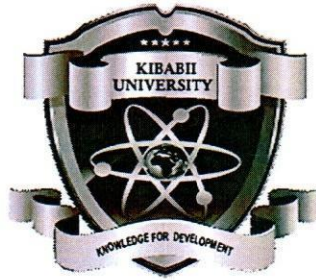


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# KIBABII UNIVERSITY

## UNIVERSITY EXAMINATIONS 2021/2022 ACADEMIC YEAR FOURTH YEAR FIRST SEMESTER MAIN EXAM

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: SCH 414

COURSE TITLE: STATISTICAL THERMODYNAMICS

DATE: 23/05/2022

TIME: 9:00AM-11:00AM

1. a) Define the following terms as used in statistical thermodynamics (5 marks)
- (i) Ensemble
  - (ii) Thermodynamics
  - (iii) Microstate
  - (iv) Partition function
  - (v) Phase space
- b). What is the enthalpy of 1 mole of an ideal monatomic gas? (3 marks)
- c). Differentiate between classical and statistical thermodynamics (6 marks)
- d). Give four application of statistical thermodynamics (4 marks)
- e). State three types of partition function as used in statistical thermodynamics (3 marks)
- f). Calculate the number of ways of distributing 20 identical objects with the arrangement 1,0,3,5,10,1 (4 marks)
- g). What is principle of equal a priori probability (2marks)

- h). A part from using factorial in the calculation of the number of weight of identical objects derive the starlings approximation, expression for the weights (3 marks)
- 2.a) Explain the differences among the three types of distribution as used in statistical thermodynamics. (9 marks)
- b). You have six distinguishable particles and two energy levels one with a degeneracy of two and the other with degeneracy of five. Calculate the number of microstates in this system (11 marks)
- 3.a) Derive all the four Maxwell Thermodynamical relations using the differential form of the equations of U, H, A and G (10 marks)
- b). State and explain the three types of ensembles as used in statistical thermodynamics (10 marks)
- 4 a). What is meant by molecular partition function (2 marks)
- b). Derive relationships between the following partition function and thermodynamic functions. (12 marks)
- i. Partition function and heat capacity at constant volume
  - ii. Partition function and heat capacity at constant pressure
  - iii. Partition function and internal energy
- c). Explain three important properties of macroscopic system that distinguishing the from microscopic systems (6 marks)
5. a). Calculate the molar Gibbs energy of Ar at 298.18 K and  $10^5$  pa, assuming that the gas demonstrates ideal behavior (8 marks)
- b). For an ensemble consisting of 1.00 moles of particles having two energy levels separated by  $h\nu = 1.00 * 10^{-20}$  J, at what temperature will the internal energy of this system equal 1.00 kJ? (8 marks)
- c). What thermodynamic properties can be obtained from the partition function? (4marks)