A

23124 **120 MINUTES**

1. Converting volume integral into surface integral is done by using---.
   A) Gradient theorem for line integrals
   B) Gauss's divergence theorem
   C) Green's theorem
   D) Stoke's theorem

2. If the velocity of light (c), the constant of gravitation (G) and Planck's constant (h) be chosen as the fundamental units, find the dimension of mass in this new system.
   A) $[c^{\frac{1}{2}} h^{\frac{1}{2}} G^{\frac{-1}{2}}]$ B) $[chG^{-1}]$ C) $[ch^{-1}G^{\frac{-3}{2}}]$ D) $[ch^{2}G^{\frac{-2}{3}}]$

3. Find the value of 'a' $\vec{A} = a\hat{\imath} + \hat{\jmath} + \sqrt{5}\hat{k}$ subtends an angle 60^0 with $\vec{B} = 4\hat{\imath} - 5\hat{\jmath} + \sqrt{5}\hat{k}$
   A) $\sqrt{\frac{35}{3}}$ B) $\sqrt{\frac{26}{3}}$ C) $\sqrt{\frac{2}{3}}$ D) $\sqrt{\frac{46}{3}}$

4. Find the divergence of the product of a scalar (S) and a vector (**A**).
   A) S div **A**+**A** . grad S B) (∇S ∇x**A**) – (∇. **A** ∇S)
   C) **A**. grad S D) None of these

5. Find the Fourier cosine transform of $e^{-ax}, a > 0$:
   A) $\left(\frac{a}{a^2+s^2}\right)$ B) $\frac{\sqrt{2}}{\pi}\left(\frac{a}{a^2+s^2}\right)$
   C) $\frac{\sqrt{2}}{\pi}\left(\frac{a}{1+s^2}\right)$ D) $\left(\frac{a}{a^2+1}\right)$

6. Which of the following is equivalent to the series, $x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \cdots$
   A) $ln\,(1+x)$ B) $Sin\,x$ C) e^x D) $1/(1+x)$

7. The Lagrange's equation of motion for an electrical circuit comprising of an inductance (L) and a capacitance (c). The capacitor is charged to 'q' Coulombs and the circuit current is 'i' Amperes is….?
   A) $L\ddot{c} + \frac{\ddot{q}}{C} = 0$ B) $\ddot{Lq} + \frac{\dot{q}}{C} = 0$ C) $L\ddot{q} + \frac{q}{C} = 0$ D) None of these

8. Which of the following is **not** true regarding the Poisson- brackets?

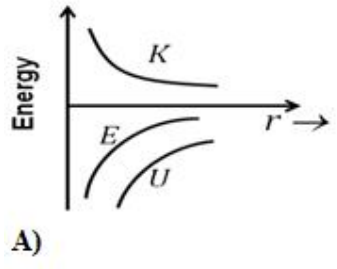
A) $\dot{F}(q,p,t) = [F,H] + \frac{\partial F}{\partial t}$ B) $[q_i, q_j]_{q,p} = 0$

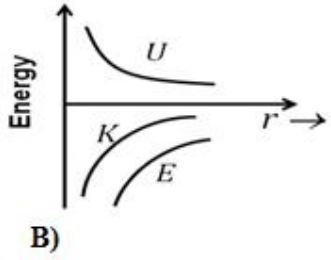
C) $[q_i, p_j]_{q,p} = \delta_{ij}$ D) If [F, H] =0, then H is a constant of motion

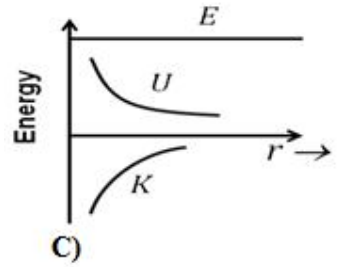
9. A cricket ball of mass 150 g moving with a velocity of 12 m/s is hit by a bat so that the ball is turned back with a velocity of 20 m/s. The force of the blow lasts for 0.01 s. Calculate the average force on the ball exerted by the bat.

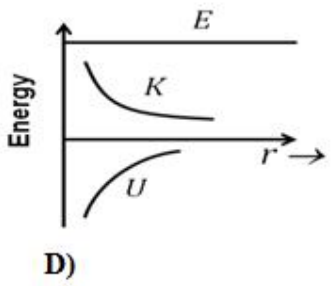
A) 240 N B) 120,000 N C) 480 N D) 120 N

10. Which of the following correctly depicts the variation of kinetic energy (K), potential energy (U) and total energy (E) of the circular (radius = r) planetary motion of a body?









