M.Tech.(Material Science & Technology)

1. Which of the following is not an allotrope of carbon

A) Diamond B) Graphite
C) Dendrimer D) Carbon nanotube

2. Which of the following cubic cell has minimum packing fraction

A) Simple Cubic Cell B) Body Centre Cubic Cell
C) Face Centre Cubic Cell D) Hexagonal Cubic Cell

3. Residual resistivity in metals owes its origin due to

A) Zero point energy of free electron gas.
B) Presence of impurities/vacancies and defects in the metal crystal
C) Different modes of lattice vibration in metal crystals.
D) Minimum scattering of free electrons in metal crystals.

4. The pure semiconductor having highly –ve temperature coefficient of resistivity are

A) Thermistor B) Conductor C) Insulator D) Transistor

5. In the polycrystalline structures, the grain boundaries are not characterised by property that

A) Atomic packing is loose
B) Prone to diffusion and chemical activity
C) Form cleavage surfaces in the crystals
D) The mechanical strength is maximum

6. The number of four-fold rotation axes in a cubic unit cell are

A) 7 B) 9 C) 3 D) 5

7. Which of the following information about crystal is not yielded by X-ray diffraction studies:

A) Dimensions of unit cell of the crystal
B) Shape of the unit cell of the crystal
C) Symmetries observed by the crystal
D) Atoms or molecules or group of atoms occupying lattice positions

8. Silver has FCC structure. If inter-atomic separation between atoms 0.288nm then lattice constant is

A) 0.204nm B) 0.408nm C) 0.144nm D) 10nm

9. The spacing between the principal planes of a crystal is $0.2nm$. It is found that the first order Bragg reflection of a beam of monochromatic x-rays occurs at an angle of 30^{o}, then the wavelength of x-rays is:

A) 0.05nm B) 0.1nm C) 0.2nm D) 0.4nm

10. Which of these is not a ferroelectric material

A) Rochelle salt B) Potassium Diphosphate
C) $SrTiO_3$ D) Quartz.

11. Which of the following are temperature independent
A) Ferromagnetism B) Paramagnetism C) Ferrimagnetism D) Diamagnetism

12. Which is not true about effective mass of electron in a crystal:
A) It is positive within the allowed energy regions
B) It is zero at the topmost level of band
C) It is negative in the forbidden zone
D Always remains positive

13. Which of the following phenomena indicate the onset of superconductivity
A) Very high electric resistance and high thermal conductivity
B) Nearly zero electric resistance and perfect diamagnetic nature.
C) Very low specific heat and high bend gap energy.
D) Very high specific heat and low electric resistance.

14. Electric resistance of a metal owes its origin to
A) Lattice vibration of ions.
B) Scattering of conduction electrons.
C) Trapping of electrons in the vacant site of crystal
D) Recombination of free electrons with ions on regular sites in kernel.

15. At very high frequency of alteration of electric field applied on a dielectric medium, the insulating nature is observed only if
A) Electronic polarizability is non-vanishing.
B) Ionic polarizability vanishes.
C) All the three polarizabilities vanish.
D) Dipolar polarizability vanishes.

16. In the polycrystalline structures, the grain boundaries are not characterised by the property that
A) Atomic packing is loose.
B) Prone to diffusion and chemical activity.
C) Form cleavage surfaces in the crystals.
D) The mechanical strength is maximum.

17. Two consecutive planes having Millers indices (034) and lattice constants a=b=c=10nm are separated by distance of
A) 2.8nm B) 3.2nm C) 3nm D) 2nm

18. Which of the following is not an ionic defect
A) Frankel defect B) Schottky defect C) Color Centre D) Screw dislocation

19. The tensile strength of metals is much less than theoretically prediction because
A) Most of the metals have dislocations induced in them.
B) Most metals are extractable in pure form.
C) Point defects reduce the actual strength.
D) Point defects enhance mechanical strength.

