ENTRANCE EXAMINATION FOR ADMISSION, MAY 2012.

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 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. If θ lies in the first quadrant and cosθ = 8/17, then the value of cos(30+θ)+cos(45-θ)+cos(120-θ) is

(A) $\left(\dfrac{\sqrt{3}-1}{2}+\dfrac{1}{\sqrt{2}}\right)\dfrac{23}{17}$

(B) $\left(\dfrac{\sqrt{3}+1}{2}+\dfrac{1}{\sqrt{2}}\right)\dfrac{23}{17}$

(C) $\left(\dfrac{\sqrt{3}-1}{2}-\dfrac{1}{\sqrt{2}}\right)\dfrac{23}{17}$

(D) $\left(\dfrac{\sqrt{3}+1}{2}-\dfrac{1}{\sqrt{2}}\right)\dfrac{23}{17}$

2. sin47 + sin61 – sin 11 – sin 25 is equal to

(A) sin 36   (B) cos 36   (C) sin 7   (D) cos 7

3. $1-\cos^2\theta$ is equal to.

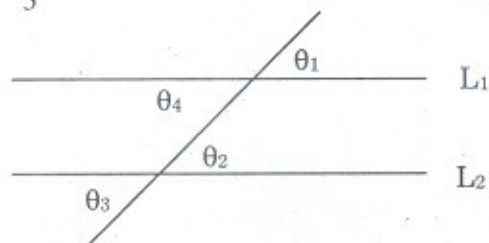(A) sinθ   (B) sin²θ   (C) cosθ   (D) cos²θ + 1

4. The distance between points P(4,1) and Q(2,1) is

(A) 0   (B) 2   (C) $\sqrt{6}$ (D) $\sqrt{2}$

5. If G(x,y) is the centroid of the triangle with vertices A(x_1,y_1), B(x_2,y_2) and C(x_3,y_3), then x is equal to

(A) $\dfrac{x^2}{2}$

(B) $\dfrac{x_1+x_2+x_3}{3}$

(C) $\dfrac{x_1^2+x_2^2+x_3^2}{3}$

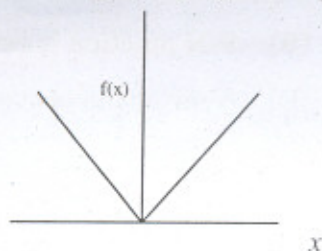(D) $\dfrac{x_1+x_2}{3}$

6.

If $\theta_1 = 30°$, then θ_3 equals to _____, if L1 and L2 are parallel lines.

(A) 30°   (B) 60°   (C) 90°   (D) 120°

7. The parametric equation of the parabola or the coordinates of any point on it are $x = at^2$ and what is y?

   (A) ½ at   (B) ½ a^2t (C) 2at   (D) ½ at^2

8. The function in the given graph is represented by

   (A) $y = mx + x$ (B) $y = x^2$ (C) $y = |x|$ (D) $y = x$

9. Projection of a vector A on vector B is

   (A) A.B   (B) A×B   (C) ∇A   (D) ∇.(A×B)

10. If a vector A is parallel to B then A×B is

    (A) 1   (B) −1   (C) ∞   (D) 0

11. A current carrying loop lying in a magnetic field behaves like a

    (A) Nonmagnetic material   (B) Magnetic dipole
    (C) Magnetic pole   (D) Magnetic material

12. The area under hysteresis loop is proportional to

    (A) Magnetic energy density   (B) Thermal energy per unit volume
    (C) Electrical energy per unit volume (D) Mechanical energy per unit volume

13. The energy emitted by a source is in the form of

    (A) Electrons   (B) Neutrons   (C) Photons   (D) Protons

14. If the elements with the principal quantum number n>3 do not exist in nature, the number of possible elements will be

    (A) 14   (B) 28   (C) 60   (D) 105

3

15. Transition from state n=4 to n=3 in a hydrogen like atom results in UV radiation. IR radiation will be obtained in the transition when