11. The generalized momenta for the Lagrangian $L = \frac{m}{2}(\dot{r}^2 + r^2\dot{\theta}^2) - \frac{v}{r}$ are----.

A) $m\dot{r}^2$ and $mr^2\dot{\theta}$ B) $m\dot{r}^2$ and $mr^2\theta^2$

C) $m\dot{r}$ and $m\dot{r}\dot{\theta}$ D) $m\dot{r}\ and\ mr^2\dot{\theta}$

12. If $Q = Aq + Bp,\ P = Cq + Dp$ is canonical, then,

A) $AD - BC = 1$ B) $AD + BC = 0$

C) $AD - BC = -1$ D) $AD - BC = 0$

13. Find the angular momentum of a particle of mass m moving under the action of a central force whose potential $V(r)=kmr^3$ (k>0)) such that its orbit will be a circle of radius a about the origin.

A) $ma^2\sqrt{3ka}$ B) $ma^2\sqrt{ka}$ C) $ma\sqrt{ka}$ D) $ma^3\sqrt{ka}$

14. Match the List I with that in List II

List I		**List II**	
a	D' Alembert's principle	1	$\delta \int_{t_1}^{t_2} L\, dt = 0$
b	Hamilton's characteristic function	2	$\sum_j p_j \dot{q}_j - L(q_j \dot{q}_j)$
c	Hamilton's principle	3	$\sum (F_i - \dot{p}_i).\, \delta r_i = 0$
d	Hamiltonian	4	$\int \sum_j p_j \dot{q}_j\, dt$

A) a-3, b-4, c-2, d-1 B) a-4, b-3, c-1, d-2
C) a-3, b-4, c-1, d-2 D) a-4, b-3, c-2, d-1

15. Assertion(A) : The moment of inertia of a rigid body reduces to its minimum value, when the axis of rotation passes through its centre of gravity.
Reason(R) : The weight of the body always acts through its centre of gravity.

A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true but R is not the correct explanation of A
C) A is true but R is false
D) A is false but R is true

16. A particle moving on a very long frictionless wire which rotates with constant angular velocity about a horizontal axis is an example of :

A) Holonomic, conservative system
B) Rheonomic, Non-holonomic, Non-conservative system
C) Rheonomic, holonomic, conservative system
D) Conservative system

17. The expectation value of momentum is----.

A) $\int \psi^* \psi \left(\frac{\hbar}{i}\nabla\right) d\tau$ B) $\int \psi^* i\hbar\nabla\, \psi\, d\tau$

C) $\int \frac{\hbar}{i}\nabla(\, \psi^*\psi) d\tau$ D) $\int \psi^* \left(\frac{\hbar}{i}\nabla\right) \psi\, d\tau$

18. Normalize the wave function $\psi(x) = N \sin\left(\frac{4\pi x}{L}\right)$ for a quantum particle of mass m confined to move in the domain $0 \leq x \leq L$. Also calculate the probability P(x) of finding the particle in the region from x = 0 to x = L/4.

A) $\psi(x) = \sqrt{\frac{3}{L}} \sin\left(\frac{8\pi x}{L}\right)$ and P(x) = 15%

B) $\psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{4\pi x}{L}\right)$ and P(x) = 25%

C) $\psi(x) = \sqrt{\frac{1}{L}} \sin h\left(\frac{4\pi x}{L}\right)$ and P(x) = 40%

D) Wavefunction is non-normalizable and hence cannot calculate the probability

19. Match the List I with that in List II, which includes terms from partial wave analysis of scattering theory:

List I		List II	
a	Scattering amplitude f(θ)	1	$\frac{4\pi}{k^2}\sum_{l=0}^{\infty}(2l+1)\sin^2\delta_l$
b	Total scattering cross section (σ)	2	$\frac{1}{k}\sum_{l=0}^{\infty}(2l+1)\,P_l(\cos\theta)\,e^{i\delta_l}\sin\delta_l$
c	Phase shift ($\sin\delta_l$)	3	$\sigma = \frac{4\pi}{k} Im\, f(0)$
d	Optical theorem	4	$-k\int_0^{\infty} U(r) r^2 j_{l^2}(kr)\,dr$

A) a-2, b-1, c-4, d-3 B) a-3, b-4, c-2, d-1
C) a-4, b-3, c-1, d-2 D) a-2, b-1, c-3, d-4

20. What is the degeneracy for the n=2 level of a three dimensional isotropic oscillator?
A) 2 B) 4 C) 6 D) 3

21. Find the average potential energy of a one dimensional harmonic oscillator in its ground state. Given $\psi_0 = \left(\frac{\alpha}{\pi}\right)^{1/4} e^{\frac{-\alpha x^2}{2}}$ where α= (m ω)/ ħ.

