ENTRANCE EXAMINATION FOR ADMISSION, MAY 2011.

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 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. The degrees of freedom when ice, water and water vapour coexist in equilibrium

    (A) 0   (B) 1   (C) −1   (D) 2

2. For a spherical particle of radius r, the volume-to-surface area ratio is

    (A) 3r   (B) 3/r   (C) r/3   (D) πr

3. The unit of electrical conductivity is

    (A) ohm m^{-1} (B) ohm^{-1} m^{-1} (C) ohm m   (D) mho^{-1} m^{-1}

4. When a 1 μm particle is crushed into number of 1 nm particles (assuming there is no weight loss), the total surface area of nanoparticles compared to the 1 μm particle.

    (A) Increases   (B) Decreases

    (C) Never changes   (D) Random

5. The genotypic ratio in the F2 generation in a monohybrid cross will be

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

6. Sex-linked genes are present in

    (A) Autosomes   (B) X-chromosomes

    (C) Mitochondrial DNA   (D) Chloroplast DNA

7. Genes are made of

    (A) Carbohydrates   (B) X-chromosomes

    (C) Fats   (D) Nucleotides

8. Which fungus was of great use in finding out genetic principles

    (A) Mucor   (B) Neurospora

    (C) Agaricus   (D) Pencillium

9. Thermal expansion in solids with increasing temperature is a consequence of

    (A) Anharmonicity of the lattice vibrations

    (B) Pressure of the electron gas

    (C) Dislocations of the lattice

    (D) None of the above

10. The motion of the simple pendulum undergoing large oscillations can be described as

    (A) Harmonic, non-conservative   (B) Harmonic, conservative

    (C) Anharmonic, non-conservative   (D) Anharmonic, conservative

11. The possible values of the total angular momentum J resulting from the addition of the two angular momenta $J_1 = 1$ and $J_2 = 2$ are

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

12. The energy separation between the two consecutive Stokes lines in Raman scattering depends on

(A) Energy separation between the vibrational levels in the excited state

(B) Wavelength of the incident light

(C) Energy separation between the vibrational levels in the ground state

(D) Intensity of the incident light

13. IUPAC name of crotanaldehyde, $CH_3CH=CH-CHO$

(A) 2–buten-3-al   (B) 3–buten–1-al

(C) 2–butenal   (D) butenaldehyde

14. Acetylene has the point group

(A) C_2h (B) C_2v (C) $C_\alpha v$ (D) $D_\alpha h$

15. Oxidation number of Chlorine in Cl_2O, Cl_2 and ClO_3^- are respectively

(A) +1, -1, +5   (B) +1, 0, -1   (C) -1, 0, -1   (D) +1, 0, +5

16. Alcohols absorbed in the infrared range of about

(A) 3600 cm^{-1} (B) 1700 cm^{-1} (C) 1600 cm^{-1} (D) 2900 cm^{-1}

17. When compared to the bulk, the bandgap energy of the semiconductor nanostructure in the quantum confinement regime

(A) Decreases   (B) Remains the same

(C) Varies randomly   (D) Increases

18. Among the following techniques which is not useful for size characterization of nanomaterials

(A) Transmission electron microscopy   (B) Infra-red spectra

(C) X-ray Diffraction   (D) Atomic Force Microscopy

19. The imperfection due to atom missing from the proper atomic site is known as

(A) Stacking Fault   (B) Grain boundary

(C) Schottky defect   (D) Frenkel defect

20. The stacking sequence of ABCABCABC... belongs to the following crystal structure

    (A) FCC   (B) HCP

    (C) Spherical   (D) None of the above

21. Memory is the responsibility of

    (A) Cerebrum   (B) Cerebellum

    (C) Medulla oblongata   (D) Spinal cord

22. Pathogenic fungi cause human diseases which are collectively termed as

    (A) Mycoses   (B) Chlamydial diseases

    (C) Food poisoning   (D) Diarrhoeal diseases

23. Which of the following protein is considered to be a fibrono protein?

    (A) Keratin   (B) Oval bumin

    (C) Hemoglobin   (D) Protein-G

24. Sodium-potassium pump is

    (A) A hormone   (B) An enzyme

    (C) A protein carrier   (D) An organelle

25. Electromagnetic radiation will be emitted in the case of a

    (A) Neutron moving in a straight line with constant speed

    (B) Proton moving in a straight line with constant speed

    (C) Proton moving in a circle with constant speed

    (D) Electron moving in a straight line with constant speed

26. If $A^T = A^{-1}$ where A is a real matrix, then A is

    (A) Normal   (B) Symmetric   (C) Hermitian   (D) Orthogonal

27. The eigen values of a square symmetric matrix are always

    (A) Positive   (B) Real and imaginary

    (C) Negative   (D) Real

28. There is no infrared absorption for nitrogen molecule because

    (A) Its polarizability is zero   (B) It has no vibrational levels

    (C) It has no rotational levels   (D) Its dipole moment is zero

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29. Which of the following complex ions cannot exist in optically active form?

