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KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER
MAIN EXAM

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: SCH 340

COURSE TITLE: STATISTICAL THERMODYNAMICS
DURATION: 2 HOURS

DATE: 12TH JANUARY 2018 **TIME:** 9 – 11 AM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 3 printed pages. Please Turn Over



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Question One

- a. Define the following terms (8 mark)
- i) Microstate
 - ii) Entropy
 - iii) Phase space
 - iv) Ensemble
- b. Calculate the number of ways of distributing 20 identical objects with the arrangement 1,0,3,5,10,1 (6 marks)
- c. A fluid of volume $5.0 \times 10^{-2} \text{ m}^3$ is contained behind a piston at a pressure of $1.0 \times 10^6 \text{ N/m}^2$. After a reversible expansion of constant pressure, the final volume is $2.0 \times 10^{-1} \text{ m}^3$. Calculate the work done by the fluid. (5 marks)
- d. State three types of ensembles as used in statistical thermodynamics (2 marks)
- e. Apart from using factorial in the calculation of the number of ways of distributing identical objects, give the Stirling's approximation expression for the weights. (2 mark)
- f. Derive an expression for the ideal gas equation of state given as $PV = NKT$ (5 marks)
- g. What is the importance of the molecular partition function (2 marks)

Question Two

- a. Differentiate between distinguishable and indistinguishable molecules (4 marks)
- b. You have six distinguishable particles and two energy levels one with a degeneracy of two and other with degeneracy of five. Calculate the number of macro states and microstates in this system. (10 marks)
- c. Show that $W = N!(n_1!n_2!\dots) = \frac{1}{2N(N-1)}$ (6 marks)

Question Three

- a. Derive the four Maxwell Thermodynamical relations, using the differential for the equations of U, H, A and G . (10 marks)

- b. Explain the types of ensemble and why it is useful in statistical thermodynamics(8marks)
- c. Describe the Monte Carlo method (2marks)

Question Four

- a. Explain the connection between Boltzmann distribution and partition function theory for independent molecules by use of relevant equations (10marks)
- b. Calculate the molar entropy of gaseous argon at 25°C using sackur-Tetrode equation (6marks)
- c. 1 Kg of water is at 0°C heated to 100°C , calculate its change in entropy (4marks)

Question Five.

- a. Unstable nuclear can undergo the following radioactivity to become more stable, Briefly explain when the following occurs. (10marks)
- i) Alpha emission
 - ii) Beta emission
 - iii) Electron capture
 - iv).Gamma radiations
- b. Discuss some of the practical application of nuclear chemistry in (8marks)
- i) Medicine
 - ii) Industry
 - iii) Agriculture
 - iv).carbon dating
- c. Describe Nuclear fission reactor (2marks)