = 1 \text{ Amp}$$