Tech
2

ENTRANCE EXAMINATION FOR ADMISSION, MAY 2011.

M.Tech. (NANO SCIENCES AND TECHNOLOGY)

COURSE CODE : 305

Register Number :

Signature of the Invigilator
(with date)

COURSE CODE : 305

Time : 2 Hours Max : 400 Marks

Instructions to Candidates :

1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.
2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.
3. Read each question carefully and shade the relevant answer (A) or (B) or (C) or (D) in the relevant box of the ANSWER SHEET using HB pencil.
4. Avoid blind guessing. A wrong answer will fetch you –1 mark and the correct answer will fetch 4 marks.
5. Do not write anything in the question paper. Use the white sheets attached at the end for rough works.
6. Do not open the question paper until the start signal is given.
7. Do not attempt to answer after stop signal is given. Any such attempt will disqualify your candidature.
8. On stop signal, keep the question paper and the answer sheet on your table and wait for the invigilator to collect them.
9. Use of Calculators, Tables, etc. are prohibited.

1. Which molecule has the largest dipole moment?

(A) HCl (B) H_2 (C) HF (D) HI

2. Buffer solution can be prepared by mixing equal ratio of

(A) CH_3 COONa + HCl (B) $CH_3COONa + CH_3COOH$

(C) $CH_3COOH + NaOH$ (D) $NaCl + H_2O$

3. Which of the following is a soft base?

(A) CH_3COO^- (B) H^- (C) NO_3^- (D) CO_3^{2-}

4. On dissolving NaCl in water, the pH of the solution

(A) Increases (B) Decreases

(C) Remaining unchanged (D) May increases or decreases

5. Nucleophiles are

(A) Lewis acid (B) Lewis bases

(C) Bronsted acid (D) None

6. Which of the following molecules will not show IR spectrum?

(A) H_2 (B) HCl (C) CH_4 (D) H_2O

7. Blue metal is a mixture of

(A) Cu_2S and FeS (B) Cu and Ni (C) Cu and Zn (D) Zn and ZnO

8. Which one of the following represents a set of electrophiles?

(A) Br^+ and CCl_2 (B) $AlCl_3$ and Cl^- (C) H^+ and H_2O (D) CN^- and NH_3

9. In the S_N^2 reaction mechanism which one of the following is the most reactive?

(A) C_6H_6 (B) CH_3X (C) C_2H_5X (D) R_2CHX

10. Which of the following does not assume a linear structure?

(A) $SnCl_2$ (B) NCO^- (C) CS_2 (D) NO_2^+

11. Dimerisation of cyclopentadiene is an example of a

(A) Friedel-Crafts reaction (B) Chain reaction

(C) Condensation polymerization (D) Diels Alder reaction

12. Which of the following reacts fastest with OH^-?

(A) Benzamide (B) Benzoyl chloride

(C) Ethyl benzoate (D) Sodium benzoate

13. Isobutyric acid

(A) Butanoic acid (B) 2-methyl propanic acid

(C) 2-methyl propionic acid (D) Valeric acid

14. A process is spontaneous at all temperature when

(A) $\Delta H > 0$ and $\Delta S \square 0$ (B) $\Delta H \square 0$ and $\Delta S > 0$

(C) $\Delta H = 0$ and $\Delta S = 0$ (D) $\Delta H \square 0$ and $\Delta S = 0$

