

EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE 2005/2006 (AUG-SEP. 2007)

FIRST SEMESTER

REPEAT

PH 305 – FUNDAMENTALS OF STATISTICAL PHYSICS

Time: 01 hour.

Answer ALL Questions.

1. What do you understand by the terms macrostate, microstate and thermodynamic probability of a system. For a system obeying Maxwell Boltzman statistics, show that

a)
$$E = \frac{Nk_B T^2}{Z} \frac{\partial Z}{\partial T}$$

b)
$$S = Nk_B \ln Z + \frac{Nk_B T}{Z} \frac{\partial Z}{\partial T}$$

c)
$$F = -Nk_B T \ln Z$$

Where the symbols have their usual meaning.



2. The thermodynamics probability of an assembly of Fermions can be written as

$$\Omega = \prod \frac{g_j!}{N_j!(g_j - N_j)!}$$

- a) If the system is in equilibrium, prove that

$$\sum_j \ln \left(\frac{N_j}{g_j - N_j} \right) dN_j = 0$$

- b) Also show that

$$\sum_j dN_j = 0 \text{ and}$$

$$\sum_j \epsilon_j dN_j = 0$$

- c) Using the results in (a) and (b), obtain the Fermi-Dirac distribution function

- d) For a degenerate, spin $\frac{1}{2}$, non-interacting Fermi gas at zero temperature, show that the energy of a system of N such particles confined to a volume V can be written as

$$E = \frac{3N\epsilon_F}{5}$$

Where the symbols have their usual meanings.