TEST SERIES CSIR-NET/JRF Dec. 2017

BOOKLET SERIES C

Paper Code 05

Test Type: TEST SERIES

PHYSICAL SCIENCES

Duration: 02:00 Hours

Date: 02-12-2017

Maximum Marks: 120

Read the following instructions carefully:

* Single Paper Test is divided into **TWO** Parts.

Part - A: This part shall carry **10** questions. Each question shall be of **2 marks.**

Part - B: This part shall contain **50** questions. Each question shall be of **2 marks**.

* Darken the appropriate bubbles with HB pencil/Ball Pen to write your answer.

* There will be negative marking @25% for each wrong answer.

* The candidates shall be allowed to carry the Question Paper Booklet after completion of the exam.

* For rough work, blank sheet is attached at the end of test booklet.

PART-A : GENERAL APTITUDE

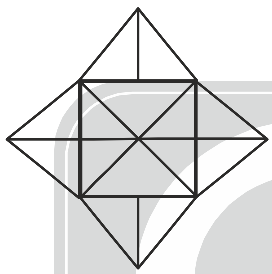
1. Today is Sunday. After 61 days, it will be
(a) Wednesday (b) Friday (c) Monday (d) Thursday

2. Which of the following is not the member of the series
2, 5, 10, 17, 26, 37, 50, 64
(a) 50 (b) 26 (c) 37 (d) 64

3. A boat man goes 2 km against the current of the stream in 1 hour and goes 1 km along the current in 10 minutes. How long will it take to go 5 km in stationary water?
(a) 40 minute (b) 1 hour (c) 1 hr 15 min (d) 1 hr 30 min

4. A man said to a lady, "The son of your only brother is the brother of my wife." What is the lady to the man,
(a) Sister (b) Sister of father in law
(c) Grand father (d) Maternal aunt

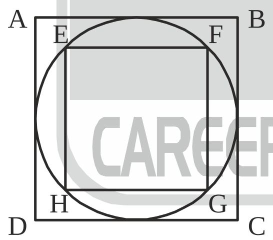
5. How many triangles are there in the following figure



(a) 18 (b) 28 (c) 20 (d) 24

6. In a certain code, SOBER is written as RNADQ. How LOTUS can be written in that code?
(a) KNSTR (b) MPUWT (c) KMSTR (d) LMRST

7. If side of the squrae ABCD is a, then the ratio of AC and FH is



(a) $\sqrt{2}$ (b) $\frac{1}{2}$ (c) 2 (d) $\frac{1}{\sqrt{2}}$

8. A man sells two wrist watches one at a profit of 10% and another at a loss of 10% but the selling price of each watch is 200. Find the profit or loss%
(a) Profit of 1% (b) Loss of 1% (c) Profit of 2% (d) Loss of 2%

9. A speaks the truth in 70 percent cases and B in 80 percent cases. The probability that they will contradict each other in describing a single event is
(a) 0.36 (b) 0.38 (c) 0.40 (d) 0.42

10. A train of unknown length crosses a platform L_1 meters in t_1 seconds and also crosses a telegraph post in t_0 seconds. What is speed of the train?
(a) $L_1(t_1 - t_0)$ (b) $\frac{L_1}{t_1 - t_0}$ (c) $\frac{L_1 t_1}{t_0^2}$ (d) $\frac{L_1 t_1}{t_1 + t_0}$

PART-B : MP, THERMO. & STATS AND NUCLEAR & PARTICLE PHYSICS

11. Let 1, $\frac{-1+\sqrt{3}i}{2}$, $\frac{-1-\sqrt{3}i}{2}$ are eigenvalues of a 3×3 matrix A. If A can be expanded as power series expansion of exponential as $e^A=\sum_{n=0}^{\infty}\frac{A^n}{n!}$, then the value of $\det(e^A)$ is

(a) $e-\frac{1}{e}$ (b) e^2-e (c) 1 (d) 0

12. Consider a $n\times n\ (n>1)$ matrix A, in which A_{ij} is the product of the indices i and j^2. The matrix A, will have
(a) non-degenerate eigenvalues.
(b) one degenerate eigenvalue having degeneracy (n - 1).
(c) one degenerate eigenvalue having degeneracy n.
(d) two degenerate eigenvalues both having degeneracies 2 & (n - 2) repectively.

