A material has a Fermi energy of 0.34 eV. *a*) At 74°F, determine the energy $E = E_F + 2.4k_BT$ and the probability that a state at this energy is occupied by an electron (unitless and %). *b*) At 74°F, determine the energy $E = E_F - 2.8k_BT$ and the probability that a state at this energy is occupied by a hole (unitless and %).

74 °F = 296.483 K using Google

$2.4 k_B T = 2.4(8.617333\times10^{-5})296.483 = 0.061317 \text{ eV}$

a) $E = E_F + 2.4 k_B T = 0.34 + 0.061317$

$\underline{\underline{E = 0.40132 \text{ eV}}}$

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

$f_F(0.40132 \text{ eV}) = \dfrac{1}{1 + e^{(0.40132-0.34)/8.6173\times10^{-5}/296.483}}$

$\underline{\underline{f_F(0.40132 \text{ eV}) = 0.08317 \text{ or } 8.317\%}}$

b) $E = E_F - 2.8 k_B T = 0.34 - 0.061317\left(\frac{2.8}{2.4}\right)$

$\underline{\underline{E = 0.26846 \text{ eV}}}$

$f_{hole}(0.26846 \text{ eV}) = 1 - f_F(0.26846 \text{ eV})$

$= 1 - \dfrac{1}{1 + e^{(0.26846-0.34)/8.6173\times10^{-5}/296.483}}$

$\underline{\underline{f_{hole}(0.26846 \text{ eV}) = 0.05732 \text{ or } 5.732\%}}$