



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

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

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 equipartition 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) $\langle (v_x + bv_y)^2 \rangle$

[15marks]