13. The value of the integral $\int_C\left[2y\,dx+(1-x)\,dy\right]$, where C is the portion of the curve $y=1-x^3$ from the point (-1, 2) to (2, -7), is
(a) 0 (b) 1 (c) 2 (d) 3

14. Plane polar co-ordinates (ρ,ϕ) and Cartesian co-ordinates (x, y) are related by the expressions $x=\rho\cos\phi,\ y=\rho\sin\phi$. An arbitrary function $f(x,y)$ can be re-expressed as a function $g(\rho,\phi)$. Then transformation of the expression $\frac{\partial^2 f}{\partial x^2}+\frac{\partial^2 f}{\partial y^2}$ into the plane polar coordiantes, is

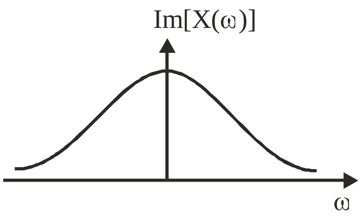
(a) $\frac{\partial^2 g}{\partial\rho^2}+\frac{\partial^2 g}{\partial\phi^2}$ (b) $\frac{\partial^2 g}{\partial\rho^2}+\frac{1}{\rho^2}\frac{\partial^2 g}{\partial\phi^2}$ (c) $\frac{\partial^2 g}{\partial\rho^2}+\frac{1}{\rho}\frac{\partial^2 g}{\partial\phi^2}+\frac{1}{\rho^2}\frac{\partial^2 g}{\partial\phi^2}$ (d) $\frac{\partial^2 g}{\partial\rho^2}+\frac{1}{\rho}\frac{\partial^2 g}{\partial\phi^2}$

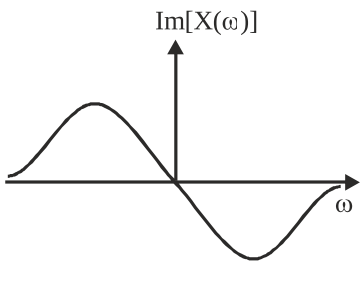
15. The fourier transform of a function $f(t)$ can be defined as

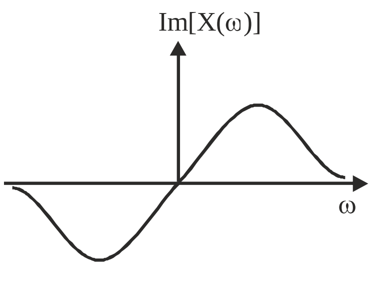
$$X(\omega)=\int_{-\infty}^{\infty}f(t)e^{-i\omega t}dt$$

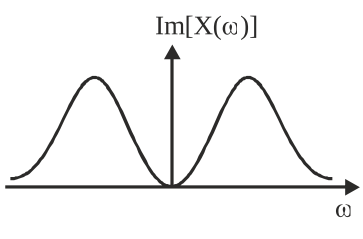
If $f(t)=e^{-t/2}u_0(t)$, where $u_0(t)$ is an unit step function defined as $u_0(t)=\begin{cases}1 & \text{for } t\ge0\\ 0 & \text{for } t<0\end{cases}$

Then the variation of $\mathrm{Im}[X(\omega)]$ will be

(a) 

(b) 

(c) 

(d) 

16. The displacement of a damped harmonic oscillator as a function of time is given by

$$f(t)=\begin{cases} 0 & \text{for } t<0 \\ e^{-t/\tau}\sin\omega_0 t & \text{for } t\ge 0 \end{cases}$$

where ω_0 and τ are positive real constants. The fourier transform of the function, will be proportional to

(a) $\frac{1}{2}\left[\frac{1}{\omega+\omega_0-\frac{i}{\tau}}+\frac{1}{\omega-\omega_0-\frac{i}{\tau}}\right]$

(b) $\frac{1}{2}\left[\frac{1}{\omega+\omega_0-\frac{i}{\tau}}-\frac{1}{\omega-\omega_0-\frac{i}{\tau}}\right]$

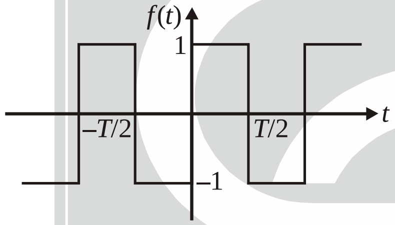
(c) $\frac{1}{2}\left[\frac{1}{\omega+\frac{\omega_0 i}{\tau}}-\frac{1}{\omega-\frac{\omega_0 i}{\tau}}\right]$