A) $\frac{1}{2}\hbar\omega$ B) $2\hbar\omega$ C) $\frac{3}{4}\hbar\omega$ D) $\frac{1}{4}\hbar\omega$

22. Find the value of $L_+L_- + L_-L_+$ when operates on ψ_{lm} in the state $|l=1, m=1>$. L_+ and L_- are angular momentum ladder operators.

A) $\frac{\hbar^2}{2}$ B) $2\hbar^2$ C) $\hbar^2$ D) 0

23. Assertion : Klein-Gordon equation is $\frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2} - \nabla^2\psi + \left(\frac{mc}{\hbar}\right)^2\psi = 0$ and it describes a relativistic particle.

Reason : Klein-Gordon equation is valid for electron.

A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true but R is not the correct explanation of A
C) A is true but R is false
D) A is false but R is true

24. Which of the following correctly gives the TdS equation?

A) $TdS = C_v dT + T\left(\frac{\partial V}{\partial T}\right)_P dP$

B) $TdS = C_v dT - T\left(\frac{\partial P}{\partial T}\right)_V dP$

C) $TdS = C_p dT - T\left(\frac{\partial V}{\partial T}\right)_p dP$

D) $TdS = C_p dT + T\left(\frac{\partial P}{\partial T}\right)_V dV$

25. In a canonical ensemble, when a system A of fixed volume comes in contact with a large reservoir B, then ----.

A) A can exchange only particles with B
B) A can exchange only energy with B
C) Nothing can be exchanged between A and B
D) Both particle and energy can be exchanged between A and B

26. Match the List I with that in List II

List I		List II	
a	Stirling's approximation	1	$T_B < \frac{h^2}{2\pi m k_B}\left(\frac{N}{2.61\,V}\right)^{2/3}$
b	Bose Einstein condensation	2	Entropy and maximum probability
c	Change in thermodynamic potentials	3	$ln\,N! = N\,ln\,N - N$
d	Boltzmann relation	4	Chemical potential

A) a-2, b-4, c-3, d-1 B) a-3, b-1, c-4, d-2
C) a-2, b-3, c-1, d-4 D) a-1, b-3, c-2, d-4

27. At what temperature will the average speed of hydrogen molecule be the same as that of nitrogen molecule at 35^0C?

A) 308°K B) 33°K C) 22°K D) 152°K

28. Choose the correct option for the physical interpretation of Fermi energy at absolute zero (E_{F0}) for a spin half particle having energy E to occupy a quantum state.

A) All quantum states with E< E_{F0}, are occupied
B) All quantum states with E> E_{F0}, are empty
C) Both A and B are correct
D) Only B is correct

29. The relation $\left(\frac{\partial P}{\partial T}\right)_S \left(\frac{\partial V}{\partial S}\right)_T - \left(\frac{\partial P}{\partial S}\right)_T \left(\frac{\partial V}{\partial T}\right)_S = 1$ is called----?

A) Ehrenfest Equation B) TdS equation
C) Maxwell's equation D) Gibbs–Helmholtz equation

30. Which of the following gives motion of an incompressible fluid in phase space?

A) Liouville Theorem B) London Theory
C) Landau Theory D) Virial theorem

31. Find the ratio of temperatures of two stars A and B whose emissions are maximum at wavelengths 3500Å and 4900Å respectively.

A) 7:5 B) 1:7 C) 63:1 D) 5:7

32. Which statistics will apply to deutrons?

A) Maxwell-Boltzmann statistics
B) Bose-Einstein statistics
C) Fermi-Dirac statistics
D) Neyman-Pearson statistics

33. Which of the following is Poisson equation ?

A) $\nabla^2 V = \frac{-\rho}{\epsilon_0}\pi r^2$ B) $\nabla^2 V = \frac{-\rho}{\pi\epsilon_0}$

C) $\nabla^2 V = \frac{-\rho}{\epsilon_0}$ D) $\nabla^2 V = 0$

34. Identify the continuity equation:

A) $\nabla.\vec{\rho} + \frac{\partial \mathrm{J}}{\partial t} = 0$ B) $\nabla.\vec{\mathrm{J}} = -\frac{\partial \rho}{\partial t}$

C) $\nabla.\vec{\mathrm{D}} + \frac{\partial \mathrm{E}}{\partial t} = 0$ D) None of these

35. For two finite straight line charges λ at d distance apart, moving at constant speed v, calculate the value of v in order to balance the magnetic attraction and the electric repulsion.

