020/2016

Maximum : 100 marks

Time : 1 hour and 15 minutes

1. The ratio of mobility of holes to mobility of electrons is :

   (A) 1:2 (B) 2:1

   (C) 1:1 (D) 1:3

2. What happens to the Fermi level if an intrinsic semiconductor is doped with acceptor atoms?

   (A) Unaffected (B) Slightly raised

   (C) Slightly lowered (D) Considerably lowered

3. PIN diodes are used in which frequency range?

   (A) 20Hz-20kHz (B) Less than 100Hz

   (C) 20kHz-40kHz (D) Greater than 300MHz

4. Which of the following is not true for a common collector amplifier?

   (A) Current gain is high (B) Voltage gain is high

   (C) Output impedance is very low (D) Input impedance is very high

5. The coefficient of the term $(z-1)^2$ in the Taylor's series of the function $(z) = 1/(z^2-9)$ about the point $z = 1$ is :

   (A) $\frac{-1}{32}$ (B) $\frac{1}{32}$

   (C) $\frac{3}{128}$ (D) $\frac{-3}{128}$

6. If the uncertainty in the velocity of a particle is equal to its velocity, what is the order of uncertainty in its location?

   (A) P (B) λ

   (C) $\frac{p}{m}$ (D) $\frac{p}{2m}$

7. The energy of the particle in three dimensional cubic box of length L is given by $\frac{21\pi^2\hbar^2}{2mL^2}$, then the degeneracy of the state is :

   (A) 1 (B) 3

   (C) 6 (D) 12

8. If the operators A and B commute with H and [A, B] = C, where C is another operator, then :

(A) [H, C] = H
(B) [H, C] = 0
(C) [H, C] = C
(D) [H, C] = 1

9. If the quantum mechanical operators of two observables of a system do not commute, then :

(A) The observables are said to be incompatible
(B) The observables are said to be compatible
(C) Observables must be time independent
(D) Total energy of the system must be negative

10. How much energy is required to remove an electron from n = 8 state of hydrogen atom?

(A) 0.21 eV
(B) – 0.21 eV
(C) 13.6 eV
(D) 27.2 eV

11. The ground state of a linear harmonic oscillator is :

(A) Trigonometric function
(B) Gaussian function
(C) Hyperbolic function
(D) Bessel function

12. The mass m of a moving particle is $\frac{2m_0}{\sqrt{3}}$, where m_0 is its rest mass. The linear momentum of the particle is :

(A) $2m_0c$
(B) $\frac{2m_0}{\sqrt{3}}$
(C) $2m_0$
(D) $\frac{m_0c}{\sqrt{3}}$

13. Consider a 6 particle system with 5 particles arranged as a regular pentagon with the 6^{th} particle at the centre. If all the 5 particles are connected to the central one by rigid rods, then the number of degrees of freedom for the system is :

(A) 13
(B) 6
(C) 5
(D) 18

14. The homogeneity of time leads to the law of conservation of :

(A) Linear momentum
(B) Angular momentum
(C) Energy
(D) Parity

15. If a particle move in a horizontal plane in a central force potential U(r) , which of the following physical quantities are conserved :

(A) Angular momentum only

(B) Energy only

(C) Both angular momentum and energy

(D) Linear momentum and energy

16. Which of the following is wrong?

(A) $[L^2, L_z] = 0$

(B) $[L_z, L_+] = \hbar L_+$

(C) $[L_+, L_-] = 2\hbar L_z$

(D) $[L_-, L_z] = -\hbar L$

17. For what value of α and β do the equations $Q = q^\alpha \cos \beta p$, $p = q^\alpha \sin \beta p$, represent a canonical transformation :

(A) $\alpha = 2 ; \beta = \frac{1}{2}$

(B) $\alpha = 2 ; \beta = 2$

(C) $\alpha = \frac{1}{2} ; \beta = 2$

(D) $\alpha = 2 ; \beta = 1$

18. If a particle hasrest mass m_0 and velocity $\frac{c}{2}$, then the momentum of the particle is :

(A) $m_0 c$

(B) $2m_0 c$

(C) $\frac{m_0 c}{\sqrt{2}}$

(D) $\frac{m_0 c}{\sqrt{3}}$

19. If all the surfaces are closed in a region containing volume V, then which of the following theorem is applicable?

(A) Stokes theorem

(B) Green's theorem

(C) Gauss Divergence theorem

(D) DeMorgans theorem

20. A spherically symmetric charge distribution is given by $\rho(r) = \rho_0\left(\frac{1-r^2}{a^2}\right)$, if the value of r is between 0 and a and $\rho(r) = 0$, if r is greater than a. if $8\pi a^2 \rho_0 = k$, then the total charge of the distribution is :