(d) $\frac{1}{2}\left[\frac{1}{\omega+\frac{\omega_0 i}{\tau}}+\frac{1}{\omega-\frac{\omega_0 i}{\tau}}\right]$

17. The value of the integral $\int_0^\infty t^2 e^{-t}\sin t\, dt$, is

(a) 0 (b) -1/2 (c) 1 (d) 1/2

18. The fourier series of the square wave function, as shown in the figure below, is (Here, $\omega=\frac{2\pi}{T}$ is the angular frequency)



(a) $\frac{4}{\pi}\left(\sin\omega t-\frac{\sin 2\omega t}{2}+\frac{\sin 3\omega t}{3}-\cdots\right)$

(b) $\frac{4}{\pi}\left(\sin\omega t+\frac{\sin 2\omega t}{2}+\frac{\sin 3\omega t}{3}+\cdots\right)$

(c) $\frac{4}{\pi}\left(\sin\omega t+\frac{\sin 3\omega t}{3}+\frac{\sin 5\omega t}{5}+\cdots\right)$

(d) $\frac{4}{\pi}\left(\sin\omega t-\frac{\sin 3\omega t}{3}+\frac{\sin 5\omega t}{5}-\cdots\right)$

19. Consider the following function in the complex argand plane:

$$f(z)=\sum_{j=1}^{n}\frac{A_j}{z^j}+g(z)$$

where $g(z)$ is analytic at all points inside and on the simple, closed, positively oriented contour γ containing $z=0$ in its interior, then the value of the integral $\int_\gamma f(z)\,dz$ is equal to

(a) $2\pi i A_1$ (b) $2\pi i+g(0)$ (c) 0 (d) $2\pi i A_1+g(0)$

20. The principal value of the integral $\int_{-\infty}^{\infty}\frac{x\sin x}{x^2+4x-5}dx$ is

(a) π (b) 2π (c) 3π (d) $-\pi$

21. The Laurrent series expansion of the complex function $f(z)=\dfrac{1}{z(z+2)}$ about z = 1, can be written as

$$f(z)=-\frac{1}{2}\left[\sum_{n=1}^{\infty}\frac{(-1)^n}{(z-1)^n}+\sum_{n=0}^{\infty}\frac{(-1)^n(z-1)^n}{3^{n+1}}\right]$$

The region of convergence for the given Laurrent series expansion, is

(a) $0<|z-1|<2$ (b) $1<|z-1|<3$ (c) $0<|z-1|<3$ (d) $2<|z-1|<3$

22. The real number λ such that the differential equation

$$\frac{d^2y}{dx^2}+2(\lambda-1)(\lambda-3)\frac{dy}{dx}+(\lambda-2)y=0$$

has a solution of the form $y(x)=a\cos\beta x+b\sin\beta x$ (for non-zero real numbers a and b). Then the value of λ, is

(a) 2 (b) –2 (c) 3 (d) –3

23. The general solution of the following second order linear differential equation:

$$x^2y''+xy'+\left(x^2-\frac{1}{4}\right)y=0$$

(where C_1 and C_2 are real constants), will be

(a) $C_1\sqrt{\frac{2}{\pi x}}\sin x+C_2\sqrt{\frac{2}{\pi x}}\cos x$ (b) $C_1\sqrt{\frac{2x}{\pi}}\sin x+C_2\sqrt{\frac{2x}{\pi}}\cos x$

(c) $C_1\sqrt{\frac{2}{\pi x}}\sin^2 x+C_2\sqrt{\frac{2}{\pi x}}\cos^2 x$ (d) $C_1\sqrt{\frac{2x}{\pi}}\sin^2 x+C_2\sqrt{\frac{2x}{\pi}}\cos^2 x$

24. The waiting time x (in minute) of a customer waiting to be served at a ticket counter has the density function

$$f(x)=\begin{cases}2e^{-2x} & \text{for} \quad x\geq 0\\ 0 & \text{elsewhere}\end{cases}$$

The average waiting time at the ticket counter, will be

(a) $\frac{1}{3}$ minute (b) $\frac{1}{2}$ minute (c) $\frac{1}{4}$ minute (d) $\frac{2}{3}$ minute

25. Consider a dice with the property that the probability of a face with n dots showing up is proportional to n. If the dice is thrown twice, then the probability that the sum of the numbers that turn up is odd, is

