

# ENTRANCE EXAMINATION – 2019

## M.Tech. (Nanoscience and Technology)

Marks: 70

Time: 2.00 hrs

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 questions of 1 mark each.  
There is a negative marking of 0.33 marks for every wrong answer.
2. Part 'B': It consists of 25 questions of 2 marks each with no negative marking.
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 to the invigilator at the end of the examination
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.

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**PART A**

1. What is the process of heating the water under atmospheric pressure?
  - A. isobaric process
  - B. adiabatic process
  - C. isothermal process
  - D. isochoric process
  
2. If 9 V is supplied to a Si diode and a 270  $\Omega$  resistor connected in series, then the voltage drop across the Si diode is
  - A. 0.7 V
  - B. 1.1 eV
  - C. 1.1 V
  - D. 0.7 eV
  
3. If  $\theta$  is the angle of diffraction and  $\lambda$  is the wavelength of the incident light, then the dispersion of a typical optical diffraction grating is
  - A.  $\cot\theta/\lambda$
  - B.  $\sin\theta/\lambda$
  - C.  $\cos\theta/\lambda$
  - D.  $\tan\theta/\lambda$
  
4. The threshold wavelength for photoelectric emission from a material is 520 nm. Photoelectrons will be emitted from the material if the incident monochromatic radiation is most probably from
  - A. an infrared lamp
  - B. a source of wavelength 620 nm
  - C. an UV source
  - D. a microwave source

5. The uncertainty in the position of an electron confined to an atom of radius,  $r$ , is

- A. just greater than  $r$
- B. far greater than  $r$
- C. just greater than  $r^2$
- D. less than  $r$

6. The wavelength that can be associated with a body of mass 1 kg moving with a velocity 0.5 m/sec is ( $h$  = Planck's constant)

- A.  $(\frac{1}{2})h$  meters
- B.  $h^2$  meters
- C.  $h^{1/2}$  meters
- D.  $2h$  meters

7. At any junction in an electrical circuit, the algebraic sum of the currents

- A. must be equal to -1
- B. must be equal to 1
- C. is always positive but not necessarily equal to 1
- D. must be equal to 0

8. An ideal Voltmeter has

- A. an infinite resistance
- B. a resistance just greater than that of all of the circuit elements
- C. a resistance exactly equal to the total resistance offered by all of the circuit elements
- D. a resistance lesser than that of all of the circuit elements

9. If  $\Psi(x,y,z,t)$  is the wave function associated with a moving body then the probability of experimentally finding the body at the point  $(x,y,z)$  at the time  $t$  is proportional to

- A.  $|\Psi|$  at  $t$
- B.  $|\Psi|^3$  at  $t$
- C.  $|\Psi|^2$  at  $t$
- D.  $|\Psi|^4$  at  $t$

10. Which of the following represents the state of highest symmetry
- A. Amorphous solid
  - B. Simple cubic crystal structure
  - C. Quasicrystal
  - D. Triclinic crystal structure
11. Heat of a chemical reaction is dependent on
- A. only pressure
  - B. only temperature
  - C. neither temperature nor pressure
  - D. both temperature and pressure
12. Work done by a system
- A. is the state description of the system
  - B. is a path function
  - C. is the thermodynamic property of the system
  - D. is a point function
13. At what angle of projection, the range of projectile attains maximum?
- A.  $75^\circ$
  - B.  $55^\circ$
  - C.  $65^\circ$
  - D.  $45^\circ$
14. If  $n$  is the number of the shells in an atom, then the maximum number of electrons the shell can accommodate is
- A.  $2n^2$
  - B.  $n^2$
  - C.  $2n$
  - D.  $n^2/2$
15. If  $d$  is the diameter of a ball mill, then the power required to drive it with a particular ball load varies proportionally as
- A.  $d^{1/5}$
  - B.  $d^{2/5}$
  - C.  $d^{1/2}$
  - D.  $d^{5/2}$

16. Chemisorption (chemical adsorption) is
- A. Hydrogen bonding
  - B. Van der Waals bonding
  - C. reversible
  - D. irreversible
17. A reduction in grain size of an alloy is not beneficial for enhancing the alloy's
- A. fatigue strength
  - B. creep strength
  - C. ultimate tensile strength
  - D. toughness
18. The deeply seated macro defects in thick components could be detected by
- A. magnetic particle inspection
  - B. eddy current testing
  - C. ultrasonic testing
  - D. liquid penetrant inspection
19. If the size of a spherical Au particle decreases from micron scale to nano scale, then its
- A. melting point as well as surface energy increase
  - B. melting point decreases and surface energy increases
  - C. melting point as well as surface energy decrease
  - D. melting point increases and surface energy decreases
20. Which of the laws of thermodynamics leads to the concept of entropy?
- A. third law of thermodynamics
  - B. first law of thermodynamics
  - C. second law of thermodynamics
  - D. zeroth law of thermodynamics