15. Which of the following has the highest lattice energy?

(A) KF (B) CsF (C) NaF (D) RbF

16. An example of colligative property is

(A) Boiling point (B) Freezing point

(C) Osmotic pressure (D) Vapour pressure

17. Molecule NH_3 has the symmetry point group of

(A) D_4v (B) T_d (C) C_3v (D) C_3h

18. The Strength of an acid depends on its

(A) Acidity (B) Basicity

(C) Degree of dissociation (D) Molecular weight

19. Higher ionization potential in a period is shown by

(A) Nobel gases (B) Alkali metals

(C) Halogens (D) Alkaline earth metals

20. Least acidic in the series BF_3, BCl_3 and BBr_3, is BF_3 because

(A) F - is most electronegative

(B) F - has a small size

(C) B^{3+} has a very small size

(D) Back donation of electrons from F to B

21. Iodine is an example of

(A) Ionic crystal (B) Covalent crystal

(C) Molecular crystals (D) Metallic crystal

22. Which of the following alkaline earth metal ion has highest ionic mobility in aqueous solution?

(A) Be^{2+} (B) Mg^{2+} (C) Ba^{2+} (D) Ca^{2+}

23. The oxidation number of Phosphorous in Pyrophosphorous acid is

(A) +1 (B) +4 (C) +5 (D) +3

24. Condition for spontaneous change of a given system is

(A) dS is positive (B) dS is negative

(C) $dS_{E,V}$ is positive (D) $dS_{E,v}$ is negative

25. Which of the following is not a Lewis acid?

(A) $AlCl_3$ (B) SbF_5 (C) SO_2 (D) CN^-

26. Which of the following is the most acidic in water?

(A) CH_4 (B) NH_3 (C) H_2O (D) HF

27. Which of the following is a hard acid?

(A) Li^+ (B) Cu^+ (C) Ag^+ (D) Au^+

28. Which one of the following gas is extremely soluble in water?

(A) Carbon dioxide (B) Ammonia

(C) Chlorine (D) Hydrogen Sulphide

29. Hydrogen atom contains protons, electrons and neutron respectively as

(A) 1,0,1 (B) 1,1,0 (C) 1,1,1 (D) 0,1,0

30. Pyrene is the commercial name for

(A) Chloroform (B) Carbon tetrachloride

(C) Methylene Chloride (D) Calcium oxychloride

31. Marble is

(A) Calcium carbonate (B) Sodium carbonate

(C) Magnesium sulphate (D) Ferric chloride

32. Which of the following is backing soda?

(A) $Na_2CO_3 \cdot 10H_2O$ (B) $NaHCO_3$

(C) $Na_2CO_3 \cdot H_2O$ (D) NH_4Cl

33. The formula aluminium carbide is

(A) Al_2C_3 (B) Al_3C_4 (C) Al_4C_3 (D) AlC_2

34. An Earth satellite of mass m revolves at a height h from the surface of the Earth. If R is the Earth's radius and g is the acceleration due to gravity at the surface of the Earth, then the velocity of the satellite is given by

(A) $\frac{g R^2}{R+h}$ (B) $\sqrt{\frac{gR}{R+h}}$ (C) $\frac{gR}{R+h}$ (D) $\sqrt{\frac{gR^2}{R+h}}$

35. Density of water is

(A) 1 g/cm^3 (B) 10 g/cm^3 (C) 100 g/cm^3 (D) 1000 g/cm^3

36. Which of the following quality of light will not vary with respect to medium?

(A) Velocity (B) Amplitude (C) Frequency (D) Intensity

37. Force constant of a spring is defined by

(A) $\sqrt{m/k}$ (B) $\sqrt{mk}$ (C) $\sqrt{k/m}$ (D) $\sqrt{k^2 m}$

38. Find the value of the normalization constant A, of the a particle moving in a 1-D box of dimension 0 to 'a' and its wave function is $\psi(x) = A \sin\left(\frac{n\pi x}{a}\right)$

(A) $\sqrt{\frac{2}{a}}$ (B) $\sqrt{\frac{a}{2}}$ (C) $\sqrt{\frac{1}{2a}}$ (D) $\sqrt{2a}$

39. The equation $\nabla^2 \rho = 0$, is called as

(A) Laplace equation (B) Poisson's equation

(C) Pascal's law (D) Boyles law

40. Magnetic induction in a solenoid is proportional to

(A) number of turns (B) current

(C) diameter (D) (A) and (B)

