OCET 2011

Sr. No. :

Question Booklet Series : A

Important : Please consult your Admit Card / Roll No. Slip before filling your Roll Number on the Test Booklet and Answer Sheet.

Roll No. *In Figures* *In Words*

O.M.R. Answer Sheet Serial No.

Signature of the Candidate :

Subject : M. Tech. (Nano Science and Nano Tech.)

Time : 90 minutes **Number of Questions : 75** **Maximum Marks : 75**

DO NOT OPEN THE SEAL ON THE BOOKLET UNTIL ASKED TO DO SO

INSTRUCTIONS

1. Write your Roll No. on the Question Booklet and also on the OMR Answer Sheet in the space provided and nowhere else.
2. Enter the Subject and Series Code of Question Booklet on the OMR Answer Sheet. Darken the corresponding bubbles with **Black Ball Point / Black Gel pen.**
3. Do not make any identification mark on the Answer Sheet or Question Booklet.
4. To open the Question Booklet remove the paper seal (s) gently when asked to do so.
5. Please check that this Question Booklet contains **75** questions. In case of any discrepancy, inform the Assistant Superintendent within 10 minutes of the start of test.
6. Each question has four alternative answers (A, B, C, D) of which only one is correct. For each question, darken only one bubble (A or B or C or D), whichever you think is the correct answer, on the Answer Sheet with **Black Ball Point / Black Gel pen.**
7. If you do not want to answer a question, leave all the bubbles corresponding to that question blank in the Answer Sheet. No marks will be deducted in such cases.
8. Darken the bubbles in the OMR Answer Sheet according to the Serial No. of the questions given in the Question Booklet.
9. Negative marking will be adopted for evaluation i.e., 1/4th of the marks of the question will be deducted for each wrong answer. A wrong answer means incorrect answer or wrong filling of bubble.
10. For calculations, use of simple log tables is permitted. Borrowing of log tables and any other material is not allowed.
11. For rough work only the sheets marked "Rough Work" at the end of the Question Booklet be used.
12. The Answer Sheet is designed for **computer evaluation**. Therefore, if you do not follow the instructions given on the Answer Sheet, it may make evaluation by the computer difficult. **Any resultant loss to the candidate on the above account, i.e., not following the instructions completely, shall be of the candidate only.**
13. After the test, hand over the Question Booklet and the Answer Sheet to the Assistant Superintendent on duty.
14. In no case the Answer Sheet, the Question Booklet, or its part or any material copied/ noted from this Booklet is to be taken out of the examination hall. Any candidate found doing so would be expelled from the examination.
15. A candidate who creates disturbance of any kind or changes his/her seat or is found in possession of any paper possibly of any assistance or found giving or receiving assistance or found using any other unfair means during the examination will be expelled from the examination by the Centre Superintendent / Observer whose decision shall be final.
16. **Telecommunication equipment such as pager, cellular phone, wireless, scanner, etc., is not permitted inside the examination hall. Use of calculators is not allowed.**

1. **In a metal at 0 K, the Fermi energy is :**
   (A) the highest energy of any electron
   (B) the lowest energy of any electron
   (C) the mean thermal energy of the electrons
   (D) the energy of the top valence band

2. **A hole refers to :**
   (A) A proton
   (B) A positively charged electron
   (C) An electron that has somehow lost its charge
   (D) The absence of an electron in an otherwise filled band

3. **In addition to the daughter nucleus and electron or positron, the products of a beta decay includes :**
   (A) A neutron
   (B) A neutrino
   (C) A proton
   (D) An alpha particle

4. **The energy gap (in eV) between the valency and conduction bands of an insulator is of the order :**
   (A) 0.001
   (B) 0.1
   (C) 10
   (D) 100

5. **The number of states in a shell with a principal quantum number n = 3 is :**
   (A) 3
   (B) 9
   (C) 15
   (D) 18

6. **To observe the Zeeman effect one uses :**
   (A) A strong uniform magnetic field
   (B) A strong non-uniform magnetic field
   (C) A strong uniform electric field
   (D) Mutually perpendicular electric and magnetic fields

7. **Characteristic K X-radiation of an element is caused by :**
   (A) Stoppage of electrons by the nucleus
   (B) Ejection of an electron from an outer shell
   (C) Transition of an electron to the innermost orbit
   (D) Scattering of the incident radiation with a change of wavelength