**PART B**

21. Two equal negative charges  $-q$  are fixed at points  $(0, -a)$  and  $(0, a)$  on the Y-axis. If a charge  $Q$  is released from rest at the point  $(2a, 0)$  on the X-axis, it will
- A. execute oscillations but not simple harmonic motion
  - B. execute simple harmonic motion about the origin
  - C. move to the origin and remain at rest
  - D. move to infinity along X-axis
22. What is the order of temperature at which the average molecular kinetic energy of gaseous hydrogen is equal to the binding energy of hydrogen atom in gaseous hydrogen?
- A.  $\sim 10^2$  K
  - B.  $\sim 10^3$  K
  - C.  $\sim 10^4$  K
  - D.  $\sim 10^5$  K
23. If a radiation wavelength of  $1 \text{ \AA}$  is incident on a diffraction grating with  $1 \text{ \AA}$  as the distance between the rulings in the grating, the first order maximum occurs at
- A.  $\sin^{-1}(1)$
  - B.  $\sin^{-1}(1/2)$
  - C.  $\sin^{-1}(2)$
  - D.  $\sin^{-1}(0.33)$
24. When ionic crystals are subjected to a very high frequency ( $> 10^{13}/\text{sec}$ ) external electric field:
- A. only ions can move with the electric field oscillations
  - B. only electron distribution is affected
  - C. both ions and electron distribution are affected
  - D. both ions and electron distribution are not affected
25. If a charged particle is released from rest in a region of steady and uniform electric and magnetic fields that are parallel to each other, then the particle will move in a
- A. cycloid path
  - B. circular path
  - C. helical path
  - D. straight line

26. If a metal rod with a Young's modulus of 200 GPa is pulled in tension under a stress of 200 MPa, then what is the elastic strain that is recovered when the rod is completely unloaded?

- A. 0.1%
- B. 1%
- C. 0.2%
- D. 2%

27. What is the angle between the crystallographic directions [111] and [11-2] in a cubic crystal?

- A. 0°
- B. 45°
- C. 90°
- D. 180°

28. When an elastic body is strained within in its elastic limit, it stores energy called as

- A. impact energy
- B. proof resilience
- C. strain energy
- D. resilience

29. Which of the following describes the photocatalytic mechanism of  $\text{TiO}_2$

- A.  $\text{TiO}_2 + \text{UV} \rightarrow \text{h}^+ + \text{e}^-$ ;  $\text{H}_2\text{O} + \text{h}^+ \rightarrow \text{H}^+ + \text{OH}^-$ ;  $\text{e}^- + \text{O}_2 \rightarrow \text{O}_2^-$
- B.  $\text{TiO}_2 + \text{UV} \rightarrow \text{h}^+ + \text{e}^-$ ;  $\text{H}_2\text{O} + \text{e}^- \rightarrow \text{H}^+ + \text{OH}^-$ ;  $\text{O}_2 + \text{h}^+ \rightarrow \text{O}_2^+$
- C.  $\text{TiO}_2 + \text{Vis. light} \rightarrow \text{h}^+ + \text{e}^-$ ;  $\text{H}_2\text{O} + \text{e}^- \rightarrow \text{H}^+ + \text{OH}^-$ ;  $\text{O}_2 + \text{h}^+ \rightarrow \text{O}_2^+$
- D.  $\text{TiO}_2 + \text{Vis. light} \rightarrow \text{h}^+ + \text{e}^-$ ;  $\text{H}_2\text{O} + \text{h}^+ \rightarrow \text{H}^+ + \text{OH}^-$ ;  $\text{e}^- + \text{O}_2 \rightarrow \text{O}_2^-$

30. The monomer of poly vinyl chloride (PVC) is

- A. ethylene dichloride
- B. chloroethene
- C. ethylene chloride
- D. chloroform