(a) $\frac{108}{441}$ (b) $\frac{144}{441}$ (c) $\frac{225}{441}$ (d) $\frac{216}{441}$

26. The infinite series $\frac{1}{2}x^2+\frac{1}{4}x^4+\frac{1}{6}x^6+.......$

where $-1<x<1$, can be summed to the value

(a) $\frac{1}{2}\ell n\left[\frac{(1+x)}{(1-x)}\right]$ (b) $-\frac{1}{2}\ell n\left(1-x^2\right)$ (c) $\tanh x$ (d) $\frac{1}{2}\ell n\left(1-x^2\right)$

27. The integral $\int_1^3 x^2 dx$ is to evaluated upto 2 decimal places using Simpson's $\frac{1}{3}$ rule. If the interval [1, 3] is divided into 4 equal parts, then the value of the integral is
(a) 7.67 (b) 7.33 (c) 8.33 (d) 8.67

28. It is known that the root of the function $f(x)$ lies between 0 and 1. After 10 iterations of the bisection method, the approximate accuracy of the root will be correct up to
(a) 5 decimal places (b) 4 decimal places (c) 3 decimal places (d) 2 decimal places

29. The length element 'ds' of an arc in a particular coordinate system, is given by
$$(ds)^2 = 2(dx^1)^2 + (dx^2)^2 + \sqrt{3}(dx^1)(dx^2)$$
The corresponding metric tensor g_{ij} is
(a) $\begin{pmatrix} 2 & \sqrt{3} \\ \sqrt{3} & 1 \end{pmatrix}$ (b) $\begin{pmatrix} 2 & \sqrt{3}/2 \\ \sqrt{3}/2 & 1 \end{pmatrix}$ (c) $\begin{pmatrix} 2 & 1 \\ \sqrt{3}/2 & \sqrt{3}/2 \end{pmatrix}$ (d) $\begin{pmatrix} 1 & \sqrt{3}/2 \\ \sqrt{3}/2 & 2 \end{pmatrix}$

30. Let SU(2) be a group of special unitary matrices (determinant +1) under matrix multiplication. The generators of the group, are
(a) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ (b) $\frac{1}{2}\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}, \frac{1}{2}\begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}, \frac{1}{2}\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$
(c) $\frac{1}{2}\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}, \frac{1}{2}\begin{bmatrix} 0 & i \\ i & 0 \end{bmatrix}, \frac{1}{2}\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ (d) $\frac{1}{2}\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}, \frac{1}{2}\begin{bmatrix} i & 0 \\ 0 & -i \end{bmatrix}, \frac{1}{2}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

31. From the semi-empirical mass formula, the binding energy is given by
$B = a_1 A - a_2 A^{2/3} - a_3 z^2 A^{-1/3} - a_4 (A - 2z)^2 A^{-1} \pm \delta$
If $a_1 = 14.1\, MeV$, $a_2 = 13.0\, MeV$, $a_3 = 0.58\, MeV$, $a_4 = 19.3\, MeV$
The value of z for most stable nuclei for A = 43 is
(a) 18 (b) 19 (c) 20 (d) 21

32. The single particle energy difference between the d-orbitals (i.e. $^1d_{5/2}$ & $^1d_{3/2}$) of the nucleus $^{114}_{50}Sn$ is 5 MeV. The energy difference between the states in its 1f orbitals is
(a) 1 MeV (b) 3 MeV (c) 5 MeV (d) 7 MeV

33. The $_5B^{10}(\alpha, p)\,_6C^{13}$ reaction shows among others a resonance for an excitation energy of the compound nucleus of 13.23 MeV. The width of this level as found experimentally is 130 KeV. The mean life of the nucleus for this excitation is
(a) 3×10^{-18} sec (b) 5×10^{-21} sec (c) 2×10^{-21} sec (d) 4×10^{-17} sec

34. For the reaction, $p + p \rightarrow p + p + \pi^0$ where target p is at rest, the threshold momentum of the incident proton [Given : m_p = 938 MeV/c², $m_{\pi^0} = 135\, MeV/c^2$] required to initiate the reaction is
(a) $776.5\, MeV/c$ (b) $280\, MeV/c$ (c) $562\, MeV/c$ (d) $1675\, MeV/c$