    (A) $2 \to 1$ (B) $3 \to 2$ (C) $4 \to 2$ (D) $5 \to 4$

16. Drift current is less than diffusion current in p-n junction. This means

    (A) P-N junction is forward biased   (B) P-N junction is reverse biased

    (C) P-N junction is unbiased   (D) None of the above

17. In a P-N junction diode the holes are due to

    (A) Neutrons   (B) Protons

    (C) Missing electrons   (D) Nucleus

18. The motion of the centre of mass of a system of two particles is unaffected by their internal forces

    (A) Irrespective of the actual directions of the internal forces

    (B) Only if they are along the line joining the particles

    (C) Only if they are at right angles to the line joining the particles

    (D) Only if they are obliquely inclined to the line joining the particles

19. A cylindrical tube, open at both ends, has a fundamental frequency n. if one of the end is closed, the fundamental frequency will become

    (A) 2n   (B) n   (C) n/2   (D) 4n

20. Choose the correct statement from the following

    (A) The average kinetic energy of a molecule of any gas is the same at the same temperature

    (B) The average kinetic energy of a molecule of a gas is dependent of its temperature

    (C) The average kinetic energy of 1g of any gas is the same at the same temperature

    (D) The average kinetic energy of 1g of any gas is independent of its temperature

21. In which of the following is the angle between two covalent bond is greatest?

    (A) NH_3 (B) H_2O (C) CH_4 (D) CO_2

22. Bond energy maximum in

    (A) O-O   (B) $C \equiv C$ (C) $C \equiv N$ (D) $N \equiv N$

23. The couple between base unit of DNA is through

    (A) Hydrogen bonding   (B) Electrostatic bonding
    (C) Covalent bonding   (D) Van der Waal's forces

24. Methanol and acetone can be separated by

    (A) Fractional distillation   (B) Distillation
    (C) Steam distillation   (D) Vacuum distillation

25. Two immiscible liquid are separated by

    (A) Separating funnel   (B) Fractional distillation
    (C) Chromatography   (D) Sublimation

26. Chromatography technique is used for separation of a

    (A) Small samples of mixtures   (B) Plant pigments
    (C) Dye stuffs   (D) All of the above

27. Silica gel is used for keeping away from moisture because it

    (A) Adsorbs water molecule   (B) Absorbs water molecule
    (C) React with water   (D) None of the above

