TEST SERIES CSIR-NET/JRF JUNE 2018

BOOKLET SERIES C

Paper Code 05

Test Type: TEST SERIES

PHYSICAL SCIENCES

Duration: 02:00 Hours

Date: 29-05-2018

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.

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PART-A : GENERAL APTITUDE

1. Find the odd one in the given set of numbers

8, 27, 64, 100, 125, 216, 343

(a) 27 (b) 100 (c) 125 (d) 343

2. A number consists of 3 digits whose sum is 10. The middle digit is equal to the sum of the other two and the number will be increased by 99 if its digits are reversed. The number is

(a) 145 (b) 253 (c) 370 (d) 352

3. Excluding stoppages, the speed of a bus is 54 kmph and including stoppages, it is 45 kmph. For how many minutes does the bus top per hour?

(a) 9 (b) 10 (c) 12 (d) 20

4. The percentage profit earned by selling an article for Rs. 1920 is equal to the percentage loss increased by selling the same article for Rs. 1280. At what price should the article be sold to make 25 percent profit?

(a) Rs 2000 (b) Rs. 2200 (c) Rs. 2400 (d) none

5. The hardest substance available on earth is

(a) Gold (b) Iron (c) Diamond (d) Platinum

6. It is more difficult to walk on a sandy road than on a concrete road because

(a) Sand is soft and concrete is hard

(b) The friction between sand and feet is less than that between concrete and feet

(c) The friction between sand and feet is more than that between concrete and feet

(d) The sand is grainy but concrete is smooth

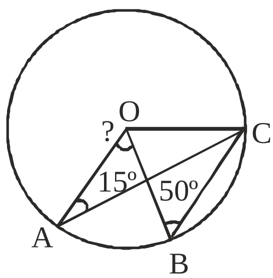
7. An application was received by class teacher in the afternoon of a weekday. Next day, she forwarded it to the student coordinator, who was on leave that day. The student coordinator put up the application to the principal next day in the evening. The principal studied the application and disposed off the matter on the same day, i.e. saturday, which day was the application received by the class teacher?

(a) Monday (b) Wednesday (c) Tuesday (d) Thursday

8. A cylinderical rod of iron whose height is 8 times its radius is melted and cast into spherical balls each of half the radius of the cylinder. The number of spherical balls is

(a) 12 (b) 16 (c) 24 (d) 48

9. In the given figure O is the centre $\angle$OBC = 50º and $\angle$ OAC = 15º. Then the value of the $\angle$AOB is



(a) 30 (b) 40 (c) 20 (d) 70

10. In a certain code, SIKKIM is written as THLJJL. How is TRAINING written in that code?

(a) SQBHOHOF (b) UQBHOIOF

(c) UQBHOHOI (d) UQBHOHOF

PART-B : MP + THERMO & STATS + NUCLEAR & PARTICLE PHYSICS

11. A particle of mass M which is at rest in the laboratory, decays into two particles, one of which has a mass M/2 while the other is massless. The magnitude of the momentum of each of the particle in the laboratory frame, is

(a) $\frac{Mc}{4}$ (b) $\frac{3Mc}{4}$ (c) $\frac{Mc}{8}$ (d) $\frac{3Mc}{8}$

12. The reaction $\pi^- + n \to K^- + \Lambda^0$ can not proceed via strong interaction because it violates the conservation of

(a) electric charge (b) baryon number (c) strangeness (d) angular momentum

13. ${}_6C^{11}$ decays to ${}_5B^{11}$ by positive β-emission. The maximum energy of the neutrino is [the atomic masses of ${}_6C^{11}$ and ${}_5B^{11}$ are 11.011433 amu and 11.009305 amu]

(a) 1.98 MeV (b) 0.96 MeV (c) 1.47 MeV (d) 0.51 MeV

14. A nucleus having mass number 240 decays by α-emission to the ground state of its daughther nucleus. The ratio of the kinetic energy of α-particle and the Q-value of the reaction is