   (A) $[Co(en)(NH_3)_3Cl]^{2-}$
   (B) Trans $[Co(en)_2Cl_2]^+$
   (C) $[Co(en)_2(NH_3)Cl]^{2+}$
   (D) $[Co(en)(NH_3)_2Cl_2]^+$

30. Iron is extracted from its Oxide ore by

   (A) Pyrometallurgy
   (B) Hydrometallurgy
   (C) Electrometallurgy
   (D) Sequestration

31. In case of organic compounds, on introduction of conjugated double bond the absorption band shifts to a region of longer λ. This is referred to as

   (A) Hypsochromic Shift
   (B) Bathochromic Shift
   (C) Chromophoric Shift
   (D) Auxochromic Shift

32. In which one of the following cases does a reaction not proceed spontaneously?

   (A) ΔH is -ve and AS is +ve
   (B) ΔH is +ve and AS is –ve
   (C) ΔH is +ve and AS is zero
   (D) ΔH is -ve and AS is –ve

33. Engineering stress-strain curve and True stress-strain curve are equal up to

   (A) Proportional limit
   (B) Elastic limit
   (C) Yield point
   (D) Tensile strength point

34. Mechanical deformation under elevated temperature is known as

   (A) Plastic deformation
   (B) Elastic deformation
   (C) Creep
   (D) Anelastic deformation

35. The reaction of a solid phase upon cooling transforming into two different solids is known as

   (A) Eutectic   (B) Peritectic   (C) Eutectoid   (D) Peritectoid

36. Time dependent deformation of a material at elevated temperature is known as

   (A) Creep
   (B) Superplasticity
   (C) Toughness
   (D) Fatigue

37. Total oxygen that can be carried in blood is

   (A) 200 ml   (B) 100 ml   (C) 1000-1200 ml   (D) 2000-3000 ml

38. Root hairs develop from

   (A) Exodermis
   (B) Exodermal cells
   (C) Endodermis
   (D) Epidermal cells

39. Fermentation for industrial production of ethanol is carried out by

   (A) Saccharomytes
   (B) Lactobacillus
   (C) Streptomyces
   (D) Acetobactor

40. Oxyheamoglobin behaves as

   (A) Strong base
   (B) Strong acid
   (C) Weak acid
   (D) Weak base

41. Bose Einstein condensation temperature TB refers to the temperature below which

   (A) An essembly of Bose gas condenses to liquid state

   (B) There is an appreciable occupation of the ground state in an electron system

   (C) There is a significantly large occupancy of the ground state in a system of bosons

   (D) The bosons behave like Fermions

42. The experimental study shows that superconductors have an energy gap. Which one of the following is incorrect

   (A) The gap separates the lowest excited state in a superconductor from the ground state

   (B) The temperature dependence of electronic specific heat indicates the existence of an energy gap

   (C) BCS theory explains the energy gap

   (D) The energy gap in superconductors is similar to the energy gap in insulators

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

   (A) H_2 (B) CO   (C) HCl   (D) HBr

44. The hyperfine splitting of the spectral lines of an atom is due to

   (A) The coupling between the spins of two or more electrons

   (B) The coupling between the spins and orbital angular momentum of the electrons

   (C) The coupling between the electron spins and the nuclear spin

   (D) The effect of external electromagnetic fields

45. Heisenberg's uncertainty principle is applicable to

(A) atoms only

(B) electrons only

(C) nucleus only

(D) any moving object

46. Silicon are

(A) Organometallic compounds

(B) Compounds obtained from silica

(C) Compounds obtained by hydrolysis of organochlorosilanes

(D) Macromolecules prepared from silicates

47. Which of the following set of ions are colourless?

(A) $Zn^{2+}, Cu^{2+}, Ti^{3+}, Co^{2+}$

(B) $Zn^{2+}, Cu^{+}, Ti^{4+}, V^{2+}$

(C) $Cr^{3+}, Mn^{2+}, Zn^{2+}, Ti^{4+}$

(D) $Mn^{7+}, Cr^{6+}, Cu^{+}, V^{2+}$

48. Which of the following statement is not correct?

(A) The oxides and hydroxides of d-block elements are less basic than those off-block elements

