D-5

# Entrance Examinations 2024

Ph.D. (Nano Science 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. Only non-programmable (only scientific) calculators are permitted inside the Examination Hall.

6. This book contains 12 pages including this cover sheet.

D-5

## PART A

1. An angle θ (radians), $0 < \theta < \pi/2$, which increases twice as fast as its sine is

   A. $\pi/2$
   B. $3\pi/2$
   C. $\pi/4$
   D. $\pi/3$

2. $\int_{\pi/4}^{3\pi/4} \frac{dx}{1+\cos x} =$

   A. -2
   B. 2
   C. 4
   D. -1

3. Figure out the odd statement about ceramics in the following

   A. good insulators of electricity
   B. good insulators of heat
   C. ductile in nature
   D. contains mostly ionic and covalent bonds

4. What is the diameter of the largest circle that can be inscribed within the rhombus formed from the midpoint of a unit square?

   A. $1/(2\sqrt{2})$
   B. $1/\sqrt{2}$
   C. $2\sqrt{2}$
   D. $\sqrt{2}$

5. The magnitude of drift velocity for unit electric field is

   A. electrical conductivity
   B. electrical resistivity
   C. electric potential
   D. mobility of charge carriers

6. How many grams of $H_2SO_4$ are present in 0.25 moles of $H_2SO_4$ ?

   A. 2.45g
   B. 24.5g
   C. 0.245g
   D. 0.25g

7. In a certain code 'GONE' is written as 5 % 2 # and 'MEDAL' is written as 4 # 3 $ @ then how will 'GOLD' be written in that code?
   A. 5 @ % 3
   B. 5 % @ 3
   C. 5 # @ 3
   D. 5 % # 3

8. When white visible light passes through hydrogen gas and is then converted to a spectrum of colors, the spectrum will contain
   A. wavelengths or colors that are generated by hydrogen
   B. wavelengths or colors that are diffracted by hydrogen
   C. missing wavelengths or colors that are absorbed by hydrogen
   D. wavelengths or colors that are refracted by hydrogen

9. The change in the internal energy of the ideal gas is directly proportional to
   A. change in volume
   B. change in pressure
   C. change in temperature
   D. change in density

10. For the emission of characteristic X-rays from the K-shell of an element, the incident energy should be
   A. less than the corresponding ionization potential
   B. greater than the corresponding ionization potential
   C. greater than the bond energy
   D. less than the bond energy

11. Phase diagram of $H_2O$ shows
   A. stable phases
   B. metastable states
   C. the effect of pressure and composition on the state
   D. the effect of composition and temperature on the state

12. A firm is hiring to fill four vacancies. The candidates are five men and three women. If every candidate is equally likely to be chosen then the probability that at least one woman will be selected is _____ (round off to 2 decimal places).
   A. 0.93
   B. 0.78
   C. 0.55
   D. 0.67

13. The average of the annual salaries of A, B and S is ₹ 400000. The average of the annual salaries of B, S and B is ₹ 500000. The annual salary of B is ₹ 600000. What is the annual salary of A as a percentage of the annual salary of B?
    A. 50%
    B. 100%
    C. 75%
    D. 125%

14. A stone can be thrown up to a maximum height of 10m. What is the maximum horizontal distance it can be thrown under similar conditions?
    A. $20\sqrt{2}$ m
    B. 10 m
    C. $10\sqrt{2}$ m
    D. 20 m

15. Which of the following quantity is zero when a uniform object is supported at its centre of gravity under no external force?
    A. weight
    B. mass
    C. moment
    D. force

16. The addition of 4.523, 2.3 and 6.24 will have significant figures of
    A. two
    B. three
    C. four
    D. five

17. The total number of electrons present in 18mL of water (density of water is 1g/mL) is
    A. $6.02 \times 10^{23}$
    B. $6.02 \times 10^{24}$
    C. $6.02 \times 10^{25}$
    D. $6.02 \times 10^{26}$

18. Surface area per gram of the adsorbent is called
    A. molar surface area
    B. normal surface area
    C. specific surface area
    D. equivalent surface area

