February 2008 Paper –II

1. The value of the following continued fractions
$$3 - \cfrac{1}{3 - \cfrac{1}{3 - \cdots \ldots \ldots}}$$
(a) $\frac{[3+\sqrt{5}]}{2}$ (b) $\frac{[3-\sqrt{5}]}{2}$
(c) $\frac{[5+\sqrt{3}]}{2}$ (d) $\frac{[5-\sqrt{3}]}{2}$

2. For $0 \leq x < \infty$, the following is true
(a) $\sin hx < e^x < \cos hx$
(b) $\sin hx < \cos hx < e^x$
(c) $e^x < \cos hx < \sin hx$
(d) $e^x < \sin hx < \cos hx$

3. Find the constant $'a'$ for which the vector $\vec{A} = (x + 3y)\,\vec{i} + (y - 2z)\,\vec{j} + (x + az)\,\vec{k}$ Solenoid.
(a) 1 (c) -1
(b) 2 (d) -2

4. The Rank of the matrix:
$$\begin{bmatrix} 4 & 3 & 2 & 1 \\ 2 & -1 & 5 & 4 \\ 6 & 2 & 7 & 5 \\ 0 & 5 & -8 & -7 \end{bmatrix}$$
(a) 1 (c) 3
(b) 2 (d) 4

5. A hermitian matrix of order n satisfies the property $A^4 = I$ where I is the unit matrix of order n. The eigenvalues of A can only be of the form
(a) ± 1 (b) $\pm 1, \pm i$
(c) n^{th} Root of unity (d) Any real number

6. The differential equation $(x^3 + 3xy^2)\,dx + (3x^2t + y^3)dy = 0$ has the solution, with arbitrary constant C,
(a) $x^4 + 6x^2y^2 + y^4 = 0$
(b) $x^4 - 6x^2y^2 + y^4 = 0$
(c) $x^4 + 6x^3y + 6xy^3 + y^4 = 0$
(d) $x^4 + y^4 = 0$

7. Consider a function $f(x) = 3 \sin x$ and $f(x + \pi) = f(x)$ for all x. The function will have a Fourier series with
(a) Sine terms and period π
(b) Cosine terms and period π
(c) Sine terms of period 2π
(d) Sine and cosine terms of period 2π

8. The value of $\sqrt{i}$ Where $i = -\sqrt{1}$
(a) $\pm\frac{[1+i]}{\sqrt{2}}$ (b) $\pm\frac{[1-i]}{\sqrt{2}}$
(c) $\frac{[1+i]}{\sqrt{2}}$ (d) $\frac{[1-i]}{\sqrt{2}}$

9. Action is defined as
(a) $\int_{t1}^{t2} T\,dt$ (b) $\int_{t1}^{t2} H\,dt$
(c) $\int_{t1}^{t2} (p\dot{q} + H)\,dt$ (d) $\int_{t1}^{t2} L\,dt$

10. For a geostationary satellite which of the statement is correct.
(a) Satellite completes one revolution in 24 hours from east towards west.
(b) Satellite completes one revolution in 24 hours from west towards east.
(c) Satellite completes one revolution in one year from east towards west.

(d) Satellite completes one revolution in one year from west towards east.

11. Which of the relations in Classical Mechanics is wrong?

(a) $L = p_i \dot{p}_i - H$ (b) $\dot{p}_i = -\frac{\partial H}{\partial q_i}$

(c) $\dot{q}_i = -\frac{\partial H}{\partial p_i}$ (d) $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_i}\right) - \frac{\partial L}{\partial q_i} = 0$

12. Isotropy of medium is related to the conservation of

(a) Energy

(b) Mass

(c) Linear momentum

(d) Angular momentum

13. Reduced mass m_e , of a system Comprising one electron of mass m_c and one proton of mass m_p iS nearly

(a) m_p (b) m_c

(c) $m_e + m_p$ (d) $m_e - m_p$

14. A particle of mass m is Constrained to move along the X- axis, in a potential given by $V(x) = a + bx + cx^2$, where c is a positive constant. If the particle is disturbed slightly from its equilibrium position, then it

(a) Performs SHM with period $2\pi\sqrt{\frac{m}{2C}}$

(b) Performs SHM with period $2\pi\sqrt{\frac{bm}{ac}}$

(c) Performs SHM with period$2\pi\sqrt{\frac{2c}{m}}$

(d) Does not perform SHM

15. If the angular frequency ω and wave number k are related through the expression$\omega = \sin k \ln k$, the group velocity at $k = \frac{\pi}{2}$ is

(a) $\frac{2}{\pi} + \ln\frac{2}{\pi}$ (b) $\frac{2}{\pi} - \ln\frac{2}{\pi}$

(c) $\ln\frac{\pi}{2}$ (d) $\frac{2}{\pi}$

16. Kinetic energy of a relativistic electron moving with velocity v is where $m_0$the rest mass of electron and c the speed of light is. m_0V