8. **The ground state energy of a hydrogen atom is –13.6 eV. The minus sign indicates :**
   (A) The kinetic energy is negative
   (B) The potential energy is positive
   (C) The electron might escape from the atom
   (D) The electron and proton are bound together

9. Which of the following crystal structures has closest packing of atoms ?

(A) Simple cubic structure

(B) Body centered cubic structure

(C) Face centered cubic structure

(D) Hexagonal close packed (hcp) structure

10. A real gas is changed slowly from the state I to state II, during this process no work is done on or by the gas, this process must be :

(A) isothermal (B) adiabatic

(C) isovolumic (D) isobaric

11. Pulling the plates of an isolated charged capacitor apart :

(A) Increases the capacitance

(B) Increases the potential difference

(C) Does not affect the potential difference

(D) Does not affect the capacitance

12. If an electron has zero orbital angular momentum, the magnitude of its dipole moment is equal to :

(A) Zero (B) Half the Bohr magneton

(C) A Bohr magneton (D) Twice a Bohr magneton

13. For an electromagnetic wave the direction of the vector $\vec{E} \times \vec{B}$ gives :

(A) The direction of the electric field

(B) The direction of the magnetic field

(C) The direction of the wave propagation

(D) The direction of the emf induced by the wave

14. Alternating voltage of frequency 50 Hz is used as the input of a full wave rectifier. Number of pulses of the rectified output obtained in one second will be :

(A) 25 (B) 50

(C) 100 (D) 200

15. The largest X-ray wavelength that could be diffracted by rock salts crystal planes with a separation of 0.282 nm is :

(A) 0.564 nm (B) 0.282 nm

(C) 0.0282 nm (D) 0.141 nm

16. **The eigen values of the matrix** $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ **is :**

(A) 2, 3, 2 (B) –2, 3, 6

(C) 1, 5, 1 (D) 0, 2, 5

17. **The rank of the matrix** $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 2 & 1 & 2 \end{bmatrix}$ **is :**

(A) 1 (B) 2

(C) 3 (D) 0

18. **What is the probability of getting doublets when two dice are thrown simultaneously ?**

(A) $\frac{1}{2}$ (B) $\frac{1}{3}$

(C) $\frac{1}{6}$ (D) $\frac{2}{3}$

19. **If** $\left|\frac{z-5i}{z+5i}\right| = 1$ **, then z = x + iy lie on :**

(A) The real axis (B) The imaginary axis

(C) The straight line y = 5 (D) A circle passing through origin

20. **Solving by variation of parameter for the equation** $\frac{d^2y}{dx^2} + y = \sec x$ **, the value of Wronskion is :**

(A) 1 (B) 2

(C) 3 (D) 4

21. **Elimination of a and b from** $z = ae^{bt} \sin bx$ **gives the partial differential equation :**

(A) $\frac{\partial z}{\partial x} + \frac{\partial z}{\partial t} = 0$ (B) $\frac{\partial z}{\partial x} + z = 0$

(C) $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial t^2} = 0$ (D) $\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial t^2} = 0$

22. **Consider the polynomial $x^3 + 2x + 3$ over integers. If α, β, γ are the roots of $x^2 + 2x + 3 = 0$, then what is the value of $\alpha^3 + \beta^3 + \gamma^3$?**

(A) –4 (B) –6

(C) 9 (D) –9

23. **The function $f(x) = -2x^3 - 9x^2 - 12x + 1$ is an increasing function in the interval :**

(A) $-1 < x < 2$ (B) $1 < x < 2$

(C) $-2 < x < -1$ (D) $-2 < x < 1$

24. **If $\lim_{x \to 0} \frac{(1 - \cos x) - ax \sin x}{x^4}$ exists and is finite, then the value of a must be :**

(A) 1 (B) $\frac{1}{2}$

(C) $\frac{1}{3}$ (D) $\frac{1}{4}$

25. **If $e^u = \frac{x^4 + y^4}{x + y}$, show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :**