(a) $\frac{1}{60}$ (b) $\frac{55}{57}$ (c) $\frac{57}{60}$ (d) $\frac{59}{60}$

15. The nuclear spin-parity of a nucleus in excited state and ground state are $\frac{3}{2}^+$ and $\frac{1}{2}^-$, respectively. The electromagnetic radiation emitted when the nucleus makes a transition from the excited state to the ground state are

(a) E_2, M_1 (b) E_1, M_2 (c) E_2, M_3 (d) E_3, M_2

16. The dominant interactions underlying the following processes:

$A: \Xi^- \to \Lambda^0 + \pi^-, B: K^- + p \longrightarrow \Omega^- + K^+ + K^0, C: \Sigma^0 \longrightarrow \Lambda^0 + \gamma$ are

(a) A : strong, B : electromagnetic, C : weak
(b) A : strong, B : weak, C : electromagnetic
(c) A:weak, B : strong, C : electromagnetic
(d) A : electromagnetic, B : strong, C : weak

17. According to the shell model, the spin and parity of two nuclei ${}^{63}_{29}Cu$ and ${}^{25}_{12}Mg$ are, respectively

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

18. If the binding enegy B of a nucleus is given by

$$B = a_v A - a_s A^{2/3} - a_c \frac{Z(Z-1)}{A^{1/3}} - a_a \frac{(A-2Z)^2}{A}$$

where, $a_v = 15.5\,MeV$, $a_s = 16.8\,MeV$, $a_c = 0.75$ and $a_a = 24\,MeV$, then the atomic number Z for the most stable isobar for a nucleus with mass number A = 125 is

(a) 50 (b) 55 (c) 58 (d) 52

19. The first excited state of ^{182}W is 2^+ and is 100 keV above the ground state. The energy of third excited state of ^{182}W is

(a) 583 keV (b) 333 keV (c) 100 keV (d) 700 keV

20. Which of the following reaction(s) is/are allowed via strong interaction?

(I) $\Delta^+ \to p + \pi^0$ (II) $K^- + p \longrightarrow \Lambda^0 + \pi^0$

(a) I and II (b) only I (c) only II (d) neither I nor II

21. According to the shell model, the nuclear magnetic moment of the $^{33}_{16}S$ nucleus is
(a) $+3.79\ \mu_N$ (b) $1.15\ \mu_N$ (c) $-1.9131\ \mu_N$ (d) $-1.15\ \mu_N$

22. If a radioactive element P decays to Q, which in turn decays to a stable element R. The decay constant from P to Q is λ_1, and that from Q to R is λ_2. If N_0 be the number of parent atoms initially, then the time at which the number of daughter nuclei Q will be maximum, is

(a) $\dfrac{\log\left(\dfrac{\lambda_2}{\lambda_1}\right)}{(\lambda_2-\lambda_1)}$ (b) $\dfrac{\log\left(\dfrac{\lambda_1}{\lambda_2}\right)}{(\lambda_2-\lambda_1)}$ (c) $\dfrac{\log\left(\dfrac{\lambda_1}{\lambda_2}\right)}{(\lambda_2+\lambda_1)}$ (d) $\dfrac{\log\left(\dfrac{\lambda_2}{\lambda_1}\right)}{(\lambda_2+\lambda_1)}$

23. The Σ^0-hyperon, decays to $\Lambda^0+\gamma$ with a mean life time of 7.4×10^{-20} sec. The decay width of Σ^0-hyperon, in keV is
(a) 9.85 (b) 4.96 (c) 4.45 (d) 8.87

24. For the β-decay nuclear reaction, ${}_1H^3 \to {}_2He^3 + e^- + \overline{v}_e$, the transition is
(a) allowed both by fermi and Gamow-Teller selection rule
(b) allowed by fermi and but not by Gamow-Teller selection rule
(c) not allowed by fermi but allowed by Gamow-Teller selection rule
(d) Not allowed both by fermi and Gamow-Teller selection rule

