

ENTRANCE EXAMINATION FOR ADMISSION, MAY 2012.

Ph.D. (NANO SCIENCE AND TECHNOLOGY)

COURSE CODE : 160

Register Number :

Signature of the Invigilator
(with date)

COURSE CODE : 160

Time : 2 Hours

Max : 400 Marks

Instructions to Candidates :

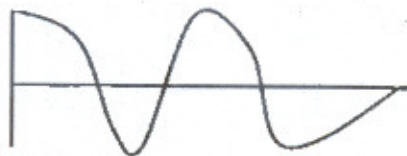
1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.
2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.
3. Read each of the question carefully and shade the relevant 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. Magnitude of a vector is $2i + 3j + k$ is
 (A) $\sqrt{14}$ (B) 6 (C) 14 (D) $\sqrt{6}$
2. The set of elements is said to be group if it has
 (A) Closed property (B) Associate property
 (C) Identity property (D) All of the above
3. What is the probability of getting 2 and 3 when throwing a dice
 (A) $1/6$ (B) $3/6$ (C) $2/6$ (D) $4/6$
4. Find x in the series: 0, 1, 2, 5, 26, x , 393930
 (A) 652 (B) 600 (C) 626 (D) 627
5. Fourier series expansion is possible only if the function is
 (A) Periodic (B) Non-periodic
 (C) Discontinuous (D) All of the above
6. If the two ends of a PN junction are joined by a wire
 (A) There will not be steady current in the circuit
 (B) There will be a steady current from n-side to p-side
 (C) There will be a steady current from p-side to n-side
 (D) There may or may not be a current depending upon the resistance of the connecting wire
7. The mass number of a nucleus is equal to
 (A) Number of neutrons in the nucleus
 (B) Number of Protons in the nucleus
 (C) None of these
 (D) Number of Nucleons in the nucleus
8. As compared to ^{12}C atom, ^{14}C atom has
 (A) Two extra Protons and two extra electrons
 (B) Two extra Protons but no extra electrons
 (C) Two extra neutrons and no extra electrons
 (D) Two extra neutrons and two extra electrons

9. An α particle is bombarded on ^{14}N . As a result a ^{17}O nucleus is formed and a particle is emitted. This particle is
 (A) Neutron (B) Proton (C) Electron (D) Positron
10. During a nuclear fission reaction
 (A) A heavy nucleus breaks into two fragments by itself
 (B) A light nucleus bombarded by thermal neutrons breaks up
 (C) A heavy nucleus bombarded by thermal neutrons breaks up
 (D) Two light nuclei combine to give a heavier nucleus and other products
11. Which of the following properties does not have any unit?
 (A) Ionization potential (B) Electro negativity
 (C) Atomic radii (D) Electron affinity
12. Which of the following halogens has the highest bond energy?
 (A) Cl_2 (B) Br_2 (C) I_2 (D) F_2
13. NO^+ has a bond order
 (A) 2 (B) $2\frac{1}{2}$ (C) 3 (D) $3\frac{1}{2}$
14. The lowest boiling point among the following hydrides is of
 (A) NH_3 (B) PH_3 (C) AsH_3 (D) SbH_3
15. In the formation of N_2^+ from N_2 molecule the electron is removed from
 (A) π orbital (B) π^* orbital (C) σ orbital (D) σ^* orbital
16. If a pure copper wire is bent multiple times, its resistivity
 (A) increases (B) decreases
 (C) does not change (D) decreases and then increases
17. The plastics which soften upon being heated but regain all their original properties on cooling are known as
 (A) thermoplastics (B) thermosetting plastics
 (C) thermoelastic (D) cellulose

