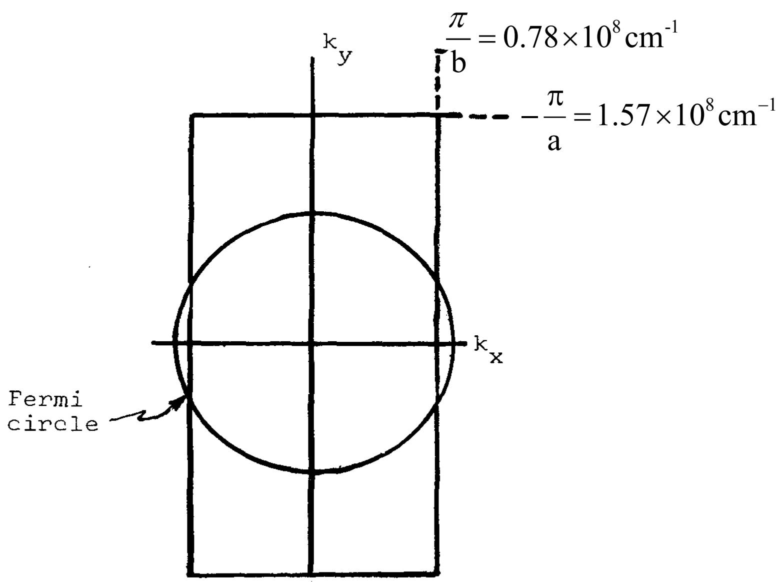
Homework 10 Solutions

Chapter 9, Problem 2.



b.

$$N = 2\times\frac{\pi k_F^2}{(2\pi/k)^2}$$

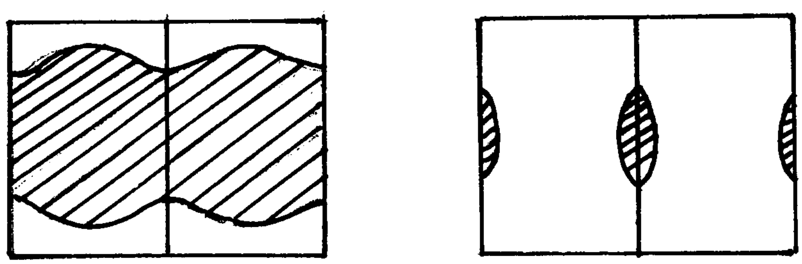
$$n = N/L^2 = k_F^2/2\pi$$

$$k_F = \sqrt{2\pi n}$$

$$n = \frac{1}{8}\times10^{16}\,\text{els/cm}^2$$

$$k_F = 0.89\times10^{8}\,\text{cm}^{-1}$$

c.



1st band   2nd band

Problem 7a.

$\Delta(\frac{1}{H}) = \frac{2\pi e}{\hbar c S}$, where $S = \pi k_F^2$, with $k_F = 0.75\times10^8\ \text{cm}^{-1}$ from Table 6.1, for potassium. Thus

$$\Delta(\frac{1}{H}) \simeq \frac{2}{137\ k_F^{\ 2}\ e} \simeq 0.55\times10^{-8}\ \text{G}^{-1}.$$

b.

$$\omega_c R = v_F\ ;\quad R = \frac{v_F mc}{eB} = \frac{\hbar k_F c}{eB}$$

$$\simeq 0.5\times10^{-3}\ \text{cm}$$

$$\pi R^2 \simeq 0.7\times10^{-6}\ \text{cm}^2.$$

Chapter 10.

1a. $\frac{d^2B}{dx^2} = \frac{1}{\lambda^2}B$; this is the London equation. The proposed solution is seen directly to satisfy this and to satisfy the boundary conditions $B\left(\pm\frac{1}{2}\delta\right) = B_a$. (b) For $\delta << \lambda_L$,

$$\cosh\frac{x}{\lambda} = 1 + \frac{1}{2}\left(\frac{x}{\lambda_L}\right)^2 + \ldots$$
$$\cosh\frac{\delta}{2\lambda} = 1 + \frac{1}{2}\left(\frac{\delta}{2\lambda}\right)^2 + \ldots$$

therefore $B(x) = B_a - B_a\left(1/8\lambda^2\right)\left(\delta^2 - 4x^2\right)$.