

3 (Sem-6) PHY M 4

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PHYSICS

(Major)

Paper : 6.4

Full Marks : 60

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Write the answers to the two Groups in separate books

GROUP—A

(Statistical Mechanics)

(Marks : 30)

1. Answer the following questions : 1×4=4

- (a) Give the statistical definition of entropy.
- (b) What is Fermi energy?
- (c) State Liouville's theorem.
- (d) What do you mean by 'bosons' and 'fermions'?

2. Answer the following questions : 2×3=6

- (a) How do you define the most probable macrostate? What is its importance in statistical physics?

(2)

(b) Name the statistics which is obeyed by photoelectrons and photons.

(c) What is phase space and how can it be related to elementary cell?

3. Answer the following questions : $5 \times 2 = 10$

(a) Assuming M-B distribution of molecular velocity, show that the most probable velocity is given by

$$v_{mp} = \sqrt{\frac{2kT}{m}}$$

(b) Compare the distribution laws according to M-B, B-E and F-D statistics. Under what conditions do B-E and F-D statistics yield classical result?

4. Answer any one of the following : 10

(a) What are fermions? Write down the postulate of F-D statistics. Derive an expression for the probability distribution of particles governed by F-D statistics. $1+2+7=10$

(b) What is B-E condensation? Explain B-E condensation applying B-E statistics. Define gas degeneracy. $1+8+1=10$

(3)

Or

(c) (i) Starting from

$$g(p) dp = \frac{V}{n^3} \iiint dp_x dp_y dp_z$$

find the number of phase space cells lying in the momentum interval p and $p+dp$, and energy interval u and $u+du$. 5

(ii) Using Maxwell's velocity distribution law, obtain the energy distribution law for the kinetic energy u . 5

GROUP—B

(Computer Applications)

(Marks : 30)

1. State True or False : $1 \times 3 = 3$

(a) Arithmetic operators are associative from left to right.

(b) Keywords can be used as identifiers.

(c) Loops cannot be nested.

2. Write FORTRAN-95 or C or C++ statements to perform the following tasks : $2+2=4$

(a) To increment each element of an array by 5

(b) To find the result of

$$2 + 4 + 6 + \dots + 20 \text{ terms}$$

3. Answer any *three* of the following questions :

5×3=15

- (a) Write a program in either FORTRAN-95 or C or C++ to find real roots of the equation $x^3 - 27 = 0$.
- (b) Write a program in either FORTRAN-95 or C or C++ to arrange a list in ascending order.
- (c) Write a program in either FORTRAN-95 or C or C++ to find the smallest of five numbers.
- (d) A rocket is launched from the ground. Its acceleration is registered during the first 80 seconds and is given in the table below. Write a program to find velocity of the rocket at $t = 80$ sec using Simpson's 1/3rd rule :

t (sec)	0	10	20	30	40	50	60	70	80
f (cm/sec ²)	30	31.6	33.34	35.47	37.75	40.33	43.25	46.69	50.67

- (e) Give a brief description of data types available in the programming language of your choice.
4. Write a program in either FORTRAN-95 or C or C++ to fit a straight line to a given set of data points using least square method. 8

Or

Write a program to find the roots of a system of linear equations.

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