28. Intermolecular hydrogen bonding is strogest in

    (A) Methylamine   (B) Phenol
    (C) Formaldehyde   (D) Methanol

29. Which one of the following does not have sp^2 hybridized carbon?

    (A) Acetone   (B) Acetic acid
    (C) Acetonitrile   (D) Acetamide

30. How will you separate solution of benzene + $CHCl_3$

    (A) Sublimation   (B) Filtration
    (C) Distillation   (D) Crystallisation

31. Hall-Petch equation is relation of yield strength to

   (A) Grain size   (B) Hardness

   (C) Fatique   (D) Fracture

32. The alloy duralumin is primarily used in _____ industry

   (A) Automobile   (B) Defence

   (C) Aircraft   (D) Chemical processing

33. Crevice corrosion occurs due to

   (A) Alloy formation   (B) Low melting point

   (C) Residual stress   (D) Deficiency in oxygen

34. Soft magnetic materials has

   (A) Low hysteresis losses and low eddy current losses

   (B) Low hysteresis losses and high eddy current losses

   (C) High hysteresis losses and low eddy current losses

   (D) High hysteresis losses and high eddy current losses

35. Burger's vector characterizes

   (A) Dislocation line (B) Space   (C) Fracture   (D) Hardness

36. Brass is an alloy of

   (A) Aluminium – Copper   (B) Copper – Zinc

   (C) Aluminium – Zinc   (D) Zinc – Copper – Aluminium

37. Gibb's phase rule states that

   (A) $F=C+P+2$ (B) $F=C-P+2$ (C) $F=C-P-2$ (D) $F=C+P-2$

38. Czochralski method is a

   (A) Crystal growth technique   (B) Welding technique

   (C) Forging technique   (D) X –ray analysis technique

39. Germanium is not preferred as semiconductor due to

    (A) Formation of water soluble oxide   (B) Lower band gap energy

    (C) Higher melting point   (D) Low junction leakage current

40. Diamond have high modules

    (A) Due to covalent bond   (B) Due to ionic bond

    (C) Due to alloy formation   (D) Due to ceramic nature

41. Pellagra can be prevented by treatment with

    (A) thiamine   (B) niacin   (C) pyridoxine   (D) vitamin B_{12}

42. A ring is absent in the chemical structure of which of the following vitamins or coenzymes

    (A) niacin   (B) tetrahydrofolic acid

    (C) cholecalciferol   (D) pantothenic acid

43. Pantothenic acid is a constituent of the coenzyme involved in

    (A) decarboxylation   (B) acetylation

    (C) dehydrogenation   (D) reduction

44. Biotin is involved in which of the following types of reactions?

    (A) Hydroxylations   (B) Decarboxylations

    (C) Carboxylations   (D) Dehydrations

45. Which of the following vitamins is the precursor of CoA?

    (A) Riboflavin   (B) Pantothenate

    (C) Thiamine   (D) Cobamide

46. In patients fed an equal amount (on a molar basis) of carbohydrates and fats, the respiratory quotient is

(A) 2.72   (B) 1.00   (C) 0.86   (D) 0.72

47. All the following descriptions of calcium are correct EXCEPT

(A) it diffuses as a divalent cation

(B) it is required as a cofactor for many reactions

(C) it freely diffuses across the endoplasmic reticulum of muscle cells

(D) it is most highly concentrated in bone

48. All the following enzymes or events play a major role in adipocytes EXCEPT

(A) lipolysis

(B) glycerol kinase

(C) hormone-sensitive triacylglyceride lipase

(D) glycolysis

49. The major source of extracellualar cholesterol for human tissues is

(A) very low-density lipoprotein (VLDL)

(B) low-density lipoprotein (LDL)

(C) high-density lipoprotein (HDL)

(D) albumin

50. Most major metabolic pathways are considered to be either mainly anabolic or catabolic. Which of the following pathways is most correctly considered to be amphibolic?

(A) Lipolysis   (B) Glycolysis

(C) β-oxidation of fatty acids   (D) Citric acid cycle
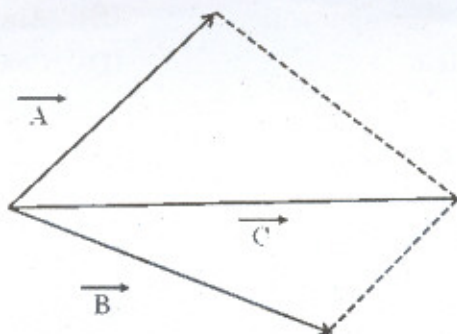
51. $\int \dfrac{dx}{x} = ?$

(A) e^x (B) e^{-x} (C) $\ln x$ (D) $\dfrac{1}{\log x}$

52. Find the value of $\vec{C}$

(A) $\overline{A}\Big/\overline{B}$ (B) $\overline{A} - \overline{B}$ (C) $\overline{A} + \overline{B}$ (D) $\overline{B}\Big/\overline{A}$

53. $\nabla \times \overline{A} = 0$ *then* $\overline{A}$ is

(A) Coplanar

(B) Collinear

(C) Divergent

(D) Irrotational

54. If $\nabla \overline{A} = 0$ *then* A is

(A) Null (B) ∞ (C) $-\infty$ (D) Constant

55. If $G = \{A,B,C,D,E\}$ is an Abelian group, then one of the following is true

(A) $AB = BA$ (B) $\dfrac{A}{B} = \dfrac{B}{A}$ (C) $AB = C^{-1}$ (D) $E = \infty$

56. If a matrix $A = \begin{pmatrix} 8 & X & 0 \\ 4 & 0 & 2 \\ 12 & 6 & 0 \end{pmatrix}$ is singular, then the value X is

