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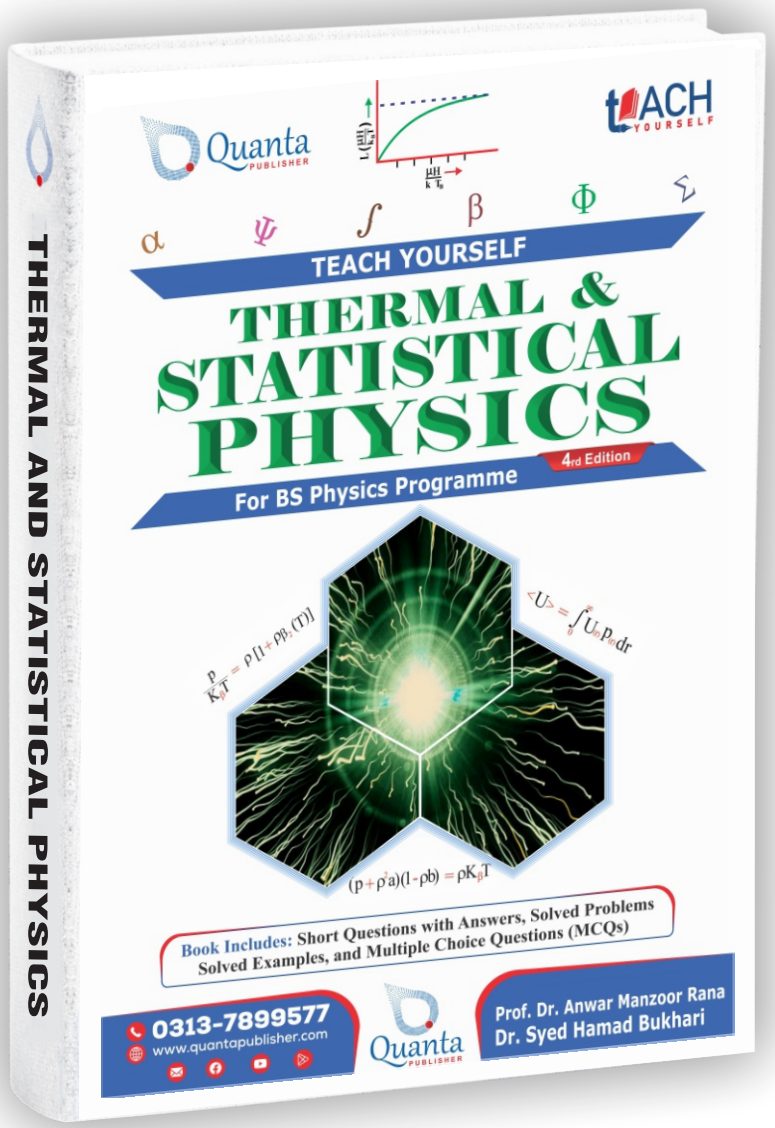
BS Physics

PAST PAPERS



UNIVERSITY OF THE PUNJAB

Roll No. .....

Seventh Semester 2018
Examination: B.S. 4 Years Programme

PAPER: Statistical Mechanics **TIME ALLOWED: 30 mins.**
Course Code: PHY-401 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

NOTE: Try to be focused and give only precise answers, of the asked questions.

Section-I

Q.No.1

Four possible answers A, B, C, and D to each question are given. Encircle the correct answer. Cutting and overwriting is not allowed. 10

1. Which of the following space is used in statistical mechanics?
(a) configuration space (b) phase space (c) Gamma space (d) both b and c

2. Which is not conserved in NVT ensemble?
(a) energy (b) temperature (c) number of particles (d) None of these

3. The spin of He-4 is
(a) 2 (b) 0 (c) 1/2 (d) 1

4. An ensemble in which system can exchange both energy and particles with a reservoir is known as
(a) Micro Canonical (b) Grand canonical (c) Canonical (d) both b and c

5. Free electrons in metals obey
(a) Bose-Einstein statistics
(b) Fermi-Dirac statistics
(c) Gibbs statistics
(d) Maxwell-Boltzmann statistics

6. Photons are described by
(a) Maxwell-Boltzmann statistics
(b) Bose-Einstein statistics
(c) Fermi-Dirac statistics
(d) All of these

7. Which can be determined from canonical Partition function?
(a) Free energy (b) Average energy (c) entropy (d) All of these

8. For indistinguishable particles
(a) wave functions overlap (b) no wave functions (c) Pauli exclusion always hold (d) both a and c

9. No two electrons can exist in same quantum state. This is known as
(a) Heisenberg Principle (b) Pauli exclusion Principle (c) Bohr principle (d) None of these

10. The entropy of a system in a single pure quantum state is zero. This is known as
(a) first law of thermodynamics (b) third law of thermodynamics (c) second law of thermodynamics
(d) zeroth law of thermodynamics

UNIVERSITY OF THE PUNJAB

Seventh Semester 2018
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Statistical Mechanics **TIME ALLOWED: 2 hrs. & 30 min**
Course Code: PHY-401 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

NOTE: Try to be focused and give only precise answers, of the asked questions.