20. The interference differs from diffraction
A) It can be observed with white light
B) Unlike diffraction, the interference fringes are of varying intensity
C) Interference minima are completely dark and that of diffraction are not
D) The diffraction fringes are of equal width

21. If the Fermi energy of silver at 0K is 5eV, the mean energy of electron in silver at 0K is
A) 5 eV B) 7.5 eV C) 12 eV D) 3 eV

22. The amplitude (E) of the light waves and the distance(x) from the source are related as
A) $E \propto x^{-2}$ B) $E \propto x^{-1}$ C) $E \propto x$ D) $E \propto x^{2}$

23. In metals which of the equation will hold good?
A) $\vec{\nabla} \times \vec{H} = \vec{J}$ B) $\vec{\nabla} \times \vec{H} = \vec{D}$ C) $\vec{\nabla} \times \vec{H} = \frac{\partial \vec{D}}{\partial t}$ D) $\vec{\nabla} \times \vec{J} = \frac{\partial \vec{D}}{\partial t}$

24. The wave function of a certain particle is $\Psi = A\, e^{i \propto x}$ for $0 < x < L$. The value of normalization constant A is
A) $\sqrt{\frac{2}{L}}$ B) $\sqrt{\frac{1}{L}}$ C) $\frac{2}{L}$ D) $\frac{1}{L}$

25. A pendulum of length L having supporting mass M swings back and forth with period T. If the mass is doubled, what is the new period?
A) T B) T/2 C) 2T D) $T\sqrt{2}$

26. The Lagrange's equations of motion for a system of particles is equivalent to _____ equations of motion
A) Laplace B) Poisson C) Newton's (D) Maxwell's

27. Two electric bulbs rated P_1 and P_2 watt at V volts are connected in series across V volt mains, then their total power consumption P is
A) P_1+P_2 B) $\sqrt{P_1P_2}$ C) $P_1P_2/(P_1+P_2)$ D) $(P_1+P_2)/P_1P_2$

28. A proton and an alpha particle enters in a uniform magnetic field with the same velocity. The period of rotation of the alpha particle will be
A) Four times that of proton B) Two times that of proton
C) Same as that of proton D) Less than that of proton

29. The mass equivalent to 931 MeV energy is
A) 1.66×10^{-27} kg B) 6.02×10^{-24} kg
C) 1.66×10^{-20} kg D) 6.02×10^{-27} kg

30. In which of the medium sound travels faster?

A) Gas B) Liquid C) Solid D) Water vapour

31. Rayleigh Jeans Law holds good for which of the following:

A) Shorter wavelength B) Longer wavelength

C) High temperature D) High energy

32. What is the lattice constant for FCC lattice having atomic radius 1.476 Å

A) 1.476 Å B) 5.216 Å C) 4.175 Å D) 3.408 Å

33. A superconducting material when placed in a magnetic field will

A) Attract the magnetic field towards its centre

B) Repel all the magnetic lines of forces passing through it

C) Attract the magnetic field but transfer it into a concentrated zone

D) Not influence the magnetic field

34. The decay constant of a radioactive sample is λ. The half life and the average life of the sample are respectively

A) $\frac{1}{\lambda}$ and $\frac{\ln 2}{\lambda}$ B) $\frac{\ln 2}{\lambda}$ and $\frac{1}{\lambda}$ C) $\frac{\lambda}{\ln 2}$ and $\frac{1}{\lambda}$ D) $\frac{1}{\lambda}$ and λ ln2

35. The time independent Schrodinger's equation of a system represents the conservation of

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

C) Total Kinetic energy of the system D) Total binding energy of the system

36. For azimuthal quantum number $l = 2$, the total number of possible values of magnetic quantum number m_l is

A) 3 B) 5 C) 2 D) 1

37. The de-Broglie wavelength of an electron accelerated from rest on application of potential of 400 V is:

A) 0.165 Å B) 0.512 Å C) 0.613 Å D) 0.251 Å

38. Which of the following cannot be polarized?

A) Radio waves B) Sound waves C) X-rays D) UV rays

39. Identify the initiator used in anionic addition polymerization

A) BuLi B) BF_3

C) Ziegler Natta catalyst D) Benzoyl peroxide

40. Which is the correct order of energy required for various electronic transitions

A) n to Π* › σ to σ* › Π to Π* › n to σ* B) σ to σ* › n to σ* › Π to Π* › n to Π*

C) σ to σ* › Π to Π* › n to Π* › n to σ* D) n to σ* › Π to Π* › n to Π* › σ to σ*

41. For a solution of camphor in hexane in a 10 cm cell, the absorbance was found to be 2.52 at 295 nm with ε_{max} = 14. What will be the concentration of camphor

A) 0.0018 moles/lt B) 0.018 moles/lt
C) 1.8 moles/lt D) 0.18 moles/lt

42. The specific corrosive environment for stress corrosion of stainless steel is
A) Nitrate solution B) Ammonical solution
C) Alkali solution D) Water containing electrolytes