35. Which of the following reactions is forbidden?
(a) $e^- + p \rightarrow n + v_e$ (b) $\bar{v}_\mu + p \rightarrow n + \mu^+$ (c) $\Lambda^0 \rightarrow p + e^- + \bar{v}_e$ (d) $\Omega^- \rightarrow \Xi^0 + k^-$

36. If reaction $\pi^- + p \to \Lambda^0 + X$ is governed by strong interaction, then the particle X is

(a) π^0 (b) K^0 (c) n (d) $\bar{K}^0$

37. Read the following statements

(I) In the process, $p + p \to k^+ + \Sigma^+$, baryon number, isospin and its third component are not conserved

(II) In the process $p + n \to \Lambda^0 + \Sigma^+$, strangeness number and the third component of isospin are not conserved

(III) The reaction $\Sigma^+ \to \Lambda^0 + k^+$ is allowed by weak interaction

(IV) The reaction $\Xi^- \to \Lambda^0 + \pi^-$ is allowed by weak interaction

Choose the correct option

(a) Only I and II are correct (b) Only II and IV are correct

(c) Only I, II and IV are correct (d) I, II, III and IV are correct

38. The β^+ decay reaction is given by : ${}_{12}Mg^{23} \to {}_{11}Na^{23} + \beta^+ + \nu_e$. If atomic masses of Mg^{23} and Na^{23} are 23.0002 and 22.99618 amu respectively, then the end point energy (maximum energy) of the emitted β^+ particles is

(a) 1.36 MeV (b) 3.74 MeV (c) 3.23 MeV (d) 2.72 MeV

39. The quark content for Σ^-, π^+ & Ξ^- are respectively

(a) $dss, u\bar{d}$ and uds (b) $dds, u\bar{d}$ and ssd (c) $sdd, u\bar{s}$ and ssd (d) $dss, u\bar{s}$ and dss

40. If the first excited rotational state of a nucleus has energy equal to 93.3 KeV, then the energy of the third excited rotational state is approximately equal to

(a) 640 KeV (b) 653 KeV (c) 549 KeV (d) 689 KeV

41. The spin and parity J^P for the nuclei ${}_3Li^7$ and ${}_{11}Na^{23}$ in ground state are respectively

(a) $\frac{3}{2}^-$ and $\frac{3}{2}^+$ (b) $\frac{3}{2}^-$ and $\frac{5}{2}^+$ (c) $\frac{3}{2}^-$ and $\frac{5}{2}^-$ (d) $\frac{3}{2}^+$ and $\frac{3}{2}^-$

42. 1gm of radium is reduced by 2.1 mg in 5 years by α-decay. The half-life period of radium is

(a) 1056 years (b) 1672 years (c) 1590 years (d) 2282 years

43. The magnetic dipole moment of ${}_8O^{17}$ nucleus in terms of nuclear magneton μ_N is

(a) 1.36 μ_N (b) –1.91 μ_N (c) 4.79 μ_N (d) 0.86 μ_N

44. The two stars *A* and *B* radiate exactly the same power (consider that both stars behave as black body). If the radius of star *A* is three times that of star *B*, what is the ratio of the surface temperatures of both stars at absolute scale $T_A : T_B$?

(a) $\sqrt{3}:1$ (b) 3 : 1 (c) $1:\sqrt[4]{3}$ (d) $1:\sqrt{3}$

45. The relation between entropy (*S*) and energy (*E*) for a thermodynamic system is given by $S = CV^2 \ln E$, where *C* is a constant. The correct relation between pressure (*P*), energy (*E*) and volume (*V*) for the system is

(a) $P = \frac{2E \ln E}{V}$ (b) $P = \frac{2E}{V}$ (c) $P = \frac{E}{2V}$ (d) $P = \frac{2}{3}\frac{E}{V}\ln E$

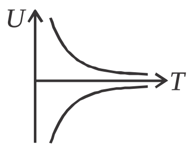
46. An equation of state for a certain thermodynamic system is found to be $PV^2 - aTV = bT$ where a and b are constants. The isothermal compressibility of the system is given by

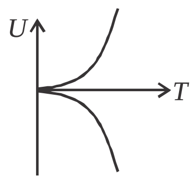
(a) $\dfrac{2PV - aT}{V}$ (b) $\dfrac{V}{2PV - aT}$ (c) $\dfrac{1}{aT - PV^2}$ (d) $\dfrac{V}{PV + aT}$

