1. The conservation laws are generally the consequences of some underlying

A.	symmetry	B.	asymmetry
C.	isotropy	D.	homogeneity

2. Homogeneity of time leads to the conservation of

A.	linear momentum	B.	Angular momentum
C.	kinetic energy	D.	total energy

3. If $\vec{v}_{12}$ and $\vec{v}'_{12}$ be the relative velocities of two balls along the common normal before and after collision, ε is the coefficient of restitution, then

A.	$\vec{v}'_{12} = \varepsilon(\vec{v}_{12})$	B.	$\vec{v}'_{12} = \vec{v}_{12}/\varepsilon$
C.	$\vec{v}'_{12} = -\varepsilon(\vec{v}_{12})$	D.	$\vec{v}'_{12} = \varepsilon/\vec{v}_{12}$

4. An explosion blows a rocket into three parts. Two pieces go off at right angles to each other: 1 kg piece with velocity of 12 ms^{-1} and other 2 kg piece with velocity 8 ms^{-1}. If the third piece flies of with a velocity of 40 ms^{-1}, then the mass (in kg) of the third piece is

A.	0.2	B.	0. 3
C.	0.4	D.	0.5

5. A particle of mass m moves in a circular orbit of radius r having angular momentum L about its centre. The kinetic energy of particle is

A.	L/mr^2	B.	$L^2/2mr^2$
C.	L/m^2r^2	D.	L^2/m^2r^2

6. A sphere of mass M_1 moving with velocity v_1 collides elastically with another sphere of mass M_2 at rest. After collision of the two spheres they moves in opposite directions with the same velocity, the ratio of their masses M_1/M_2 are

A.	1/2	B.	1/3
C.	2/3	D.	3/5

7. If $\vec{F}$ be a conservative force field, then

A.	$\nabla^2\vec{F} = 0$	B.	$\nabla\vec{F} = 0$
C.	$\nabla.\vec{F} = 0$	D.	$\nabla \times \vec{F} = 0$

8. A particle of mass m moves on a path given by $\vec{r} = a\,cos\omega t\,\hat{\imath} + b\,sin\omega t\,\hat{\jmath}$. The angular momentum of the particle is

A.	0	B.	$mab\omega\hat{k}$
C.	$ma^2b^2\omega^2\hat{k}$	D.	$\frac{1}{2}(ma^2b^2\omega^2)\hat{k}$

9. If $\vec{a}$ and $\vec{b}$ are two vectors then the value of $(\vec{a}+\vec{b}) \times (\vec{a}-\vec{b})$ is

A.	$\vec{a} \times \vec{b}$	B.	$-2(\vec{b} \times \vec{a})$
C.	$\vec{b} \times \vec{a}$	D.	$2(\vec{b} \times \vec{a})$

10. Three identical particles with velocities $v_0\hat{\imath}$, $-3v_0\hat{\jmath}$ and $5v_0\hat{k}$ collides successively with each other in such a way that they form a single particle. The velocity vector of the resultant particle is

A.	$v_0/3(\hat{\imath}+\hat{\jmath}+\hat{k})$	B.	$v_0/3(\hat{\imath}-\hat{\jmath}+\hat{k})$
C.	$v_0/3(\hat{\imath}-3\hat{\jmath}+\hat{k})$	D.	$v_0/3(\hat{\imath}-\hat{\jmath}+5\hat{k})$

11. The total work done on a particle is equal to the change in its kinetic energy

A.	always	B.	Only if the forces acting on the body are conservative
C.	Only in inertial frame	D.	If no external force is acting

12. A particle moves along the x-axis from $x = 0$ to $x = 5\ m$ under the influence of a force given by $\vec{F} = (7 - 2x + 3x^2)\hat{\imath}\ N$. the work done in the process is

A.	360 J	B.	85J
C.	185J	D.	135J

13. The velocity of the electron in the first Bohr's orbit as compared to that of light is about

A.	1/300	B.	1/500
C.	1/137	D.	1/187

14. That light is a wave is evidenced by

A.	Black body radiation	B.	Photoelectric effect
C.	Radioactive emission	D.	Interference phenomenon

15. When light wave is reflected from glass-air interface, the change of phase of the reflected wave is

A.	π	B.	2π
C.	0	D.	$\pi/2$

16. The radii of dark Newton's rings are proportional to square root of

A	even natural numbers	B	odd natural numbers
C	all natural numbers	D	none of these

17. If D be the distance between the screen and slit, b the width of slit, then the width of the central maximum in the diffraction pattern with light of wavelength λ is