31. The range of molecular weights of typical plastics is
- A.  $10^8$ - $10^{10}$
  - B. 6000-10000
  - C. 20000-25000
  - D. 1000-5000
32. In a typical equation of the form  $y = A \sin(kx - \omega t)$ ,  $y$  cannot represent
- A. a magnetic field
  - B. an electric field
  - C. pressure
  - D. optical absorption
33. If a current,  $I$ , flows along the length of an infinitely long straight thin-walled pipe, then
- A. the magnetic field at all points inside the pipe is the same, but not zero
  - B. the magnetic field at all points inside the pipe is zero
  - C. the magnetic field is zero only along the axis of the pipe
  - D. the magnetic field is different at different points inside the pipe
34. At the triple point of water, what is the number of degrees of freedom?
- A. 3
  - B. 2
  - C. 1
  - D. 0
35. At any point on the inversion curve, Joule-Thomson co-efficient is always
- A. positive
  - B. zero
  - C. negative
  - D. infinity
36. For a given ceramic sample, if the lengths of the internal cracks in two different conditions are,  $a_1 = 0.5 \mu\text{m}$  and  $a_2 = 4.5 \mu\text{m}$ , then the ratio  $(\sigma_2/\sigma_1)$  of the fracture strengths is
- A.  $(1/3)^{1/2}$
  - B. 3
  - C.  $(1/3)$
  - D.  $(3)^{1/2}$

37. If  $t_f$  is the time to failure,  $T$  is the temperature and  $C$  is a material's constant, then Larson-Miller Parameter (L.M.) is given by

- A. L.M. =  $T \{\log t_f + C\}$
- B. L.M. =  $t_f [\log T + C]$
- C. L.M. =  $C [\log t_f + T]$
- D. L.M. =  $C [\log T + t_f]$

38. If  $V$ ,  $T$ ,  $P$ ,  $S$  and  $U$  represent Volume, Temperature, Pressure, Entropy and Internal energy respectively, then the combination of first and second laws of thermodynamics results in which one of the following relations

- A.  $dU = TdS - PdV$
- B.  $dS = TdU - PdV$
- C.  $dV = TdS - PdU$
- D.  $dU = PdS - TdV$

39. Which one of the following is not a refractory metal?

- A. W
- B. Ti
- C. Ta
- D. Mo

40. In a steady state diffusion process, the rate of accumulation is

- A. positive but not equal to one
- B. negative
- C. zero
- D. one

41. If  $T$  is the temperature and  $D$  is the diffusion co-efficient, then the activation energy required for the given diffusion process is estimated using which one of the following plots?

- A.  $\ln D$  versus  $1/T$
- B.  $\ln T$  versus  $1/D$
- C.  $\ln (1/T)$  versus  $D$
- D.  $\ln (1/T)$  versus  $\ln (1/D)$

42. Which one of the following is the fusion welding process?

- A. friction welding
- B. electron beam welding
- C. friction stir welding
- D. resistance welding

43. Which of the following attempts to relate the macroscopic properties of an assembly of particles to the microscopic properties of particles themselves?

- A. Quantum mechanics
- B. Classical mechanics
- C. Wave mechanics
- D. Statistical mechanics

44. Discrete NaCl molecules are found only in sodium chloride vapor because

- A. cohesive energy in crystalline NaCl is far greater than the bond energy in molecular NaCl
- B. cohesive energy in crystalline NaCl is equal to the bond energy in molecular NaCl
- C. cohesive energy in crystalline NaCl is far lesser than the bond energy in molecular NaCl
- D. cohesive energy in crystalline NaCl is just lesser than the bond energy in molecular NaCl

45. The presence of As as an impurity in Si crystal leads to

- A. donor levels close to the valence band of Si
- B. donor levels close to the conduction band of Si
- C. acceptor levels close to the valence band of Si
- D. acceptor levels close to the conduction band of Si

# University of Hyderabad

## Entrance Examinations - 2019

School/Department/Centre : School of Engineering Sciences and Technology

Course/Subject : M.Tech. (Nanoscience and Technology)

| Question Number | Answer | Question Number | Answer |
|-----------------|--------|-----------------|--------|
| 1.              | A      | 24.             | B      |
| 2.              | A      | 25.             | D      |
| 3.              | D      | 26.             | A      |
| 4.              | C      | 27.             | C      |
| 5.              | D      | 28.             | C      |
| 6.              | D      | 29.             | A      |
| 7.              | D      | 30.             | B      |
| 8.              | A      | 31.             | C      |
| 9.              | C      | 32.             | D      |
| 10.             | B      | 33.             | B      |
| 11.             | D      | 34.             | D      |
| 12.             | B      | 35.             | B      |
| 13.             | D      | 36.             | C      |
| 14.             | A      | 37.             | A      |
| 15.             | D      | 38.             | A      |
| 16.             | D      | 39.             | B      |
| 17.             | B      | 40.             | C      |
| 18.             | C      | 41.             | A      |
| 19.             | B      | 42.             | B      |
| 20.             | C      | 43.             | D      |
| 21.             | A      | 44.             | A      |
| 22.             | D      | 45.             | B      |
| 23.             | A      |                 |        |