September 2009 Paper-II

1. Which of the following functions is not entire
   (a) $x^2 - y^2 + i((2xy)$

   (b) $(x^2 - y^2) - i((2xy)$

   (c) $(y^3 - 3x^2y) + i(x^3 - 3xy^2)$

   (d) $e^{-y}\sin x - ie^{-y}\cos x$

2. $1,3,5,7 \ldots (2n-1) = \cdots ..$

   (a) $(2n-1)!$ (b) $(2n)! - 2(n!)$

   (c) $\frac{(2n)!}{2(n!)}$ (d) $\frac{(2n)!}{2^n n!}$

3. If $\vec{c} = \vec{a} \times \vec{b}$ and $\vec{b} = \vec{c} \times \vec{a}$ then which of the following gets implied?

   (a) $\vec{a}.\vec{b} = c^2$ (b) $\vec{a}.\vec{c} = b^2$

   (c) $\vec{a} \perp \vec{b}$ (d) $\vec{a} \,||\, (\vec{b} \times \vec{c})$

4. $\int_{-4}^{4} |2 - x| \, dx = \cdots ..$
   (a) 4 (b) 10

   (c) 16 (d) 20

5. Which of the following statements is false about the curve $x^2 + y^3 = 64$
   (a) The curve does not pass through the origin.

   (b) The curve is symmetric about y axis.

   (c) The curve is symmetric about x axis

   (d) The curve extends to infinity

6. The slope of tangent to the curve $f(x, y) =$ constant at a point (x, y) on the curve is
   (a) $\frac{\partial f}{\partial x}$ (b) $-\frac{\partial f}{\partial x}$

   (c) $-\frac{\left(\frac{\partial f}{\partial x}\right)}{\left(\frac{\partial f}{\partial y}\right)}$ (d) $-\frac{\left(\frac{\partial f}{\partial y}\right)}{\left(\frac{\partial f}{\partial x}\right)}$

7. Eigenvalues of Hermitian operator are.. .
   (a) Pure real numbers

   (b) Pure imaginary number

   (c) Unimodular

   (d) $0,1-1$

8. A non-singular matrix A is of order 3×3. then determinant of adj A is given by.
   (a) $|\text{Adj A}| = |A|^{-1}$ (b) $|\text{Adj A}| = |A|$

   (c) $|\text{Adj A}| = |A|^2$ (d) $|\text{Adj A}| = |A|^3$

9. The order and the degree of the differential equation

   $\frac{d^2y}{dx^2} + 4\left(\frac{dy}{dx}\right)^4 - 7y = 0$

   (a) 1 and 2 respectively

   (b) 2 and 1 respectively

   (c) 2 and 4 respectively

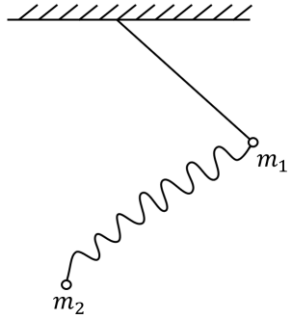
   (d) 4 and 2 respectively

10. A particle of charge q is moving along X axis. It enters the magnetic field regine with magnetic field along Z-axis. the Particle will turn
    (a)Towards $+y-$ axis (b)Towards$-y-$ axis

    (c)Towards $+z-$ axis (d)Towards$-z-$ axis

11. A mass m_1 attached to the ceiling with a string of length L another mass m_2 is attached to it by a spring as shown in figure. The number of degrees of freedom for this system is
    (a) 6 (b) 5

(c) 4 (d) 3



12. A particle of mass m and charge is moving in the combined field of gravity and a constant electric field E. The electric field is in the horizontal plane. Taking X-axis parallel to the electric field and z-axis vertically upward, the potential energy o the particle is given by

(a) $+ mgz - q|\overline{E}|x$ (b) $- mgz - q|\overline{E}|x$

(c) $+ mgz + q|\overline{E}|x$ (d) $- mgz + q|\overline{E}|x$

13. For the dispersion relation which of $\omega^2 = ak^2$the Statements is Correct

(a) Phase velocity is a α.

(b) Group velocity is α.

(c) Group velocity and phase velocity are equal.

(d) Phase velocity exists but the group velocity does not exist.

14. Observer O notes that two events are separated in space and time by 600 m and 8×10^{-7}s. How fast must observer O' be moving relative to O in order that the events be simultaneous to O?

(a) 0.4 C (b) 0.1 C

(c) 0.2 C (d) 0.3 C

15. For spectrum of a star which of the following is correct.

(a) It shows a red-shift

(b) It shows a blue-shift

(c) There is no shift

(d) All the wavelength suffer an Equal shift

16. A uniform circular disc of radius R has center's C and mass M.A circular hole of Radius $\frac{R}{2}$.is made in the disc centred at a point Distance $\frac{R}{2}$ from C. The remaining portion thus has mass $\frac{3M}{4}$ The moment of inertia of this portion about an axis passing through C and perpendicular to the plane of the disc is

(a) $\frac{3}{4}MR^2$ (b) $\frac{3}{8}$ MR^2

(c) $\frac{9}{16}MR^2$ (d) $\frac{13}{32}$ MR^2

17. For a Simple pendulum of length l executing motion in the verticle y-z plane, the generalized coordinate is

(a) The length l of the pendulum.