25. The uncertainty in the momentum of a nucleon within a nucleus varies with the mass number A as
(a) A (b) A^2 (c) $A^{-2/3}$ (d) $A^{-1/3}$

26. Consider the following function:

$$f(t)=\begin{cases}0 & \text{for } -1\le t\le 0\\ \dfrac{\pi}{2}\sin(\pi t) & \text{for } 0\le t\le 1\end{cases} \quad \text{and } f(t+2)=f(t)$$

In the Fourier series expansion of the given function, the ratio b_2/b_1 will be (Symbols have their usual meanings)

(a) not defined (b) 1 (c) 0 (d) $\pi/4$

27. Consider the following initial value problem:

$$y''+2y'+10y=6\delta(t-2)-3\delta(t-3),\ y(0)=0,\ y'(0)=0$$

where $\delta(t-a)$ is the dirac delta function. The Laplace transform of the solution $y(t)$ of the differential equation, will be

(a) $\dfrac{6e^{-2s}-3e^{-3s}}{s^2+2s+10}$ (b) $\dfrac{6e^{2s}-3e^{3s}}{s^2+2s+10}$ (c) $\dfrac{6e^{-2s}-3e^{-3s}}{s^2-2s-10}$ (d) None of these

28. Consider partial differential equation $\dfrac{\partial^2 u}{\partial x\,\partial y}=e^u-e^{-2u}$, on applying $V(x,y)=e^{u(x,t)}$, above equation takes the form :

(a) $V\dfrac{\partial^2 V}{\partial x\,\partial y}-\dfrac{\partial V}{\partial x}\dfrac{\partial V}{\partial y}=V^3-1$ (b) $V\dfrac{\partial^2 V}{\partial x\,\partial y}+\dfrac{\partial V}{\partial x}\dfrac{\partial V}{\partial y}=V^3-1$

(c) $\dfrac{\partial^2 V}{\partial x\,\partial y}+\dfrac{\partial V}{\partial x}\dfrac{\partial V}{\partial y}=V^3+1$ (d) $\dfrac{\partial^2 V}{\partial x\,\partial y}-\dfrac{\partial V}{\partial x}\dfrac{\partial V}{\partial y}=V^3+1$

29. The interval $[0,1]$ is divided into 4 parts of equal length to evaluate the integral $\int_0^1 \frac{dx}{2x+3}$ using Trapezoidal rule. The percentage error (in magnitude) in the calculation will be approximately,

[You can use the result: $\ln(5/3) = 0.51082$]

(a) 0.29 % (b) 0.78% (c) 1.14 % (d) 1.83%

30. The surface '*A*' consists of the top and four sides (but not the bottom) of the cube with vertices $(\pm 1, \pm 1, \pm 1)$ oriented outward, then the value of the integral

$$\iint_S (\text{curl } \vec{F}) \cdot d\vec{A}, \text{ where } \vec{F}(x, y, z) = \langle xyz,\ xy,\ x^2yz \rangle.$$

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

31. If the function $W = f(z) = u(r, \theta) + iv(r, \theta)$ is analytic in the entire complex argand plane, then the value of dW/dz is equal to

(a) $2e^{i\theta}\frac{\partial W}{\partial r}$ (b) $2e^{-i\theta}\frac{\partial W}{\partial \theta}$ (c) $2e^{-i\theta}\frac{\partial W}{\partial r}$ (d) $2e^{i\theta}\frac{\partial W}{\partial \theta}$

32. Consider the complex integral

$$I = \int_C \frac{(z^3 + z + i)\sin z}{z^4 + iz^3} dz,$$

where C is the positively oriented circle $|z| = \pi$. Then, which of the following statements is CORRECT?

(a) $z = 0$ is third order pole and $z = -i$ is first order pole and $I = 2\pi \sinh(1)$.

