794.

<u>**Problem 53.8 (RHK)**</u>

We have to prove that the occupancy probabilities for two states whose energies are equally spaced above and below the Fermi energy add up to one.

<u>**Solution:**</u>

The occupation probability in Fermi-Dirac statistics is

$$p = \frac{1}{\exp\left(\left(E - E_F\right)/kT\right)+1},$$

where E_F is the Fermi energy.

Let $\left|E - E_F\right| = \Delta$. We have

$$p\left(E_F + \Delta\right) + p\left(E_F - \Delta\right) = \frac{1}{\left(\exp\left(\Delta/kT\right)+1\right)} + \frac{1}{\exp\left(-\Delta/kT\right)+1}$$

$$= \frac{2 + \exp\left(\Delta/kT\right) + \exp\left(-\Delta/kT\right)}{\left(\exp\left(\Delta/kT\right)+1\right)\left(\exp\left(-\Delta/kT\right)+1\right)}$$

$$= 1.$$