A) 4.5×10^6 m/s B) 6.6×10^8 m/s
C) 9.3×10^8 m/s D) 3×10^8 m/s

36. Which of the following is the Lorentz gauge and Coulomb gauge respectively?

A) $\nabla.\vec{A} - \epsilon_0\mu_0 \frac{\partial V}{\partial t} = 0, \quad \nabla\vec{A} = 0$

B) $\nabla.\vec{A} + \epsilon_0\mu_0 \frac{\partial V}{\partial t} = 0, \quad \nabla.\vec{A} = 0$

C) $\nabla^2.\vec{A} - \epsilon_0\mu_0 \frac{\partial V}{\partial t} = 0, \ \nabla x\vec{A} = 0$

D) $\nabla^2.\vec{A} - \epsilon_0\mu_0 \frac{\partial V}{\partial t} = 0, \quad \nabla.\vec{B} = 0$

37. Identify the Poynting theorem:

A) $\frac{d^2W}{dt^2} = -\frac{\partial}{\partial t}\int\left(\frac{B^2}{2\mu_0} + \frac{\varepsilon_0 E^2}{2}\right)d\tau - \int\left(\frac{\vec{E}\times\vec{B}}{\mu_0}\right).dS = 0$

B) $\frac{dW}{dt} = -\frac{\partial}{\partial t}\int\left(\frac{B^2}{2\mu_0} + \frac{\varepsilon_0 E^2}{2}\right)dS - \int\left(\frac{\vec{E}\times\vec{B}}{\mu_0}\right).dS = 0$

C) $\frac{dW}{dt} = -\frac{\partial}{\partial t}\int\left(\frac{B^2}{2\mu_0} + \frac{\varepsilon_0 E^2}{2}\right)d\tau - \int\left(\frac{\vec{E}\times\vec{B}}{\mu_0}\right).dS = 0$

D) $\frac{dW}{dt} = -\frac{\partial}{\partial t}\int\left(\frac{B^2}{2\mu_0} + \frac{\varepsilon_0 E^2}{2}\right)d\tau - \int\left(\frac{\vec{E}\times\vec{B}}{\mu_0\varepsilon_0}\right).dS = 0$

38. Calculate the inductance of a solenoid of 2000 turns wound uniformly over a length of 50 cm on a cylindrical paper tube 4 cm in diameter:

A) $80\ \pi^2$ H B) $80\ \pi^2$ mH C) $8\ \pi^2$ mH D) $800\ \pi^2$ H

39. Paraffin has the index of refraction 1.45. Calculate the relative permittivity of Paraffin and velocity of electromagnetic radiation in Paraffin.

A) 2.1 and 2.07×10^8 m/s B) 4.2 and 3×10^8 m/s
C) 8.85×10^{-12} and 3×10^8 m/s D) Data inadequate

40. $\sqrt{\frac{\mu}{\varepsilon}}$ has the dimension of ----? (where μ is permeability and ε is permittivity of the medium)

A) Capacitance B) Refractive index
C) Inductance D) Impedance

41. Choose the correct option:
A) Retarded potential is associated with nonstatic sources
B) Divergence of a solenoidal current is zero
C) Poynting vector gives the energy flux density transported by the fields
D) All of the above

42. Power radiated by a point charge is:
A) Inversely proportional to the square of its acceleration
B) Directly proportional to its acceleration
C) Directly proportional to the square of its acceleration
D) Inversely proportional to the cube of its acceleration

43. The Lande g-factor for the level $^3P_1$ is ----.
A) 3/2 B) 2/3 C) 1/2 D) 5/2

44. Match the List I with that in List II

List I		**List II (wavelength range involved)**	
a	Electron Spin Resonance	1	Visible-UV range
b	Vibrational states transition	2	Micro wave
c	Nuclear Magnetic Resonance	3	Radio waves
d	Electronic level transition	4	Infrared

A) a-4, b-2, c-1, d-3 B) a-1, b-3, c-2, d-4
C) a-3, b-1, c-2, d-4 D) a-2, b-4, c-3, d-1

