$$B = \int_{-\alpha_1}^{\alpha_2} \frac{\mu_0 I}{4\pi a} \cos\theta \, d\theta$$
$$B = \frac{\mu_0 I}{4\pi a} \int_{-\alpha_1}^{\alpha_2} \cos\theta \, d\theta$$
$$B = \frac{\mu_0 I}{4\pi a} [\sin\theta]_{-\alpha_1}^{\alpha_2}$$
$$B = \frac{\mu_0 I}{4\pi a} [\sin\alpha_2 - \sin(-\alpha_1)]$$
$$\boldsymbol{B = \frac{\mu_0 I}{4\pi a} [\sin\alpha_2 + \sin\alpha_1]} ----(5)$$

The above result gives magnetic field due to a current carrying straight conductor of finite Length.

If the conductor is infinitely long then, $\boldsymbol{\alpha_1 = \alpha_2} = \frac{\pi}{2}$,

eq. (4) becomes,

$$B = \frac{\mu_0 I}{4\pi a}\left[\sin\frac{\pi}{2} + \sin\frac{\pi}{2}\right]$$
$$\boldsymbol{B = \frac{\mu_0 I}{2\pi a}} ------(6)$$

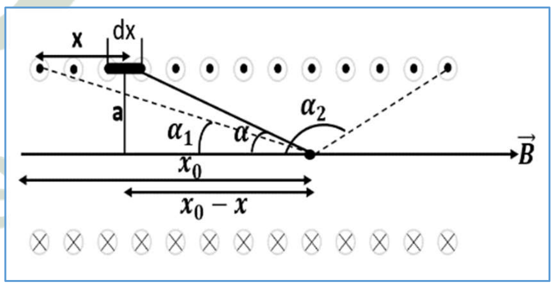
The above result gives magnetic field due to a current carrying straight conductor of infinite length.

Note:

- Magnetic field due to a very long straight conductor at the point perpendicular to near the midpoint of the conductor is, $\boldsymbol{B = \frac{\mu_0 I}{2\pi a}}$.
- Magnetic field due to a very long straight conductor at the point lies near to one end of the conductor is, $\boldsymbol{B = \frac{1}{2}(\frac{\mu_0 I}{2\pi a})}$, it means the magnetic field at a point due to infinite long linear conductor carrying current near its center is twice than that near its one of the ends.
- The value of magnetic field is same in magnitude at all those points which are equidistant from the straight conductor carrying current.

Magnetic Field due to long solenoid:

Solenoid is a helical winding of insulated wire. A solenoid can be thought of as being made up of many narrow identical circular coils placed side by side.



Consider a solenoid having number of turns per unit length (n) and radius $'a'$ is carrying current I. Let P be a point on the axis of solenoid at a distance x_0 from one of the end where the strength of magnetic field is to be determined.

Consider an elementary length $'dx'$ of the solenoid at a distance $'x'$ from one of the end.

The number of turns per unit length is $n = \frac{N}{l}$, where N is total number of turns and l is the length of solenoid, then number of turns in elementary length dx is $'ndx'$.

Now, the magnetic field due to elementary length of the solenoid (considered circular coil) is,

$$dB = \frac{\mu_0 n dx \quad ^2}{2(a^2+(x-x_0)^2)^{3/2}} ---------(1)$$

using geometry in figure,

$$or, \tan\alpha = \frac{a}{x-x_0}$$
$$or, x - x_0 = a\cot\alpha ----------(2)$$