(b) $z = 0$ is second order, $z = -i$ is first order pole and $I = 2\pi \sinh(1)$

(c) $z = 0$ is second order, $z = -i$ is second order pole and $I = 2\pi \cosh(1)$

(d) $z = 0$ is third order, $z = -i$ is third order pole and $I = 2\pi \cosh(1)$

33. If $J_n(x)$ is the Bessel's function of first kind, then $\left(\frac{8}{x^2} - 1\right) J_1(x) - \frac{4}{x} J_0(x)$ can be written as

[You may use the recurrence relation $J_{n+1}(x) = \frac{2n}{x} J_n(x) - J_{n-1}(x)$]

(a) $J_4(x)$ (b) $J_3(x)$ (c) $J_3(x) + J_2(x)$ (c) None of these

34. Let $H_n(x)$ be the Hermite polynomial satisfying the following generating function relation:

$$e^{2xt - t^2} = \sum_{n=0}^{\infty} \frac{H_n(x)}{n!} t^n$$

The value of $H_6(0)$ is

(a) 1680 (b) -1680 (c) 120 (d) -120

35. The length element '*ds*' of an arc in a particular coordinate system, is given by

$$ds^2 = a\,dx^2 + b\,dy^2 + c\,dz^2 + 2f\,dy\,dz + 2g\,dz\,dx + 2h\,dx\,dy,$$

then the correcponding metric tensor g_{ij} is

(a) $\begin{pmatrix} a & 2h & 2g \\ 2h & b & 2f \\ 2g & 2f & c \end{pmatrix}$ (b) $\begin{pmatrix} a & h & g \\ h & b & f \\ g & f & c \end{pmatrix}$ (c) $\begin{pmatrix} a & 2h & 0 \\ 0 & b & 2f \\ 2g & 0 & c \end{pmatrix}$ (d) $\begin{pmatrix} a & h & b \\ f & g & c \\ 0 & b & a \end{pmatrix}$

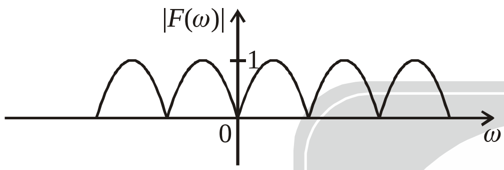
36. A total of $(2n+1)$ tickets are numbered consecutively. Three tickets are drawn at random. The probability that these numbers are in A.P., will be

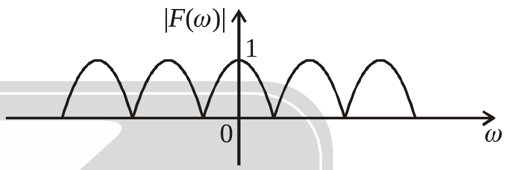
(a) $\frac{3n}{4n^2}$ (b) $\frac{3n}{4n^2+1}$ (c) $\frac{n}{4n^2+1}$ (d) $\frac{n}{4n^2-1}$

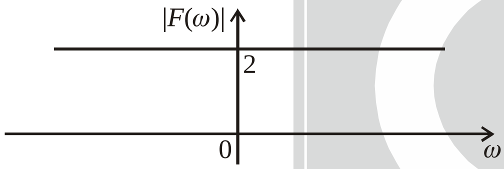
37. Suppose that the probability of a transistor manufactured by a certain firm being defective is 0.015. What is the probability that there is no defective transistor in a batch of 100 ?

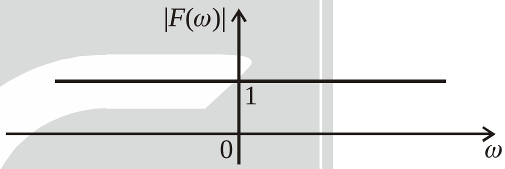
(a) 0.123 (b) 0.223 (c) 0.322 (d) 0.312

38. Consider a dirac-delta function of strength 2 and centred at $t = 3$. Which of the following graph best represents the variation of the modulus of Fourier transform of this function?