45. Coherence length of laser is:
A) Directly proportional to width of spectral line
B) Directly proportional to length of active medium
C) Inversely proportional to width of spectral line
D) Inversely proportional to length of active medium

46. Which of the following is true?
A) All three fundamental vibrational modes of H_2O are Raman active
B) H_2 can give IR or microwave spectra
C) Symmetric stretching mode of CO_2 is Infrared active
D) Both B and C

47. Identify the force constant of the bond in a diatomic molecule behaving as an harmonic oscillator.
A) $k = 4\pi\mu^2\bar{\nu}_e^{\,2}$ B) $k = 4\pi^2c^2\mu\bar{\nu}_e^{\,2}$
C) $k = 4\pi^2\mu^2\bar{\nu}_e^{\,2}$ D) $k = 2\pi^2\mu^2\bar{\nu}_e^{\,2}$

48. Which of the following relation connects rotation constant and centrifugal distortion constant?

A) $\bar{\omega}^2 = \frac{2B^2}{D}$ B) $B = \frac{h}{8\pi^2 ID}$ C) $\bar{\omega}^2 = \frac{4B^3}{D}$ D) $\bar{\omega}^2 = \frac{D}{4B^3}$

49. Spontaneous emission between two electronic states of same multiplicity gives:
A) Phosphorescence B) Fluorescence
C) Non-radioactive decay D) Cherenkov radiation

50. The energies (in eV) of regular triplets of an excited state measured from the ground state are 7.4803, 7.4828 and 7.4878 respectively. Find the spectral term of J, S and L of the triplets:

A) $^3D_2, ^3D_1, ^3D_0$ B) $^2P_{3/2}, ^2P_{1/2}, ^2P_0$
C) $^3S_2, ^3S_1, ^3S_0$ D) $^3P_2, ^3P_1, ^3P_0$

51. Find the ratio of frequencies of the first line of Lyman series and second line of Balmer series:
A) 27:5 B) 4:1 C) 1:4 D) 5:27

52. Calculate the Zeeman shift in normal Zeeman effect under a magnetic field of 0.91 T. The unmodified line is 3140 Å.

A) 0.42 Å B) 4.2 Å C) 0.042 Å D) None of these

53. The condition for the maximum intensity of spectral line is ---.

A) $\Delta L = 1, \Delta J = -1$ B) $\Delta L = -1, \Delta J = -1$
C) $\Delta L = 1, \Delta J = 0$ D) $\Delta L = -1, \Delta J = 1$

54. Which nucleus have maximum binding energy per nucleon?
A) Fe^{56} B) U^{235} C) Mo^{97} D) Ba^{138}

55. Which is a baryon?
A) neutron B) pi-meson C) mu-meson D) electron

56. Which of the following pair of quantities is **not** conserved in nuclear reactions?

A) spin, isotopic spin
B) linear momentum, angular momentum
C) magnetic dipole moment, electric quadrupole moment
D) charge, parity

57. Which of the below equations resembles carbon-nitrogen cycle?

A) $4p + 2\beta^- \rightarrow He^4$

B) $3p \rightarrow He^4 + \beta^+$

C) $4p \rightarrow He^4 + 2\beta^+ + 2\gamma$ rays + 2υ

D) $N_3^{14} + C_3^{13} + O^{15} \rightarrow He^4 + 2\gamma$ rays

58. The ground state of deuteron is ----.

A) ${}^3_1S\ state$

B) ${}^3_2P\ state$

C) $Mixture\ of\ {}^3_1S\ and\ {}^3_1P\ states$

D) $Mixture\ of\ {}^3_1S\ and\ {}^3_1D\ states$

59. Which of the following disintegration series will give Bi^{209} as the end product?

A) Actinium B) Uranium C) Thorium D) Neptunium

60. A radioactive source containing two radio isotopes have half lives (in hours) of 1 and 2 respectively. Calculate the total number of radioactive nuclei present initially in the radioactive source. (Given the initial activity of each as R=1000 in 2 Bq).