(A) $\frac{k}{15}$

(B) $\frac{ka}{17}$

(C) $\frac{ka}{15}$

(D) Zero

21. What happens to velocity of light as it travels from a denser medium to a rarer medium?

(A) Decreases
(B) Increases
(C) Remains the same
(D) Cannot predict

22. Gibbs paradox in statistical mechanics is related to the additive property of :

(A) Energy
(B) Momentum
(C) Entropy
(D) Temperature

23. The rms speed of hydrogen gas molecules at STP is v m/s The gas is heated at constant volume till the pressure become 9 times its original value. What will be the new rms speed?

(A) $3v$
(B) $9v$
(C) $18v$
(D) $\frac{v}{3}$

24. A canonical ensemble represents :

(A) An equilibrium system with a fixed volume which can exchange energy and matter with the surroundings
(B) An equilibrium system with a fixed volume and a fixed number of particles which can exchange energy with the surroundings
(C) An isolated system
(D) A system at constant pressure

25. What is to a nuclear physicist as Hydrogen is to an Atomic physicist?

(A) Neutron
(B) Deuteron
(C) Deuterium
(D) Proton

26. Which of the following statement about nuclear force is wrong?

(A) Spindependent
(B) Charge symmetric
(C) Always attractive
(D) Depends on the momentum of the nucleons

27. The relation between mean life τ and half-life $T_{\frac{1}{2}}$ of a radioactive sample is :

(A) $\tau = 2T_{\frac{1}{2}}$
(B) $\tau = \frac{T_{\frac{1}{2}}}{2}$
(C) $\tau = \frac{T_{\frac{1}{2}}}{0.693}$
(D) $\tau = 0.693T_{\frac{1}{2}}$

28. The ratio of energies of thermal neutrons to slow neutrons in keV is :

(A) $25\times10^{-6}:1$

(B) $1:10^{3}$

(C) $1:10^{6}$

(D) $1:25\times10^{-6}$

29. Residue of the function $f(z)=\frac{z^2}{(z^4+4)}$ at $z=2i$ is :

(A) $e^{\frac{3i\pi}{4}}$

(B) $e^{i\pi}$

(C) $e^{\frac{3i\pi}{2}}$

(D) $e^{\frac{i\pi}{2}}$

30. The electric field due to a charge q is given by $E=\frac{qr}{r^2}$. The value of the surface integral $\iint E\cdot dS$ depends on :

(A) The area of the surface

(B) The radial distance r

(C) The shape of the surface

(D) The charge

31. The field of magnetic vector **B** is always :

(A) Irrotational

(B) Solenoidal

(C) Non-solenoidal

(D) Both irrotational and non-solenoidal

32. Eight electric dipoles of charges of magnitude 'e' are placed inside a cube .The total electric flux coming out of the cube will be :

(A) $\frac{8e}{\epsilon_0}$

(B) $\frac{16e}{\epsilon_0}$

(C) $\frac{e}{\epsilon_0}$

(D) Zero

33. A point charge is placed at the centre of a spherical Gaussian surface. The electric flux crossing the surface will change if :

(A) The sphere is replaced by a cube of different volume and surface area

(B) The point charge is moved off from the centre but still remains inside the sphere

(C) The point charge is moved just to the outside of the sphere

(D) Another point charge is placed just outside the sphere

34. A vector field F is said to be conservative if and only if :

(A) F is the curl of some vector **r**

(B) F can be represented as a gradient of a scalar function Φ

(C) $div\mathbf{F} = 0$

(D) $curl\mathbf{F} = \mathbf{F}$

35. Which of the following involves the four concepts of discrete energy levels, Larmorprecession, space quantization and L-S coupling?