41. When Ar gas is discharged it produces the following color?

(A) Red (B) Blue (C) Green (D) Yellow

42. Which one of the following is not a Maxwell's equation?

(A) $\nabla \cdot E = \frac{1}{\varepsilon_0}\rho$ (B) $\nabla \cdot B = 0$

(C) $\nabla^2 \rho = 0$ (D) $\nabla \times E = -\partial B/\partial t$

43. Magnetic field is induced by

(A) Constant electric field (B) Changing electric field

(C) Static charge (D) None

44. Dipole moment of two equal and opposite charges (q) separated by a distance d, is

(A) q-d (B) q+d (C) qd (D) q/d

45. Electric field by an infinite plane carries a uniform surface charge σ is

(A) σ/ε_0 (B) $2\sigma/\varepsilon_0$ (C) $\sigma/2\varepsilon_0$ (D) σ^2/ε_0

46. An electrical dipole is placed at an angle of 30° to a non-uniform electrical field. The dipole will experience

(A) A torque only

(B) A translational force only in the direction of the field

(C) A translational force only in a direction normal to the direction of the field

(D) A torque as well as translational force

47. Amorphous materials are

(A) Having no regular array of atoms

(B) Having regular array of atoms

(C) Showing Bragg's diffraction

(D) Similar to crystalline structure

48. Total number of Bravais lattices is

(A) 7 (B) 8 (C) 14 (D) 32

49. Total number of atoms belongs to the BCC structure is

(A) 1 (B) 2 (C) 3 (D) 4

50. Capacitance of a parallel plate capacitor whose electrodes are separated by a distance d with area of cross section A is

(A) $\sigma A/\varepsilon_0$ (B) $\varepsilon_0 A/d$ (C) $\varepsilon_0 Ad$ (D) $A/\varepsilon_0 d$

51. Algebraic sum of currents i_1, and i_2 at the junction is

(A) i_1+i_2 (B) i_1-i_2 (C) $i_1 \cdot i_2$ (D) 0

52. Net charge of the n-type semiconductor is

(A) 0 (B) Positive

(C) Negative (D) Cannot be determined

53. Fermi level, E_F of an intrinsic semiconductor lies

(A) Close to the valence band (B) Close to the conduction band

(C) Middle of the band gap (D) None of the above

54. Velocity of Cerenkov radiation in a given medium is (c is the velocity of light)

(A) Equal to c (B) Less than c

(C) Greater than c (D) Zero

55. Brewster's angle is an angle at which

(A) Diffraction occurs (B) Interference occurs

(C) Refraction occurs (D) Total internal reflection occurs

56. When the train moves with the velocity v_1 and a car moves in the same direction with a velocity v_2 in the same direction. What is the velocity observed by a passenger in a train?

(A) $v_1 + v_2$ (B) v_1-v_2 (C) v_1/v_2 (D) $v_1 \cdot v_2$

57. A jet is said to be supersonic jet when it travels with a velocity

(A) Equal to the velocity of light (B) Greater than the velocity of light

(C) Equal to the velocity of sound (D) Greater than the velocity of sound

58. At NTP, the pressure is

(A) 1 mbar (B) 1 bar (C) I Torr (D) 1 m Torr

59. Nuclear fission reaction is assisted by

(A) Neutron (B) Electron (C) Proton (D) Photon

60. The Balmer series occurs when an electron relaxes from any higher state to

(A) State with n = 1 (B) State with n = 2

(C) State with n = 3 (D) State with n = 4

61. The energy eigen values, $E_n = n^2 h^2 / (8ma^2)$, corresponds to

(A) Hydrogen atom (B) Harmonic oscillator

(C) Particle in a box (D) Deuterium

62. Dimension of entropy is

(A) K (B) K^{-1}

(C) JK^{-1} (D) Dimensionless

63. Boyles law states

(A) $(P \propto 1/V)_T$ (B) $(P \propto V)_T$ (C) $(P \propto 1/T)_v$ (D) $(P \propto T)_v$