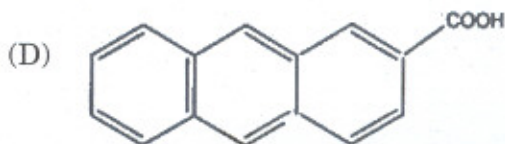
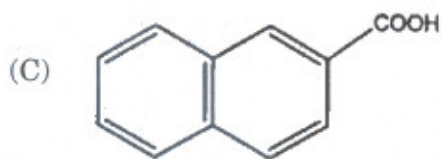
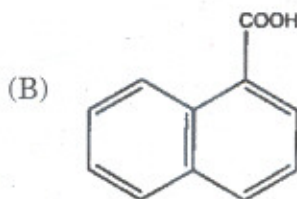
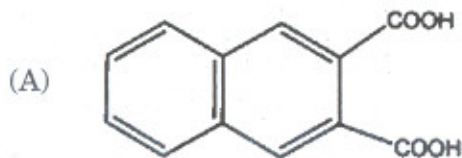
18. Smallest repeat entity of the crystal structures is known as
 (A) lattice (B) unit cell (C) Miller indices (D) phase
19. Diffusion can occur in
 (A) Solids (B) Liquids (C) Gases (D) All
20. The relation between the phase (P), component (C) and degrees of freedom (F) is given by the equation $F =$
 (A) $C+P$ (B) $P(C-1)$ (C) $C-P+2$ (D) $C-P$
21. At neutral pH, a mixture of amino acids in solution would be predominantly
 (A) dipolar ions (B) non polar molecules
 (C) positive and monovalent (D) hydrophobic
22. The greatest buffering capacity at physiological pH would be provided by a protein rich in which of the following amino acids?
 (A) Lysine (B) Histidine (C) Aspartic acid (D) Valine
23. Which of the following classes of aminoacids contains only nonessential aminoacids?
 (A) Basic aminoacids (B) Branched-chain aminoacids
 (C) Aromatic aminoacids (D) None of the above
24. Which of the following statements about solutions of aminoacids at physiological pH is the same?
 (A) All aminoacids contain both positive and negative charges
 (B) All aminoacids contain positively charged side chains
 (C) Some aminoacids contain negatively charged side chains
 (D) All aminoacids contain negatively charged side chains
25. In proteins, the α -helix and β -pleated sheet are examples of
 (A) Primary structure (B) Secondary structure
 (C) Tertiary structure (D) Quaternary structure
26. $\lim_{x \rightarrow 0} \frac{(1 - \cos x)}{x^2}$
 (A) 1 (B) ∞ (C) $-\infty$ (D) 1

27. Value of $\int_0^1 xe^x dx = ?$
 (A) 0 (B) $-\infty$ (C) $+\infty$ (D) 1
28. Slope of a line passing parallel to x axis is
 (A) 0 (B) ∞ (C) $-\infty$ (D) 1
29. Equation $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ represents
 (A) Square (B) Straight line (C) Parabola (D) Ellipse
30. The curve in the figure is described by a function

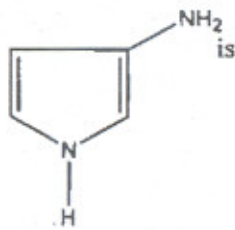


- (A) $\sin x$ (B) $\cos x$ (C) $\sinh hx$ (D) $\cosh x$
31. A charged particle is projected at a very high speed perpendicular to a uniform magnetic field. The particle will
 (A) Move along a circle
 (B) Move along a curve with increasing radius of curvature
 (C) Move along a curve with decreasing radius of curvature
 (D) Move along a straight line
32. An experimenter measures the length of a rod. Initially the experimenter and the rod are at rest with respect to the lab. Consider the following statements.
 i. If the rod starts moving parallel to its length but the observer stays at rest the measured length will be reduced
 ii. If the rod stays at rest, but the observer starts moving parallel to the measured length of the rod, the length will be reduced
 (A) i is true but ii is false
 (B) ii is true but i is false
 (C) Both i and ii are true
 (D) Both i and ii are false
33. In which of the following transitions will the wavelength be minimum?
 (A) $n=5$ to $n=4$ (B) $n=4$ to $n=3$ (C) $n=3$ to $n=2$ (d) $n=2$ to $n=1$

34. Which of the following parameters are the same for all hydrogen like atoms in their ground state?
- (A) Radius of the orbit
 (B) Speed of the electron
 (C) Energy of the atom
 (D) Orbital angular momentum of the electron
35. In a LASER tube, all the photons
- (A) Have the same wavelength
 (B) Have same energy
 (C) Move in the same direction
 (D) Move with the same speed
36. The Born exponent for Ag^+ ion type is
- (A) 5 (B) 7 (C) 9 (D) 10
37. The example of covalent solid is
- (A) $CaSO_4$ (B) SiC (C) $NaCl$ (D) CaF_2
38. Which of following set of molecules have 2 lone pairs in each
- (A) IF_5, BrF_5, PF_5 (B) XeF_4, BrF_3, SCl_2
 (C) SF_6, XeF_6, PCl_3 (D) $TeCl_4, XeOF_4, SnCl_2$
39. The correct structure for 2-napthanoic acid is

