UNIT IIIA

EQUILIBRIUM— A Microscopic Understanding

The distributions of the microscopic particles among the allowed energy levels, macrostate distributions, provide the basis for understanding equilibrium. This unit develops procedures for determination of these distributions, their respective probabilities, and properties in small systems composed of each of three particle types. From these results, conclusions are drawn about equilibrium in small and, by extrapolation, large, "real" systems. It is found that a group of very similar high probability macrostates dominates the probability and properties of isolated systems after long times. Further, no matter the state in which an isolated system resides, it will, through particle collisions, attain an equilibrium group macrostate after a short time and will henceforward remain in equilibrium.

Objectives

To complete this unit the student must demonstrate that he/she can:

1. Define and distinguish (employing degeneracy) between an energy level and an energy state.

2. Determine macrostate distributions in small systems.

3. Describe the significance of, and the circumstances for which one is justified in making, *the independent particle assumption.*

4. Choose (and justify) the statistics applicable to a given physical system.

5. Distinguish between a microstate and a macrostate.

6. Choose and employ the counting formula to compute the number of microstates in a macrostate. Determine the probability of a macrostate.

7. Calculate an example property for a microstate, macrostate, and/or system.

8. Describe the extrapolation of small system results to large systems in terms of the properties and probabilities of the most probable macrostate, equilibrium group macrostates, and nonequilibrium macrostates.

9. Discuss equilibrium in isolated systems and the processes that lead to equilibrium.