KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS**
**2016/2017 ACADEMIC YEAR**

**SPECIAL/SUPPLEMENTARY EXAMINATIONS**

**FOR THE DEGREE**
**OF**
**BACHELOR OF SCIENCE**

**COURSE CODE: SCH 340**

**COURSE TITLE: STATISTICAL THERMODYNAMICS**

**DATE: 22ND SEPTEMBER 2017** **TIME: 3 - 5PM**

**INSTRUCTIONS TO CANDIDATES**

Answer QUESTION 1 and any other TWO questions

TIME: 2 Hours

**QUESTION ONE (30 MARKS)**

a) Define the following terms: **[6 marks]**
   i. Thermodynamics
   ii. Stirling's approximation
   iii. Entropy

b) What is mean by the phrase "a priori probability" as applied to statistical thermodynamics?**[2 marks]**

c) Differentiate between microstates and microstates as used in statistical thermodynamics **[2 marks]**

d) Calculate the number of ways of distributing 30 identical objects with the arrangement 6, 0, 2, 8, 10, 4, the configuration is {6, 0, 2, 8, 10, 4} with N = 30 **[6 marks]**

e) Describe the physical significance of the partition function. **[3 marks]**

f) Write an expression for the partition function of a linear molecule (such as HCl)treated as a rigid rotor and explain each of the terms.**[5 marks]**

g) Explain the three types of ensembles as used in statistical thermodynamics **[6 marks]**

**QUESTION TWO (20 MARKS)**

a) Explain what is meant by an ensemble and why it is useful in statistical thermodynamics. **[4marks]**

b) Discuss the two ways by which the parameter β may be identified with 1/kT.**[6 marks]**

c) By use of relevant equations, explain the connection between the Boltzmann distribution and partition function theory for independent molecules **[10 marks]**

**QUESTION THREE (20 MARKS)**

a) Explain what is meant by an ensemble and why it is useful in statistical thermodynamics. **[4 marks]**

b) Calculate the ratio of the translational partition functions of xenon and helium at the same temperature and volume. **[5 marks]**

c) What is the temperature of a two-level system of energy separation equivalent to 300 $cm^{-1}$ when the population of the upper state is one-half that of the lower state? **[5 marks]**

d) Show that W= N!/(n1!n2!....)= 1/2N(N-1) **[6 marks]**

**QUESTION FOUR (20 MARKS)**

**a)** Using the differential form of the equations of U, H, A and G derive all the four Maxwell relations. **[10 marks]**

**b)** Starting with the Boltzmann formula $S=k\ln W$, derive an expression that relates the statistical entropy to the internal energy of a system **[10 marks]**

**QUESTION FIVE(20 MARKS)**

**a)** Explain how the internal energy and entropy of a system composed of two levels vary with temperature. Use equations to illustrate your explanations. **[10 marks]**

b) State the expression for the Boltzmann distribution function and explain meaning of each term each of the terms **[10 marks]**

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