43. In acidic solution which of the following is not used to control corrosion
A) Amine B) Na_2SO_3 C) Marcaptans D) Antimony oxide

44. The attack of O_2 on Mo leads to formation of which type of layer
A) Non stable B) Stable C) Porous D) Volatile

45. Identify the non conducting polymer
A) Polyacetylene B) Polypyrrole C) Polythiophene D) Polyethylene

46. Identify the amorphous polymer
A) High density polyethylene B) Low density polyethylene
C) Nylon D) Polyester

47. Select one of the monomer for nylon 6,6 from the given choices
A) Sebacic acid B) Adipic acid C) Caprolactum D) ε-amino acid

48. The number of peaks observed in IR spectra of H_2O is
A) 3 B) 4 C) 2 D) 5

49. In which of the given solvents the value of λ of ethylene will be maximum
A) Water B) Chloroform C) Methyl alcohol D) Hexane

50. The value of CFSE for the complex $[TiCl_4]^{2-}$ is
A) -8 Dq B) -5.34 Dq C) -12 Dq D) 8.90 Dq

51. Which of the following is the catalyst for hydrogenation reaction of alkenes
A) K_2PdCl_4 B) $RhHCO(PPh_3)_3$ C) Zn-Cu Oxide D) $RhCl(PPh_3)_3$

52. Entropy change in an isobaric process is given by
A) $nC_p\ln T_2/T_1$ B) $-nR\ln P_2/P_1$ C) $nR\ln V_1/V_2$ D) $-nR\ln P_1/P_2$

53. Which of the following does not favour the formation of tetrahedral complex
A) Weak field ligand B) Bulky ligands
C) Low oxidation state of metal D) High oxidation state of metal

54. The entropy change accompanying the heating of one mole of helium (C_v = 3/2R) from a temperature of 100K to 300K at constant pressure is
A) 25.17 J/K mol B) -13.17 J/K mol
C) 22.83 J/K mol D) 13.17 J/K mol

55. The enthalpy change for combustion of one mole of sulfur dioxide in bomb calorimeter at 25 ^{o}C which releases 97.030 kJ of heat is

A) -97.030 kJ B) -98.14 kJ C) +98.14 kJ D) 97.030 kJ

56. Which of the following is not the property of a enzyme catalysis

A) Organic in nature
B) Operate by lock and key mechanism
C) Very specific in action
D) Their activity is independent of temperature

57. Select the one absorbing IR radiation at highest frequency

A) O-H B) O-D C) F-H D) F- D

58. The general solution of the ordinary differential equation $3x^2\, y\ dx + (y^4 - x^3)dy = 0$ is

A) $3\,x^3 + y^4 = cy$ B) $3\,x^3 + c\,y^4 = y$

C) $y = c\,x^4 + y^2$ D) $y = e^{5x} + 4\,y$

59. An integrating factor of the differential equation $\frac{dy}{dx} + P(x)\,y = Q(x)$ is given by

A) $e^{\int Q(x)dx}$ B) $e^{P(x)}$ C) $e^{Q(x)}$ D) $e^{\int P(x)dx}$

60. The general solution of the differential equation $(D+1)^2 y = e^{-x}$ where $D = \frac{d}{dx}$, is given by

(E) $y = (c_1 + c_2)x\, e^{-x} + x\, e^{-x^2}$ B) $y = (c_1 + c_2\, x)e^{-x} + \frac{x^2}{2}e^{-x}$

C) $y = c_1 e^{x} + c_2 e^{2x}$ D) $y = (c_1 + c_2 x^2)e^{-2x} + x^3$

61. Find the Fourier integral representation of the function $f(x) = \begin{cases} 1 & if\ |x| < 1 \\ 0 & if\ |x| > 1 \end{cases}$.

A) $\int_0^{\infty} \frac{\cos(wx)\sin(w)}{w^2}\, dw$

B) $\frac{2}{\pi}\int_0^{\infty} \frac{\sin(wx)\sin(w)}{w}\, dw$

C) $\frac{2}{\pi}\int_0^{\infty} \frac{\cos(wx)\sin(w)}{w}\, dw$

D) $\frac{2}{\pi}\int_0^{\infty} \frac{\cos(wx)\cos(w)}{w}\, dw$

62. Let $f(x) = x^2, (-1 < x < 1)$ e a periodic function with period p=2, then using the concept of Fourier series of f(x) , find the sum of the following

$1 - \frac{1}{4} + \frac{1}{9} - \frac{1}{16}$+-…….