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

57. The rank of a matrix $A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$ is
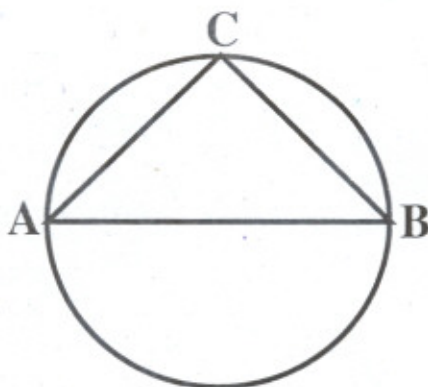
(A) 0   (B) 1   (C) 2   (D) 3

58. If A is a real square matrix, then AA^T is

(A) Unsymmetrical   (B) Always symmetric

(C) Skew symmetric   (D) Sometimes symmetric

59. If the vector $\overline{A}$ and $\overline{B}$ are orthogonal to each other

(A) $\overline{A} = \overline{B} = 0$ (B) $\overline{A} + \overline{B} = 0$ (C) $\overline{A} - \overline{B} = 0$ (D) $\overline{A}.\overline{B} = 0$

60. In this circle, where AB is the diameter, then $\lfloor ACB$ is

(A) Acute   (B) Obtuse   (C) 90^0 (D) 45^0

61. As one journeys along the magnetic equator, the angle of the dip will

(A) Increase

(B) Decrease

(C) Remain unchanged

(D) Increase or decrease depending on the direction of the journey

62. The frequency of the charge circulating at right angles to a uniform magnetic field does not depend upon

(A) The speed of the charge   (B) Mass of the charge

(C) Charge of the particle   (D) Magnetic field

63. The mass of a proton is 1847 times that of an electron. An electron and a proton are projected into a uniform electric field in a direction at right angles to the direction of the field with same initial kinetic energy. Then

(A) The electron trajectory will be less curved than the proton trajectory

(B) The proton trajectory will be less curved than the electron trajectory

(C) Both the trajectories will be equally curved

(D) None of the above

64. Monochromatic light is refracted from air into glass of refractive index n. The ratio of wavelengths of the incident and refracted waves is

(A) 1:1 (B) n (C) n:1 (D) n^2:1

65. Which one of the following phenomena cannot be explained by the wave theory of light?

(A) Refraction (B) Total internal reflection

(C) Diffraction (D) Photoelectric effect

66. In Young's double slit experiment, if the distance between the slits and the screen is doubled and the separation between the slits is reduced to half, the fringewidth

(A) Is doubled (B) Becomes four times

(C) Is halved (D) Remains unchanged

67. Two electron beams having velocities in the ratio of 1:2 are subjected separately to two identical magnetic fields. The ratio of deflection produced is

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

68. You are sitting in a room in which uniform magnetic field is present vertically downwards direction. When an electron is projected in horizontal direction, it will be moving in a circular path with constant speed

(A) Clockwise in the vertical plane

(B) Clockwise in the horizontal plane

(C) Anti-clockwise in the horizontal plane

(D) Anti-clockwise in the vertical plane

69. In a continuum spectrum the limiting frequency is

(A) Inversely proportional to the potential through which electrons have been accelerated

(B) Is directly proportional to the accelerating potential

(C) Not dependent upon the accelerating potential

(D) Is dependent upon the nature of the target material

70. Slow neutrons are incident on a sample of uranium containing both $_{92}U^{235}$ and $_{92}U^{238}$ isotopes. Then

(A) Both isotopes will undergo fission and break up

(B) Only $_{92}U^{235}$ atoms undergo fission

(C) Only $_{92}U^{238}$ atoms undergo fission

(D) Neither of the isotopes will undergo fission and break up

71. Boron behaves as a

(A) Metal

(B) Transition element

(C) Non-metal

(D) None of the above

72. Which one of the following statement regarding BF_3 is not correct?

(A) It is a Lewis acid

(B) It is an electron deficient compound

(C) It is an ionic compound

(D) It form adducts

73. The three states of matter are solid, liquid and gas which of the following statement is true about them?

(A) Gases and liquids have viscosity as a common property

(B) The molecules in all the three states process a random translational motion

(C) Gases cannot be converted into solids without passing through liquid phase

(D) Solids and liquids have pressure as a common property

74. Strong inter molecule forces exist in
   - (A) Gases
   - (B) Liquids
   - (C) Amorphous solids
   - (D) Crystalline solids

