NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCE

2021_2 EXAMINATIONS

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

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

QUESTION 1

(a) Define the following terms; (i) Most probable velocity (ii) Root-mean-square velocity [5 marks]

(b) Show that the most probable speed at which $n(v)$ has its maximum value $V_P = \sqrt{\frac{2RT}{M}}$ [10marks]

(c) Show that the root mean square speed of gas molecule $V_{rms} = \sqrt{\frac{3RT}{M}}$ [10marks]

QUESTION 2

(a) Derive Dulong-petit's law on the basis of equipartition theorem [5marks]

(b) Show that for a perfect gas represented by a grand canonical ensemble, the probability of finding the subsystem with n atoms is given by Poisson distribution

$\omega(n) = \frac{1}{n!}(n)^n e^{-\bar{n}}$ where $\bar{n}$ is the number of atoms present [10marks]

QUESTION 3

(a) If twelve particles are distributed randomly between two boxes A and B with equal probability, then calculate

(i) The probability of the distribution $(8, 4)$

(ii) The probability of the most probable distribution

(iii) The probability of least probable distribution. [9marks]

(b) Find the probability that in tossing a coin 12 times we get (i) 4 heads 8 tails (ii) 6 heads 6 tails [6marks]

QUESTION 4

Three particles are to be distributed in four energy states $a, b, c\ and\ d$ write down all the possible ways for such a distribution if the particles are (i) Fermions (ii) Bosons [15marks]

QUESTION 5

Let v_x, v_y, v_z represent the three Cartesian components of velocity of a molecule in a gas. Using symmetry consideration and equipartion theorem, deduce, expression for the following mean values in terms of K, T and m. (i) $\langle v_x \rangle$ (ii) $\langle \bar{v}_x^2 \rangle$ (iii) $\langle v_x v_z \rangle$ (iv) $\langle \left(v_x + b v_y\right)^2 \rangle$

[15marks]