Section-II

Q.No.2

Answer the following short questions. Each question carries equal marks (20)

(i) What are limitations of Debye's model?

(ii) Define (a) NVT ensemble (b) chemical potential

(iii) What is meant by degenerate Fermi gas? Which statistics is involved in it?

(iv) Define Gibbs free energy and enthalpy.

(v) What are draw backs of Einstein model?

Q.No.3

(a) Discuss concentration fluctuation for grand canonical ensemble. (6)

(b) What is Gibbs paradox? How can we resolve it? (4)

Q.No.4

(a) Define Photon gas. Derive Bose-Einstein distribution function. (6)

(b) What is Bose-Einstein condensate? Under what conditions it is formed? Give examples of this state of matter. (4)

Q.No.5

(a) Define density operator. Is it linear? What is its significance? (4)

(b) Write down properties of density matrix. Also define mixed state and pure state. (6)

Govt. College UNIVERSITY, FAISALABAD

External Semester Examinations Fall-2022-2023

Roll No.:

Programme: BS Physics

Semester: 7th | **Part:** Subjective | **Credit Hrs.:** 3(3-0)

Course Code: PHY-605 | **Course Title:** Statistical Mechanics | **Marks:** 80

Time allowed: *2:30 Hours*

Note: Attempt all questions. All the questions carry equal marks.

Q-2(a): Write atleast three important properties of entropy. How do we set up an expression for the entropy in statistical mechanics? (10)

(b) What is **STIRLING** Approximation? Use it to **SHOW** that: $\log[\frac{N!}{(N/2)!}] = \log(2N/e)^{N/2}$. (02)

(c) Write note on the following: Grand Canonical Ensemble (08)

Q-3(a): Given the statement of MAXWELL-BOLTZMANN Velocity DISTRIBUTION, $\omega(v) = 4\pi(\frac{M}{2\pi T})^{3/2} v^2 e^{\frac{Mv^2}{2T}} dv$, explain what this statement means in your own words that the MOST PROBABLE SPEED is given by: $v_{MP} = (\frac{2T}{M})^{1/2}$. (10)

(b): How can we understand **GENERAL** tendency for the **ENTROPY** of a closed system to **INCREASE**? (04)

(c) Calculate the specific heat at constant volume for Helium at 30 K and 450 K. (06)

Q-4(a): Show that a Simple Harmonic Oscillator (**SHO**), the orbit in **PHASE** Space is an **ELLIPSE**. Also mention values of **SEMI** Major and Minor axes. (14)

(b): Discuss the Analytical Nature of P (q, p) for a Microcanonocal Ensemble (06)

Q-5 (a): Show that the CANONICAL Ensemble PARTITION Function of a PERFECT GAS is: $Z = \frac{1}{N!}(\frac{V}{\lambda^3})^N$, where $\lambda = \frac{h}{(2\pi MT)^{1/2}}$, and THEORETICALLY show that this FUNCTION must produce the ENTROPY of a form: $\xi = N\log[\frac{e(\frac{V}{N})}{\lambda^3}] + \frac{3N}{2}$. (10)

(b) A sealed and thermally insulated container of total volume V is divided into two equal volumes by an impermeable wall. The left half of the container is initially occupied by n moles of an ideal gas at temperature T. The CHANGE in ENTROPY of the system when wall is suddenly removed and the gas expands to fill the entire volume. (10)

...minations Fall-2022-2023 Roll No:

Semester: 7th **Programme:** BS Physics
Course Code: PHY-605 **Part:** Objective
Time allowed: 30 Minutes **Course Title:** Statistical Mechanics **Credit Hrs.:** 3(3-0) **Marks:** 20

Q.No.01 Choose the correct answer:

1. The average value of physical quantity A (q, p) for actual system of interest is

a) $\bar{A} = \int_{-\infty}^{+\infty} A(q,p)P(q,p,t)dT$ b) $\bar{A} = \int_{-\infty}^{+\infty} A(q,p)\rho(q,p,t)dT$ c) $\bar{A} = \int_{-\infty}^{+\infty} A(q,p)\rho(q,p,t)dT$ d) $\bar{A} = \int_{-\infty}^{+\infty} A(q,$

2. The value of $\gamma(C_p/C_v)$ for a DIATOMIC GAS molecule is

a) 1.66 b) 1.4 c) 1.33 d) 1

The trajectory of S.H.O in phase space is

a) Ellipse b) Circle c) Parabola d) Spiral

4. In phase space, the total probability is obtained by taking

a) Sum of individual probability b) Product of individual probability c) Subtraction of individual probability d) Division of individual probability