(B) The size of atoms and ions of d-block elements are relatively smaller than those of the f-block elements

(C) The tendency of d-block elements to form complexes is less than that off-block elements

(D) f-block elements are called transition elements

49. A liquid medium containing a colloidal suspension of ferromagnetic nanoparticle is known as

(A) Magnetic resonance

(B) Plasmon resonance

(C) Superconductor

(D) Ferrofluid

50. Essential property for medicinal applications of nanostructure is

(A) High mechanical property

(B) Low toxicity

(C) High toxicity

(D) High mechanical property

51. Metals showing more than one crystal structure are known as

(A) Polymorphism

(B) Bravais lattice

(C) Miller indices

(D) Hall-Petch relation

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52. Among the following which is not true

    (A) Nanograined materials have lower hardness and strength than the coarse grained structure

    (B) Nanograined material have greater total grain boundary area

    (C) Nanograined material impede dislocation motions

    (D) For materials yield strength varies with the grain size

53. Pale yellowish colour of cowmilk is due to the presence of

    (A) Carotine   (B) Xanthophyll

    (C) Riboflavin   (D) None of the above

54. Enzyme catalyzed reactions can be inhibited by

    (A) Mg^{2+} (B) Zn   (C) Cu^{2+} (D) Hg^{2+}

55. Ratio of WBC/RBC in human blood is

    (A) 1 : 100   (B) 1 : 200   (C) 500 : 1   (D) 1 : 500

56. Which of the following type of cancer will be observed in such transformed cells?

    (A) Adenoma   (B) Melanoma   (C) Sarcoma   (D) Hepatoma

57. Consider the energy E in the first Brillouin zone as a function of the magnitude of the wave vector k for a crystal with lattice constant a then

    (A) The slope of E versus k is proportional to the group velocity

    (B) The slope of E versus k has its maximum value at $k = \pi/a$

    (C) The plot of E versus k will be parabolic in the interval $(-\pi/a) < k < (\pi/a)$

    (D) The slope of E versus k is nonzero for all k in the interval $(-\pi/a) < k < (\pi/a)$

58. All vibrations producing a change in the dielectric dipole moment of a molecule yield

    (A) Raman spectra   (B) Infrared spectra

    (C) Ultraviolet spectra   (D) X-ray spectra

59. In a nanomaterial the surface to volume ratio is

    (A) Higher than the bulk   (B) Lower than the bulk

    (C) Is always a constant   (D) There is no change from the bulk

60. The valency of Au in gold nanoparticle is

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

61. Which has the largest size?

    (A) Sc^{3+} (B) Y^{3+} (C) La^{3+} (D) Ac^{3+}

62. Coordination number and oxidation state of Cr in $K_3[Cr(C_2O_4)_3]$ are respectively

    (A) 3 and +3   (B) 3 and 0   (C) 6 and +3   (D) 4 and +2

63. In Joule-Thomson expansion

    (A) $dS = 0$ (B) $dG = 0$ (C) $dE = 0$ (D) $dH = 0$

64. The EMF of the cell is $H_2 \mid HI\,(0.01\,M) \mid\mid AgI \mid Ag \mid AgI \mid\mid H_2 \mid HI\,(0.01\,M) \parallel$ H$_2$ is approximately

    (A) 2×0.0591 (B) -0.0591 (C) $+0.591$ (D) 0.0296

65. Ceramic materials exhibit

    (A) Higher compressive strength   (B) Higher tensile strength

    (C) Ductile fracture behaviour   (D) Extensive plastic deformation

66. For the orbital angular quantum number value of 3, the total number of magnetic quantum number values are

    (A) 6   (B) 7   (C) 8   (D) 9

67. In iron, which among the following elements can diffuse fast

    (A) C   (B) Ni   (C) H   (D) Cr

68. For structural applications, covalent and ionic solids are not suitable because

    (A) They are ductile   (B) They have weak bonds

    (C) They have high elastic moduli   (D) They are brittle

69. Polymorphism is mainly due to

    (A) Monogenic inheritance   (B) Polygenic inheritance

    (C) Both of the above   (D) None of the above

70. The nerve messages enter the cell through the

    (A) Dendrite   (B) Axon   (C) Cytan   (D) Synapse

71. Absence of magnesium causes

    (A) Plasmolysis   (B) Etiolation   (C) Nacrosis   (D) Chlorosis

72. Red root of sugarcane is caused by

   (A)   Viruses   (B)   Bacterium

   (C)   Fungus   (D)   Mineral deficiency

73. The time independent Schrodinger equation of a system represents the conservation of the

   (A)   Total binding energy of the system   (B)   Total potential energy of the system