75. Association of molecules in water due to
   - (A) Covalent bonding
   - (B) Hydrogen bonding
   - (C) Ionic bonding
   - (D) Van der Wall's force

76. Normal boiling point of a liquid is that temperature at which vapour pressure of the liquid is equal to
   - (A) Zero
   - (B) 380 mm of Hg
   - (C) 760 mm of Hg
   - (D) 100 mm of Hg

77. If η_1 and η_2 are co-efficient of viscosities of the two liquids, d_1 and d_2 their densities and t_1 and t_2 the flow times in Ostwald viscometer, then
   - (A) $\eta_1/\eta_2 = d_1 * t_2/d_2 * t_1$
   - (B) $\eta_1/\eta_2 = d_2 * t_2/d_1 * t_1$
   - (C) $\eta_1/\eta_2 = d_1 * t_1/d_2 * t_2$
   - (D) $\eta_1/\eta_2 = d_2 * t_1/d_1 * t_2$

78. Which of the following expressions regarding the unit of co-efficient of viscosity is not true?
   - (A) Dyne cm^{-2} sec
   - (B) Dyne cm^2 sec^{-1}
   - (C) $N\ m^{-2}$ sec
   - (D) 1 poise= 10^{-1} $N\ m^{-2}$ sec

79. Which one is not the property of crystalline solid?
   - (A) Isotropic
   - (B) Sharp melting point
   - (C) A definite and regular geometry
   - (D) High intermolecular forces

80. Tetragonal crystal system has the following unit cell dimension
   - (A) $a=b=c$ and $\alpha=\beta=\gamma=90^\circ$
   - (B) $a=b\neq c$ and $\alpha=\beta=\gamma=90^\circ$
   - (C) $a\neq b\neq c$ and $\alpha=\beta=\gamma=90^\circ$
   - (D) $a=b\neq c$ and $\alpha=\beta=90$, $\gamma=120^\circ$

81. The crystal defect arising due to atoms missing from the proper atomic position is known as
   - (A) Frenkel defect
   - (B) Stacking fault
   - (C) Grain defect
   - (D) Schottky defect

82. X – Ray diffraction is useful for
    (A) Crystal structure determination
    (B) Bandgap energy measurement
    (C) Fluorescence
    (D) Calorimetric characterization

83. Pitting is related to
    (A) Thin film formation
    (B) Form of corrosion
    (C) Swelling in polymers
    (D) Energy density of fuel cell

84. Lithography is the
    (A) Fabrication of structures / devices
    (B) Colloid stabilization method
    (C) Printing technique
    (D) Scientific method

85. Zeta potential is related to
    (A) Galvanic corrosion
    (B) Surface charge
    (C) Electrophoretic effect
    (D) Bio molecular reaction

86. Carbon nanotubes are having ————— Character
    (A) Metallic
    (B) Semiconducting
    (C) Insulating
    (D) Metallic, semiconducting and insulating

87. Which is not the allotropic form of carbon among the following?
    (A) Diamond
    (B) Graphite
    (C) Fullerenes
    (D) Methane

88. Quantum dots have ————— confinement
    (A) Zero dimensional
    (B) One dimensional
    (C) Two Dimensional
    (D) Three dimensional

89. Moore's law is related to
    (A) Semiconductor
    (B) Metal
    (C) Polymers
    (D) Ceramics

90. The heat treatment carried out to decrease the grain size is known as
    (A) Normalizing
    (B) Full annealing
    (C) Spheriodizing
    (D) Hydroforming