5. According to Maxwell-Boltzmann velocity distribution; the average speed $\bar{u}$ of the particle of a classical gas is

a) $8k_BT/\pi m$ b) $8k_BT/\pi m)^{1/2}$ c) $(\pi m/8k_BT)^{1/2}$ d) $\pi m/8k_BT$

6. If a change is reversible, we cannot have

a) $\Delta S_{composite} > 0$ b) $\Delta S_{composite} = 0$ c) $\Delta S_{composite} < 0$ d) both a) & b)

7. PLANK's formula for BLACK BODY radiation can be derived from STATISTICS

a) Fermi-Dirac b) Bose-Einstein c) Max Well-Boltzmann d) (a) and (b)

8. If the wave function of identical particles change sign when these are interchanged, the particles are

a) Boson b) Fermions c) Photons d) Negatron

9. In case of micro canonical ensemble, the volume of sphere and its thickness should be

a) Greater than 1 b) Less than 0 c) Different d) Same

10. Which of the following is true in regard to the energy of an isolated system

a) $dQ \neq 0$ b) $dW \neq 0$ c) E = constant d) All of the mentioned

11. A red glass piece is heated until it glows in dark. The color of the glow will be

a) Red b) Orange c) Green d) Violet

12. Which of the following parameters does not characterize the thermodynamic state of matter?

a) Volume b) Temperature c) Pressure d) Work

13. Which is meaningful arrangements for case of n particles and two boxes, if n_1 in box-1 and remaining $n_2 = n-n_1$ in box-2

a) $n!\ .n_2!/\ n_1!$ b) $n!/\ n_1!.n_2!$ c) $n!\ .(n!-n_1!)/\ n_1!$ d) $n!\ .(n!-n_1!)/\ n_2!$

14. What will the total number of microstates for particles $n = 3$ and compartments $C = 2$

a) 9 b) 5 c) 8 d) 1

15. The relation for heat conductivity of monatomic gases is (*where, l is mean free path, ρN is particle density*)

a) $\lambda=3/2k_Bvl\rho N$ b) $\lambda=1/3k_Bvl\rho N$ c) $\lambda=2/3k_Bvl\rho N$ d) $\lambda=1/2k_Bvl\rho N$

16. Temperature T and Chemical potential μ may be used to characterize an

a) Closed system b) Particle system c) Open system d) Isolated system

17. The probability of occurrence of two independent events is equal to their

a) Sum b) Difference c) product d) Ratio

18. The system will do work as much its Helmholtz free energy as

a) $F = P\ \log Z$ b) $F = -T\ \log Z$ c) $F = T\ \log Z$ d) $F = -T\ \log A$

19. The difference between molar specific heats at constant pressure and at constant volume is always equal to about

a) Avogardo's number b) Gas constant c) 1.41 d) Gibbs Constant

20. The average number of particles (probability) in Energy state ϵ_s is given as

a) $1/1 + [\exp(\varepsilon - \mu)/T]$ b) $1/1 - [\exp(\varepsilon - \mu)/T]$ c) $1/1 + [\exp(\varepsilon + \mu)/T]$ d) $1/1 + [\exp(\varepsilon - \mu)]$

Govt. College UNIVERSITY, FAISALABAD

External Semester Examinations Fall-2023-2024

Roll [redacted]

Degree: BS-Physics **Semester:** 7th **Marks:** 80

Part: Subjective **Course Title:** Statistical Mechanics **Course Code:** PHY-605

Note: Attempt all questions. All the questions carry equal marks. ***Time allowed:*** *2:30 Hours*

Q-2(a): Derive Rotational Partition Function, keeping Quantum Prediction, and then discuss conditions of varying Temperatures (10)

(b) In a system of 8 distinguishable particles distributed in two equal sized compartments, calculate probability of the macrostate 2, 6. (03)

(c) Write note on the following: Grand Canonical Ensemble (07)

Q-3(a): Given the statement of MAXWELL-BOLTZMANN Velocity DISTRIBUTION $\omega(v) = 4\pi(\frac{M}{2\pi T})^{3/2} v^2 e^{\frac{Mv^2}{2T}} dv$. explain what this statement means in your own words that the MOST PROBABLE SPEED is given by: $v_{MP} = (\frac{2T}{M})^{1/2}$. (10)

(b): How can we understand **GENERAL** tendency for the **ENTROPY** of a closed system to **INCREASE**? (02)

(c) Write note on the following: Equilibrium Conditions (08)

Q-4(a): Show that a Simple Harmonic Oscillator (***SHO***), the orbit in **PHASE** Space is an **ELLIPSE**. Also mentio values of **SEMI** Major and Minor axes. (14)

(b): Discuss the Analytical Nature of P (q, p) for a Microcanonocal Ensemble (06)

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(b) A sealed and thermally insulated container of total volume V is divided into two equal volumes by a impermeable wall. The left half of the container is initially occupied by n moles of an ideal gas temperature T. The CHANGE in ENTROPY of the system when wall is suddenly removed and the g expands to fill the entire volume. (10)