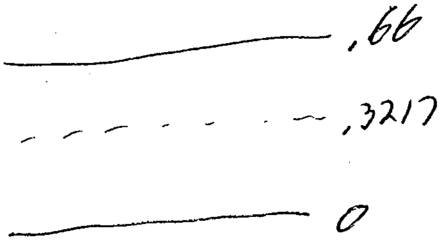
①

a.) $E_i = \frac{E_c + E_v}{2} + \frac{3}{4} kT \ln \frac{m_p^*}{m_n^*}$

$= \text{midgap} + \frac{3}{4}(.026) \ln\left(\frac{.36}{.55}\right)$

$= \text{midgap} - 8.3 \text{ meV}$

if $E_g = .66$ and $E_v = 0$



then $E_i = .3217$ eV

b.) $g_c(E) > g_v(E)$

density of states

if germanium is intrinsic then $n = p$

$n = p \Rightarrow \int g_c(E) f(E) dE = \int g_v(E)(1 - f(E))d$

if $g_c > g_v$ then fermi level must be skewed toward valence band to get an equal number of carriers

② $R = \frac{\rho L}{A}$ $\qquad \rho = \frac{1}{\sigma}$

$$\sigma = \cancelto{0}{qn}\mu_n + qp\mu_p$$

$p = N_a - N_d$ compensation via
$p = 10^{17} - 4\times10^{16}$ diffusion over
$p = 6\times10^{16}\ cm^{-3}$ bulk

For mobility purposes, $N_{dopants} = 10^{17} + 4\times10$
$= 1.4\times10^{17}$

Thus using Fig 3.5 in the text
$\mu_p = 350\ \frac{cm^2}{V\text{-}s}$

$\sigma = qp\mu_p = (1.6\times10^{-19})(6\times10^{16})(350)$

$\sigma = 3.36\ \frac{1}{\Omega\text{-}cm}$

$\rho = .30\ \Omega\text{-}cm$

$R = \rho\frac{L}{A} \qquad A = \frac{1}{2}\pi(10^{-4})^2 = 1.57\times10^{-8}\ cm^2$

$L = 100\times10^{-4}\ cm$

$$\boxed{R = 191\ K\Omega}$$