A) 108x 10^5 B) 32 x 10^5 C) 76x 10^5 D) 108x 10^7

61. Which of the following pairs are correctly matched?

A) Nuclear fusion → Atom Bomb

B) Breeder reactor → Pu^{239}

C) Nuclear force → Spin independent

D) None of these

62. Calculate the threshold energy for the incoming projectile for the reaction ${}^{19}_9F + n \rightarrow {}^{19}_8O + p$. Given the Q value =-3.9 MeV

A) 4.1 MeV B) -4.1 MeV C) 3.7 MeV D) 2.9 MeV

63. Choose the correct option for the correct match of the following pairs

A) Alpha decay → Gamow's theory

B) Beta decay → Fermi's theory

C) Neutrino hypothesis → Pauli

D) All of these

64. In a synchrotron, the magnetic field must be changed to compensate for ----.
A) Increase in radius of the circular path
B) Air resistance
C) Relativistic increase in mass
D) None of these

65. The color quantum number has been introduced to satisfy ---.
A) Gell-Mann-Nishijima formula
B) Pauli's exclusion principle
C) The CPT theorem
D) Soddy-Fajan's displacement laws

66. Choose the odd one:
A) Tensor potential B) Coulomb potential
B) Gravitational potential D) Spherically symmetric potential

67. A lattice plane cuts intercepts of 2a, 3b and 6c along the axes in a crystal. If a, b, c are primitive vectors of the unit cell, find the Miller indices of the given plane.
A) 1/2:1/3:1/6 B) 1:2:3 C) 3:2:1 D) 2:3:3

68. At lower temperature, the lattice specific heat varies as ----.
A) T^3 B) $\exp(T^2)$ C) T^{-3} D) T^{-1}

69. Match the List I with that in List II

List I		**List II**	
a	Reflection from an (hkl) plane	1	Brillouin Zone
b	Wiedemann-Franz law	2	Quantum tunneling
c	Josephson effect	3	Lorentz number
d	Forbidden energy band	4	Geometrical structure factor

A) a-4, b-3, c-1, d-2 B) a-3, b-4, c-2, d-1
C) a-1, b-2, c-4, d-3 D) a-4, b-3, c-2, d-1

70. Calculate the electrical conductivity of an n-type semiconductor wherein an electric field of 300 Vm^{-1}causes a drift velocity of 100 ms^{-1} for the electron. The electron concentration is $3x10^{20}$ m^{-3}.

A) 48 Ω^{-1} m^{-1} B) 0.06 Ω^{-1} m^{-1} C) 16 Ω^{-1} m^{-1} D) 16 moh/cm

71. Choose the correct option that represents a 2nd order phase transition?
A) Continuous phase transitions
B) Bose condensation
C) Paramagnetic to Ferromagnetic below Curie temperature
D) All of these

72. Which of the below represents the unit cell characteristics given as $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90°$

A) Triclinic B) Monoclinic

C) Orthorhombic D) Trigonal

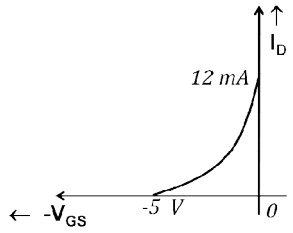
73. Calculate the Hall voltage produced in a sample of Silicon of thickness 200 μm when dopped with 10^{23} phosphorous atoms/m^3 and subjected to a magnetic field of 1.6 T and a current of 1mA is passed through it.

A) 0.5 μV B) 0.5 mV C) 6.25 mV D) 1.5 mV

74. Which of the following relates polarizability of a dielectric material?

A) Ehrenfests Equations
B) Curie-Weiss law
C) Clausius-Mossotti relation
D) Debye-Scherre formula

75. The equation of drain current (in mA) for the transfer characteristics of a JFET shown in figure is ---.



A) $I_D = 12\left[1 + \frac{V_{GS}}{5}\right]$ B) $I_D = 12\left[1 - \frac{V_{GS}}{5}\right]^2$

C) $I_D = 12\left[1 - \frac{V_{GS\,(off)}}{5}\right]^2$ D) $I_D = 12\left[1 + \frac{V_{GS}}{5}\right]^2$

76. Calculate the reverse current through a photodiode when exposed to an illumination of 4 mW/cm^2. Given the sensitivity of a photodiode is 40 μA/mW/cm^2.

A) 13.3 mA B) 10 μA C) 160 μA D) 1.6 μA

77. Calculate the series resistance required when three 10-Watt, 10-Volt, 1000mA zener diodes are connected in series to obtain 30V regulated output from a 45 V dc supply.