19. The elastic scattering of photons is called as _____

A. atmospheric scattering
B. Rayleigh scattering
C. conserved scattering
D. Raman Scattering

20. Multiplication of real-valued square matrices of the same dimension is

A. commutative
B. not always possible to compute
C. always positive definite
D. associative

## PART B

21. The Raman spectroscopy can be used to determine

A. band gap
B. chemical composition
C. crystal structure
D. nature of chemical bond

22. The SI unit of dielectric strength is

A. $N/m^2$
B. $V/m^2$
C. V/m
D. C/m

23. The property that relates the magnetic flux density to the magnetic field strength is

A. permittivity
B. inductance
C. capacitance
D. permeability

24. Which one of the following properties can be extracted using UV photoelectron spectroscopy?

A. work function
B. refractive index
C. magnetic permeability
D. dielectric constant

25. Cross linking of polymers

A. significantly decreases glass transition temperature
B. mildly decreases glass transition temperature
C. increases glass transition temperature
D. does not affect glass transition temperature

26. On which surface can a circular dislocation loop with an edge character (all around the loop) glide?

A. cylindrical surface
B. cuboidal surface
C. pyramidal surface
D. prismatic surface

27. If the homologous temperature of a material is doubled, then the equilibrium vacancy concentration per atom
    A. increases by a factor of 2
    B. decreases by a factor of 2
    C. remains constant
    D. cannot be computed with the provided information

28. Which of the following statements is true for Scanning Electron Microscopy
    A. as working distance increases, resolution increases
    B. as working distance decreases, resolution increases
    C. as working distance decreases, depth of field increases
    D. as working distance changes, depth of field remains unaltered

29. Which one of the following statements is correct regarding the electrical resistivity of metallic nanostructured materials
    A. electrical resistivity increases with decreasing grain size
    B. electrical resistivity significantly decreases with decreasing grain size
    C. electrical resistivity is independent of grain size
    D. electrical resistivity nominally decreases with decreasing grain size

30. Which of the following statements is correct
    A. 2D pentagonal lattice is not possible because the interior angle in a regular pentagon is $108^0$
    B. 2D pentagonal lattice is not possible because the interior angle in a regular pentagon is $120^0$
    C. 2D pentagonal lattice is possible because the interior angle in a regular pentagon is $108^0$
    D. 2D pentagonal lattice is possible because the interior angle in a regular pentagon is $90^0$

31. The relationship between kinetic energy contained in each molecule of an ideal gas and absolute temperature includes
    A. Planck's constant
    B. Avogadro number
    C. Boltzmann constant
    D. universal gas constant

32. Zener breakdown in semiconductor diode occurs when
    A. forward current exceeds the threshold value
    B. reverse bias exceeds the threshold value
    C. forward bias exceeds the threshold value
    D. potential barrier is reduced

33. Fine grain sizes are obtained by
    A. decreasing nucleation rate
    B. increasing cooling rate
    C. decreasing undercooling
    D. all of the above

34. Most metallic nanostructured materials possess
    A. higher strength and higher ductility
    B. lower strength and higher ductility
    C. higher strength and lower ductility
    D. lower strength and lower ductility

35. According to Kirkendall effect, in a binary solution of A and B
    A. the lower melting component diffuses much faster than the higher melting component
    B. the lower melting component diffuses much slower than the higher melting component
    C. the lower melting component shall not diffuse
    D. the higher melting component diffuses much faster than the lower melting component

36. A tensile load of 200 N is applied to a fiber reinforced metal matrix composite of 1 $mm^2$ cross-sectional area. The volume fraction of fibers parallel to the loading direction is 0.35. What is the stress on the fibers, when the applied load is perpendicular to the fibers?
    A. 200 MPa
    B. 100 MPa
    C. 70 MPa
    D. 700 MPa

37. The efficiency of the Carnot engine depends solely on
    A. heat supplied by source/ Heat supplied by the sink
    B. temperature of the sink/ Temperature of the source
    C. temperature of the source
    D. temperature of the sink

38. A monochromatic light is incident at an angle of $60^0$ to the surface normal of a material in air. The refracted light beam travels through the material at an angle of $30^0$ with respect to the normal to the surface. What is the refractive index of the material?
    A. $\sqrt{3}$
    B. 2
    C. ½
    D. $1/\sqrt{3}$

39. Heat required to raise the temperature of 1 mole of a substance by $1^0C$ is called
    A. specific heat
    B. molar heat capacity
    C. water equivalent
    D. specific gravity

40. Which type of molecules form micelles
    A. any non-polar molecules
    B. any polar molecules
    C. surfactant molecules
    D. salt of weak acid and weak base

41. Similar chemical properties can be expected from which pair of atomic numbers
    A. 13,22
    B. 3,11
    C. 4,24
    D. 2,4