A) $\frac{\pi^2}{12}$ B) $\frac{\pi}{3}$ C) $\frac{\pi}{6}$ D) 0

63. Let $z = f(x^2 - y^2)$, then the partial differential equation representing this surface is given by

(B) $y\,p = x^2 q$ B) $y^2 q = x\,p$ C) $y\,p + x\,q = 0$ D) $y\,q + xp = 0$

64. The partial differential equation of all the planes having equal x and y intercepts is given by

A) $\frac{\partial z}{\partial x} = \left(\frac{\partial z}{\partial x}\right)^2$ B) $\frac{\partial z}{\partial x} = x^2 + y^2$ C) $\frac{\partial z}{\partial y} = x^2 + y^2$ D) $\frac{\partial z}{\partial x} = \frac{\partial z}{\partial y}$

65. Find the volume of the solid generated by revolving the region between the y-axis and the curve $x = \frac{2}{y},\ 1 \le y \le 4$, about the y-axis

A) $3\,\pi$ B) 10 C) π D) 1

66. Find the length of the curve $x = \int_0^y \sqrt{\sec^4(t) - 1}\ \ dt,\ -\frac{\pi}{4} \le y \le \frac{\pi}{4}$.

A) 1.5 B) 2 C) 3 D) 2.5

67. The sum of the series $1 - \frac{1}{3} + \frac{1}{9} - \frac{1}{27} + \frac{1}{81} \mp \cdots$ ... ... is given by

A) 1 B) $\frac{3}{4}$ C) $\frac{2}{3}$ D) -2

68. The value of $\lim_{n\to\infty} \sqrt[n]{n^2}$ is

(B) -1 B) -2 C) 1 D) 0

69. Let $(x, y) = x^2 - xy + \frac{1}{2}y^2 + 3$. Find an upper bound for the error in the approximation of $(x, y) \approx L(x.y)$ (Linearization of f) over the rectangle R: $|x - 3| \le 0.1,\ |y - 2| \le 0.1$?

(B) 0.04 B) 1.40 C) 0.004 D) 0.40

70. Find the Laplace Transform of $f(t) = t\sin(3t)$

A) $s^3 + \frac{2}{s^2+9}$ B) $\sin(s) + \cos(s)$ C) $\frac{6s}{(s^2+9)^2}$ D) $\frac{s^3}{S^4+9}$

71. Let $f(t) = L^{-1}\left(\overline{f(s)}\right)$, then the inverse Laplace transform of $e^{-as}\overline{f\ (s)}$ is given by

A) $f(t - a)u(t)$ B) $f(t - a)\ u(t - a)$

C) $f(t)u(t - a)$ D) $f(t)u(t)$

72. Find the value of the integral $\int_{t=0}^{\infty}\int_{u=0}^{u=t} e^{-t}\,\frac{sinu}{u}\ du\ dt$

A) $\frac{\pi}{4}$ B) $-\frac{\pi}{4}$ C) $\frac{\pi}{2}$ D) $-\frac{\pi}{2}$

73. If $r = 5.0\ cm$ and $\square = 12.0\ cm$ to the nearest millimeter, what should we expect the maximum percentage error in calculating $V = \pi\, r^2\square$ to be?

A) 2.8% B) $\pm$ 3.5% C) $\pm$ 9% D) $\pm$4.83%

74. Which one of the following fields is conservative?

A) $(y + 3x)\hat{\imath}\ + (2x + z)\ \hat{\jmath}\ + (x - y)\hat{k}$

B) $(y^2 + z)\hat{\imath}\ + (x^2 + z)\ \hat{\jmath}\ + (x^2 + y)\hat{k}$

C) $(y + z)\hat{\imath}\ + (x + z)\ \hat{\jmath}\ + (x + y)\hat{k}$

D) $(y - z)\hat{\imath}\ + (x - z)\ \hat{\jmath}\ + (x - y)\hat{k}$

75. Evaluate the integral $\oint_C (y^2\,dx + x^2 dy)$, C: The triangle bounded by x=0, x+y=1, y=0 in the xy-plane.

A) 0 B) -1 C) 1 D) 2

x-x-x