3.41 The Fermi energy for copper at $T = 300$ K is 7.0 eV. The electrons in copper follow the Fermi–Dirac distribution function. (*a*) Find the probability of an energy level at 7.15 eV being occupied by an electron. (*b*) Repeat part (*a*) for $T = 1000$ K. (Assume that E_F is a constant.) (*c*) Repeat part (*a*) for $E = 6.85$ eV and $T = 300$ K. (*d*) Determine the probability of the energy state at $E = E_F$ being occupied at $T = 300$ K and at $T = 1000$ K.

a) Per (3.79), $f_F(E) = \dfrac{1}{1 + e^{(E-E_F)/k_B T}}$

@ 300K

$$f_F(7.15\text{eV}) = \frac{1}{1 + e^{(7.15-7)/(8.6173\times10^{-5}(300))}}$$

$$f_F(7.15\text{eV}) = 0.0030116 \text{ or } 0.30116\%$$

b) $f_F(7.15\text{eV})$ @ 1000K

$$f_F(7.15\text{eV}) = \frac{1}{1 + e^{(7.15-7)/(8.6173\times10^{-5}(1000))}}$$

$$f_F(7.15\text{eV}) = 0.14923 = 14.923\%$$

c) @ 300K

$$f_F(6.85\text{eV}) = \frac{1}{1 + e^{(6.85-7)/(8.6173\times10^{-5}(300))}}$$

$$f_F(6.85\text{eV}) = 0.99699 = 99.699\%$$

d) @ $E = E_F$, $f_F(E_F) = \dfrac{1}{1+e^0} = \tfrac{1}{2} = 50\%$