5.48 A semiconductor Hall device at $T = 300$ K has the following geometry: $d = 10^{-3}$cm, $W = 10^{-2}$ cm, and $L = 10^{-1}$cm. The following parameters are measured: $I_X = 0.50$ mA, $V_X = 15$ V, $V_H = -5.2$ mV, and $B_Z = 0.10$ tesla. Determine the (*a*) conductivity type, (*b*) majority carrier concentration, and (*c*) majority carrier mobility.

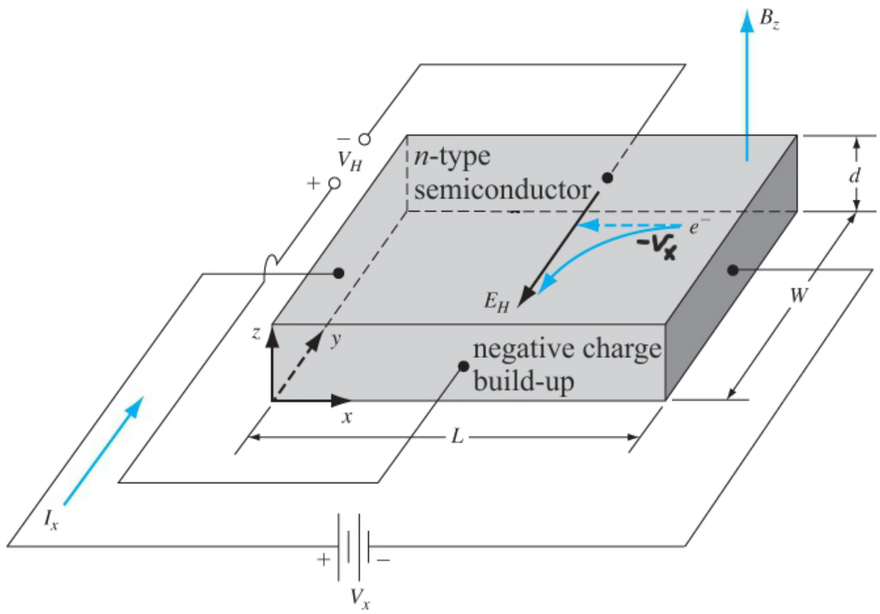

Figure 5.13 | Geometry for measuring the Hall effect.

- In MKS units, $L = 10^{-3}$ m, $W = 10^{-4}$ m, and $d = 10^{-5}$ m.

a) Since $V_H = -5.2$ mV < 0 $\Rightarrow$ ***n*-type semiconductor.**

b) Per (5.56), with all MKS units,

$$n = \frac{-I_x B_z}{e\,d\,V_H} = \frac{-0.5\times10^{-3}(0.1)}{(1.602176634\times10^{-19})10^{-5}(-5.2\times10^{-3})}$$

$\Rightarrow$ **$n = 6.00145 \times 10^{21}$ #/m^3 = = 6.00145×10^{15} #/cm^3**.

c) Per (5.60), the electron mobility is

$$\mu_n = \frac{I_x L}{e n V_x W d} = \frac{0.5\times10^{-3}(0.001)}{(1.602176634\times10^{-19})\,6.00145\times10^{21}(15)10^{-4}(10^{-5})}$$

$\Rightarrow$ **$\mu_n = 0.0346667$ m^2/V-s = 346.667 cm^2/V-s**.