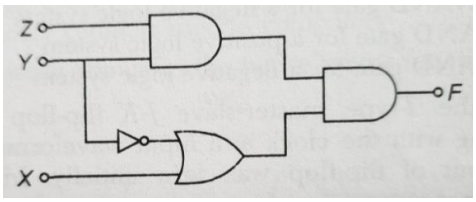
A) 35Ω B) 15 Ω C) 45Ω D) 30Ω

78. An emitter follower is also known as:
A) Grounded base circuit
B) Grounded emitter circuit
C) Grounded collector circuit
D) None of these

79. The data sheet of an E-MOSFET gives $I_{D\ (on)}$ =384 mA at V_{GS}=10V and $V_{GS(th)}$=2V. Calculate approximate drain current for V_{GS}=5.5V.

A) 98.7 mA B) 73.5 mA C) 384 mA D) 9.87 mA

80. Identify the function F generated by the logic network shown:



A) $F = Z + Y + \bar{Y}X$ B) $F = \overline{ZY} + Y\bar{X}$

C) $F = XYZ$ D) $F = Z(X + Y)$

81. Match the List I with that in List II

List I		**List II**	
a	Wien bridge oscillator	1	$\frac{1}{2\pi RC\sqrt{6}}$
b	Phase shift oscillator	2	$\frac{1}{2\pi\sqrt{L_T C}}$
c	Hartley Oscillator	3	$\frac{1}{2\pi\sqrt{R_1 C_1 R_2 C_2}}$
d	Colpitts Oscillator	4	$\frac{1}{2\pi\sqrt{LC_T}}$

A) a-3, b-1, c-4, d-2 B) a-2, b-3, c-1, d-4
C) a-3, b-2, c-4, d-1 D) a-3, b-1, c-2, d-4

82 If the resolution of a D/A converter is approximately 0.4% of its full scale range, then it is :
A) a 16-bit converter B) a 10-bit converter
C) a 12-bit converter D) a 8-bit converter

83. Choose the correct option:
A) When measured quantities are added or subtracted, errors add
B) When errors are random and independent, they add in quadrature
C) When measured quantities are multiplied or divided, relative errors add
D) All of these

84. The mass ratio of each pair of fission products produced by a single fission event of U^{235} is always roughly :
A) 3:2 B) 3:1 C) 2:1 D) 1:1

85. The binding energy per nucleon is analogous to ----- of a liquid.
A) Condensation
B) Surface tension
C) Latent heat of vaporization
D) None of these

86. A radioisotope decays from 120 g to 15 g over a period of 72 hours. What is the half-life of the isotope?
A) 24 hours B) 36 hours C) 12 hours D) 60 hours

87. The parity of $\Psi(x) = \cos kx$ is-----.
A) Odd B) 0 C) Undefined D) Even

88. The strong interactions between u and d quarks is mediated by -----symmetry.
A) Gauge B) Charge C) Isospin D) None of these

89. The reciprocal lattice of a Cubic lattice is a------.
A) BCC lattice B) Cubic lattice C) FCC lattice D) None of these

90. Drude model for conductivity is applicable to:
A) Semiconductors B) Multivalent metals
C) Metals D) Both A and B

91. An electron beam enters a crossed-field with magnetic and electric fields of 2.0 mT and 6.0×10^3 N/C, respectively. What must the velocity of the electron beam to traverse the crossed fields un-deflected?
A) $3x10^6$ m/s B) 6×10^3 m/s C) 12 m/s D) 10 m/s

92. According to Bloch theorem the solutions to the Schrödinger equation in a periodic potential take the form of a----- modulated by a periodic function.
A) square wave B) standing wave
C) spherical wave D) plane wave

93. Frenkel defect is an example of------ defect.
A) Line B) Surface C) Volume D) Dislocation

94. The peak inverse voltage (PIV) of the diode in the center tapped full wave rectifier is -----the transformer secondary terminal voltage.
A) Equal B) Half C) times D) Twice

95. A junction transistor, whose base signal is generated by illumination of the base is called:
A) Photodiode B) Solar Cell
C) LED D) Photo-transistor

96. Which of the following is an indirect band gap semiconductor?
A) Silicon B) Gallium arsenide
C) Gallium nitride D) Lead sulphide

97. The common mode gain for an ideal operational amplifier is
A) Infinity B) Not defined C) Zero D) Unity

98. A measurement is recorded as 75.5 + 0.5. What is the relative uncertainty in the measurement?
A) 0.7 % B) 0.5% C) 5 % D) 7 %

