Problem 1

- a. For Maxwell-Boltzmann, the particles are identifiable and do not obey the Pauli exclusion principle. For Fermi-Dirac, the particles are not identifiable and obey the Pauli exclusion principle. For Bose-Einstein, the particles are not identifiable and do not obey the Pauli exclusion principle.
- b. A gas molecule in equilibrium obeys the Maxwell-Boltzmann distribution. An electron in a free-electron gas obeys the Fermi-Dirac distribution. A photon obeys the Bose-Einstein distribution.
- c. With 4 objects and 2 boxes, there exists 2^4 ways to arrange the particles among the boxes without regard for the resulting distribution. The probability of a giving arrangement is the number of independent ways of arriving at that arrangement divided by 2^4. There are sixteen possible arrangements.

Configuration	Probability
QS1:(A,B,C,D) QS2:(0)	$\frac{1}{2^4}$
QS1:(A,B,C) QS2:(D)	$\frac{4}{2^4}$
QS1:(A,B) QS2:(C,D)	$\frac{6}{2^4}$
QS1:(A) QS2:(B,C,D)	$\frac{4}{2^4}$
QS1:(0) QS2:(A,B,C,D)	$\frac{1}{2^4}$
QS1:(D) QS2:(A,C,B)	$\frac{4}{2^4}$
QS1:(C,D) QS2:(A,B)	$\frac{6}{2^4}$
QS1:(B,C,D) QS2:(A)	$\frac{4}{2^4}$
QS1:(C) QS2:(A,B,D)	$\frac{4}{2^4}$
QS1:(C,B) QS2:(A,D)	$\frac{6}{2^4}$
QS1:(A,C,D) QS2:(B)	$\frac{4}{2^4}$
QS1:(B) QS2:(A,C,D)	$\frac{4}{2^4}$
QS1:(B,D) QS2:(A,C)	$\frac{6}{2^4}$
QS1:(A,B,D) QS2:(C)	$\frac{4}{2^4}$
QS1:(A,C) QS2:(B,D)	$\frac{6}{2^4}$
QS1:(A,D) QS2:(B,C)	$\frac{6}{2^4}$

Problem 2

The number of states, G, between 0 and 1 ev is given by:

$$
\begin{aligned}
G &= \int_0^1 g(\epsilon) d\epsilon \\
&= \int_0^1 \frac{8\sqrt{2}\pi V}{h^3} m^{\frac{3}{2}} \sqrt{\epsilon} d\epsilon \\
&= \frac{8\sqrt{2}\pi V}{h^3} m^{3/2} \frac{2\epsilon^{\frac{3}{2}}}{3} |_0^1 \\
&= 4.51190E21
\end{aligned}
$$

Problem 3

The probability of a state being filled with energy $\epsilon_f + \Delta\epsilon$:

$$
\begin{aligned}
f(\epsilon_f + \Delta\epsilon) &= \frac{1}{1 + e^{(\epsilon_f + \Delta\epsilon - \epsilon_f)/kT}} \\
&= \frac{1}{1 + e^{(\Delta\epsilon)/kT}}
\end{aligned}
$$

The probability of a state being empty with energy $\epsilon_f - \Delta\epsilon$:

$$
\begin{aligned}
1 - f(\epsilon_f - \Delta\epsilon) &= 1 - \frac{1}{1 + e^{(\epsilon_f - \Delta\epsilon - \epsilon_f)/kT}} \\
&= \frac{1 + e^{(-\Delta\epsilon)/kT} - 1}{1 + e^{(-\Delta\epsilon)/kT}} \\
&= \frac{1}{1 + e^{(\Delta\epsilon)/kT}}
\end{aligned}
$$