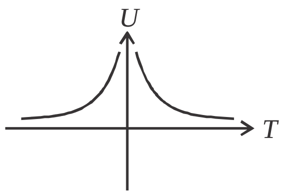
47. The entropy S of an ideal paramagnet in a magnetic field is given approximated by

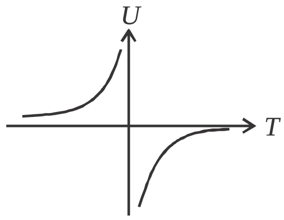
$$S = S_0 - CU^2$$

where, U is the energy of the spin system and C is a constant. For the variation of internal energy with absolute temperature T, which of the following plots is correct?

(a) 

(b) 

(c) 

(d) 

48. In the first –order phase transition which is/are continuous?

(a) Volume (b) Chemical potential (c) Entropy (d) all

49. Consider a quantum mechanical rigid rotator with Hamiltonian $H = \dfrac{L^2}{2I}$, where L is the magnitude of orbital angular momentum, is in thermal equilibrium at temperature T. The average energy of the rotator if it assumes only two values of angular momentum quantum number $\ell = 0$ and $\ell = 1$, is

(a) $\dfrac{\hbar^2}{2I\left[1+e^{-\frac{\hbar^2}{2IkT}}\right]}$ (b) $\dfrac{\left[1+\frac{3\hbar^2}{I}e^{-\frac{\hbar^2}{IkT}}\right]}{\left[1+3e^{-\frac{\hbar^2}{2IkT}}\right]}$ (c) $\dfrac{\hbar^2}{I\left[2+e^{+\frac{\hbar^2}{IkT}}\right]}$ (d) $\dfrac{\frac{3\hbar^2}{I}}{\left[3+e^{\frac{\hbar^2}{IkT}}\right]}$

50. Consider a system of distinguishable particles with energy levels $0, \varepsilon, 2\varepsilon, 3\varepsilon, 4\varepsilon, ...$. For a system with 2 particles and energy 2ε, the entropy of the system is

(a) $k\ln 3$ (b) $2k\ln 2$ (c) $2k\ln 3$ (d) $k\ln 5$

51. The Hamiltonian marix for a quantum mechanical system can be written as

$$H = -\frac{gB}{\sqrt{2}}\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}, \text{ where } g, B > 0 \text{ constants.}$$

The system is in thermal equilibrium at temperature T, the average energy of the system is given by

(a) 0 (b) $\dfrac{2gB}{3}$ (c) $\dfrac{-gB\left(e^{\beta gB} - e^{-\beta gB}\right)}{\left(1+e^{\beta gB}+e^{-\beta gB}\right)}$ (d) $\dfrac{-gB\left(e^{\beta gB} + e^{-\beta gB}\right)}{\left(1+e^{\beta gB}+e^{-\beta gB}\right)}$

52. Consider that the density of states $g(E)$ for super-relativistic gas is defined as

$$g(E)=\begin{cases}1, & 0<E<E_D\\ 0, & E>E_D\end{cases}$$

The specific heat at constant volume C_V for gas of bosons and fermions in very low temperature limit ($T\to 0$) varies as

(a) $C_V\ \alpha\ T^3$ for bosons and $C_V\ \alpha\ T$ for fermions

(b) $C_V\ \alpha\ T$ for bosons and for fermions $C_V\ \alpha\ T^3$

(c) $C_V\ \alpha\ T^2$ for bosons and for fermions $C_V\ \alpha\ T$

(d) $C_V\ \alpha\ T$ for bosons and for fermions $C_V\ \alpha\ T$

53. In a certain process, the entropy increases as i.e. $S\propto T^2$, where T is absolute temperature. The heat capacity at constant volume will vary as

(a) $C=$ constant. (b) $C\propto T$ (c) $C\propto T^2$ (d) $C\propto T^3$

54. Consider an ideal Fermi gas is confined in one dimensional region of length L at $T=0$. If the density of gas increases to two times of its initial value, then its Fermi energy

(a) increases to eight times of its initial value (b) increases to $2\sqrt{2}$ times of its initial value
(c) increases to four times of its initial value (d) remains unchanged

55. The equation of state for adiabatic process performed on an ideal gas consisting of non-relativistic rigid triangular molecular in terms of pressure (P) and volume (V) is given by

(a) $PV^{9/7}=$ constant (b) $PV^{7/5}=$ constant (c) $PV^{5/3}=$ constant (d) $PV^{4/3}=$ constant

56. A process is performed on 2 moles of an ideal mono-atomic gas in which its entropy depends on absolute temperature T as $S=\frac{\alpha}{T}$, where α is a constant. What is the work performed by the gas if its temperature varies from T_1 to T_2?