99. Find the curl of $\vec{F}(x,y,z) = xyz\,\vec{i} + y\,\vec{j} + z\,\vec{k}$ at (1, 2, 3).
A) $2\vec{j} - 3\vec{k}$ B) $\vec{j} + 3\vec{k}$ C) $2\vec{j} + 3\vec{k}$ D) $\vec{j} - 3\vec{k}$

100. Compute the Laplace transform of {cos(2t) + 7 sin(2t)}:
A) $\frac{s+14}{s^2+4}$ B) $\frac{s-14}{s^2+4}$ C) $\frac{s+2}{s^2+4}$ D) $\frac{s-2}{s^2+4}$

101. For $f(z) = \frac{e^z}{z^3}$ the residue at the pole is:
A) 1 B) (e/2) C) 0 D) (1/2)

102. The position of an object is determined to an accuracy of 10^{-6} cm using an electron microscope. The resulting uncertainty in momentum will be nearly:
A) 10^{-28} gm.cm/s B) 10^{-40} gm.cm/s
C) 10^{-21}gm.cm/s D) 10^{-30} gm.cm/s

103. The orbital angular momentum of an electron in the 2s orbital is:
A) √2 h /2 π B) 0 C) 2 ×h/(2π) D) h/(2π)

104. What will be the total spin quantum number "s" for two spin-1/2 particles for which the spin quantum numbers are s1 = (1/2) and s2 = (1/2)?
A) 1 or 0 only B) ½ only
C) 1 or 0 or ½ only D) None of these

105. Under the action of a central force there is conservation of:
A) Angular momentum B) Mechanical Energy
C) Torque D) All of the above

106. In a perfectly inelastic collision the coefficient of restitution equals
A) 1 B) 0
C) -1 D) greater than 1

107. The rank of inertia tensor is:
A) 1 B) 3 C) 2 D) None of these

108. A---- has a constant corresponding momentum for the Hamiltonian as well as for the Lagrangian.
A) canonical coordinate B) phase space
C) generalized momentum D) cyclic coordinate

109. Lorentz transformations can be used to find solutions on problems related to:
A) Length contraction B) Time dilation
C) Relative mass D) All of these

110. The energy that can be absorbed or released due to a change of the particle number of the given species is:
A) Internal energy B) Chemical potential
C) Entropy D) Thermodynamic potential

111. A function that combines enthalpy and entropy into a single value is:
A) Thermodynamic potential
B) Internal Energy
C) Chemical potential
D) Gibb's free energy

112. In the limit of low frequencies Planck's law tends to the:
A) Wien approximation B) Rayleigh–Jeans law
C) Stephan's law D) Maxwell–Boltzmann distribution

113. A cubic space (1.5 cm on each side) has positively charged particles. Imagine that the space is surrounded by a Gaussian surface of the same dimension as that of the cube and the electric field generated by the charges is normal to the Gaussian faces of the cube. If the electric field at each surface has a magnitude 760 N/C find the charge density in the space described. (Take charge $q = 9.1 \times 10^{-8}$ C)

A) 2.7×10^{-8} C/m^3 B) 4.1×10^{-7} C/m^3

C) 2.7×10^{-7} C/m^3 D) 4.1×10^{-8} C/m^3

114. A round coil of 10 turns and radius 1m carries a current of 5 A through it. Determine the field due to the coil at a distance of 2m from it. .
Take $\mu_0 = 4\pi \times 10^{-7}$ Wb/A-m.

A) 314.16×10^{-7} T B) 314.16×10^{-5} T
C) 314.16×10^{-6} T D) 314.16×10^{-4} T

115. The dimension of magnetic vector potential is:
A) $MLT^{-1}Q^{-1}$ B) $MLT^{-2}Q^{-1}$ C) $MLT^{1}Q^{-1}$ D) $MLT^{-1}Q^{1}$

116. ------provides a powerful tool for studying the geometry of objects that are too small to be viewed directly.
A) Polarization B) Diffraction C) Interference D) Reflection

117. A waveguide cannot support a:
A) TE wave B) TM wave C) TEM wave D) None of these

118. ESR cannot be observed in -----materials.
A) Paramagnetic B) Ferromagnetic
C) Diamagnetic D) All of the listed

119. The polarizability ellipsoid of H_2O is expected to ----- when the bonds undergo a symmetric stretch.
A) Increase B) Decrease
C) Remain unaffected D) Disappear

120. The fine structure of hydrogen spectrum is explained by:
A) Orbital angular momentum
B) Finite size of nucleus
C) Spin angular momentum of electrons
D) The presence of neutrons in the nucleus