(a)


(b)


(c)


(d)


39. Which of the following matrices is an element of the group $SU(2)$?

(a) $\begin{pmatrix} 1/2 & \sqrt{3}i/2 \\ \sqrt{3}i/2 & 1/2 \end{pmatrix}$ (b) $\begin{pmatrix} 1/2 & i/2 \\ -i/2 & 1/2 \end{pmatrix}$

(c) $\begin{pmatrix} 1/2 & \sqrt{3}i/2 \\ -\sqrt{3}i/2 & 1/2 \end{pmatrix}$ (d) $\begin{pmatrix} 1/2 & i/2 \\ i/2 & 1/2 \end{pmatrix}$

40. Consider the following matrix:

$$A = \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$$

The eigenvalues of the matrix $B = A^4 - 3A^3 + 3A^2 - 2A + 8I$, are respectively

(a) $2+i,\ 2-i$ (b) $i,\ -i$ (c) $1+i,\ 1-i$ (d) None of these

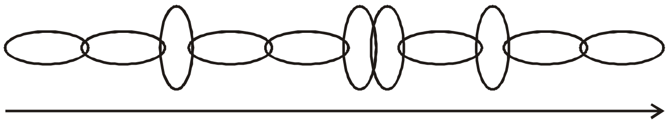
41. Consider the following symmetric function: $\psi(x) = A\exp(-k|x|)$, where A and k are positive real constants.

Then ψ'' can be expressed as

(a) $k^2\psi(x) - 2Ak\delta(x)$ (b) $k^2\psi(x) - 2\delta(x)$

(c) $k^2\psi(x) - \frac{Ak}{2}\delta(x)$ (d) $k^2\psi(x) - \frac{2}{Ak}\delta(x)$

42. Consider a one-dimensional chain consisting of $n \gg 1$ segments as illustrated in the figure. Let the length of each segment be 'a' when the long dimension of the segment is parallel to the chain and zero when the segment is vertical (i.e., long dimension normal to the chain direction). Each segment has just two states, a horizontal orientation and a vertical orientation, and each of these states is not degenerate. The distance between the chain ends is nx. The entropy of the chain as a function of x is



(a) $k_B \ln n!$

(b) $k_B \ln \dfrac{n!}{\left(\frac{x}{a}n\right)!\left(n+\frac{x}{a}n\right)!}$

(c) $k_B \ln \left(\frac{x}{a}n\right)\left(n-\frac{x}{a}n\right)$

(d) $k_B \ln \dfrac{n!}{\left(\frac{x}{a}n\right)!\left(n-\frac{x}{a}n\right)!}$

43. A thermally insulated cylinder, closed at both ends, is fitted with a frictionless heat-conducting piston which divides the cylinder into two parts. Initially, the piston is clamped in the center, with 1 litre of air at 200 K and 2 atm pressure on one side and 1 litre of air at 300 K and 1 atm on the other side. The piston is released and the system reaches equilibrium in pressure and temperature, with the piston at a new position. The final pressure and temperature are respectively.

(a) 1.5 atm and 225 K (b) 1.0 atm and 225 K (c) 1.0 atm and 225 K (d) 1.5 atm and 250 K

44. A system of particles occupying single-particle levels and obeying Maxwell-Boltzmann statistics is in thermal contact with a heat reservoir at temperature T. If the population distribution in the non-degenerate energy levels is as shown, what is the temperature of the system ? [Take 1 eV = 10^{-19} J, ln 2 = 0.7 and $k_B = 10^{-23}$ J/K)

Energy (eV)	Population
7×10^{-3}	8 %
14×10^{-3}	4 %

(a) 175 K (b) 50 K (c) 150 K (d) 100 K

45. Electromagnetic radiation following the Planck distribution fills a cavity of volume V. Initially ω_i is the frequency of the maximum of the curve of $u_i(\omega)$, the energy density per unit angular frequency versus ω. If the volume is expanded quasistatically to 2V, what is the final peak frequency ω_f of the $u_f(\omega)$ distribution curve ? The expansion is adiabatic.

