



KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR
FOURTH YEAR FIRST SEMESTER
MAIN EXAM

FOR THE DEGREE OF BACHELOR OF SCIENCES IN CHEMISTRY

COURSE CODE: SCH 414

COURSE TITLE: STATISTICAL THERMODYNAMICS

DATE: 20/04/2023

TIME: 9:00-11:00AM

QUESTION ONE (30MARKS)

1. a) Define the following terms as used in statistical thermodynamics. (5 marks)
- i. An ensemble
 - ii. A particle
 - iii. Probability theory
 - iv. Statistical thermodynamics
 - v. Phase space
- b). Differentiate between macrostate and microstate (4marks)
- c). State four types of heat capacity as used in statistical thermodynamics (4 marks)
- d) Explain the significance of molecular partition function (2marks)
- e). State the concepts in which statistical thermodynamics provides a deeper understanding (4marks)
- f). Calculate the number of ways of distributing 21 identical objects with the arrangement 6,0,5,0,4,0,3,0,2,0,0,1 (4 marks)
- h). Calculate the translational partition function of an H_2 molecule confined to a 100 cm^3 vessel at 25°C we use $m = 2.016\text{ u}$; then (4marks)
- h). State three significance of partition function (3 marks)

QUESTION TWO (20MARKS)

2. a) Explain the differences among the three types of distribution or statistics as used in statistical thermodynamics. (10marks)
- b). State and explain the three types of ensembles as used in statistical thermodynamics (10 marks)

QUESTION THREE (20MARKS)

- 3 a). 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 (10 marks)
- b) For an ensemble consisting of 1.00 moles of particles having two energy levels separated by $h\nu = 1.00 \times 10^{-20}$ J, at what temperature will the internal energy of this system equal 1.00 kJ? (10marks)

QUESTION FOUR (20MARKS)

4. a) Derive all the four Maxwell Thermodynamical relations using the differential form of the equations of U, H, A and G (10 marks)
- b). Calculate the molar Gibbs energy of Ar at 298.18 K and 10^5 pa, assuming that the gas demonstrates ideal behavior (10marks)

QUESTION FIVE (20MARKS)

5. a). What is Thermodynamic reversibility (5marks)
- b). Give five application of statistical thermodynamics (5 marks)
- b). Derive relationships between the following partition function and thermodynamic functions. (10 marks)
- Partition function and heat capacity at constant volume
 - Partition function and heat capacity at constant pressure
 - Partition function and internal energy