C-43

ENTRANCE EXAMINATIONS 2023
Ph.D. (Nanoscience and Technology)

Marks: 70
Time: 2 h Hall Ticket No:

I. Write your Hall Ticket Number on the OMR Answer Sheet given to you. Also write the Hall Ticket Number in the Space provided above.
II. Read the following instructions carefully before answering the questions.
III. This Question paper has TWO parts: PART 'A' AND PART 'B'

1. Part 'A': It consists of 20 objective type questions of **1.75** marks each.
2. Part 'B: It consists of 35 objective questions of **1** mark each.
3. All questions are to be answered. Answers for these questions are to be entered on the OMR sheet, filling the appropriate circle against each question. For example, if the answer to a question is D, it should be marked as below:

No additional sheets will be provided. Rough work can be done in the question paper itself.

4. Hand over the OMR answer sheet at the end of the examination to the invigilator.

5. Mobile phones, log tables and calculators of any type are NOT permitted inside the Examination Hall.

6. This book contains 11 pages including this cover sheet.

C-43

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PART A

1. If the surface energy of each of the face of a cube is Υ, then total surface energy of the cube is
   A. 6Υ
   B. 4Υ
   C. 2Υ
   D. 0Υ

2. Quantum dots are
   A. Nanotubes
   B. Nanowires
   C. 2D nanomaterials
   D. 0D nanomaterials

3. Which of the following has the highest frequency in the electromagnetic spectrum?
   A. X-rays
   B. Gamma rays
   C. UV rays
   D. Radio waves

4. The attractive force binding the protons and neutrons in nucleus of an atom is known as
   A. Nuclear force
   B. Coulomb force
   C. Electromagnetic force
   D. Electromotive force

5. Which of the following colours has the highest wavelength?
   A. Blue
   B. Orange
   C. Green
   D. Red

6. Metals are transparent to
   A. UV
   B. Visible light
   C. X-ray
   D. Radio waves

7. The number that least fits this set: (324, 441, 97, and 64) is
   A. 324
   B. 441
   C. 97
   D. 64

8. If $x > y > 1$, which of the following must be true?
(i) $\ln x > \ln y$
(ii) $\exp(x) > \exp(y)$
(iii) $yx > xy$
(iv) $\cos x > \cos y$
   A. (i) and (ii)
   B. (i) and (iii)
   C. (iii) and (iv)
   D. (ii) and (iv)

9. From a circular sheet of paper of radius 30 cm, sector of 10% area is removed. If the remaining part is used to make a conical surface, then the ratio of the radius and height of the cone is
   A. $7:\sqrt{19}$
   B. $9:\sqrt{19}$
   C. $11:\sqrt{19}$
   D. $13:\sqrt{19}$

10. Which of the following is true about mass and weight?
   A. Mass is a vector quantity and weight is a scalar quantity
   B. Both are vector quantities
   C. Both are scalar quantities
   D. Mass is a scalar quantity and weight is a vector quantity

11. Which of the following is not true about viscosity?
   i. It is the property of a liquid by virtue of which it opposes relative motion of layers
   ii. It is not a property of gases
   iii. It decreases with increase in pressure
   iv. It is zero for an ideal fluid
   A. (i) and (ii) only
   B. (ii) and (iii) only
   C. (iii) and (iv) only
   D. (i) and (iv) only

12. If the distance between a Na ion and a Cl ion in NaCl crystal is 0.28 nm, then the lattice parameter of the crystal is
   A. 0.8 nm
   B. 0.56 nm
   C. 0.28 nm
   D. 0.14 nm

13. A 220 V, 100 W bulb is connected to 110 V source. What is the power consumed by the bulb in W?
    A. 10
    B. 15
    C. 20
    D. 25

14. A body of mass 20 kg is lying at rest. Under the action of a constant force, it gains speed of 7 m/s. The work done by the force will be
    A. 490 J
    B. 500 J
    C. 300 J
    D. 390 J

15. What is the force between two small charged spheres having charges of $2x10^{-7}$ C and $3x10^{-7}$ C placed 30 cm apart in the air?
    A. $6x10^{-6}$ N
    B. $6x10^{-3}$ N
    C. 0.6 N
    D. $5x10^{-6}$ N