91. The reactions of the urea cycle occur

    (A) in the cytosol

    (B) in the mitochondrial matrix

    (C) in the mitrochondrial matrix and the cytosol

    (D) only in cytosomes

92. Depletion of α-ketoglutarate during hyperammonemia leads to the formation of

    (A) glycine   (B) arginine   (C) proline   (D) glutamine

93. A solution of glutamic acid is titrated from pH 1.0 to 7.0 by the addition of 5 ml of a solution of 1M NaOH. What is the approximate number of millimoles of amino acid in the sample (pK_{a1} = 2.19, pK_{a2} = 4.25, pK_{a3} = 9.67)?

    (A) 1.5   (B) 3.0   (C) 12.0   (D) 18.0

94. Which of the following statements best describes the function of carnitine?

    (A) it transports medium-chain fatty acids into gut epithelial cells

    (B) it transports medium-chain fatty acids across the inner mitochondrial membrane

    (C) it is a derivative of vitamin A and is involved in adaptation of retina to darkness

    (D) it is a transacylationreactincatalyzed by a transferase.

95. The fatty acid synthetase complex

    (A) catalyzes six sequential enzymatic steps

    (B) catalyzes seven sequential enzymatic steps

    (C) catalyzes eight different enzymatic

    (D) it is composed of six different proteins

96. In the pathway leading to biosynthesis of acetoacetate from acetyl CoA in liver, the immediate precursor of acetoacetate is which of the following substances?

    (A) 3-Hydroxybutyrate

    (B) Acetoacetyl CoA

    (C) 3-Hydroxybutyryl CoA

    (D) 3-Hydroxy 3-methylglutaryl CoA

97. Which of the following intermediates can be isolated from yeast that is fermenting wine but not from healthy muscle?

(A) Acetyl CoA   (B) Lactate   (C) Acetaldehyde   (D) Citrate

98. The structure shown below is the mucopolysaccharide
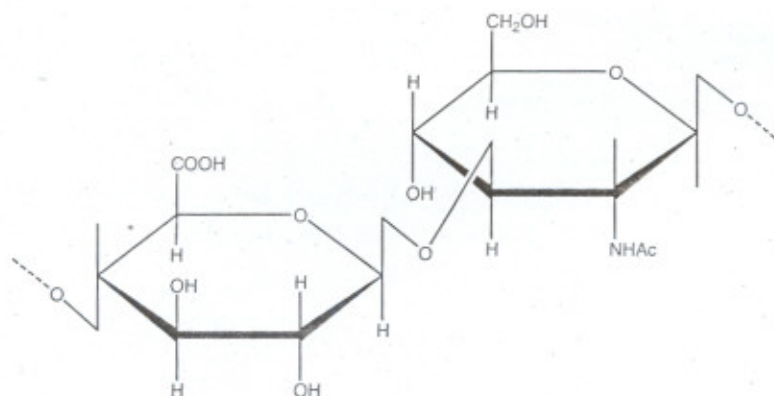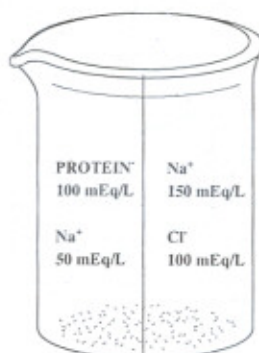

(A) chitin   (B) chondroitin sulfate
(C) heparin   (D) hyaluronic acid

99. In the Far East, beriberi is a serious health problem. It is characterized by neurologic and cardiac symptoms. Beriberi is caused by a deficiency of

(A) choline   (B) ethanolamine   (C) serine   (D) glycine

100. A theoretical nonequilibrium situation involving a membrane permeable only to sodium and chloride is shown below. According to the Donnan equilibrium, what will be the final concentration of chloride on the left?

(A) 0   (B) 25 mEq/L   (C) 33 mEq/L   (D) 50 mEq/L