(a) $\frac{1}{2}\left(\frac{m_0V^2}{1 - V^2/C^2}\right)$ (b) m_0C^2

(c) $\left(\frac{m_0V^2}{1 - V^2/C^2}\right)m_0C^2$ (d) $\frac{1}{2}\left(\frac{m_0C^2}{1 - V^2/C^2}\right)$

17. A point charge q is brought at a distance 2a from the center of an isolated, uncharged conducting sphere of radius a. The potential of the sphere is raised by

(a) $\frac{q^2}{8\pi\epsilon_0 a}$ (b) $\frac{q^2}{4\pi\epsilon_0 a}$

(c) $\frac{q^2}{2\pi\epsilon_0 a}$ (d) *Zero*

18. Point charges q each are placed at two neighbouring corners of a Square and charges $-q$ each are placed at the remaining corners This system of charges has monopole, dipole and quadrupole as given here

(a) Zero monopole, dipole and quadrupole

(b) Non-zero dipole, no monopole and quadrupole

(c) Zero monopole, non-zero" dipole and Quadrupole

(d) All the three non-zero

19. The characteristic impedance of an air filled loss less coaxial transmission line with radii of 10 and 5cm for outer and inner conductor is
(a) 41.1 Ω (b) 277 Ω

(c) 50 Ω (d) 84.4 Ω

20. A small bar magnet is placed with its length parallel to a magnetic field and its north- south direction opposite to the uniform magnetic field. The magnetic field will be zero at
(a) two points in the end-on position of the magnet

(b) Two points on broad-side position of the magnet

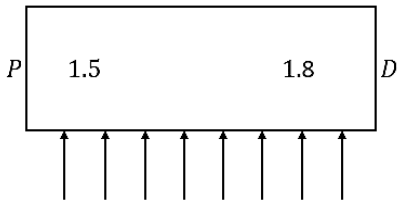
(c) All points on a certain circle in the meridian plane of the magnet

(d) Nowhere

21. A plane electromagnetic wave traveling in a medium is described by $E = 100 \cos (6 \times 10^8 t - 4x)$ V/m where x is in meters and t in seconds. The dielectric constant of the medium must be
(a) 1.5 (b) 2.0

(c) 2.4 (d) 4.0

22. An optical plane wave is incident normally on one surface of a rectangular glass slab whose refractive index increases from 1.5 to 1.8 from P (left) to Q (right), as shown in the Figure. After refraction, the wave will



(a) Be totally reflected

(b) Be deviated towards side P

(c) Be levitated towards side Q

(d) Go undevoted

23. Consider the following for the speed of electromagnetic wave in a doubly Refracting material
(i) It takes two discrete values v_1 and v_2
(ii) It takes all values between v_1 and v_2
(iii) Both v_1 and v_2 are less than c.
(iv) $v_1 < c$ and $v_2 > c$ Which are following combinations are correct?
(a) (i) and (ii) only (b) (i) and (iv) only

(c) (i) only (d) (i) and (ii) only

24. When an electromagnetic wave having wavelength 20 cm in free air enters a perfect dielectric, its velocity is seen to be $1.35 \times \frac{10^8 m}{s}$. m/s. Its wavelength in the dielectric must be
(a) 5 cm (b) 9 cm

(c) 27 cm (d) 44 cm

25. A rectangular waveguide has width a and heightb. EM waves of wavelength λ can propagate through it if
(a) $\lambda > 2a$ (b) $\lambda > a$

(c) $\lambda > 2b$ (d) $\lambda > 2b$

26. A relativistic particle has rest mass m_0 and kinetic energy K The wavelength of the Corresponding matter-wave is
(a) $\frac{h}{\sqrt{2m_0K}}$ (b) $\frac{hc}{\sqrt{K + 2m_0K}}$

(c) $\frac{hc}{\sqrt{k(K + 2m_0K\,C^2)}}$ (d) $\frac{hc}{\sqrt{K(K - 2m_0K\,C^2)}}$

27. In the time dependent Schrodinger equation the wav function $\psi(\bar{r}, t)$ is

(a) Always complex

(b) Always real

(c) Always imaginary

(d) Can be real as well as imaginary

28. In the Bohr atomic model out of the total energyE, kinetic energy K and potential energy V
(a) Only E varies in a discrete Manner

(b) E and K vary in discrete Manners

(c) E and V vary in discrete Manners

(d) All the three E, K and V vary in discrete Manners

29. At $t = 0$ the position of a neutron is known with accuracy Δx_0. Its uncertainty in its position at time t is

(a) $\frac{\hbar t}{2\,\Delta x_0}$ (b) $\frac{\hbar^2 t}{2\,\Delta x_0}$

(c) $\frac{\hbar t^2}{2\,\Delta x_0 m_0}$ (d) $\frac{\hbar}{2m_0\,\Delta x_0}$

Where $m_0$is rest mass particle?

