2018

PHYSICS

(Major)

Paper : 6.4

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

GROUP—A

(Statistical Mechanics)

1. Choose the correct option : 1×4=4

(a) The quantum statistics reduces to classical statistics under which of the following conditions?

(i) $\rho\lambda^3 = 1$

(ii) $\rho\lambda^3 >> 1$

(iii) $\rho\lambda^3 << 1$

(iv) $\rho = 0$

(b) Statistical methods give greater accuracy when the number of observations is

(i) very small

(ii) very large

(iii) neither very small nor very large

(c) Pauli's exclusion principle applies to

(i) MB Statistics

(ii) BE Statistics

(iii) FD Statistics

(iv) None of the above

(d) According to which statistics, the energy at absolute zero cannot be zero?

(i) MB statistics

(ii) BE statistics

(iii) FD statistics

(iv) None of the above

2. Answer the following : 2×3=6

(a) Show that the minimum volume of a volume element in phase space $\approx h^3$.

(b) An electron gas obeys the MB statistics. Calculate the average thermal energy (in eV) of an electron in the system at 300 K.

(c) Do electrons have zero energy at 0 K? If not, why?

3. Answer the following : 5×2=10

(a) Starting from BE distribution function deduce the Planck radiation formula.

(b) Derive Boltzmann entropy relation.

4. Answer any *one* of the following : 10

(a) What is Bose-Einstein statistics? What are the basic postulates used? Derive an expression for the most probable distribution of the particles of a system obeying BE statistics.

(b) What are fermions? Applying Fermi-Dirac distribution law, derive the expression for energy distribution of free electrons in a metal.

(c) State the assumption made by MB statistics for distribution of velocities of the molecules of an ideal gas and hence derive Maxwell's law of distribution of velocities of the molecules of an ideal gas using Maxwell-Boltzmann energy distribution formula.

GROUP—B

(Computer Applications)

1. State whether the following are True or False : 1×3=3

(a) Relational operators have higher precedence than arithmetic operators.

(b) If statement can be nested.

(c) A function can return multiple values.

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

(a) To interchange value of two variables *a* and *b* (say)

(b) To find the result of the expression

$$1+3+5+7+\cdots+99$$

3. Answer any *three* of the following questions : 5×3=15

(a) Write a program in either FORTRAN-95 or C or C++ to compute the roots of a quadratic equation.

(b) Write a program in either FORTRAN-95 or C or C++ to sort a list of numbers in ascending order.

(c) The velocity v (in km/minute) of a motorbike which starts from rest, is given at fixed intervals of time t (in minute) as follows :

t	2	4	6	8	10	12	14	16	18	20
v	10	18	25	29	32	20	11	5	2	0

Write a program in FORTRAN-95 or C or C++ to approximate distance (in minute) rounded to two places of decimals, covered in 20 minutes using Simpson's $\frac{1}{3}$rd rule.

(d) Write a program in FORTRAN-95 or C or C++ to calculate sum of the first 20 terms of the following sequence :

1, 4, 9, 25, ...

(e) Draw a flowchart and write a program to find the smallest of three numbers.

4. Write a program in either FORTRAN-95 or C or C++ to find roots of a system of linear equations. 8

Or

Write a program either in FORTRAN-95 or C or C++ to find solution of an ordinary differential equation $\frac{dy}{dx} = 2xy$ in the interval [1, 1·5] having initial value $y = 1$ at $x = 1$ and step size $h = 0{\cdot}1$.

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