NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCES
SEPTEMBER, 2020_1 EXAMINATION

COURSE CODE: **PHY311**
COURSE TITLE: **KINETIC THEORY AND STATISTICAL MECHANICS**
CREDIT UNIT **2**
TIME ALLOWED **(2 HRS)**

INSTRUCTION: ***Answer question 1 and any other four questions***

QUESTION 1

(a) i- What do you understand by statistical mechanics? **2 marks**
ii- Four coins are flipped in succession. Find the total number of possible outcomes. **2 marks**

(b) i- Differentiate between permutation and combination. **2 marks**
ii-Seven physicists assembled for a meeting shake hands with one another. How many handshakes take place? **3 marks**

(c) i-Define Entropy and state how it relates to probability. **2 marks**
ii- Using $W_f/W_i = \left(v_{f/v_i}\right)^N$ and $\Delta S = nR\ln\left(\frac{v_f}{v_i}\right)$ **5 marks**
Show that; $S = K\ln(W)$

(d) i-, Differentiate between macrostate and microstate. Give examples. **3 marks**
ii- Briefly explain each of the following:
1. Microcanonical ensemble **3 marks**

QUESTION 2

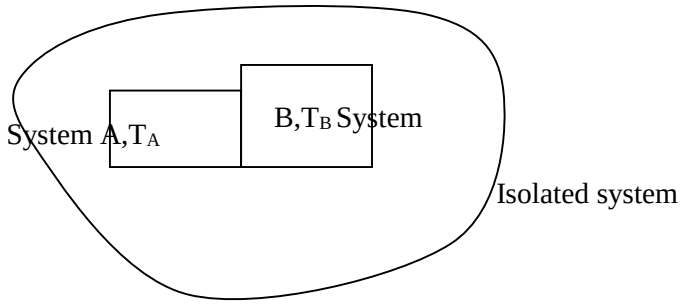
Derive the probability $W_N(n_1)$ for finding the particle at position x=ml after N steps. **12 marks**

QUESTION 3

A particle of mass m is free to move in one dimension. Denote its position coordinate by x and its momentum by p. Suppose that this particle is confined with a box so as to be located between x=0 and x=L, and suppose that its energy is known to lie between E and E+dE. Draw the classical phase space of this particle, indicating the regions of this space which are accessible to the particle. **12 marks**

QUESTION 4

Consider two system A and system B with constant specific heat C'_A and C'_B and originally at respective temperature T_A and T_B, are brought into thermal contact with each other. After the system come to equilibrium, they reach a come final temperature T_f. What is the entropy change of the entire system in this process?



12 marks

QUESTION 5

5. With the help of the partition function, $z = \sum_R e^{-\beta(n_1\varepsilon_1 + n_2\varepsilon_2 + \ldots)}$ compute the Maxwell-Boltzmann distribution. **12 marks**

QUESTION 6

Using the Taylor expansion and derive the Gaussian distribution. **12 marks**