30. The eigenvalues of a Hermitian Operator are ….
(a) Always real

(b) Always imaginary

(c) Always complex

(d) Can be real as well as imaginary

31. Two angular momenta $j_1 = 1$ and $j_2 = \frac{3}{2}$ are coupled. The total number of m, values is
(a) 12 (b) 9

(c) 4 (d) 3

32. An atomic system is perturbed $H'^{(r,t)} = 2\,H'(r)\cos(\omega t)$ by The probability $P_{n\to k}(t)$ when plotted as a function of $\omega_{kn} - \omega$ show sinusoidal oscillations The area of the main peak is proportional to
(a) t^2 (b) t^1

(c) t^0 (d) t^{-2}

33. In a central field a particle with wavenumber k is scattered. It's scattering amplitude in the forward directions f(0). the product of the total cross section σ and k is equal to
(a) $4\,\pi\,f(0)$

(b) $4\,\pi$ imaginary part of $f(0)$

(c) $2\,\pi\,f(0)$

(d) $2\,\pi$ Real part of f(0

34. For a system having energy E and entropy S at temperatureT, the term $(E - TS)$ represents
(a) Pressure (b) Enthalpy

(c) Helmholtz free energy (d) Gibbs free energy

35. Gibb's potential is given by
(a) U (b) $U + PV$

(c) $U - TS$ (d) $U - TS + PV$

36. A simple pendulum of length l and mass of the bob makes Oscillations about its equilibrium position taken as the origin of the coordinate system. The phase space trajectory of the pendulum is
(a) An ellipse in the positive half of -coordinate

(b) A rectangle

(c) An ellipse in the positive half of y- coordinates

(d) A full ellipse with major axis equal to twice the amplitude of Oscillation

37. Mean tree path tor a typical ga at room temperature (300 K) and atmospheric pressure (10^6 dynescm^{-2}). Is of the order of
(a) 1 cm (b) 10^{-5}cm
(c) 10^{-8} cm (d) 10^2 cm

38. A system of N particles in 3- dimensions has a phase space of Dimension
(a) 3N (b) N
(c) 6N (d) 2N

39. There are two particles distributed in three quantum States. The number of microstates according to Maxwell-Boltzmann. Bose Einstein and Femi – Dirac Statistics will be a 9,6,3
(a) 9,6,3 (b) 6,3,9
(c) 3,6,9 (d) 6,9,3

40. The paramagnetic susceptibility for an ideal Femi gas is
(a) Independent of the Temperature
(b) Decreases with temperature
(c) Increases quadratically with temperature
(d) Increase linearly with temperature

41. The density of the states for an ideal Fermi gas in one two and three dimension depend on the energy as follows
(a) $E^{1/2}$ For all (b) $E^{-1/2}$, E^0 , $E^{1/2}$
(c) E^2 for all (d) $E^{1/2}, E, E^{3/2}$

42. The most stable device measure a temperature of around 1800^0c. is
(a) Platinum Resistance Thermocouple
(b) Thermocouple
(c) Radiation pyrometer'
(d) Gas thermometer

43. Normal pn junction photo diode detector work in
(a) Forward biased region
(b) Reversed biased region
(c) Exponential region
(d) Breakdown region

44. The intensity of a waveform in Oscilloscope can be Varied
(a)Varying the accelerating Voltage in the electron gun
(b)Varying the voltage acres the X-Y plates
(c)Varying the frequency of the ne base
(d)Varying the current through the focusing lenses

45. A voltage Source has voltage V with 10k ohm internal Resistance. The voltage Is Assured by a voltmeter having 90 k ohm resistance. The error involved in the measurement is
(a) 10 % (b) 1%
(c) 0.1% (d) 0.0196

46. The loading effect of a voltmeter be less when it has
(a) Low input impendence
(b) High input impedance
(c) when zero of the scale is in the middle
(d) Deflection is large

47. In Michelson interferometer 200 Fringe are shifted when movable mirror is displaced

through 005896 mm. The wavelength of light is then

(a) 2948 A^0 (b) 11792 A^0

(c) 2948 A^0 (d) 1474 A^0

48. Two interfering beams of light. Each with wavelength λ will produce complete darkness when the path difference between them is

(a) $\frac{\lambda}{4}$ (b) $\frac{\lambda}{2}$

(c) λ (d) 2λ

49. The Unlimited vacuum achievable room an oil rotary pump is limited due to

(a) The vapour pressure of the oil

(b) The speed of rotation of the rotor

(c) The finite gap between the stator and rotor

(d) The viscosity of the oil

50. Compton effect m X-rays is explained on the basis of

(a) Collision between incident photon and electron in atom

(b) Collision between photon and neutron

(c) Collision between electron and electron

(d) Collision between photon and atom

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