(A) Paschen-Back effect

(B) Frank-Hertz Experiment

(C) Stern and Gerlach experiment

(D) Zeeman effect

36. Which of the following molecules does not exhibit a rotational spectrum?

(A) H_2

(B) CO

(C) HCl

(D) HBr

37. For a specimen of V_3Ga, the critical fields are 0.176T and 0.528T at 14K and 13K respectively. Calculate the transition temperature :

(A) 13.5 K

(B) 14.5 K

(C) 15.5 K

(D) 10.5 K

38. In which of the following cases an atom is expected to possess nuclear magnetic moment?

(A) Number of protons and neutrons are equal

(B) Nucleus has only protons

(C) Nucleus has only neutrons

(D) Number of neutrons and protons are unequal.

39. Gold at nano scale is :

(A) Transparent

(B) Red in colour

(C) Blue in colour

(D) An insulator

40. Which of the following is not an object oriented programming language?

(A) Java

(B) C++

(C) C

(D) Ruby

41. The point group of ammonia molecule is :

(A) C_2V

(B) C_3V

(C) D_2h

(D) Td

42. Number of microstates for d^3 configuration is :

(A) 100

(B) 10

(C) 1

(D) 120

43. What is the term symbol arising from the ground state electronic configuration of Na?

(A) $^2S_{\frac{1}{2}}$ (B) $^2P_{\frac{1}{2}}$

(C) $^2P_{\frac{3}{2}}$ (D) $^2S_0$

44. Which among the following is the strongest conjugate base?

(A) CH_3COO^- (B) NO_3^-

(C) SO_4^{2-} (D) Cl^-

45. Which among the following is thermodynamically the most stable allotropic form of carbon at normal temperatures and pressures?

(A) Fullerene (B) Diamond

(C) β - Graphite (D) α - Graphite

46. The oxidation number of P in pyrophosphorous acid is :

(A) +2 (B) +1

(C) +5 (D) +3

47. The strongest reducing agent amongst the following is :

(A) BiH_3 (B) NH_3

(C) AsH_3 (D) PH_3

48. A graphical representation of free energy vs. temperature for the formation of oxides of elements is :

(A) Phase diagram (B) Ellingham diagram

(C) Pourbaix diagram (D) Flow diagram

49. Siderite is an ore of :

(A) Al (B) Zn

(C) Pb (D) Fe

50. For noble gases, the electronic partition function has a value of :

(A) 0 (B) 1

(C) 2 (D) $\frac{1}{2}$

51. Cross Cannizzaro reaction is given by :

(A) Acetaldehyde, Formaldehyde (B) Benzaldehyde, Acetaldehyde

(C) Benzaldehyde, Formaldehyde (D) All of these

52. Iodoform test is not given by :

(A) 3-Pentanone (B) 2-Pentanone

(C) Acetaldehyde (D) Ethanol

53. Which of the following is not aromatic?

(A) Benzene (B) Anthracene

(C) Cyclobutadiene (D) Thiophene

54. Aliphatic polyamides are generally known as :

(A) Polypropylene (B) Terylenes

(C) Bakelite (D) Nylones

55. Stereoisomer's resulting from the restricted rotation about the single bonds, where the rotational barrier is high enough to permit isolation of the isomeric species are called :

(A) Atropisomers (B) Diastereomers

(C) Epimers (D) Anomers

56. An anomalous ORD (Optical Rotatory Dispersion) curve exhibits both a maximum and minimum, and a point of crossover. This effect in ORD is called :

(A) Gauche effect (B) Anomeric effect

(C) Cotton effect (D) Stereoelectronic effect

57. Esters having an α-hydrogen atom on treatment with a strong base like sodium ethoxide gives a β-keto ester. Identify this reaction :