16. In which manner heat capacity depends on temperature from 0 Kelvin to melting/boiling temperature?
    A. linear
    B. logarithmic
    C. exponential
    D. none of the above

17. Which of the following is an example for homogeneous mixture?
    A. Oil in water
    B. Salt in sulphur
    C. Sugar in water
    D. Sodium chloride in nickel powder

18. Heat involved in a phase change is
    A. Heat capacity
    B. Latent heat
    C. Entropy of transformation
    D. Disorderness

19. Which of the following properties are not concerned with plasticity?
    A. Ductility
    B. Toughness
    C. Resilience
    D. Tensile strength

C-43

20. Which of the following is not a property of metallic glasses?
    A. long range crystalline order
    B. short range crystalline order
    C. high viscosity
    D. high impact toughness

PART B

21. Two coins are tossed simultaneously. The probability (upto two decimal point accuracy) of getting at least one head is
    A. 0.71
    B. 0.75
    C. 0.72
    D. 0.77

22. When a monoatomic gas atom of radius R is placed in a uniform electric field E, the induced dipole moment is proportional to
    A. R^4
    B. R^2
    C. R^3
    D. R

23. For a given dielectric, as the temperature increases, the ionic polarizability
    A. decreases
    B. increases
    C. remains unaltered
    D. may decrease or increase with temperature

24. The mobility of charge carriers in an intrinsic semiconductor is proportional to
    A. $T^{1/2}$
    B. $T^{-3/2}$
    C. $T^{3/2}$
    D. T^{-2}

25. In an impurity semiconductor, donor impurity atoms
    A. add holes to the valence band
    B. remove electrons from the valence band
    C. add electrons to the conduction band
    D. add electrons to the valence band

26. The susceptibility of a diamagnetic material is essentially independent of temperature
    A. as long as the electronic structure is independent of temperature
    B. at very low temperature of the order of 10K
    C. at very high temperature
    D. under all circumstances

27. Interaction between the neighbouring dipoles is negligible in the case of
    A. ferrimagnetic materials
    B. diamagnetic materials
    C. paramagnetic materials
    D. antiferromagnetic materials

C-43

28. Curie's law predicts that the susceptibility
    A. is independent of the absolute temperature
    B. is inversely proportional to the absolute temperature
    C. is linearly proportional to the absolute temperature
    D. depends on the applied field

29. At Neel temperature
    A. susceptibility is maximum
    B. permeability is maximum
    C. susceptibility is minimum
    D. permeability is minimum

30. Surface plasmons effect is found in
    A. Metal nanoparticles
    B. Ceramic nanoparticles
    C. Polymer nanoparticles
    D. Ceramic 2D nanomaterials

31. Degeneracies of the energy level for a particle in one dimensional box for the quantum numbers n1=1, n2=2 and n3=2 is
    A. 1
    B. 2
    C. 3
    D. 0

32. When the grain size of a material decreases from micron to nano size, its melting point
    A. Decreases
    B. Increases
    C. Remains constant
    D. Decreases and then remains constant after a certain size

33. Which of the following characterization techniques involves estimation of the binding energy of the materials?
    A. Raman spectroscopy
    B. XPS
    C. FT IR
    D. XRD

34. The wavelength required to design an element of diameter scales as (scaling law)
    A. $\lambda \sim L$
    B. $\lambda \sim L^2$
    C. $\lambda \sim L^{-1}$
    D. $\lambda \sim L^{-2}$

35. Which of the following material deposition techniques involves plasma for the deposition of the material?
    A. Thermal evaporation
    B. Sputtering
    C. Sol-gel
    D. Co-precipitation

36. Which of the following is correct with regard to vapour pressure of a substance?
    A. The vapour pressure equals atmospheric pressure at melting temperature
    B. The vapour pressure equals atmospheric pressure at freezing temperature
    C. The vapour pressure is non zero at 80% of boiling temperature
    D. Vapour pressure is always equal to the atmospheric pressure

37. Which of the following techniques is used to determine particle sizes in the sub-nanometer range?
    A. Sieving
    B. X ray radiography
    C. Dynamic light scattering
    D. Sedimentation