A.	$D\lambda/2b$	B.	$2D\lambda/b$
C.	$b/2D\lambda$	D.	$b\lambda/2D$

18. In Nicol prism, the *O*-ray is totally internally reflected and the *E*-ray is transmitted. This statement is

A.	true	B.	false
C.	partly true	D.	partly false

19. When the *O*-ray and *E*-ray travel along the optic axis of an uniaxial crystal

A.	$\mu_e > \mu_o$	B.	$\mu_e < \mu_o$
C.	$\mu_e = \mu_o$	D.	$\mu_e = 1/\mu_o$

20. The standard wavelength (in nm) emitted from He-Ne laser is

A.	543.2	B.	595.2
C.	632.8	D.	635.8

21. In gas lasers population inversion is generally acheived by

A.	optical pumping	B.	electrical discharge
C.	thermally	D.	Chemical reactions

22. In holography which one is recorded

A.	phase information	B.	amplitude information
C.	both phase and amplitude information	D.	Intensity information

23. The drift velocity of electron in a metal is of the order of

A.	$3 \times 10^8\ ms^{-1}$	B.	$3 \times 10^6\ ms^{-1}$
C.	$10\ mms^{-1}$	D.	$100\ ms^{-1}$

24. Two long parallel conductors carrying current in the same direction

A.	repel each other	B.	Attract each other
C.	do not interact	D.	none of these

25. If ε and ε_0 be the permittivity of a material and of free space

A.	$\varepsilon_r = \frac{\varepsilon_0}{\varepsilon}$	B.	$\varepsilon_r = \frac{\varepsilon}{\varepsilon_0}$
C.	$\varepsilon_r = \varepsilon\varepsilon_0$	D.	$\varepsilon_r = \frac{1}{\varepsilon\varepsilon_0}$

26. The dipolar polarizability α_d is equal to

A.	μ^2/kT	B.	$\mu^2/3kT$
C.	$3kT/\mu^2$	D.	μ^2/kT

27. Poisson's equation in electrostatics is given by

A.	$\nabla^2 V = \text{Constant}$	B.	$\nabla^2 V = -\frac{\rho}{\varepsilon_0}$
C.	$\nabla^2 V = \frac{\rho}{\varepsilon_0}$	D.	$\nabla^2 V = -\rho\varepsilon_0$

28. In cylindrical coordinates the volume element dV is

A.	$d\rho d\varphi dz$	B.	$\rho d\rho d\varphi dz$
C.	$\rho d\varphi dz$	D.	$\rho d\rho dz$

29. If an electromagnetic wave propagates through a medium of relative permittivity 4 and relative permeability 1, then the velocity of wave (in ms^{-1}) is

A.	3×10^8	B.	3×10^6
C.	1.5×10^8	D.	1.5×10^6

30. Capacitance of a parallel plate capacitor is $2\mu F$. The rate at which the potential difference between the two plates must change to get displacement current of 0.4 A is

A.	1.5×10^3 V/s	B.	2×10^5 V/s
C.	2×10^{-5} V/s	D.	1.5×10^{3} V/s

31. The vector $\vec{A} = (x+3y)\hat{\imath} + (y-2z)\hat{\jmath} + (x+\alpha z)\hat{k}$ is solenoidal for

A.	$\alpha = 2$	B.	$\alpha = \infty$
C.	$\alpha = -2$	D.	$\alpha = 0$

32. Which of the following quantities is independent of wavelength in the electromagnetic wave $\vec{E}(x,t) = \vec{E}_0 sin(\omega t - kx)$

A.	k	B.	ω
C.	k/ω	D.	ωk

33. If $\hat{k}$, ω and $\hat{n}$ be the propagation vector, angular frequency and unit vector along the direction of propagation of electromagnetic wave then

A.	$k \geq \frac{\omega}{c}$	C.	$k \geq \frac{c}{\omega}$
C.	$k = \frac{\omega}{c}$	D.	$k = c\omega$

34. The postulate of special theory are applicable to

A.	stationary frame	B.	accelerated frame
C.	Inertial frame	D.	none of these

35. The existence of zero point energy for a linear harmonic oscillator is a consequence of

A.	Pauli's exclusion principle	B.	Hook's law
C.	matter waves	D.	Uncertainty relation

36. For scattering angle $\varphi = 90°$, Compton's shift $\Delta\lambda$ reduces to

A.	$\frac{h}{mc}(1 + cos\varphi)$	B.	$\frac{h}{mc}$
C.	0	D.	$\frac{h}{mc}(1 - cos\varphi)$

37. In photoelectric effect, at stopping potential V_0 the photocurrent (i) becomes

A.	∞	B.	constant
C.	0	D.	1/e of i

38. The Compton wavelength (in Å) for an electron is

A.	2.0	B.	0. 2
C.	0.02	D.	0.002

39. de Broglie wavelength is associated with particles in motion only, if it is a