42. The oxide of an element whose electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^1$
    A. neutral
    B. amphoteric
    C. basic
    D. acidic

43. The maximum number of isomers for an alkene with the molecular formula $C_4H_8$ is
    A. 2
    B. 3
    C. 4
    D. 5

44. Pristine Graphene has a bandgap of
    A. zero eV
    B. between 1 and 2eV
    C. more than 3eV
    D. between 2 and 3 eV

45. Lithography is not a process to fabricate
    A. solar cells
    B. sensors
    C. MOSFET
    D. alloys

46. Which of the following is used to measure the chemical composition of the nanomaterials
    A. Raman spectroscopy
    B. X-ray Diffraction
    C. Energy Dispersive Spectroscopy
    D. UV spectroscopy

47. Which of the following is not a semiconductor material
    A. ZnS
    B. GaAs
    C. ZnO
    D. $Fe_2O_3$

48. What is the primary purpose of applying a negative bias to the substrate in a sputter deposition
    A. to increase the temperature of the substrate
    B. to attract positively charged ions to enhance the film's adhesion and density
    C. to repel neutral atoms, preventing contamination
    D. to reduce the deposition rate

49. The primary function of a reducing agent in metallic nanomaterials synthesis is to
    A. act as a solvent for the reaction
    B. donate electrons to the metal ions
    C. accept electrons from the metal ions
    D. increase the temperature of the reaction mixture

50. The Fermi energy of the electron (n= density of free electrons) at 0 K is inversely proportional to
    A. $n^2$
    B. $n^{2/3}$
    C. n
    D. $n^{-2/3}$

51. The magnetization (M) of a solid is related to its magnetic induction (B) and the field strength(H) by the equation
    A. $B= \mu_0 H + M$
    B. $B= \mu_0 H - M$
    C. $B= \mu_0 M + H$
    D. $M= B/\mu_0 - H$

52. The spontaneous polarization is due to
    A. ionized electrons
    B. free electrons
    C. permanent dipoles
    D. electric field

53. An electric motor of power rating 300W is used to drive the stirrer in a water bath. If 50% of its energy supplied to the motor is utilized in stirring the water, without any other losses, then the work done on the water in 25 min is
    A. 0.225 kJ
    B. 2.25 kJ
    C. 22.5 kJ
    D. 225 kJ

54. The purpose of FT IR (Fourier Transform Infrared Spectroscopy) is to study
    A. chemical groups present in the sample
    B. crystal structure of the sample
    C. composition of the sample
    D. roughness of the sample

55. In a semiconductor a bound electron-hole pair is called an exciton, which can be produced by
    A. a phonon having an energy greater than that of the band gap of the material
    B. a phonon having an energy lower than that of the band gap of the material
    C. a phonon having an energy equal to that of the band gap of the material
    D. a phonon having any energy since it does not depend on the band gap of the material

# University of Hyderabad

## Entrance Examinations - 2024

## Ph.D. Admissions – January 2025 session

## Revised Final key (after challenges)

**Course : Ph.D.** **Subject : Nanoscience Technology(D5)**

| Q.No. | Answer | Q.No. | Answer | Q.No. | Answer |
|---|---|---|---|---|---|
| 1 | D | 26 | A | 51 | D |
| 2 | B | 27 | D | 52 | C |
| 3 | C | 28 | B | 53 | D |
| 4 | B | 29 | A | 54 | A |
| 5 | D | 30 | A | 55 | A |
| 6 | B | 31 | C | | |
| 7 | B | 32 | B | | |
| 8 | C | 33 | B | | |
| 9 | C | 34 | C | | |
| 10 | B | 35 | A | | |
| 11 | A | 36 | A | | |
| 12 | A | 37 | B | | |
| 13 | A | 38 | A | | |
| 14 | D | 39 | B | | |
| 15 | C | 40 | C | | |
| 16 | B | 41 | B | | |
| 17 | B | 42 | C | | |
| 18 | C | 43 | C | | |
| 19 | B | 44 | A | | |
| 20 | D | 45 | D | | |
| 21 | D | 46 | C | | |
| 22 | C | 47 | D | | |
| 23 | D | 48 | B | | |
| 24 | A | 49 | B | | |
| 25 | C | 50 | D | | |

Note/Remarks : 8-4 - Option 'B' is Correct.

J P Gautam

**Signature**
**School/Department/Centre**