64. Combination of thermodynamics first and second laws states that

(A) dS = TdU – PdV (B) dU = TdS – PdV

(C) dS = TdV – PdS (D) dV = TdS – PdU

65. In an ideal gas, the molecules are

(A) Interacting electrically (B) Interacting magnetically

(C) Idle (D) Non-interacting

66. The strongest force is

(A) Gravitational force (B) Electromagnetic force

(C) Nuclear force (D) None

67. Antiparticle of electron is

(A) Positron (B) Proton (C) Neutron (D) Photon

68. Magnitude of a vector, 3i + 4j + 2k is

(A) 9 (B) $\sqrt{29}$ (C) 29 (D) $\sqrt{9}$

69. If $a = (3, 4, 0)$ and $b = (0, 2, -3)$, then $b - |a|$ is equal to

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

70. Which vector is perpendicular to the plane containing the three points P (2, 1, 5), Q (–1, 3,4), and R (3, 0, 6)?

(A) $2i - j + k$ (B) $i + 2j + 2k$ (C) $2i + 2j - k$ (D) $i + 2j + k$

71. A vector is said to said to be normalized, then its norm is

(A) 0 (B) 1 (C) ∞ (D) $-\infty$

72. If $\nabla \times A = 0$, then A is

(A) Unit vector (B) Solenoidal (C) Irrotational (D) Planar

73. $e^{i\theta}$ is defined by Euler theorem as

(A) $\cos\theta + i\sin\theta$ (B) $\cos\theta - i\sin\theta$ (C) $\sin\theta + i\cos\theta$ (D) $\sin\theta - i\cos\theta$

74. $Z = a + ib$, then $1/Z$ =?

(A) a – ib (B) $(a - ib)/(a^2 + b^2)$

(C) $(a + ib)/(a^2 + b^2)$ (D) $(a + ib)^2$

75. If $Z1$ and $Z2$ are complex numbers then $|Z1\,Z2|$ is

(A) $|Z1| + |Z2|$ (B) $|Z1| - |Z2|$ (C) $|Z1| \cdot |Z2|$ (D) $|Z1| / |Z2|$

76. Modulus of $Z = (1 - i)/(1 + i)$ is,

(A) i (B) 1 (C) $-i$ (D) -1

77. Which of the following is not correct for the complex numbers $Z1, Z2$ and $Z3$?

(A) $Z1 + Z2 = Z2 + Z1$ (B) $Z1 + (Z2 + Z3) = (Z1 + Z2) + Z3$

(C) $Z + Z^{-1} = 0$ (D) $ZZ^{-1} = 1$

78. The kronecker delta, δ_{ij} is equal to the following value when $i = j$

(A) 0 (B) 1 (C) ∞ (D) -1

79. For the beta function $\beta(m,n)$ is

(A) $\beta(m)+\beta(n)$ (B) $\beta(m)-\beta(n)$ (C) $\beta(n,m)$ (D) $\beta(m,n)^2$

80. Gamma function $\Gamma(n)$ is defined for $n>0$ as

(A) $\int_0^\infty e^{-x}\, x^{n+1}\, dx$ (B) $\int_0^\infty e^{-x}\, x^{n-1}\, dx$ (C) $\int_0^\infty e^{x}\, x^{n-1}\, dx$ (D) $\int_0^\infty e^{-x}\, x^{2n-1}\, dx$

81. Laplace transform of e^{at} is

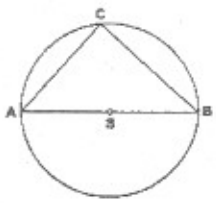
(A) 1/(s-a) (B) 1/(s + a) (C) $1/(s^2+1)$ (D) None