A.	charged	B.	uncharged
C.	both charged and uncharged	D.	none of these

40. The uncertainty principle is a consequence of

A.	dual nature of matter	B.	wave nature of matter
C.	particle nature of matter	D.	none of these

41. An electron moving through a potential difference of 150 V has a de Broglie wavelength (in Å) of

A.	1	B.	10
C.	100	D.	1000

42. The number of basic crystal system is

A.	4	B.	5
C.	6	D.	7

43. Miller indices (hkl) represents

A.	a set of parallel planes	B.	a particular plane
C.	a set of arbitrary plane	D.	none of these

44. The Miller indices of a plane having intercepts 2, ∞, ∞ units on a,b,c axes respectively are

A.	101	B.	001
C.	0	D.	020

45. If a and r be respectively the lattice constant and radius of an atom in a BCC structure, then

A.	$r = \frac{\sqrt{3}}{4}a$	B.	$r = \frac{\sqrt{2}}{4}a$
C.	$r = a$	D.	$r = \frac{a}{\sqrt{3}}$

46. The atomic packing factor for FCC structure is

A.	74%	B.	52%
C.	68%	D.	49%

47. The crystal structure of aluminum is

A.	SC	B.	BCC
C.	FCC	D.	HCP

48. Miller indices of a plane having intercepts of 8a, 4b, and 2c on a, b, c axes respectively are

A.	(124)	B.	(004)
C.	(142)	D.	(101)

49. NaCl crystal is

A.	SC	B.	BCC
C.	FCC	C.	none of these

50. Production of continuous x-rays is termed as

A.	Compton effect	B.	Scattering
C.	Inverse photoelectric effect	D.	Photoelectric effect

51. The amplitude of electric and magnetic fields are related to each other by the relation

A.	$E_0 B_0 = c$	B.	$B_0 = E_0 c$
C.	$E_0 = B_0 c$	D.	$E_0 B_0 = c^2$

52. Davissons & Germer experiments relates to

A.	interference	B.	polarization
C.	electron diffraction	D.	phosphorine

53. Matter waves

A.	are longitudinal	B.	are electromagnetic
C.	always travel with c	D.	shows diffraction

54. The phase velocity (v_p) and the group velocity (v_g) of a de Broglie wave in free space (speed of light = c) are related as

A.	$v_p = \sqrt{2} v_g$	B.	$v_p v_g = c^2$
C.	$v_p v_g = c$	D.	$v_p v_g = c^{1/2}$

55. The wave function of certain particle is $\psi(x) = A\ cos^2 x$ for $-\frac{\pi}{2}$ to $\frac{\pi}{2}$; then the value of A is

A.	$\sqrt{\frac{8}{3\pi}}$	B.	$\sqrt{\frac{3}{8\pi}}$
C.	$\sqrt{\frac{1}{2\pi}}$	D.	$\sqrt{\frac{3}{2\pi}}$

56. The state of a free particle is represented by a wave function $\psi(x,0) = Ne^{\frac{x^2}{2a^2} + ik_0 x}$; the value of N is

A.	$\frac{1}{\sqrt{a\pi}}$	B.	$\frac{1}{\pi^{1/2} a^{1/4}}$
C.	$\frac{1}{\pi^{1/4} a^{1/2}}$	D.	$\frac{1}{\pi a}$

57. Which of the following operator is Hermition?

A.	$i\frac{d}{dx}$	B.	$\left(\frac{d}{dx}\right)^2$
C.	$\left(\frac{d}{dx}\right)^3$	D.	$\frac{d}{dx}$

58. The value of $[L_z, L^2]$ is

A.	$i\hbar$	B.	1
C.	$L_x + iL_y$	D.	0

59. The potential field of hydrogen atom is			
A.	$V(r) = -\frac{A}{r^2}$	B.	$V(r) = 0$
C.	$V(r) = Ae^{-r/a_0}$	D.	$V(r) = -\frac{A}{r}$
60. Electrons have half integral spin and obey			
A	B-E Statistics	B.	M-B Statistics
C	F-D Statistics	D.	both B-E & F-D Statistics
61. The change in the internal energy of the gas is directly proportional to			
A	change in volume	B.	change in pressure
C	change in temperature	D.	none of these
62. If the degree of freedom of a gas is n, then C_p/C_v is			
A.	$\frac{2n}{n+1}$	B.	$1+\frac{2}{n}$
C.	$1+\frac{1}{n}$	D.	$1+\frac{1}{2n}$
63. According to quantum mechanics, for a free particle V=0			
A.	energy levels are discrete and equispaced	B.	energy levels are discrete and not equispaced
C.	energy is zero	D.	Energy levels are continuum
64. In electromagnetic field which one of the following remains invariant under Lorentz transformation			
A.	$\vec{E} \times \vec{B}$	B.	$E^2 - c^2B^2$
C.	E^2	D	B^2
65. If $\vec{r}$ is position vector, then curl $\vec{r}$ is			
A.	1	B.	3
C.	0	D.	$\vec{r}/r$
66. $\nabla\left(\frac{\vec{r}}{r^3}\right)$ is equal to			
A.	r^2	B.	r^3
C.	$r^{1/3}$	D.	0
67. In a gas the expression for average speed of molecule is given by			
A.	$\sqrt{\frac{3kT}{m}}$	B.	$\sqrt{\frac{2kT}{m}}$
C.	$\sqrt{\frac{8kT}{\pi m}}$	D.	$\sqrt{\frac{3kT}{2m}}$
68. At 0K fluids are assumed to have			
A.	minimum entropy	B.	zero entropy
C.	maximum entropy	D.	fixed value of entropy
69. Canonical ensemble is related to			
A.	the size of the system	B.	the freedom of system
C.	no. of particles in system	D.	thermal equilibrium of system