(a) ω_i (b) $\dfrac{\omega_i}{2^{1/3}}$ (c) $\dfrac{\omega_i}{2^{1/2}}$ (d) $\dfrac{\omega_i}{2}$

46. A system of N spinless atoms fixed at their position at temperature T. Each atom has only two energy levels ε_1 and ε_2, the chemical potential is

(a) $kT \ln\left(e^{-\beta\varepsilon_1} + e^{-\beta\varepsilon_2}\right)$

(b) $-kT \ln\left(e^{-\beta\varepsilon_1} + e^{-\beta\varepsilon_2}\right)$

(c) $kT \ln\left(e^{-\beta\varepsilon_1} - e^{-\beta\varepsilon_2}\right)$

(d) $-kT \ln\left(e^{-\beta\varepsilon_1} - e^{-\beta\varepsilon_2}\right)$

47. Consider the orthogonalized drunk who starts out at the proverbial lamp-post; Each step he takes is either due north, due south, due east or west, but which of the four directions he steps in is chosen purely randomly at each step. Each step is of fixed length L. What is the probability that he will be within a circle of radius 2L of the lamp-post after 3 steps ?

(a) $\dfrac{9}{64}$ (b) $\dfrac{15}{16}$ (c) $\dfrac{9}{10}$ (d) $\dfrac{9}{16}$

48. A van der Waals' gas the equation of state

$$\left(p+\frac{a}{V^2}\right)(V-b)=RT$$

the gas undergoes an isothermal expansion from volume V_1 to volume V_2. What is the change in the Helmholtz free energy ?

(a) $-RT\,\ell n\left(\frac{V_2-b}{V_1-b}\right)+a\left(\frac{1}{V_1}-\frac{1}{V_2}\right)$ (b) $-RT\,\ell n\left(\frac{V_2-b}{V_1-b}\right)-a\left(\frac{1}{V_1}-\frac{1}{V_2}\right)$

(c) $RT\,\ell n\left(\frac{V_2-b}{V_1-b}\right)+a\left(\frac{1}{V_1}-\frac{1}{V_2}\right)$ (d) $RT\,\ell n\left(\frac{V_2-b}{V_1-b}\right)-a\left(\frac{1}{V_1}-\frac{1}{V_2}\right)$

49. The isothermal compressibility (K_T) and coefficient of volume expansion (β) are defined as

$$K_T=-\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T,\ \beta=\frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$$

where V is the volume of a thermodynamic system that is the function of pressure (P) and temperature (T). Among the following, which option is correct?

(a) $\left(\frac{\partial\beta}{\partial P}\right)_V=-\left(\frac{\partial K_T}{\partial T}\right)_P$ (b) $\left(\frac{\partial\beta}{\partial P}\right)_T=\left(\frac{\partial K_T}{\partial T}\right)_P$

(c) $\left(\frac{\partial\beta}{\partial P}\right)_T=-\left(\frac{\partial K_T}{\partial T}\right)_P$ (d) $\left(\frac{\partial\beta}{\partial P}\right)_V=\left(\frac{\partial K_T}{\partial T}\right)_P$

50. Consider a gas whose internal energy (U) and pressure (P) are given by

$$U=\frac{f}{2}NK_BT-b\frac{N^2}{V};\ P=\frac{NK_BT}{V}-b\frac{N^2}{V^2}$$

where N is the number of molecules, V is the volume, f is degree of freedom, T is temperature and b is constant. The relation between temperature and volume for adiabatic process is

(a) $\ln\left(VT^f\right)=$ constant (b) $\ln\left(VT^{\left(\frac{f}{2}-1\right)}\right)=$ constant

(c) $\ln\left(VT^{\frac{2}{f}}\right)=$ constant (d) $\ln\left(VT^{\frac{f}{2}}\right)=$ constant