(A) Claisen condensation (B) Darzen condensation

(C) Aldol condensation (D) Houben-Hoesch reaction

58. The heating of an acyl azide to an isocyanate is known as :

(A) Beckmann rearrangement (B) Lossen rearrangement

(C) Allylic rearrangement (D) Curtius rearrangement

59. Anhydrous $AlCl_3$ is not used as a reagent in :

(A) Friedel-Craft reaction (B) Birch reduction

(C) Gattermann Koch reaction (D) Fries migration

60. The hereditary shortage of ceruloplasmin resulting in the accumulation of copper in liver, kidneys and brain is :

(A) Scurvy (B) Pernicious anaemia

(C) Wilson's disease (D) Beriberi

61. Which among the following is not a Haem metalloprotein?

(A) Haemerythrin (B) Cytochromes

(C) Myoglobin (D) Haemoglobin

62. Consider the following ligand substitution reaction : $V(CO)_6 + PR_3 \rightarrow V(CO)_5(PR_3) + CO$. The reaction rate exhibits the following dependence upon the identity of the phosphorous nucleophile used, $PMe_3 > PBu_3 > P(OMe)_3 > PPh_3$. Identify the type of reaction :

(A) Associative
(B) Dissociative
(C) Both associative and dissociative
(D) Cannot be predicted

63. Which compound is most likely to undergo oxidative addition of H_2?

(A) $[Fe(CO)_5]$
(B) $[RhCl(PPh_3)]$
(C) $[Rhl_4(CO_2)]^-$
(D) $[HFe(CO)_4]^-$

64. The spin only magnetic moment of the complex $[Mn(en)_2Cl_2]$ is :

(A) 1.73 μB
(B) 2.83 μB
(C) 3.8 μB
(D) 5.92 μB

65. Linkage isomerism in coordination compounds is due to :

(A) Bidentate ligand
(B) Chelating ligand
(C) Ambidentate ligand
(D) Bridging ligand

66. An equation that represents the exact relationship between the adsorption and the change of surface tension of the solvent due to presence of a solute is known as :

(A) Sackur-Tetrode equation
(B) Gibbs-Duhem equation
(C) Duhem-Margules equation
(D) Gibbs adsorption equation

67. The electric field which is created when charged particles move relative to a stationary liquid is known as :

(A) Streaming potential
(B) Electrophoresis
(C) Electro-osmosis
(D) Sedimentation potential

68. Thermodynamically, formation crystal defects is an :

(A) Exothermic process
(B) Endothermic process
(C) Neither exothermic nor endothermic
(D) May be exothermic or endothermic

69. The superconductivity is destroyed when the current in the superconductor exceeds a critical current and this effect is known as :

(A) Meissner effect
(B) Silsbee effect
(C) Stark effect
(D) Josephson effect

70. The microscopic techniques, which is based on the cantilever principle is :

(A) IR microscopy
(B) Atomic Force Microscopy
(C) Scanning Electron microscopy
(D) Transmission Electron Microscopy

71. The spectroscopic technique that deals with the emission of secondary electron is :

(A) X-ray fluorescence
(B) Photoelectron Spectroscopy
(C) Ion scattering spectroscopy
(D) Auger electron spectroscopy

72. The ESR spectrum of benzene radical $(\cdot C_6H_6)$ is :

(A) Septet
(B) Sextet
(C) Quartet
(D) Singlet

73. Identify the organic compound, which shows a septet around 1.5 ppm and a doublet around 0.9 ppm in the ^1H nuclear magnetic resonance spectrum :

(A) $C_6H_5COCH_3$
(B) $C_2H_5 - CO - CH_3$
(C) $(CH_3)_2CHNO_2$
(D) $CH_3CH_2NO_2$

74. Which is the analytical technique based on the principle of selective adsorption?

(A) Differential scanning calorimetry
(B) Chromatography
(C) Mass spectrometry
(D) Thermo-gravimetric analysis

75. Electron, proton and neutrons belong to the class of :

(A) Bosons
(B) Boltzons
(C) Fermions
(D) None of the above

76. If the partition function of systems A and B are ϕ_A and ϕ_B and their energies E_A and E_B respectively. What will be the total partition function and total energy of the two systems?