70. The classical partition function Z gives

A.	sum of energy of system	B.	sum of momentum of system
C.	sum of states of system	D.	none of these

71. A better power supply should posses

A.	higher input impedence	B.	lower input impedence
C.	total voltage resolution	D.	lowest output impedence

72. Temperature coefficient of carbon resistance is

A.	zero	B.	positive
C.	negative	D.	Both positive & negative

73. The dynamic resistance (in Ohms) of an ideal p-n junction with a forward current of 10 mA at room temperature is

A.	0.5	B.	1.5
C.	2.0	D.	2.5

74. When operated in cutoff and saturation, the transistor acts like a

A.	a linear amplifier	B.	a switch
C.	a variable resistor	D.	a variable capacitor

75. A MOSFET differs from JFET mainly because

A.	of power rating	B.	MOSFET has two gates
C.	JFET has a pn junction	D.	MOSFET do not have a physical channel

76. The mobility of an electron in a conductor is expressed in terms of

A.	$cm^2V^{-1}s^{-1}$	B.	$cm\ V^{-1}s^{-1}$
C.	$cm^2V^{-2}s^{-1}$	D.	cm^2s^{-1}

77. Infrared LED is usually fabricated from

A.	Ge	B.	Si
C.	GaAs	D.	GaAsP

78. The Impurity commonly used for realizing the base region of a silicon npn transistor is

A.	Gallium	B.	phosphorous
C.	Boron	D.	Indium

79. Digital circuits can be made by repetitive use of the following gates

A.	NOT	B.	NAND
C.	AND	D.	XOR

80. A half adder is a logic circuit with

A.	3 inputs & 1 output	B.	3 inputs & 2 output
C.	2 inputs & 1 output	D.	2 inputs & 2 output

81. Data are stored in a random access memory (RAM) during the

A.	read operation	B.	enable operation
C.	write operation	D.	address operation

82. A ROM is a

A.	volatile memory	B.	read/write memory
C.	non volatile memory	D.	byte organized memery

83. The eigen values of the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ are

A.	1,1,2	B.	0,1,2
C.	2,2,0	D.	2,2,1

84. The value of the integral $I = \frac{1}{2\pi i}\oint_c \frac{dz}{z-3}$

A.	0.5	B.	1
C.	2i	D.	0

85. According to Curie-Weiss law

A.	$\chi = \frac{C}{\Theta - T}$	B.	$\chi = \frac{C}{T + \Theta}$
C.	$\chi = \frac{C}{T - \Theta}$	D.	$\chi = \frac{C}{T\Theta}$

86. Soft super conductors observe

A.	Silsbee's effect	B	Meissner's effect
C.	both of these	D	none of these

87. The order of magnitude of binding energy (in MeV) per nucleon in a nucleus is

A.	1	B.	10
C.	100	D.	3

88. The constant $\frac{eh}{2m} = 9.2741 \times 10^{-24} JT^{-1}$ units is termed as

A.	Curie	B.	Bohr magneton
C.	Rutherford	D.	fine constant

89. According to Shell model, the ground state of ${}^{15}_{8}O$ nucleus is

A.	$\frac{3^+}{2}$	B.	$\frac{1^+}{2}$
C.	$\frac{3^-}{2}$	D.	$\frac{1^-}{2}$

90. The half life of a radioactive sample is

A.	$e^{-\lambda/2}$	B.	$\frac{ln2}{\lambda}$
C.	$\frac{ln\lambda}{2}$	D.	$\frac{\lambda}{2}$

91. ${}^{238}_{92}U$ and ${}^{234}_{92}U$ are

A.	isotones	B.	isomers
C.	isotopes	D.	isobars

92. One Bequeral is defined as

A.	1 disintegration per sec.	B.	10 disintegration per sec
C.	10^6 disintegration per sec	D.	3.7×10^6 disintegration per sec

93. Which of the following is a lepton

A.	photon	B.	$\pi - meson$
C.	$\mu - meson$	D.	proton

94. Which of the following decay is forbidden			
A.	$\mu^- \rightarrow e^- + \nu_\mu + \bar{\nu}_e$	B.	$\pi^+ \rightarrow \mu^+ + \nu_\mu$
C.	$\pi^+ \rightarrow e^+ + \nu_e$	D.	$\mu^- \rightarrow e^+ + e^- + e^-$
95. Which one of the following particles does not have spin 1/2			
A.	proton	B.	photon
C.	neutron	D.	neutrino
96. Hyperfine splitting in hydrogen ground state (in eV) is of the order of			
A.	10^{-3}	B.	10^{-13}
C.	10^{-5}	D.	10^{-15}
97. Which has the smallest levels spacing			
A.	molecular rotational levels	B.	molecular vibrational levels
C.	molecular electronic levels	D.	none of these
98. Recently the gravitational waves were detected by			
A.	LIGO	B.	VIRGO
C.	LISA	D.	EGO
99. A particle and antiparticle			
A.	must be different from each other	B.	always annihilates into two photons
C.	must have the same mass	D.	none of these
100 . The cause attributed to neutrino oscillations is due to the presence of their			
A.	charge	B.	mass
C.	spin	D.	charge and spin

1. An example of a non-conservative force is
   (A) Gravitational force
   (B) Electrostatic force
   (C) Magnetostatic force
   (D) Viscous force

