By using these relation ship to convert Eq (1) to an integral on θ from 0 to

$$B(\vec{r_2}) = \frac{\mu_0 I}{4\pi}\int_{-\infty}^{+\infty} dx \frac{\hat{i}_x \cdot (r_2 - r_1)}{|r_2 - r_1|^3}$$

By putting values.

$$B(\vec{r_2}) = \frac{\mu_0 I}{4\pi}\int_0^{\pi} -a\,cosec^2\theta \cdot \frac{|\vec{r_2} - \vec{r_1}|\sin\theta\hat{k}}{|\vec{r_2} - \vec{r_1}|^3}$$

$$B(\vec{r_2}) = \frac{\mu_0 I}{4\pi}\int_0^{\pi} -\cancel{a\,cosec^2\theta} \cdot \frac{a\,cosec\theta}{(a\,cosec\theta)^{3/2}}$$

$$B(\vec{r_2}) = \frac{\mu_0 I}{4\pi}\int_0^{\pi} \cancel{\frac{1}{\sin^2\theta}}\ \cancel{-cosec^2\theta} \cdot \sin\theta\hat{k}$$

$$= \frac{\mu_0 I}{4\pi}\int_0^{\pi} \cancel{+\sin^2\theta} \cdot \frac{1}{\cancel{a\,cosec^2\theta}\ cosec^2\theta} \cdot \sin\theta\hat{k}$$

$$= \mu_0/4\pi\, I \int^{\pi} cosec\theta \cdot \frac{1}{a\,cosec\theta} \cdot \sin\theta$$

$$B(\vec{r_2}) = \frac{\mu_0 I}{4\pi}\int_0^{\pi} \frac{1}{a}\sin\theta\,\hat{k}$$

$$B(\vec{r_2}) = \frac{\mu_0}{4\pi a} I\hat{k}\int_0^{\pi}\sin\theta\, d\theta$$

$$B(\vec{r_2}) = \frac{\mu_0 I}{4\pi a}\hat{k}\,[-\cos\theta]_0^{\pi}$$

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$$B(\vec{r_2}) = \frac{\mu_0 I}{4\pi a} K (\cos 0 - \cos \pi)$$

$$B(\vec{r_2}) = \frac{\mu_0 I}{4\pi a} . K (1 - (-1))$$

$$B(\vec{r_2}) = \frac{\mu_0 I}{4\pi a} . K (2)$$

$$B(\vec{r_2}) = \frac{\mu_0 I}{2\pi a} . K$$

which is the required.

ON a circular wire:-

A circular turn will be considered. The magnetic field produc by this simple circuit at an arbitar point is very difficult to compute; however if only points on axis of symmetry are considered. A complete vector treatment is used to demonstrate the technique. The circle is lie on xy- plane. The field is to be calculated at point r_2 on the z-axis. The circle lies in xy plane. The lenght element in this case is given as