(A) $\phi_A \times \phi_B$ and $E_A \times E_B$
(B) $\phi_A + \phi_B$ and $E_A + E_B$
(C) $\phi_A \times \phi_B$ and $E_A + E_B$
(D) $\phi_A + \phi_B$ and $E_A \times E_B$

77. In a grand canonical ensemble, which all parameters are the same for all members of the ensemble?

(A) N, V, E
(B) μ, V, T
(C) N, V, T
(D) μ, N, T

78. The order of radioactive disintegration is :

(A) 3
(B) 2
(C) 0
(D) 1

79. Identify the transformation, which has a negative value for enthalpy change :

(A) $Na_{(s)} \rightarrow Na_{(g)}$
(B) $Na_{(g)} \rightarrow Na^+_{(g)}$
(C) $Cl_{(g)} \rightarrow Cl^-$
(D) $Cl_{(g)} \rightarrow Cl^-_{(g)}$

80. Joule-Thomson expansion is :

(A) Isenthalpic
(B) Isentropic
(C) Isothermal
(D) Isochoric

81. The only officer allowed to participate in the deliberations of the Indian Parliament is :

(A) Cabinet Secretary
(B) Attorney General
(C) Solicitor General
(D) Advocate General

82. Indian Federation is based on the pattern of :

(A) Russia
(B) United States of America
(C) Switzerland
(D) Canada

83. Article 280 of the Indian Constitution deals with :

(A) Finance Commission
(B) Planning Commission
(C) Election Commission
(D) Law Commission

84. The power of the Supreme Court of India to decide dispute between the Centre and the State falls under its :

(A) Advisory jurisdiction
(B) Appellate jurisdiction
(C) Original jurisdiction
(D) Constitutional jurisdiction

85. The words 'Socialist' and 'Secular' were added to the Preamble by :

(A) 47th Amendment
(B) 44th Amendment
(C) 41st Amendment
(D) 42nd Amendment

86. A comprehensive scheme for prevention of Trafficking and Rescue Rehabilitation and Reintegration of victims' :

(A) Swadhar Greh
(B) Ujjawala
(C) Kishori Shakti Yojana
(D) Beti Bachao Beti Padhao Scheme

87. The World Environment Day is observed on :

(A) 5th September
(B) 19th June
(C) 5th June
(D) 29th August

88. The Right to Information Act was passed in the year :

(A) 2005
(B) 2008
(C) 1999
(D) 2010

89. The first Characteristic Malayalam novel :

(A) Dharma Raja
(B) Indulekha
(C) Kundalata
(D) Meenakshi

90. Pattini Jatha led by :

(A) E.M. Sankaran Namoodiri
(B) P.K. Krishna Pillai
(C) C.K. Govindan Nair
(D) A.K. Gopalan

91. Tatwaprakasika Ashram started by :

(A) Vaghbhatananda (B) V.T. Bhattathirippad

(C) Brahmananda Shivayogi (D) Sahodaran Ayyappan

92. The first Western Education School of Malabar was started by :

(A) Mr. Brennen B) Rev. Dawson

(C) Rev. Habik (D) Dr. Herman Guntert

93. 'Aathmakadhakkoru Aamukham' is an autobiography of :

(A) Lalithambika Antharjanam (B) Devaki Nilayangode

(C) Lalitha Prabhu (D) Arya Pallam

94. The person who was not associated with Vaikom struggle :

(A) K.P. Keshava Menon (B) T.K. Madhavan

(C) C.P. Ramaswami Iyer (D) Kurur Nilakantan Namboodiri

95. Abhinjana Sakunthalam was translated into Malayalam by :

(A) Kerala Varma Valiya Koyi Thamburan (B) A. Balakrishna Pillai

(C) M.R. Nair (D) C.V. Raman Pillai

96. The first computer literate Panchayat in India is :

(A) Kaviyoor (B) Vellanad

(C) Chembilode (D) Nadapuram

97. Vana Mahotsava is associated with :

(A) Jayaram Ramesh (B) Veerappa Moily

(C) Jayanthi Natarajan (D) K.M. Munshi

98. Which programme introduced in school aimed at providing basic amenity to the schools?

(A) Non-Formal Education Scheme (B) Sarva Shiksha Abhiyan

(C) Operation Black Board (D) Mahila Samakhya Programme

99. Who among the following has won the Wimbeldon Women's Singles Tennis Championship of 2015?

(A) Maria Sharappova (B) Serena Williams

(C) Martina Hingis (D) Venus Williams

100. Union HRD Minister Smt. Smrithi Irani laid the foundation stone of Indian Institute of Technology in the State of Kerala. It is being set up at :

(A) Kollam (B) Trissur

(C) Kannur (D) Palakkad