2. Isotropy of space gives rise to conservation of
   (A) Linear momentum
   (B) Angular momentum
   (C) Energy
   (D) Charge

3. In a collision of two fundamental particles in a center of mass frame
   (A) Total energy of both particles is zero
   (B) Total linear momentum is zero
   (C) Total angular momentum is zero
   (D) Total charge is zero

4. The negative result of Michelson-Morley experiment suggests that
   (A) Space is homogeneous
   (B) Light travels with a finite speed
   (C) There is no special reference frame in the universe
   (D) There is a special reference frame in the universe

5. In Theory of Special Relativity, if space-time interval $ds^2 = 0$ between two events A & B, then
   (A) Two events are simultaneous
   (B) Two events happen at the same point in space
   (C) It will take zero time for signal to travel between points A & B
   (D) Points are light like separated

6. If 1 A current flows through a circuit, then the number of electrons flowing through the circuit per second is
   (A) 0.625×10^{19}
   (B) 1.6×10^{19}
   (C) 1.6×10^{-19}
   (D) 0.625×10^{-19}

7. The resistivity of a conductor depends on
   (A) Area of the conductor
   (B) Length of the conductor
   (C) Type of material
   (D) None of these

8. Kirchhoff's Current Law works on the principle of which of the following
   (A) Law of conservation of charge
   (B) Law of conservation of energy
   (C) Both
   (D) None of the above

9. How much is the base to emitter voltage of a transistor in the ON state
   (A) Zero
   (B) 0.7 mV
   (C) 0.7 V
   (D) Variable

10. α and β are transistor parameters. If $\beta = 100$, then the approximate value of α is
   (A) 0.99
   (B) 99
   (C) 1.01
   (D) 101

11. The 1's eompliment of a binary number is obtained by changing

(A) Each '1' to a '0'
(B) Each '0' to a '1'
(C) Each '1'to a '0' and eaeh '0' to a '1'
(D) None of the above

12. A decimal number 6 in excess - 3 code is written as

(A) 0110
(B) 0011
(C) 1101
(D) 1001

13. The output of a 10 input OR gate is high

(A) Only if even number of inputs are high
(B) Only if odd number of inputs are high
(C) If any one input is high
(D) If any one input is low

14. The equivalent decimal number of a maximum binary number of length one byte is

(A) 8
(B) 64
(C) 255
(D) 256

15. The parity of the binary number 100110011 is

(A) even
(B) odd
(C) 4
(D) 5

16. The length of second's pendulum on the surface of earth is approximately 1 m. The approximate length of same pendulum on the surface of moon, where acceleration due to gravity is (1/6)th of the g on the surface of earth is

(A) 36 m
(B) 1 m
(C) 1/36 m
(D) 1/6 m

17. The displacement of particle performing simple harmonic motion is given by, $x = 8\sin(wt)+6\cos(wt)$, where distance is in cm and time is in second. The amplitude of motion is

(A) 10 cm
(B) 14 cm
(C) 2 cm
(D) 4 cm

18. A simple pendulum is set up in a trolley which moves to the right with an acceleration "a" on a horizontal plane. Then the thread of the pendulum in the mean position makes an angle q with the vertical where q is given by

(A) $\tan^{-1}(a/g)$ in the forward direction
(B) $\tan^{-1}(a/g)$ in the backward direction
(C) $\tan^{-1}(g/a)$ in the forward direction
(D) $\tan^{-1}(g/a)$ in the backward direction

19. A particle executes Simple Harmonic Motion (SHM) of amplitude "A". At what distance from mean position its kinetic energy is equal to its potential energy

(A) 0.51 A
(B) 0.61 A
(C) 0.71 A
(D) 0.81 A

20. A second's pendulum is placed in space laboratory orbiting around the earth at a height 3R from Earth's surface where R is Earth's radius. The time period of the pendulum will be

(A) Zero
(B) $\sqrt{3}$ s
(C) 3 s
(D) Infinite

21. The zeroth law of thermodynamics allows us to define

(A) work
(B) internal energy
(C) temperature
(D) entropy

22. A constant-volume gas thermometer is used to measure the temperature of an object. When the thermometer is in contact with water at its triple point (273.16 K) the pressure in the thermometer is 8.500×10^4 Pa. When it is in contact with the object the pressure is 9.650×10^4 Pa. The temperature of the object is

(A) 37.0 K
(B) 241 K
(C) 310 K
(D) 314 K

23. The two metallic strips that constitute a thermostat must differ in

(A) length
(B) thickness
(C) mass
(D) coefficient of linear expansion

24. The coefficient of expansion of certain steel is 0.000012 per C°. The coefficient of volume expansion, in $(C°)^{-1}$, is

(A) $(0.000012)^3$
(B) $(4\pi/3)(0.000012)^3$
(C) 3×0.000012
(D) 0.000012

25. Heat from Sun reaches the Earth by

(A) Radiation
(B) Conduction
(B) Convection
(D) None of the above

26. In electrostatics a field line and an equipotential surface are

(A) Always perpendicular
(B) Always parallel
(C) Makes any possible angle
(D) None of the above