(b) The y coordinates of the bob

(c) The z coordinates of the bob

(d) The angle θ between the pendulum and the vertical axis

18. An isolated conducting spherical shell of radius 10 cm has a potential of 40 V due to the Charges on it. The potential at a point distant 20 cm from its

(a) Zero (b) 10 V

(c) 30 V (d) 20 V

19. Three identical spherical conductors A, B and C carrying charges 1uC, 3uC and -6uC respectively are kept for apart First A is taken to B and after touching it, brought back to its original position. Then B and C are brought in contact and kept in their places. Finally C and A are brought in contact and separated. The final charge on C

(a) $-\frac{2}{3}$ μc (b) $\frac{3}{2}$ μc

(c) 0 μc (d) 2 μc

20. A pair of transmission lines is fed by a signal of 300 MHz and is terminated by $Z_1 =$ Zero ohms, the maxima of electric field will occur at
(a) 100 cm away from Z_L

(b) 50 cm away from Z_L

(c) 25 cm away from Z_L

(d) Will appear at Z_L Itself.

21. An EM wave has to travel through a rectangular wave grid of width a and height b. Then the cut-off wavelength of the wave is given by
(a) $\lambda_c = a$ (b) $\lambda_c = 2a$

(c) $\lambda_c = b$ (d) $\lambda_c = 2b$

22. In a region, steady and uniform electric and magnetic fields are present. These two fields are parallel to each other. A charged particle is released from rest in this region. The path of the way particle will be...
(a) a straight line (b) a circle

(c) a parabola (d) a helix

23. A straight wire of diameter 0.5 mm carrying a current of 1 A is replaced by another wire of 1 mm diameter carrying the same current. The strength of the magnetic field at any point outside the wire
(a) $\left[\frac{1}{4}\right]^{th}$ of the earlier value

(b) $\left[\frac{1}{2}\right]$ of the earlier value

(c) 2 times the earlier value

(d) same as the earlier value

24. A parallel plate capacitor With a material of dielectric constant between the plates has a capacity C is charged to potential V. The dielectric slab is slowly removed from between the plates and then reinserted. The network done by the system in this process is.
(a) $\frac{1}{2}CV^2$ (b) $\frac{1}{2}(k-1)CV^2$

(c) CV^2 (d) Zero

25. The potential at a point x measured in μm is given by

$$v(x) = \frac{20}{(x^2-4)}$$

(a) $\frac{10}{9}\frac{\text{Volt}}{\mu m}$ in the + ve x direction

(b) $\frac{10}{9}\frac{\text{Volt}}{\mu m}$ in the − ve x direction

(a) $\frac{5}{3}\frac{\text{Volt}}{\mu m}$ in the + ve x direction

(a) $\frac{5}{3}\frac{\text{Volt}}{\mu m}$ in the − ve x direction

26. A capacitance of value C is charged to have an energy U. It is then connected in parallel to an uncharged capacitor of value 3C. The percentage loss of energy in the redistribution of charges is
(a) 33% (b) 50%

(c) 75% (d) zero

27. For an electron, the spin wave Functions are denoted by α (spin − up) and β (spin − down). For system of two electrons labeled I and 2, which of the following Spin function antisymmetrie under exchange.
(a) $\alpha_1\alpha_2$ (b) $\beta_1\beta_2$

(c) $\alpha_1\beta_2 - \alpha_2\beta_1$ (d) $\alpha_1\beta_2 + \alpha_2\beta_1$

28. The ground state energy of hydrogen atom is $E_0 = 13.6$ eV. What is the first excited state energy of the positronium atom (Proton in H-atom replaced by positron)?
(a) $\frac{E_0}{2}$ (b) $2E_0$
(c) Zero (d) $\frac{E_0}{8}$

29. At time $t = 0$ a free particle is in a state
$V(x,t) = \frac{1}{\sqrt{2\pi}}\left[\frac{1}{2}e^{ikx} + \frac{1}{2}e^{-2ikx} + \frac{1}{\sqrt{2}}e^{3ikx}\right]$
Momentum of the particle at $t = 0$.
(a) Zero (b)1.25
(c) 2 (d)1.5

30. A simple harmonic oscillator has an energy spectrum $E_n = \left[(n + \frac{1}{2})\ \hbar\omega\right]$what happens to the spectrum if a perfect reflector is kept at the origin so that the oscillator can move in the domain $(0, \infty)$ instead of $(\infty, -\infty)$
(a) No change in the energy eigenvalues
(b) Only odd n eigenvalues are allowed
(c) Only even n eigenvalues are allowed
(d) Only ground state energy double

31. A quantum mechanical particle of mass m in a one-dimensional box of length L is in its ground state. What will happen to the particle energy when the size of the box is slowly reduced is half its original size, i.e. made L/2?
(a) Energy will not change.
(b) Energy will increase to double its original value
(c) Energy will decrease to half its original value
(d) Energy will increase four fold.