82. $\int \frac{\ln(\ln x)}{x \ln x} dx$ is equal to

(A) $\left[\ln(\ln x)^2\right]+C$ (B) $\frac{1}{2}\ln(\ln x)+C$

(C) $\frac{1}{2}(\ln(\ln x))^2+C$ (D) None

83. What is the angle <ACB?



(A) 30 (B) 45 (C) 60 (D) 90

84. Distance between the two points A (1,2,3) and B (1, 2, 4)

(A) 1 (B) 2 (C) 3 (D) 4

85. Projection of i + 2j + 3k on i - 2j - 2k is

(A) 3 (B) –3 (C) 9 (D) –9

86. If cos A = ¾, then what is 32 sin (A/2) sin (5A/2)?

7 (B) 8 (C) 11 (D) 15

87. $\cos(180-\theta)=$

(A) $-\sin\theta$ (B) $\sin\theta$ (C) $-\cos\theta$ (D) $\cos\theta$

88. If cos A + cos B = 0 = sin A + sin B, then cos 2A + cos 2B = is

(A) $-2\sin(A+B)$ (C) $2\sin(A+B)$ (B) $-2\cos(A+B)$ (D) $2\cos(A+B)$

89. Integrating factor of differential equation, $\cos x\frac{dy}{dx}+y\sin x=1$ is

(A) $\cos x$ (B) $\tan x$ (C) $\sin x$ (D) $\sec x$

90. Solution of the differential equation $\frac{d^2y}{dx^2}-\frac{dy}{dx}+6y=0$ is

(A) $Ae^{3x}+Be^{2x}$ (B) $Ae^{-3x}+Be^{-2x}$ (C) $Ae^{-3x}+Be^{2x}$ (D) $Ae^{3x}+Be^{-2x}$

91. $\int_{-\pi/2}^{\pi/2}\sin x\,dx=?$

(A) $\frac{1}{2}$ (B) $\frac{\sqrt{3}}{4}$ (C) $-1/2$ (D) 0

92. If a matrix is Hermitian, its eigen values are

(A) 0 (B) Real (C) Complex (D) None

93. The minor element of a21 of $A=\begin{pmatrix} a11 & a12 & a13 \\ a21 & a22 & a23 \\ a31 & a32 & a32 \end{pmatrix}$ is

(A) $\begin{vmatrix} a11 & a12 \\ a21 & a22 \end{vmatrix}$ (B) $\begin{vmatrix} a21 & a22 \\ a31 & a32 \end{vmatrix}$ (C) $\begin{vmatrix} a22 & a23 \\ a32 & a33 \end{vmatrix}$ (D) $\begin{vmatrix} a12 & a13 \\ a32 & a33 \end{vmatrix}$

94. If $\begin{vmatrix} A & B & C \\ D & E & F \\ G & H & I \end{vmatrix}=K$, then $\begin{vmatrix} A & C & B \\ D & F & E \\ G & I & H \end{vmatrix}$ is

(A) K^2 (B) K (C) $-K$ (D) $-K^2$

95. If $(\nabla \phi) = 0$, then ϕ is

(A) Solenoidal (B) Irrotational (C) Constant (D) None

96. For the matrices A and B, $(AB)^T = ?$

(A) A^TB^T (B) B^TA^T (C) $(AB)^{-1}$ (D) $A^{-1}B^{-1}$

97. Multiplicative inverse of a matrix $\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$

(A) $\begin{pmatrix} -\cos\theta & \sin\theta \\ -\sin\theta & -\cos\theta \end{pmatrix}$ (B) $\begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$

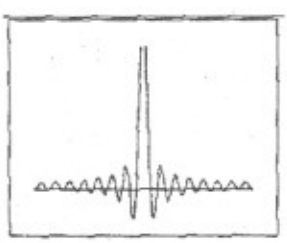
(C) $\begin{pmatrix} \cos\theta & \sin\theta \\ \sin\theta & -\cos\theta \end{pmatrix}$ (D) $\begin{pmatrix} -\cos\theta & -\sin\theta \\ \sin\theta & -\cos\theta \end{pmatrix}$

98. Equation of ellipse is

(A) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (B) $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ (C) $y^2 = 4ax$ (D) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = -1$

99. Slope of a line passing parallel to y axis is

(A) 0 (B) ∞ (C) 1 (D) None

100.  This graph is defined by the following function

(A) $\sin x$ (B) $\cos x$ (C) $\sin x/x$ (D) $\cos x - \sin x$