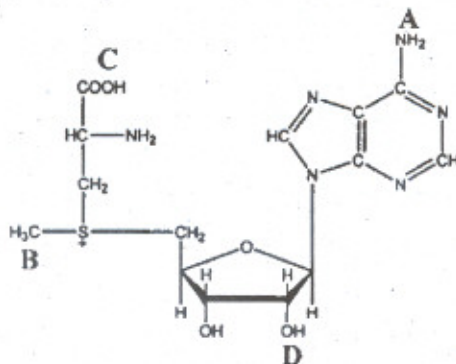


40. The correct IUPAC name of the compound



- (A) 2-amino pyridine (B) 2-amino pyrrole
(C) 3-amino pyridine (D) 3-amino pyrrole
41. In heat treatment quenching refers to
(A) Slow cooling (B) Rapid cooling
(C) Slow heating (D) Rapid heating
42. Ductility arise from
(A) Single crystal (B) Glassy structure
(C) Stress to move a dislocation is low (D) Stress to move a dislocation is high
43. For good photoemission semiconductors should have
(A) Direct bandgap (B) Indirect bandgap
(C) Photonic bandgap (D) All
44. The temperature at which new grains are formed in a metal are known as
(A) Curie temperature (B) Upper critical temperature
(C) Lower critical temperature (D) Recrystallization temperature
45. Number of atoms in a FCC unit cell is
(A) 1 (B) 2 (C) 3 (D) 4
46. The following facts are true of all transfer (t) RNAs EXCEPT that
(A) the 5' end is phosphorylated (B) they are single chains
(C) methylated bases are found (D) the anticodon loop is identical
47. Some of the enzymes utilized in DNA replication are (1) DNA-directed DNA polymerase, (2) unwinding proteins, (3) DNA polymerase I, (4) DNA-directed RNA polymerase, and (5) DNA ligase. What is the correct sequence of their use during DNA synthesis?
(A) 4, 3, 1, 2, 5 (B) 2, 3, 4, 1, 5 (C) 4, 2, 1, 5, 3 (D) 2, 4, 1, 3, 5

48. Which of the following statements regarding a double helical molecule of DNA is true?
 (A) All hydroxyl groups of pentoses are involved in linkages
 (B) Bases are perpendicular to the axis
 (C) Each strand is identical
 (D) Each strand is parallel
49. S-Adenosylmethionine is shown below with 4 substituent groups labeled A through D. Which group is S-Adenosylmethionine able to donate in creatine synthesis?



- (A) A (B) B (C) C (D) D
50. Which of the following is a metabolic pathway common to bacteria and humans?
 (A) Purine synthesis (B) Nitrogen fixation
 (C) Cell wall mucopeptide synthesis (D) Fermentation to ethyl alcohol
51. 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) $\begin{pmatrix} -\cos \theta & -\sin \theta \\ \sin \theta & -\cos \theta \end{pmatrix}$
52. $(AB)^T = ?$
 (A) $(AB)^{-1}$ (B) $A^{-1}B^{-1}$ (C) $B^T A^T$ (D) $A^T B^T$
53. Trace of a matrix is $\begin{pmatrix} 5 & 7 & 9 \\ 2 & 3 & 5 \\ 1 & 4 & 2 \end{pmatrix}$
 (A) 5 (B) 13 (C) 16 (D) 10

54. If $A = \begin{pmatrix} A & D & G \\ B & E & H \\ C & F & I \end{pmatrix}$ then $\begin{pmatrix} D & A & G \\ E & B & H \\ F & C & I \end{pmatrix}$
- (A) A^2 (B) A (C) $-A$ (D) $-A^2$
55. Find the value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin x dx =$
- (A) $\frac{1}{2}$ (B) $\sqrt{\frac{3}{4}}$ (C) $-\frac{1}{2}$ (D) 0
56. The work function of a metal is $h\nu_0$. Light of frequency ν falls on this metal. The photoelectric effect will take place only if
- (A) $\nu \geq \nu_0$ (B) $\nu > 2\nu_0$ (C) $\nu < \nu_0$ (D) $\nu < \nu_0/2$
57. When stopping potential is applied in an experiment on photoelectric effect, no photo current is observed. This means that
- (A) The emission of photoelectrons is stopped
 (B) The photoelectrons are emitted but are reabsorbed by emitter metal
 (C) The photoelectrons are accumulated near the collector plate
 (D) The photoelectrons are dispersed from the sides of the apparatus
58. The anode of a thermionic diode is connected to the negative terminal of a battery and cathode to its positive terminal
- (A) No appreciable current will pass through the diode
 (B) A large current will pass through diode from anode to cathode
 (C) A large current will pass through diode from cathode to anode
 (D) The diode will be damaged
59. A magnetic field directed in north direction acts on an electron moving in east direction. The magnetic force on the electron will act
- (A) Vertically upward (B) Towards the east
 (C) Vertically downward (D) Towards the north
60. A person is facing magnetic north. An electron in front of him flies horizontally towards the north and deflects towards east. He is in/at
- (A) Southern hemisphere (B) Equator
 (C) Northern hemisphere (D) None of these