27. If a dielectric is inserted between the plates of an air filled capacitor, the capacitance will

(A) Increase
(B) Decrease
(C) Remain same
(D) May increase or decrease depending upon type of dielectric

28. A capacitor stores .076 Coulombs of charge at 10 V. It's capacitance is

(A) 7.6 F
(B) 0.76 F
(C) 0.00076 F
(D) 0.0076 F

29. Which of the following electrostatie problems can be solved exactly?

(A) A charge placed above a grounded infinite conducting plane
(B) A charge placed away from a grounded condueting sphere
(C) None of (A) & (B)
(D) Both of (A) & (B)

30. The materials having low retentivity is suitable for making

(A) A permanent magnet
(B) A temporary magnet
(C) Weak magnets
(D) None of the above

31. Ferrites are which type of materials

(A) Paramagnetic
(B) Diamagnetic
(C) Ferromagnetic
(D) None of the above

32. What is the reluctance of air gap as compared to same gap filled with iron

(A) Reluctance of air gap is much lower as compared to iron
(B) Rcluctance of air gap is much higher as compared to iron
(C) Reluctance of air gap is slightly lower as compared to iron
(D) Reluctance of air gap is slightly higher as compared to iron

33. The Biot-Savart's law is a general modification of

(A) Kirchhoff's law
(B) Lenz's law
(C) Ampere's law
(D) Faraday's law

34. A rectangular magnet of magnetic moment M is cut into two pieces of same length, the magnetic moment of each piece will be

(A) M
(B) M/2
(C) 2M
(D) M/4

35. Energy stored in an inductor of inductance L carrying a current I is

(A) $\frac{1}{2}LI^2$
(B) $\frac{1}{2}L^2I$
(C) $\frac{1}{2}L^2I^2$
(D) $\frac{1}{2}LI$

36. In an electromagnctic wave in free space

(A) E and B fields are in phase and perpendicular
(B) E and B fields are out of phase by 90° and perpendicular
(C) E and B fields are in phase and parallel
(D) E and B fields are out of phase by 90^0 and parallel

(D) 101

37. Divergence of magnetic field is zero. This statement implies

(A) Absence of magnetic monopole
(B) Absence of magnetic quadrupole
(C) Presence of magnetic monopole
(D) Presence of magnetic quadrupole

38. In a system of charged particles in an EM field, which of the following statement is correct?

(A) Total linear momentum of all the charged particles is conserved
(B) Total energy of all the charged particles is conserved
(C) Both A & B
(D) None of A & B

39. Electromagnetic waves are transverse in nature because these waves can be

(A) Reflected
(B) Refracted
(C) Diffracted
(D) Polarized

40. Poynting vector gives

(A) Energy density in a given EM field
(B) Energy flux density in a given EM field
(C) Momentum density in a given EM field
(D) Momentum flux density in a given EM field

41. A square matrix through similarity transformation can always be

(A) Diagonalized
(B) Triagonalized
(C) Made an identity matrix
(D) Made a null matrix

42. According to determinant properties, X times multiple of one row is added to another row, then determinant

(A) Remains same
(B) Becomes X times of original determinant
(C) Becomes X/2 times of original determinant
(D) Becomes 2X times of original determinant

43. Necessary and sufficient condition for $M(x,y)dx + N(x,y)dy$ to be total differential is

(A) $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$
(B) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$
(C) $\frac{\partial M}{\partial x}\frac{\partial N}{\partial y} = 1$
(D) $\frac{\partial M}{\partial y}\frac{\partial N}{\partial x} = 1$

44. Integrating factor of equation $xdy-ydx=0$ is

(A) $1/y^2$
(B) $1/(xy)$
(C) $1/(x^2+y^2)$
(D) All of above

45. Cross product of two vectors is

(A) Commutative
(B) Associative
(C) Both A & B
(D) None of A & B

46. f(z) is a function of a complex variable z. f(z) is said to be analytic in a domain D if

(A) f(z) is defined at all points of D
(B) f(z) is defined and continuous at all points of D
(C) f(z) is defined and differentiable at all points of D
(D) None of the above

47. Value of $\exp(i3\pi/4)$ where $i = \sqrt{-1}$, is

(A) $(-1/\sqrt{2})+(1/\sqrt{2})i$
(B) $(1/\sqrt{2})+(1/\sqrt{2})i$
(C) $(1/\sqrt{2})+(-1/\sqrt{2})i$
(D) $(-1/\sqrt{2})+(-1/\sqrt{2})i$

48. Complex function which is infinite valued is

(A) sin(z)
(B) cos(z)
(C) exp(z)
(D) log(z)

49. A mapping w = f(z) is conformal at every point where

(A) f(z) is defined
(B) f(z) is continuous
(C) f(z) is analytic
(D) f(z) is analytic, except at points where derivative f'(z) is zero

50. If f(z) is analytic in a simply connected bounded domain D, then the integral of f(z) over a simple closed path in D is

(A) Zero
(B) πi
(C) $2\pi i$
(D) $4\pi i$

51. An example of a coherent source is
(A) Two bulbs of same power
(B) Two LEDs of different power
(C) One bulb and one LED of same power
(D) Light coming from a bulb by two different paths

