inevitability of processes that lead to equilibrium in this 6 particle system. In more realistic, larger systems these trends are even more pronounced.

SUMMARY QUESTIONS

We summarize this unit, particularly the last and most important section, with several questions.

1. Distinguish between dependent and independent particles.

2. On what basis are particles classified as Boltzons, Bosons, or Fermions?

3. Describe macrostates and microstates and distinguish between them.

4. How do the properties of microstates within a single macrostate compare?

5. How frequently (answer qualitatively) and by what mechanism does a "real" system change, (a) microstate? (b) macrostate?

6. What are the orders of magnitude of the absolute and relative probabilities of the most probable macrostate in a real system?

7. Compare the relative macrostate probability and the nature of particle distributions over the levels for the macrostates of the equilibrium group, one to another and to the remaining macrostates.

8. How do the properties of the macrostates of the equilibrium group compare, (a) with one another? (b) with the most probable? (c) with the ensemble average?

9. Consider a system which has been isolated for some time. How likely is it to be in one of the equilibrium group macrostates? Relatively how frequently will the system encounter one of the nonequilibrium macrostates? Relatively how frequently will the system spontaneously go through a sequence of nonequilibrium macrostates long enough that there is a measurable fluctuation in its properties?

10. Consider an isolated system immediately after an energy interaction. How likely is it to be in an equilibrium group macrostate?

11. If an isolated system is released from a nonequilibrium macrostate describe its subsequent time trace through the macrostates.

ANSWERS TO SUMMARY QUESTIONS

Students whose answers were equivalent to the following should proceed immediately to evaluation. Incorrect answers will provide a guide to where further study is needed.

1. The energy levels of dependent particles are affected by the instantaneous position or motion of other particles in the system. The energy levels of independent particles are not so affected.

2. Boltzons are distinguishable particles (lattice points in a solid). Bosons and Fermions are indistinguishable particles. Bosons have an even number of subatomic components, Fermions an odd number.

3. Macrostates are allowed distributions over the levels, $n_{j,i}$ that satisfy the constraints on the number of particles and energy. Microstates specify, additionally, in which states the particles reside and in the case of distinguishable particles which particle is in which state.

4. Since each microstate within a given macrostate has the same distribution over the levels, they have the same properties.

Answers continued bottom of next page.