

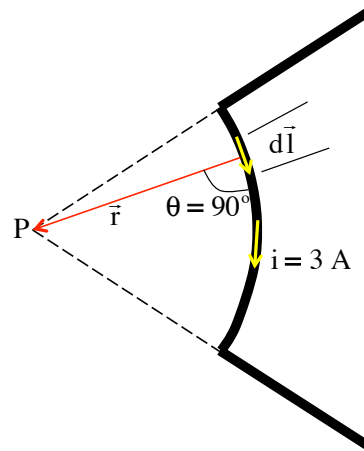
Problem 30.13

Although the sketch is not to scale (I've made the arc bigger than thirty degrees), the net magnetic field at P will be due to the three current segments. As the two linear sections are on-line with P, they will produce no field. That means we only need to derive an expression for the field due to the curved section.

Using Biot Savart:

$$\begin{aligned}
 B &= \int dB \\
 &= \frac{\mu_0 i}{4\pi} \int \frac{d\vec{l} \times \hat{r}}{r^2} \\
 &= \frac{\mu_0 i}{4\pi R^2} \int |dl| (1) \sin 90^\circ \\
 &= \frac{\mu_0 i}{4\pi R^2} s
 \end{aligned}$$

1.)



where "s" is the arc length of the curved section. Remembering that:

$$s = R\theta$$

where θ has to be in radians, we can write:

$$\begin{aligned}
 B &= \frac{\mu_0 i}{4\pi R^2} s \\
 &= \frac{\mu_0 i}{4\pi R^2} (R\theta) \\
 &= \frac{(4\pi \times 10^{-7} \text{ T} \cdot \text{m} / \text{A})(3 \text{ A})}{4\pi (.6 \text{ m})^2} \left[(.6 \text{ m}) \left[(30^\circ) \left(\frac{2\pi}{360^\circ} \right) \right] \right] \\
 &= 2.69 \times 10^{-7} \text{ T} \quad \text{into the page}
 \end{aligned}$$

2.)