(a) $\alpha\ln\left(\frac{T_1}{T_2}\right)$ (b) $+\alpha\left[\frac{1}{T_2}-\frac{1}{T_1}\right]$

(c) $\alpha\ln\left(\frac{T_1}{T_2}\right)+3R(T_1-T_2)$ (b) $\alpha\left[\frac{1}{T_2}-\frac{1}{T_1}\right]+\frac{3}{2}R(T_1-T_2)$

57. The Helmholtz free energy (A) of a thermodynamics system in terms of volume (V) and temperature (T) is given by

$$A=a+bT(1-\ell nT)-cT\ln V$$

where a, b and c are constants. The enthalpy (H) of the system is

(a) $a+(b+c)T$ (b) $b\ln T+c\ln V$ (c) $a+bT$ (d) $b\ln T-c\ln V$

58. A branch of excitations for a three-dimensional system has a dispersion relation $\in(k) = Ak^{2/3}$, where A is constant and k is magnitude of wave vector. The excitations are bosonic in nature and chemical potential (μ) is zero. The heat capacity at constant volume (C_V) of the system varies on absolute temperature (T) as

(a) $C_V \propto T^{3/2}$ (b) $C_V \propto T^3$ (c) $C_V \propto T^{7/2}$ (d) $C_V \propto T^{9/2}$

59. Consider a collection of N two level systems in thermal equilibrium at a temperature T. Each system has only two states, a ground state of energy 0 and an excited state of energy $\in$. The probability that a system will be found in excited state and entropy respectively at very high temperature, are

(a) $P \to 0, S \to 0$
(b) $P \to 1/2, S \to Nk\ln 2$
(c) $P \to \infty, S \to \infty$
(d) $P \to 1/2, S \to Nk\ln 3$

60. The mean square fluctuations in energy for a system composed of N distinguishable particles with two energy levels ε_1 and $\varepsilon_2 (= \varepsilon_1 + \Delta)$ with degeneracy g_1 and g_2 respectively in thermal equilibrium at temperature T are given by

(a) $N\dfrac{g_1\varepsilon_1 + g_2\varepsilon_2 e^{-\frac{\Delta}{kT}}}{g_1 + g_2 e^{-\frac{\Delta}{kT}}}$

(b) $\dfrac{N}{kT^2}\dfrac{g_1\varepsilon_1 + g_2\varepsilon_2 e^{-\frac{\Delta}{kT}}}{\left(g_1 + g_2 e^{-\frac{\Delta}{kT}}\right)^2}$

(c) $\dfrac{N}{kT^2}\dfrac{g_1 g_2\Delta^2 e^{-\frac{\Delta}{kT}}}{\left(g_1 + g_2 e^{-\frac{\Delta}{kT}}\right)^2}$

(d) $N\dfrac{g_1 g_2\Delta^2 e^{-\frac{\Delta}{kT}}}{\left(g_1 + g_2 e^{-\frac{\Delta}{kT}}\right)^2}$

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PHYSICAL SCIENCES
TEST SERIES-C

Date : 02-12-2017

ANSWER KEY

PART-A

1. (b)	2. (d)	3. (c)	4. (b)	5. (b)	6. (a)	7. (a)
8. (b)	9. (b)	10. (b)				

PART-B

11. (c)	12. (b)	13. (a)	14. (c)	15. (b)	16. (c)	17. (b)
18. (c)	19. (c)	20. (d)	21. (b)	22. (c)	23. (a)	24. (b)
25. (d)	26. (b)	27. (d)	28. (d)	29. (b)	30. (c)	31. (c)
32. (d)	33. (b)	34. (a)	35. (d)	36. (b)	37. (c)	38. (d)
39. (b)	40. (b)	41. (a)	42. (b)	43. (b)	44. (d)	45. (a)
46. (b)	47. (d)	48. (b)	49. (d)	50. (a)	51. (c)	52. (d)
53. (c)	54. (c)	55. (d)	56. (c)	57. (a)	58. (d)	59. (b)
60. (d)						