61. Pick out the incorrect match
- | Common Name | IUPAC name |
|----------------------|------------------|
| (A) Formamide | Methanamide |
| (B) Ethyl acetate | Ethyl ethanoate |
| (C) Acetic anhydride | Acetic anhydride |
| (D) Methyl cyanide | Ethanenitrile |
62. The IUPAC name for urea is
- | | |
|---------------------|------------------------|
| (A) diamide ketone | (B) Carbamide |
| (C) Amine formamide | (D) diamine methanone. |
63. Optical activity is shown by a molecule which
- contains at least three asymmetric centres
 - is asymmetric as a whole
 - contains a double bond
 - has a centre of symmetry
64. Erythrose and threose
- | | |
|--------------------------|----------------------------------|
| (A) are homomers | (B) are <i>cis-trans</i> isomers |
| (C) are diastereoisomers | (D) are optimers |
65. The concept of stereochemistry is based on
- | | |
|-------------------------|----------------------------------|
| (A) VSEPR theory | (B) Molecular orbital theory |
| (C) Valence bond theory | (D) Vant'Hoff and Label's theory |
66. The use of germanium in integrated circuit instead of silicon is limited as
- Germanium has higher band gap energy
 - Junction leakage current is less
 - Germanium forms water soluble oxides
 - Melting point of germanium is higher
67. Indium tin oxide is widely used as in touch-screen displays due to
- High adhesion properties
 - Transparent and conductive properties
 - Microwave characteristics
 - Dust proof properties

68. In telecommunication technology optical fibers are preferred over copper wires as
- Optical fibers have higher electrical conductivity
 - Fibers are optically translucent
 - Optical fibers show higher photon transfer than copper
 - Copper shows electromigration
69. Rule of mixtures are useful
- To predict the mechanical property of composites
 - To predict surface energy
 - To predict the weldment dissolution
 - To predict the stress
70. Carbon nanotubes are
- Conductors
 - Insulators
 - Semiconductors
 - All the above
71. The synthesis of fatty acids is often termed reductive synthesis. The reducing equivalent for fat production is provided by which of the following compounds?
- Nicotinamide adenine dinucleotide phosphate (NADP⁺)
 - Flavin adenine dinucleotide (FAD⁺)
 - The reduced form of Flavin adenine dinucleotide (FADH₂)
 - The reduced form of Nicotinamide adenine dinucleotide phosphate (NADPH)
72. Given that the standard free energy change (ΔG°) for the hydrolysis of ATP is -7.3 kcal/mol and that for the hydrolysis of glucose 6-phosphate is -3.3 kcal/mol, what is the ΔG° for the phosphorylation of glucose?
- Glucose + ATP \rightarrow Glucose 6-phosphate + ADP.
- -10.6 kcal/mol.
 - -7.3 kcal/mol.
 - -4.0 kcal/mol.
 - $+4.0$ kcal/mol.
73. The structure of glycerol for fatty acid esterification in adipocytes is
- for the most part derived from glucose
 - obtained primarily from phosphorylation of glycerol by glycerol kinase
 - formed by gluconeogenesis
 - inhibited by insulin simulation
74. The yield from complete oxidation of the fatty acids in triacylglycerols is greater than that from carbohydrates on a dry-weight basis. Which of the following fractions most closely represents the ratio of carbohydrate:fat energy yields?
- 1:2
 - 1:3
 - 1:4
 - 2:3
75. The substrate for adolase is
- glucose 6-phosphate
 - fructose 6-phosphate
 - fructose 1, 6-diphosphate
 - phosphoglyceric acid.