38. The settling rate of particles in a viscous fluid is given by
    A. Reynolds number
    B. Charles law
    C. Newtons law
    D. Stokes law

39. An adsorption isotherm is a plot between ($\frac{x}{m}$=extent of adsorption) vs
    A. Pressure at constant volume
    B. Pressure at constant temperature
    C. Volume at constant temperature
    D. Number of moles at constant volume

40. Which method is widely used to determine the specific surface area of catalysts, adsorbents and porous materials?
    A. Gas adsorption
    B. Permeametry
    C. Pycnometry
    D. Mercury porosimetry

41. Which of the following phenomenon is characterized by the prompt emission of x-rays by an atom that has been ionized by a higher energy x-ray?
    A. Spontaneous emission
    B. Phosphorescence
    C. Fluorescence
    D. Luminescence

42. Which of the following is not a surface analytical technique?
    A. XPS
    B. TOF-SIMS
    C. AES
    D. XRF

43. Which of the following spectroscopic techniques uses a single crystal diffraction to detect characteristic wavelength emitted from the specimen?
    A. Energy dispersive
    B. Wavelength dispersive
    C. X-ray fluorescence
    D. X-ray photoelectron

44. Which one is the easy axis of magnetization in iron?
    A. <100>
    B. <111>
    C. <112>
    D. <110>

45. Which one of the following is not a second rank tensor?
    A. Pressure
    B. Stress
    C. Strain
    D. Thermal conductivity

46. BCC crystal has _____octahedral and _____ tetrahedral sites
    A. 6 and 12
    B. 4 and 8
    C. 2 and 12
    D. 8 and 16

47. In the FCC lattice, the close packed layers constitute the _____ planes.
    A. {111}
    B. {220}
    C. {110}
    D. {112}

48. A Schottky defect is
    A. Substitutional impurity
    B. Interstitial impurity
    C. Pair of nearby cation and anion vacancies
    D. Vacancy-interstitial pair of cations

49. The de Broglie wavelength (in m) of a 1 kg mass moving with a velocity of 1 m/s is
    A. Newtonian gravitational constant
    B. Josephson constant
    C. Plank's constant
    D. Boltzmann constant

50. Radiography is used to detect
    A. Line defect
    B. Point defect
    C. Stacking faults
    D. Surface and volume defects

51. When temperature increases, the energy bandgap of a semiconductor
    A. Decreases
    B. Does not change
    C. Increases
    D. Almost zero

52. The product of electron and hole concentration in an extrinsic semiconductor is
    A. Zero
    B. Independent of impurity concentration
    C. Infinity
    D. Dependent on impurity concentration

53. P-N junction diode that generates visible light in a process known as
    A. Photoconductivity
    B. Electroluminescence
    C. Breakdown
    D. Tunneling

54. Angle between two neighbouring tetrahedral bonds (in degrees) in Si having a diamond cubic structure is
    A. 102.5
    B. 109.5
    C. 120
    D. 135.5

55. The crystal structure of Pb is FCC and its atomic radius is 0.175 nm. The number of atoms (closest integer) per unit area in (100) plane is
    A. 8 nm^{-2}
    B. 10 nm^{-2}
    C. 12 nm^{-2}
    D. 14 nm^{-2}

University of Hyderabad

Ph.D. Entrance Examinations - 2023

School: School of Engineering Sciences and Technology

Course: Ph.D. Subject: Nano Science and Technology

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	A	26	A	51	A
2	D	27	C	52	B
3	B	28	B	53	B
4	A	29	A	54	B
5	D	30	A	55	A
6	C	31	C	56	
7	C	32	D	57	
8	A	33	**B**	58	
9	B	34	A	59	
10	D	35	B	60	
11	B	36	C	61	
12	**B**	37	C	62	
13	D	38	D	63	
14	A	39	B	64	
15	B	40	A	65	
16	D	41	C	66	
17	C	42	D	67	
18	B	43	B	68	
19	C	44	A	69	
20	A	45	A	70	
21	B	46	A		
22	B	47	A		
23	C	48	C		
24	B	49	C		
25	C	50	D		

Note/Remarks :

Signature 26/6/2023

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