# KIBABII UNIVERSITY

## UNIVERSITY EXAMINATIONS
## 2017/2018 ACADEMIC YEAR

### THIRD YEAR FIRST SEMESTER
### SUPPLEMENTARY EXAM

### FOR THE DEGREE OF BACHELOR OF SCIENCE

**COURSE CODE:** SCH 340

**COURSE TITLE:** STATISTICAL THERMODYNAMICS

**DURATION: 2 HOURS**

**DATE: 01/10/2018**          **TIME: 11:30-1:30PM**

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<u>**INSTRUCTIONS TO CANDIDATES**</u>
- 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 ▶

KIBU observes ZERO tolerance to examination cheating

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**Question One**

a. Define the following terms (8 mark)

   i) Grand canonical ensemble

   ii) Partition function

   iii) Starlings'approximation

   iv) Nuclear decay

b. Explain the restrictions adopted when calculating the populations of states for any type of molecule in any mode of motion (4 marks)

c. Describe a thermodynamic equilibrium (3 marks)

d. State two features of the molecules of a gas that make the gas suitable to be studied in statistical thermodynamics (2 marks)

e. From the equation $(\beta)=1/KT$, explain how thermodynamic temperature is unique (2marks)

f. Explain entropy in terms of the partition function and describe the physical significance of the partition function (7 marks)

g. Defferentiate between microstates and macrostates as used in thermodynamics (4 marks)

## Question Two

a. Calculate the change in entropy when water is heated from $0^0C$ to $1^0C$ and $20^0C$ to $21^0C$, then compare the results and discuss why the change in entropy in one case is more than the other although the temperature change is the same in both cases. (10 marks)

b. Explain how the intertanal energy and entropy of a system composed of two levels vary with temperature use equation to illustrate your explanations (10 marks)

## Question Three

a. Derive the firt two Maxwell Thermodynamical relations, using the differenti al for of the equations of U,H,A and G. (5 marks)

b. Calculate the ratio of the translational partition functions of $D_2$ and $H_2$ at the same temperature and volume
(5marks)

c. Discuss the two ways by which the parameters ($\beta$) may be identified with 1/KT (5marks)

d. The energy of molecules is the sum of the independent contribritions arising from the translation,rotational and vibrational motion, show that the total partition function can be writtern as the product of the separate partition
(5marks)

## Question Four

a. Explain any two forces within the nuclei of the radioisotope materials
(4marks)

b. State two theories of nuclear structure and differentiate between nuclear fission and nuclear fusion
(6marks)

c. Explain the application of the study of nuclear science
(10marks)

## Question Five.

a. State the expression for the Boltzmann distribution function and explain meaning of each terms
(10marks)

b. Explain what is meant by an ensemble and state the three types of ensemble as used in statistical thermodynamics
(4marks)

c. A system of 6 particles that obey Maxwell Boltzmann statistics has two energy levels and with degeneracy of three and the other with degeneracy of four. Then list down all the macrostates in the system in terms of number of particles in each level then for every level determine microstates.
(6marks)