52. A thin film of oil on water looks coloured due to
(A) Diffraction of light
(B) Interference of light
(C) Scattering of light
(D) Refraction of light

53. In a Nicole prism made from Calcite crystal, if N_O,N_E and N_B are refractive indices of ordinary ray, extraordinary ray and Canada balsam, respectively, then

(A) $N_O > N_B > N_E$
(B) $N_O < N_B < N_E$
(C) $N_O < N_B > N_E$
(D) $N_O > N_B < N_E$

54. An optic axis can be found in which type of crystal
(A) Simple cubic
(B) Face centered cubic
(C) Triclinic
(D) Body centered cubic

55. Blue colour of sky is due to

(A) Diffraction of light
(B) Scattering of light
(C) Interference of light
(D) Refraction of light

56. A circularly polarized light can be resolved into

(A) Two linearly polarized light beams of equal intensity in phase
(B) Two linearly polarized light beams of unequal intensity in phase
(C) Two linearly polarized light beams of equal intensity out of phase by 90°
(D) Two linearly polarized light beams of unequal intensity out of phase by 90°

57. If a white light source is used in Young's double slit experiment, then on the sereen

(A) A narrow white fringe at the center, followed by few coloured fringes on either side
(B) Black and white alternating fringes with white fringe at the center
(C) Black and white alternating fringes with dark fringe at the center
(D) A large number of coloured fringes on either side of central fringe

58. Constructive interference happens when two waves are
(A) out of phase
(B) zero amplitude
(C) in phase
(D) in front

59. Certain light of wavelength 600 nm in vacuum enters glass having refractive index of 1.5. What will be wavelength of light inside glass?

(A) 900 nm
(B) 600 nm
(C) 400 nm
(D) 300 nm

60. A 2 level laser

(A) is most efficient laser
(B) is very difficult to operate
(C) Does not work
(D) Has very low power

61. In Schrodinger wave equation the symbol ψ represents the

(A) wavelength of the spherical wave
(B) phase of the spherical wave
(C) frequency of the spherical wave
(D) none of these

62. In the probabilistic interpretation of wave function the quantity ψ is

(A) a probability density
(B) a probability amplitude
(C) a probability wavelength
(D) a probability frequency

63. In quantum mechanics the expectation value of an operator O representing a dynamical variable is

(A) smallest of the eigenvalues of O
(B) largest of the eigenvalues of O
(C) mean value of all the eigenvalues
(D) mean value of the eigenvalues weighted by probability density

64. The energy spectrum of a particle bound in a simple harmonic potential is

(A) completely continuous
(B) both continuous and discrete
(C) completely discrete having equidistant levels
(D) completely discrete having non-equidistant levels

65. Ehrenfest theorem partially shows the connection between quantum mechanics and

(A) photonics
(B) electronics
(C) special relativity
(D) classical mechanics

66. A free particle is
(A) bound
(B) unbound
(C) both bound and unbound
(D) neither bound nor unbound

67. Schrodinger equation truly describes the behaviour of
(A) electrons
(B) electrons and atoms
(C) electrons, atoms and molecules
(D) all particles

68. In quantum mechanical tunnelling, if the barrier width is increased, tunnelling probability will
(A) increase slightly
(B) increase exponentially
(C) decrease slightly
(D) decrease exponentially

69. Which one of the following in an allowed wave function of a single particle
(A) x
(B) sin(x)
(C) $\exp(-x^2)$
(D) 1/x

70. $[p_x, p_y]$ is equal to
(A) ih
(B) p_z
(C) iz
(D) zero

71. The number of two dimensional lattices are
(A) 3 (B) 5
(C) 7 (D) 9

72. The number of crystallographically equivalent planes in the {110} family of a cubic crystal system is
(A) 4 (B) 6
(C) 8 (D) 12

73. The potential energy of a diatomic molecule in terms of interatomic distance R is given by

$$U(R) = -A/R^m + B/R^n$$

where A, B, m and n are constants for the given molecule. The equilibrium separation R_e is obtained as:

(A) $(nA/mB)^{1/n-m}$ (B) $(nA/mB)^{1/m-n}$
(C) $(nB/mA)^{1/m-n}$ (D) $(nB/mA)^{1/n-m}$

74. The concentration of Sehottky imperfections 'n' in an ionic solid at a certain temperature T is given by

(A) $N \exp(-E_p/kT)$ (B) $N \exp(E_p/kT)$
(C) $N \exp(-E_p/2kT)$ (D) $N \exp(E_p/2kT)$

75. The natural cut off frequency ω_m for a one dimensional periodic lattice with force constant K and mass M is given by

(A) (4K/M)
(B) (4M/K)
(C) $(4K/M)^{1/2}$
(D) $(4M/K)^{1/2}$

76. A crystal is subjected to a monochromatic X-ray beam; the first order diffraction is obtained at an angle of 15°. If the same X-ray beam is used, what is the angle corresponding to the third order diffraction

