SUMMARY: The distribution laws for the different statistics are as follows:

(i) M-B Statistics – $n_i = \frac{g_i}{e^{\alpha} \cdot e^{u_i/KT}}$

(ii) B-E Statistics: $n_i = \frac{g_i}{(e^{\alpha} \cdot e^{u_i/KT} - 1)}$

(iii) F-D Statistics: $n_i = \frac{g_i}{(e^{\alpha} \cdot e^{u_i/KT} + 1)}$

So that we obtain from the above

M-B: $\frac{g_i}{n_i} = e^{\alpha} \cdot e^{u_i/KT}$

B-E $\frac{g_i}{n_i} = (e^{\alpha} \cdot e^{u_i/KT} - 1)$

F-D $\frac{g_i}{n_i} = (e^{\alpha} \cdot e^{u_i/KT} + 1)$

Discussion:

(a) These relations shows that for larger values of $\left(\frac{g_i}{n_i}\right)$, all the three distribut laws become same

i.e $\frac{g_i}{n_i} = (e^{\alpha} \cdot e^{u_i/KT})$

(b) The quantity $\left(\frac{g_i}{n_i}\right)$ is obviously the "average energy per particle" in a distribution

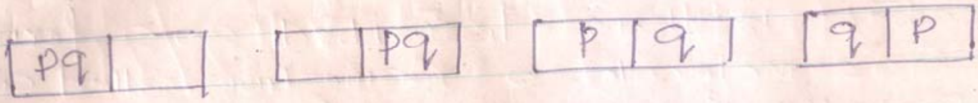
(c) Thus in the general cases the M-B Statistics is sufficient to study the state of a system but at very low temp. and at high temp. B-E Statistics must be applied. For an electron gas (within a metal) it is the Fermi-Dirac Statistics which has to be applied.

(d) The quantity $\left(\frac{n_i}{g_i}\right)$ is called the "Occupation Index" and gives the no. of particles per cell in the phase space or the occupation-index is the no. of particles possessing the same Eigen state.

The essential Difference Between the three classes of Statistical Distribution:

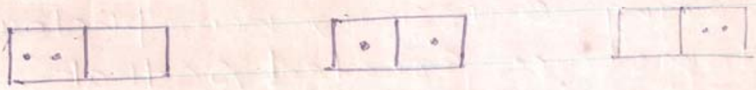
For simplicity of explanation we consider only two particles forming a collection and only two cells to be filled. Two distinct classes of Statistics become possible to deal with the distribution. These are when

(A) The particles are identical but distinguishable (such as molecules of a gas which are identical but distinguishable because of their different momenta). The distribution law in this case is known as the classical or M-B distribution law or Maxwell Boltzmann Statistics. As there is no restriction to the no. of particles in a cell, the possible arrangement are illustrated below.

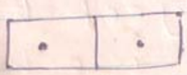


(B) The particles are identical and in-distinguishable. The distribution law in this case is known as "Quantum Statistics" and includes two Statistics namely Bose-Einstein and fermi-Dirac, Depending upon further restriction:

(i) B-E Statistics: In the B-E distribution law there is no restriction in the no. of particles present in a cell (particles such as photon, Helium atom at low temperature). The possible distributions are shown below.



(ii) F-D Statistics: In F-D distribution law dealing with identical and indistinguishable particles (such as electron: there is an added restriction that no two particles can co-exist in the same cell (according to Pauli's exclusion principle). The distribution law in this class is known as F-D Statistics and is shown below:



NOTE: A particle obeying B-E Statistics is

Called " BOSON" and that Obeying F-D Statistics is Called "FERMIONS'. For example a Photon is called a BOSON and an electron is thus described as a fermion. A Gas molecule is some-time Called a 'BOLTZON'