Ch. 28 – 34

34. (II) A wire, in a plane, has the shape shown in Fig. 28–43, two arcs of a circle connected by radial lengths of wire. Determine $\vec{\mathbf{B}}$ at point C in terms of R_1, R_2, θ, and the current I.

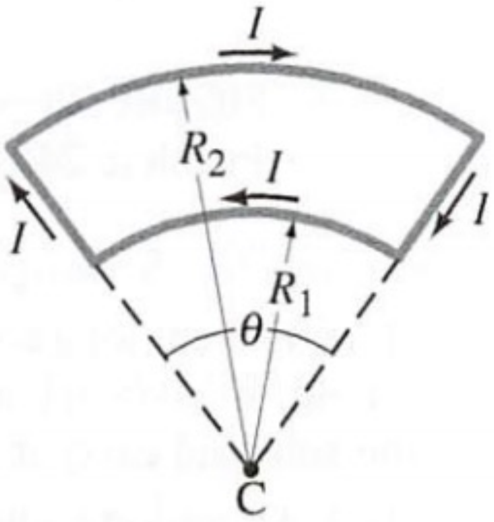


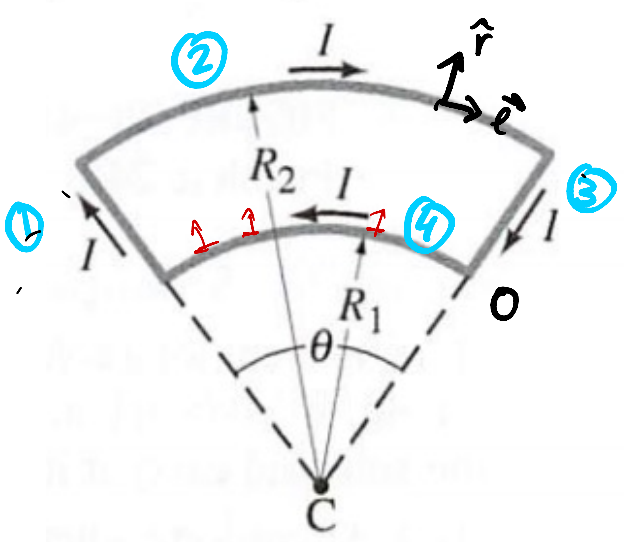
FIGURE 28–43
Problem 34.

Ch. 28 – 34

$\hat{\theta}$, $\hat{r}$, $\hat{k}$

$\hat{s}$

$\hat{s}$ $\hat{\theta}$ $\hat{k}$



① & ③ no contribution

$$\vec{B} = \frac{\mu_0 I}{4\pi} \int \frac{d\vec{\ell} \times \hat{r}}{r^2}$$

$$② = \frac{\mu_0 I}{4\pi} \int_\theta^0 \frac{d\vec{\ell} \times \hat{r}}{R_2^2}$$

$$= \frac{\mu_0 I}{4\pi R_2^2} \int_{R\theta}^0 ds$$

$$s \Big|_{R\theta}^0 = -\theta R_2$$

$$④ = \frac{\mu_0 I}{4\pi} \int_0^\theta \frac{d\vec{\ell} \times \hat{r}}{R_1^2}$$

$$= \frac{\mu_0 I}{4\pi R_1^2} \int_0^{R\theta} ds$$

$$s \Big|_0^{R\theta} = \theta R_1$$

$$B_T = \frac{\mu_0 I}{4\pi}\left(\frac{\theta}{R_1} - \frac{\theta}{R_2}\right) = \frac{\mu_0 I \theta}{4\pi}\left(\frac{R_2 - R_1}{R_1 R_2}\right)$$

$$\vec{B} = \frac{\mu_0 I \theta}{4\pi}\left(\frac{R_2 - R_1}{R_1 R_2}\right)\hat{k}$$