(A) 4 (B) 2

(C) 1 (D) 3

26. **Inverse Laplace transform of $\cot^{-1}(s)$ is :**

(A) $\frac{\sin t}{t}$ (B) $\frac{\cos t}{t}$

(C) $\frac{\tan t}{t}$ (D) $\cot t$

27. **If $\vec{A} = x^2y\hat{i} - 2xz\hat{j} + 2yz\hat{k}$, then the value of curl (curl A) at the point (1, 0, 2) is :**

(A) $4\hat{i}$ (B) $4\hat{j}$

(C) 0 (D) $4\hat{k}$

28. **If $J_n(x)$ is a Bessel function of first kind, then**

$\int_0^{\pi} [J_{-2}(x) - J_2(x)]dx$, **is equal to :**

(A) 0 (B) 1

(C) 2 (D) –2

29. If $u + 3x = 5$, $2y - v = 7$ and correlation coefficient between x and y is 0.12, then correlation coefficient between u and v is equal to :

(A) Cannot be obtained (B) 0

(C) .12 (D) –.12

30. The minimum number of subintervals required in Simpson's '3/8' rule of integration are :

(A) 2 (B) 3

(C) 4 (D) 6

31. In living systems, true criteria for spontaneity of a reaction is :

(A) Gibbs free energy (B) Enthalpy

(C) Change in entropy (D) Change in Gibbs free energy

32. In living systems usually :

(A) Pressure, volume and pH is variable (B) Amount of matter variable

(C) Pressure, temp, pH is constant (D) Pressure, temp, pH is variable

33. Halobacteria are bacteria which are found in :

(A) Hot springs (B) In acidic solutions

(C) In high salt concentration (D) In arctic regions

34. Enzymes :

(A) Alter the rate of a reaction

(B) Alter the concentration of reactants and products

(C) Lowers the activation energy barrier

(D) Increases the activation energy barrier

35. Mitochondria evolved from free living bacteria that formed a relationship with a primitive eukaryotic cell. This relationship was :

(A) Parasitic (B) Symbiotic

(C) Saprophytic (D) Lethal

36. Water is a :

(A) Polar molecule with low dielectric constant

(B) Is a non polar molecule with high dielectric constant

(C) Is a polar molecule with extensive H-bonding and high dielectric constant

(D) Is a polar molecule with little H-bonding and low dielectric constant

37. DNA is a :

(A) Polymer of nucleotides (B) Monomer of nucleotides

(C) Small molecule like benzene (D) Aggregate of nucleotides

38. Cell is :

(A) A closed system (B) An isolated system

(C) An open system (D) A complex system

39. pl is :

(A) Isobestic point (B) Isotectic point

(C) Isoelectric point (D) Isotactic point

40. One among following is not a state function :

(A) Energy (B) Entropy

(C) Pressure (D) Enthalpy

41. Amino acids are :

(A) Cations (B) Anions

(C) Polyions (D) Zwitterions

42. If one has to think of conducting a charge, which polymer is useful :

(A) Proteins (B) DNA

(C) Polysaccharides (D) Lipids

43. Alpha helices are found in :

(A) DNA (B) Proteins

(C) Carbohydrates (D) RNA

44. Evolution is :

(A) Directed to a goal (B) An intelligent design

(C) A random ongoing process (D) Over now

45. One amino acid among following is unlikely to be in an alpha helix :

(A) Proline (B) Glycine

(C) Leucine (D) Valine

46. Dimensions of Planck's constant are :

(A) $kg\ m^2\ s^{-2}$ (B) $kg\ m^2\ s^{-1}$

(C) $kg\ m\ s^{-2}$ (D) $kg\ m\ s^{-1}$

47. The potential of the electrode : Pt, H_2(0.25 atm/H^+(a_{H+} = 0.50) is taken as :

(A) 0 (B) 0.018 V

(C) 0.059 V (D) 0.118 V

48. In which of the following, van der Waals forces are likely to be most important in determining the melting point and boiling point :

(A) ICl (B) Br_2

(C) HCl (D) CO

49. Which of the following ions is diamagnetic at room temperature ?

(A) O_2^+ (B) NO^+

(C) O_2^- (D) NO^-

50. The visible absorption spectrum of $[Ti(H_2O)_6]^{3+}$ exhibits a single absorption band at 20,000 cm^{-1}. This arises from :

(A) Intramolecular vibrations

(B) d-d transitions

(C) Transfer of an electron from the titanium ion to a water molecule in the complex

