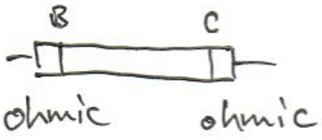
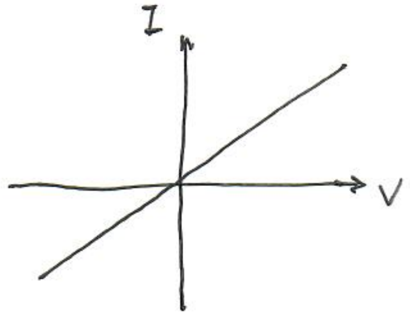
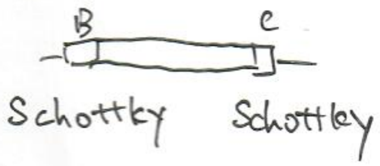
(b) Relationship between I and V: a straight line with slope equal to the conductance. (or inverse of the resistance)

$$R = \frac{L}{\sigma A} = \frac{L}{e N_d \mu_e A} = \frac{100\times10^{-4}\,\text{cm}}{(1.602\times10^{-19}\,\text{C})(10^{16}\,\text{cm}^{-3})(1350\,\text{cm}^2\text{V}^{-1}\text{s}^{-1})(10^{-6}\,\text{cm}^2)}$$
$$= 462\,\Omega$$





(c)



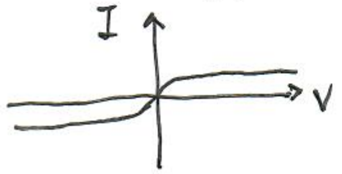
There is maximum saturation current in both directions (reverse bias).

$$J = -J_0\left[1 - \exp\left(-\frac{eV}{kT}\right)\right] \qquad \begin{cases} V = 0 \Rightarrow J = 0 \\ V = \infty \Rightarrow J = -J_0 \end{cases}$$

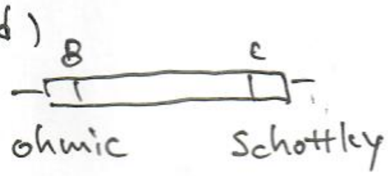
∴ the saturation current is the thermionic emission current over ϕ_B.

$$\phi_B = \phi_{Au} - \chi = 5.1\,\text{eV} - 4.01\,\text{eV} = 1.09\,\text{eV}$$

$$I_0 = A\cdot J_0 = A\cdot C_1 \exp\left(-\frac{\phi_B}{kT}\right) = (10^{-6}\,\text{cm}^2)\, C_1 \exp\left(-\frac{1.09\,\text{eV}}{8.62\times10^{-5}\,\text{eV K}^{-1}\cdot 300\,\text{K}}\right)$$



(d)



when C is reverse biased, current is limited by I_0 (themionic saturation current). when C is forward biased, current is limited by resistance of the semiconductor.