   (C)   Total kinetic energy of the system   (D)   Total energy of the system

74. In GaAs/GaAlAs quantum well light emitting diode the barrier layer is formed by

   (A)   GaAs   (B)   GaAlAs   (C)   Ga   (D)   As

75. The degeneracy of the spectral term ^3F is

   (A)   7   (B)   9   (C)   15   (D)   21

76. The lande g factor for the level $^3D_3$ is

   (A)   2/3   (B)   3/2   (C)   ¾   (D)   4/3

77. The level of quantum confinement in a quantum wire is

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

78. In a nanostructured material

   (A)   The bandgap increases compared to bulk

   (B)   The bandgap decreases compared to bulk

   (C)   The bandgap is the same as bulk

   (D)   None of the above

79. In a solar energy device

   (A)   Light is converted into electricity   (B)   Electricity is converted into light

   (C)   Light is converted into heat   (D)   Heat is converted into electricity

80. Nd : YAG laser is a

   (A)   2-level system   (B)   3-level system

   (C)   4-level system   (D)   5-level system

81. The standard EMF for the cell reaction $Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$ is 1.10 V at 25°C. The EMF for the cell reaction, when 0.1 M Cu^{2+} and 0.1 M Cu^{2+} and 0.1 M Zn^{2+} solution are used at 25°C is

   (A)   1.10 V   (B)   0.11 V   (C)   −1.10 V   (D)   −0.11 V

82. The point group of BF₃ molecules is

(A) C₃v   (B) C₂v   (C) D₃h   (D) C₃h

83. Of the given anions, the strongest Bronstead base is

(A) ClO^- (B) ClO_2^- (C) ClO_3^- (D) ClO_4^-

84. Jahn Teller effect affects the geometry of

(A) $[Ni(NH_3)_6]^{2+}$ (B) $[Cu(NH_3)_4]^{2+}$ (C) $[MnCl_4]^{2-}$ (D) None of these

85. Which one is acidic auxochromic group?

(A) –OH   (B) $-NO_2$ (C) –OR   (D) $-NH_2$

86. Which group of compound does not involve the $\pi - \pi^*$ transitions in UV spectroscopy?

(A) Alkenes   (B) Azocompunds   (C) Alcohols   (D) Cyanides

87. Which one of the following is microwave inactive?

(A) HCl   (B) Cl_2 (C) NO   (D) CO

88. Which one is not used as radioactive isotopes for Mossbauer effect?

(A) Fe^{57} (B) Zn^{67} (C) Sn^{119} (D) P^{31}

89. The atomic weight percentage of carbon present in cast iron is above

(A) 0.14   (B) 0.74   (C) 1.14   (D) 2.14

90. The coalescence of powder particles under the influence of temperature to form a dense mass is known as

(A) Sintering   (B) Vitrification   (C) Pressing   (D) Casting

91. The temperature of the antiferromagnetic-to-paramagnetic transition is called

(A) Debye   (B) Neel

(C) Curie-Weiss   (D) Antiferromagnetic Curie

92. A form of failure that occurs in the structure when subjected to cycles of alternating stress is known as

(A) Impact   (B) Fracture toughness

(C) Fatigue   (D) Creep

93. The crystal structure of GaAs is

(A) Face centered cubic
(B) Body centered cubic
(C) Tetragonal
(D) Hexagonal

94. The reciprocal lattice of face centered cubic is

(A) Body centered cubic
(B) Face centered cubic
(C) Trigonal
(D) Orthorhombic

95. The density of states is maximum for a

(A) Quantum well
(B) Quantum box
(C) Quantum wire
(D) Quantum sheet

96. Quantum dots are useful for biotechnology applications in imaging. The property that is useful for this purpose is

(A) Absorption
(B) Luminescence
(C) Reflection
(D) Transmission

97. Hydrogen bonding is maximum in

(A) diethylether
(B) ethyl bromide
(C) triethyl amine
(D) acetic acid

98. Lathanides contraction relates to

(A) density
(B) valence electrons
(C) ionic radii
(D) nuclear masses

99. The EPR spectrum of Phenyl radical shows

(A) 6 lines
(B) 18 lines
(C) 24 lines
(D) 36 lines

100. Which of the following does not have a metal-metal bond

(A) $Mn_2(CO)_{10}$
(B) $K_2Re_2Cl_8$
(C) Hg_2Cl_2
(D) Al_2Cl_6