(D) Transfer of an electron from one titanium ion to another

51. The magnetic moment of Co^{3+} in Bohr magneton is :

(A) 4.9 (B) 1.73

(C) zero (D) 1.0

52. If complete inversion of configuration occurs during hydrolysis of a haloalkane, the reaction is :

(A) SN^1 (B) SN^2

(C) E1 (D) E2

53. The frequency of a line in the spectrum of an element enables one to determine which of the following ?

(A) One of the energy levels for electrons in the atoms

(B) The ionization potential of the atom

(C) The principle quantum number of the atom

(D) The difference between two electronic energy levels of the atom

54. A compound alloy of gold and copper crystallizes in a cubic lattice in which the gold atoms occupy the lattice points at the corners of a cube and the copper atoms occupy the centres of each of the cube faces. The empirical formula of this compound is :

(A) Au_2Cu (B) AuCu

(C) Au_3Cu_6 (D) $AuCu_3$

55. The largest species in (Ti^{3+}, Ti^{2+}, Ti) and (F^-, Ne, Na^+) are :

(A) Ti^{3+} and Na^+ (B) Ti^{3+} and Ne

(C) Ti^{2+} and Ne (D) Ti and F^-

56. How many geometrical isomers are possible for $[Pt(NH_3)(NH_2OH)py(NO_2)]^+$?

(A) 3 (B) 4

(C) 2 (D) 6

57. The acid catalysed dehydration of alcohols to give alkenes involves one of the following :

(A) A free radical intermediate (B) A carbanion intermediate

(C) The expulsion of an OH^- ion (D) A carbocation intermediate

58. Which of the following is planar ?

(A) PCl_3 (B) PH_3

(C) CO_3^{2-} (D) NH_3

59. The enthalpy change for a certain reaction at 298K is –15.0 kcal/mol. If the entropy change under these conditions is –7.2 cal/mol then the free energy change for the reaction is :

(A) –12.9 kcal/mol (B) 1.3×10^4 kcal/mol

(C) -1.3×10^4 kcal/mol (D) –22.2 kcal/mol

60. Total number of optical isomers for 2,3-butanediol are :

(A) 3 (B) 4

(C) 2 (D) 9

61. The process of transforming one bit pattern into another by bitwise operation is called :

(A) Pruning (B) Masking

(C) Biting (D) Trapping

62. Binary Number 10 11 10 000 is equivalent to :

(A) 722 (B) 718

(C) 716 (D) 724

63. $\overline{A \cdot B \cdot C}$ is equal to :

(A) $\overline{A} \cdot \overline{B} \cdot \overline{C}$ (B) $\overline{A} + \overline{B} + \overline{C}$

(C) $A + B + C$ (D) $A \cdot B \cdot C$

64. How many number of bits are required for 4 GB ?

(A) 32 bits (B) 22 bits

(C) 42 bits (D) 44 bits

65. Attenuation of fibre optics is in :

(A) dB/mm (B) dB/cm

(C) db/m (D) db/km

66. _____ is used to connect one network to different network.

(A) Networking (B) Gateway

(C) Bridge (D) LAN

67. Which of the following is a functionally complete set ?

(A) AND, OR (B) AND, XOR

(C) NOT, OR (D) AND, OR, NOT

68. If both J and K input is same, then it works like :

(A) D type flip-flop (B) T type flip-flop

(C) Toggle switch (D) RS flip-flop

69. 16 bit microprocessor has memory :

(A) 1 MB (B) 64 KB

(C) 256 Byte (D) 2 MB

70. Which memory has the shortest access time ?

(A) Cache Memory (B) Magnetic Bubble Memory

(C) Magnetic Core Memory (D) RAM

71. Scanner is called :

(A) D A G (B) Parser

(C) Lexical Analyzer (D) Code optimizer

72. How many layers are there in OSI ?

(A) 5 (B) 3

(C) 9 (D) 7

73. Top to down traversing of tree is :

(A) Preorder (B) Inorder

(C) Post order (D) None of these

74. How many bits are required to encode all 26 letters, 10 symbols and 10 numerals ?

(A) 5 (B) 7

(C) 6 (D) 46

75. A half-adder is also known as :

(A) AND circuit (B) NAND circuit

(C) NOR circuit (D) EX-OR circuit

ROUGH WORK