(A) 15°
(B) 31°
(C) 51°
(D) 61°

77. The lowest energy of an electron confined to move in a one dimensional potential well of length 0.75 Å is

(A) 150.7eV
(B) 250.7eV
(C) 350.7eV
(D) 450.7eV

78. The potential of an electron in a one dimensional arrangement of atoms is identical to that used in the Kronig–Penney model. If $V_0 \alpha b << h^2/4\pi^2 m$, the energy band gap at $k=\pi/\alpha$ is

(A) $2V_0 b/\alpha$
(B) $2V_0 \alpha/b$
(C) $V_0 b/2\alpha$
(D) $V_0 \alpha/2b$

79. The susceptibility of a piece of ferric oxide is 1.5×10^{-3}. If the material is subjected to a magnetic field of 10^6 A/m, the flux density in the material is

(A) 0.259T
(B) 1.259T
(C) 2.259T
(D) 3.259T

80. The number of slip systems in an fcc crystal is

(A) 4
(B)8
(C)12
(D) 16

81. Reciprocal lattice of fcc lattice is

(A) fcc
(B) bcc
(C) sc
(D) hexagonal

82. L point in the first Brillouin Zone of an fcc lattice has coordinates

(A) $2\pi/a(1,1,1)$
(B) $2\pi/a(1,0,0)$
(C) $2\pi/a(\frac{1}{2},0,0)$
(D) $2\pi/a(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

83. In an intrinsic semiconductor, the Fermi level lies

(A) at exactly center of band gap
(B) approximately near center of band gap
(C) inside valence band
(D) inside conduction band

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1. An

84. In a degenerate semiconductor, Fermi level lies

(A) at exactly center of band gap
(B) approximately near center of band gap
(C) inside valence or conduction band
(D) 5kT away from valence or conduction band inside the band gap

85. In case of thermal equilibrium in a semiconductor, if n, p, Nc, Nv and n_i be densities of electrons, holes, effective density of states in conduction band, effective density of states in valence band and intrinsic carriers respectively, then

(A) $np = n_i^2$
(B) $np = NcNv$
(C) $np = NcNv - n_i^2$
(D) $np = n_i^2 - NcNv$

86. According to Einstein's model, at very low temperatures specific heat of solids varies with temperature T as (a is a positive constant)

(A) T
(B) T^2
(C) T^3
(D) $\exp(-a/T)$

87. Most probable speed in Maxwell-Boltzmann distribution of molecular velocities is

(A) $\sqrt{(2kT/m)}$
(B) $\sqrt{(3kT/m)}$
(C) $\sqrt{(8kT/\pi m)}$
(D) $\sqrt{(5kT/2m)}$

88. Specific heat at constant volume Cv of hydrogen gas at room temperature is (R is gas constant)

(A) 3R/2
(B) 5R/2
(C) 7R/2
(D) 9R/2

89. In micro canonical ensemble

(A) energy is fixed
(B) no. of particles is fixed
(C) both A & B
(D) none of A & B

90. In Bose-Einstein condensation, transition temperature Tc is given by

(A) $[h^2/(2\pi mk)][N/(2.612V)]^{1/3}$
(B) $[h^2/(2\pi mk)][N/(2.612V)]^{-1/3}$
(C) $[h^2/(2\pi mk)][N/(2.612V)]^{1/2}$
(D) $[h^2/(2\pi mk)][N/(2.612V)]^{-1/2}$

91. In spectroscopic notation, a single electron in an atom having angular momentum state l=3 is represented by

(A) s
(B) p
(C) d
(D) f

92. Vibrational and rotational motions of a molecule are independent of each other. This principle is known as

(A) Born-Oppenheimer approximation
(B) Raman effect
(C) Stoke's law
(D) Larmor precession

93. Number of vibrational degrees of freedom in N atom linear molecule is

(A) 3N – 3
(B) 3N – 4
(C) 3N – 5
(D) 3N – 6

94. In order to be Raman active a molecular rotation or vibration must cause some change in

(A) electric dipole moment
(B) magnetic dipole moment
(C) electric quadrupole moment
(D) molecular polarizability

95. Selection rule for Raman spectroscopy is

(A) $\Delta J = 0$
(B) $\Delta J = \pm 2$
(C) $\Delta J = 0$ or ± 2
(D) $\Delta J = \pm 1$

96. If a mu-meson is captured by a proton in 1s orbital, the radius of the mu-mesonic atom as compared to hydrogen atom will be about

(A) 200 times
(B) 200^2 times
(C) 1/200 times
(D) $1/200^2$ times

97. Nuclear shape can be determined from a measurement of

(A) nuclear electric dipole moment
(B) nuclear electric quadrupole moment
(C) nuclear magnetic dipole moment
(D) nuclear magnetic quadrupole moment

98. Ground state of deuteron is in which angular momentum state

(A) l=0
(B) combination of l=0 and l=1
(C) l=2
(D) combination of l=0 and l=2

99. Ground state of deuteron is in which spin state

(A) S = 0
(B) S = ½
(C) S = 1
(D) S = 2

100. Which of the following particles is responsible for carrying away the missing energy and momentum in the decay of neutron

(A) alpha particle
(B) neutrino
(C) lepton
(D) proton