51. The neutral lithium atom has only two levels; 2-fold degenerate ground level and 6-fold degnerate first excited levels. The first excited level is at energy 1.2 eV above the ground level (0.3 eV). The average energy (in eV) of the atom in thermal equilibrium at temperature T is given by

(a) $\frac{0.3+4.5\,e^{-\frac{1.2}{k_BT}}}{1+3\,e^{-\frac{1.2}{k_BT}}}$ (b) $\frac{0.3+3.6\,e^{-\frac{1.2}{k_BT}}}{1+3\,e^{-\frac{1.2}{k_BT}}}$ (c) $\frac{0.3+3.6\,e^{-\frac{1.5}{k_BT}}}{1+3\,e^{-\frac{1.5}{k_BT}}}$ (d) $\frac{0.6+7.2\,e^{-\frac{1.2}{k_BT}}}{1+3\,e^{-\frac{1.2}{k_BT}}}$

52. A cubic box with infinitely hard walls having volume V, contains an ideal gas consisting of N molecules, each of which has mass m, spin-½ and magnitude of magnetic moment μ. The partition function of the gas in uniform external magnetic field $\vec{B}=B_0\hat{n}$ in their equilibrium at temperature T is given by

(a) $\left[2\cosh\left(\frac{\mu B_0}{k_BT}\right)\right]^N$ (b) $\left[V\left(\frac{2\pi mk_BT}{h^2}\right)^3\left(\cosh\left(\frac{\mu B_0}{k_BT}\right)\right)\right]^N$

(c) $2V\left(\frac{2\pi mk_BT}{h^2}\right)^3\cosh\left(\frac{\mu B_0}{k_BT}\right)$ (d) $\left[2V\left(\frac{2\pi mk_BT}{h^2}\right)^3\cosh\left(\frac{\mu B_0}{k_BT}\right)\right]^N$

53. Consider a system of N particules with 3 possible non-degenerate single particle energy level separate by $\in$. The system is in thermal equilibrium at temperature T. At what temperature (T) is the ground level 2 times as is likely to be occupied as third level?

(a) $\frac{2\in}{k_B}$ (b) $\frac{\in}{k_B\ln 2}$ (c) $\frac{2\in}{k_B\ln 2}$ (d) $\frac{3\in}{k_B\ln 2}$

54. A partition divides a container into two parts of equal volume. One part contains 1 mole of O_2 gas and other part contains 4 moles of N_2 gas. Assume both gases are ideal gases. The partition is removed and gases mix. If the system is held at constant temperature, what is the change in Helmholtz free energy due to mixing?

(a) 0 (b) $5RT\ln 2$ (c) $-5RT\ln 2$ (d) $-RT\left[\ln 5+4\ln\frac{5}{4}\right]$

55. A system has 3 states of energy $\in$, $2\in$ and $3\in$ with degeneracies 1, 2 and 4 respectively. The average energy of the system in thermal equilibrium at temperature $\frac{\in}{k_B\ln 2}$ is

(a) $\in$ (b) $2\in$ (c) $\frac{5\in}{2}$ (d) $3\in$

56. 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 $C_V\,\alpha\,T$

57. Taylor expansion of $f(z)=\frac{1+2z^2}{z^3+z^5}$ around $z=0$ is given by

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

(c) $\left(\frac{1}{z^3}-\frac{1}{z}\right)-\sum_{n=0}^{\infty}z^{2n+1}$ (d) $\left(\frac{1}{z^3}-\frac{1}{z}\right)-\sum_{n=0}^{\infty}(-1)\,z^{2n+1}$

58. The integral $\int_1^3 x^2dx$ 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

59. 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) $\frac{1}{2}\ell n\left(1-x^2\right)$

60. 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

Space for rough work

Physical Sciences (NET-JRF/GATE)

Test Series- C

Date: 29-05-2018

ANSWER KEY

PART-A

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

PART-B

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