76. Solution of 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) $Ae^{3x} + Be^{-2x}$
77. Integrating factor of differential equation $\cos x \left(\frac{dy}{dx} \right) + y \sin x = 1$
 (A) $\cos x$ (B) $\tan x$ (C) $\sec x$ (D) $\sin x$
78. $\cos(180 - \theta)$ is
 (A) $-\sin \theta$ (B) $-\cos \theta$ (C) $\sin \theta$ (D) $\cos \theta$
79. If $\cos A = \frac{3}{4}$ then $32 \sin\left(\frac{A}{2}\right) \sin\left(\frac{5A}{2}\right) = ?$
 (A) 7 (B) 8 (C) 11 (D) 15
80. Projection of $i + 2j + 3k$ on $i - 2j - 2k$ is
 (A) -3 (B) 3 (C) -9 (D) 9
81. At Curie temperature the ferromagnetic material gets converted into
 (A) Non-magnetic material (B) Paramagnetic material
 (C) Diamagnetic material (D) Antiferromagnetic material
82. Which of the following is correct?
 (A) At Curie temperature ferromagnetic material becomes ferrimagnetic
 (B) At Curie temperature antiferromagnetic material becomes paramagnetic
 (C) At Neel's temperature antiferromagnetic material changes to paramagnetic
 (D) At Ned's temperature ferromagnetic material becomes ferrimagnetic
83. A resistor 'R' dissipates the power 'P' when connected to a generator. If a resistance 'R₂' is connected in series with 'R₁', the power dissipated by R₁
 (A) Increases (B) Decreases
 (C) Remains the same (D) Depends on the values of R₁ and R₂
84. Two simple pendulums of length 1m and 16m respectively are both given small displacements in the same direction at the same instant. They will again be in phase after short pendulum has completed n oscillation, where 'n' is
 (A) 1/3 (B) 1/4 (C) 4 (D) 5

85. According to Bohr's hypothesis, which of the following quantities is discrete?
 (A) Angular velocity (B) Potential energy
 (C) Momentum (D) Angular momentum
86. The angle strain in planar cyclohexane is nearly
 (A) 13° (B) 10° (C) 20° (D) 25°
87. Which of the following set of quantum numbers is possible?
 (A) $n=2, l=1, m=0, s = +\frac{1}{2}$ (B) $n=2, l=0, m=0, s = +\frac{1}{2}$
 (C) $n=2, l=1, m=0, s=0$ (D) $n=2, l=-2, m=-2, s = +\frac{1}{2}$
88. The f-type orbitals have maximum number of
 (A) 3 sub shells (B) 7 sub shells (C) 5 sub shells (D) 9 sub shells
89. Structure of solid NaCl crystal is
 (A) Cubic (B) Tetragonal (C) Triclinic (D) Monoclinic
90. Bohr's atomic model does not agree with
 (A) Line spectra of hydrogen atom (B) Heisenberg's principle
 (C) Planck's theory (D) Pauli's principle
91. Among the following which statement is false
 (A) Heat treatment can change mechanical property
 (B) Heat treatment can modify microstructure
 (C) Heat treatment cannot be decided by phase diagram
 (D) Heat treatment useful in designing properties of materials
92. Ion implantation is a process
 (A) To dope semiconductors (B) In dental application
 (C) To predict cytotoxicity (D) In residual life assessment
93. In airplanes the structural material used is
 (A) Silicon (B) Vanadium (C) Aluminum (D) Steel

94. Thermal barrier coatings are applied
- (A) For high temperature protection of turbine components
 - (B) In solid oxide fuel cells
 - (C) To protect polymer life
 - (D) To improve tensile strength
95. The mechanical properties of fiber reinforced composite does not depend on
- (A) Stress loading direction
 - (B) Interfacial bonding between fiber-matrix
 - (C) Orientation of fibre
 - (D) None of the above
96. Which of the following statement is correct?
- (A) All coenzymes are vitamins
 - (B) All coenzymes contain vitamins or are vitamins
 - (C) Prostaglandins may be derived from fat-soluble vitamins
 - (D) All water-soluble vitamins act as coenzymes or coenzyme precursors
97. All the following hormones use cyclic AMP as a second messenger EXCEPT
- (A) follicle-stimulating hormone
 - (B) luteinizing hormone
 - (C) glucagon
 - (D) estrogen
98. Insulin has many direct effects on various cell types from such tissues as muscle, fat, liver and skin. All the following cellular activities are increased following exposure to physiologic concentrations of insulin EXCEPT
- (A) plasma membrane transfer of glucose
 - (B) glucose oxidation
 - (C) gluconeogenesis
 - (D) lipogenesis
99. Following a normal overnight fast and a cup of black coffee, a diabetic woman feels slightly nauseous and decides to skip breakfast. However, she does take her shot of insulin. This may result in
- (A) heightened glycolysis
 - (B) hypoglycemia
 - (C) increased lipolysis
 - (D) glucosuria
100. All the following are involved in calcium metabolism and function EXCEPT
- (A) thyroxine
 - (B) parathyroid hormone
 - (C) calcitonin
 - (D) vitamin D