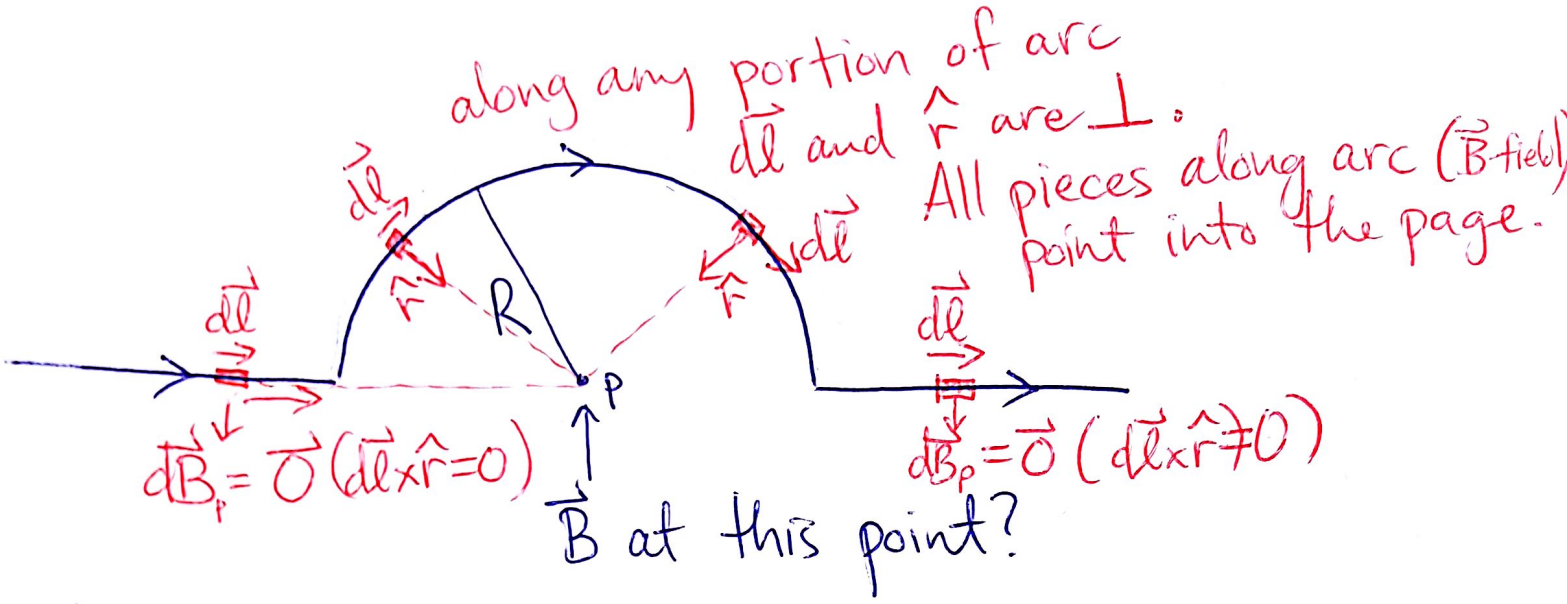

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{i\,d\vec{l}\times\hat{r}}{r^2}$$

r is distance from current element to point P

$\hat{r}$ points from current element to point P.

only piece that contributes to $\vec{B}_p$ is the arc.

$$\vec{B}_p = \int \frac{\mu_0}{4\pi}\frac{i\,d\vec{l}\times\hat{r}}{r^2}$$ for every $id\vec{l}$, $r=R$, $d\vec{l}\times\hat{r} = dl\,\otimes$

$$\vec{B}_p = \otimes\left[\frac{\mu_0 i}{4\pi R^2}\int_0^{\pi R} dl\right]$$ could replace $dl = R\,d\theta$

$$\vec{B}_p = \frac{\mu_0 i}{4\pi R^2}\,\pi R\,\otimes = \boxed{\frac{\mu_0 i}{4R}\,\otimes}$$ $\leftarrow -\hat{k}$

Generalize: for any arclength θR $\leftarrow$ general

$$\vec{B}_p = \frac{\mu_0 i}{4\pi R^2}\,\theta R = \boxed{\frac{\mu_0 i\,\theta}{4\pi R}}$$