32. A and B are non-commuting Hermitian operators. Which one of the following is Hermitian?
(a) AB (b) $A^{-1}B^{-1}$
(c) $AB + BA$ (d)$AB - BA$

33. Low energy electrons are Incident on a hard sphere of Radius a.The scattering cross section
(a) Increases with scattering angle
(b) Decreases with scattering angle.
(c) is independent of scattering angle
(d) Oscillates with scattering angle.

34. for nonrelativistic neutrons of energy E in meV, wavelength λ in Angstrom following relation holds:
$E\ (meV) = \frac{80}{[\lambda(A)]^2}$Thermal neutrons ($T = 300$ K) are incident on a simple cubic crystal of lattice constant 1A. What is the largest Bragg angle at which diffraction can occur in Principle?
(a) 180^0 (b) 60^0
(c) 90^0 (d)45^0

35. Consider N particles each with projection s along the axis of spin 1. Each particle has 3 quantization. The total number of microstates of the system will be
(a) 3N (b) 3^N
(c) N^3 (d)$(3N)^2$

36. The entropy of an isolated system in a reversible process Will be
(a)Remains constant (b)Is greater than zero
(c)Is less than zero (d)becomes infinite

37. The probability of a particle occupying a state is equal to the average occupancy of the state in case of
(a) Maxwell Boltzmann Distribution

(b) Fermi-Dirac Distribution

(c) Bose-Einstein Distribution

(d) None of the above Distributions

38. If the temperature T of a photon gas in equilibrium in a radiation cavity is doubled, the equilibrium number of photons in the cavity will increase by the factor of
(a) 2 (b)6

(c) 8 (d)9

39. 10 gms of ice at 0 C is added 20gms water at 90C in a Dewar flask. The heat of fusion of water is 1430 cal/mol. The specific heat of water is taken d independent of temperature. Heat capacity of Dewar flask is ignored. The entropy change of the system is
(a) $0.70\frac{\text{cal}}{\text{deg}}$ (b) $-7.0\frac{\text{cal}}{\text{deg}}$

(c) $-0.70\frac{\text{cal}}{\text{deg}}$ (d) 0 cal/deg

40. A system of 3 indistinguishable particles has the total energy of 4 E. There are four single particle energy states with energy 0, E, 2 E and 3 E. The number of microstates accessible to the system will be
(a) 1 (b)2

(c) 3 (d) 4

41. A particle of mass m and total energy E is executing one dimensional simple harmonic motion its trajectory in phase space is
(a) Ellipse (b) Parabola

(c) Circle (d) Hyperbola

42. Consider a gas of 2 distinguishable particles in any of the 3 single particle states. The number of microstates of the system in case of Maxwell Boltzmann gas will be
(a) 6 (b)3

(c) 1 (d) 9

43. The rate at which a heated filament of temperature T lo0ses energy by conduction and Convection just above the ambient temperature is best given by
(a) $K_1 (T_1 - T_0) + K_2 (T^4 - {T_0}^4)$

(b) $K T^4$

(c) $K (T + T_0)^2$

(d) $K T^4 - K {T_0}^4$

44. Which of the following detectors cannot be used to measure energy of the incident particles radiation?
(a)Scintillation detector.

(b)Proportional counter

(c)GM counter

(d)High purity Germanium detector

45. The inside surface of CRT coated with aquatic and connected to second Anode order to
(a) Avoid burning of the phosphor.

(b) To increase luminance

(c) To increase velocity electrons

(d) To provide ground electrons

46. Which of the following photo detector is more sensitive incident wavelength?
(a) Photodiode (b) Solar cell

(c) Pin diode (d) Photo multiplier

47. Which one of the following is more Monochromatic?
(a)Output of Nd: YAG Laser

(b) Output of Ruby les

(c) Laser pointer

(d) He: Ne Lesar Beam

48. The metallic sodium has a bcc structure. The X- corresponding to
(a) (111) (b) (200)

(c) (110) (d) (222)

49. The intensity of X-ray diffraction peak in a powder diffraction experiment is principally decided by
(a) The lattice constant of the powder Crystals.

(b) The local symmetry of Tenement of atoms in the Crystal

(c) The Average size of the crystals in the powder

(d) The Structure factor of the Crystal

50. An Incident L and Capacitance C are connected series to resistance at frequency 'f_s' when they are connected in parallel the resonance frequency 'f_p'
(a) $f_p < f_s$

(b) $f_p > f_s$

(c) $f_p = f_s$

(d) There is no Relation between the two

Answer Key				
1. b	2. d	3. c	4. c	5. c
6.	7. a	8.	9. b	10.
11. d	12. a	13. c	14. a	15. a
16.	17. d	18.	19. d	20. d
21. b	22. b	23. b	24. b	25. a
26. c	27. c	28. d	29. b	30. b
31. d	32. c	33. a	34.	35. b
36. a	37. b	38. c,d	39. d	40. c
41. a	42.	43.	44. c	45. c
46. a	47. a	48.	49. d	50. b