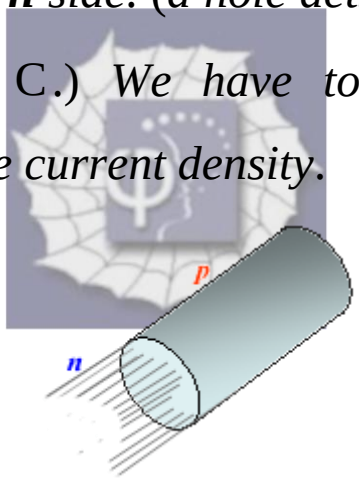
**385.**

**Problem 32.8 (RHK)**

*A* ***pn*** *junction is formed from two different semiconducting materials in the form of identical cylinders with radius* 0.165 mm. *In one application* $3.50\times10^{15}$ *electrons per second flow across the junction from* ***n*** *to the* ***p*** *side while* $2.25\times10^{15}$ *holes per second flow from* ***p*** *to the* ***n*** *side.* (*a hole acts like a particle with charge* $1.6\times10^{-19}$ C.) *We have to find* (a) *the total current and* (b) *the current density*.




**Solution:**

(a)

Electrons carry negative charge. Therefore, when they flow from the ***n*** to the ***p*** side of ***pn*** junction they contribute to electric current as flow of positive charge from ***p*** to the ***n*** side of the junction. And, holes carry positive charge equal in magnitude to the charge of

electrons and their flow from ***p*** to the ***n*** side of the junctions adds to the current flow of electrons from *n* to the *p* side.

It is given that $3.50\times10^{15}$ electrons per second flow across the junction from ***n*** to the ***p*** side and $2.25\times10^{15}$ holes per second flow from ***p*** to the ***n*** side.

Thus the total current flow through the junction is

$$i=\left(3.50\times10^{15}+2.25\times10^{15}\right)\times1.6\times10^{-19}\ \text{C s}^{-1}$$

$$=9.2\times10^{-4}\ \text{A}=0.92\ \text{mA}.$$

(b)

Radius, r, of the junction is

$$r=0.165\ \text{mm}=0.165\times10^{-3}\ \text{m}.$$

Therefore, the current density at the ***pn*** junction is

$$\sigma=\frac{i}{\pi r^2}=\frac{0.92\times10^{-3}}{\pi\times\left(0.165\times10^{-3}\right)^2}\ \text{A m}^{-2}=10.7\times10^{3}\ \text{A m}^{-2}$$

$$=10.7\ \text{kA m}^{-2}.$$