



## PART – A

Questions 1 – 10 : Choose the most grammatically correct and meaningful option from those provided at the end of each sentence :

1. One who is incapable of committing a mistake is called  
A) sure                      B) certain                      C) definite                      D) infallible
2. The opposite of 'curious' is  
A) calm                      B) indifferent                      C) undemanding                      D) provoked
3. Their entire future \_\_\_\_\_ on the result of this examination.  
A) depends                      B) depending                      C) resolved                      D) revolving
4. We haven't had \_\_\_\_\_ rest all of this week.  
A) many                      B) some                      C) any                      D) no
5. This seems to be the \_\_\_\_\_ question to answer right now.  
A) hardly                      B) hardest                      C) very hard                      D) harder
6. If I \_\_\_\_\_ the decision-maker, things would have been much easier.  
A) had been                      B) were                      C) was                      D) am
7. Everyone was in time for the show, \_\_\_\_\_ ?  
A) wasn't he                      B) isn't it                      C) weren't they                      D) were they
8. He has \_\_\_\_\_ all that he had in this gamble.  
A) lossed                      B) loosed                      C) losed                      D) lost
9. We should refrain \_\_\_\_\_ overeating.  
A) from                      B) to                      C) in doing                      D) over
10. \_\_\_\_\_ are we waiting for ?  
A) Why                      B) When                      C) What                      D) How







## PART – B

26. The atomic radius of an atom in a BCC crystal (if  $a$  is lattice parameter) is  
A)  $a$                       B)  $a/2$                       C)  $a/(4/\sqrt{3})$                       D)  $a/(4/\sqrt{2})$
27. Schottky-defect in ceramic material is  
A) Interstitial impurity                      B) Vacancy- interstitial pair of cations  
C) Pair of nearby cation and anion vacancies                      D) Substitutional impurity
28. Electron sea exists in  
A) Polar bond                      B) Ionic bond                      C) Covalent bond                      D) Metallic bond
29. Particles that mostly affect the materials properties  
A) Protons                      B) Valence electrons                      C) Neutrons                      D) Electrons
30. A metal crystallizes with a face-centered cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is  
A) 144 pm                      B) 288 pm                      C) 204 pm                      D) 408 pm
31. Solvents of covalent compounds include all but  
A) Water                      B) Alcohol  
C) Tetra chloromethane                      D) Petrol
32. Which of the following statement is incorrect ?  
A) The coordination number of each type of ion in CsCl crystal is 8.  
B) A metal that crystallizes in BCC structure has coordination number equal to 12.  
C) A unit cell of an ionic crystal shares some of its ions with other unit cells.  
D) The length of unit cell in NaCl is 552 pm. [  $r_{\text{Na}^+} = 95$  pm and  $r_{\text{Cl}^-} = 181$  pm ]
33. If  $A > B$  means the radius of A is greater than the radius of B, then which of the following comparisons is INCORRECT ?  
A)  $C > C^+$                       B)  $K^+ > Cl^-$                       C)  $As > S$                       D)  $S > O$
34. Use the information below to calculate the lattice energy for CsCl

$\text{Cs(g)} \rightarrow \text{Cs}^+(\text{g}) + \text{e}^-$	H=	386 kJ
$\text{Cs(s)} \rightarrow \text{Cs(g)}$	H=	72 kJ
$\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$	H=	236 kJ
$\text{Cl}(\text{g}) + \text{e}^- \rightarrow \text{Cl}^-(\text{g})$	H=	-342 kJ
$\text{Cs(s)} + 1/2\text{Cl}_2(\text{g}) \rightarrow \text{CsCl(s)}$	H=	-426 kJ

- A)  $\Delta H = + 680\text{kJ}$     B)  $\Delta H = + 660\text{kJ}$     C)  $\Delta H = - 660\text{kJ}$     D)  $\Delta H = - 680\text{kJ}$



35. The lattice energy is inversely proportional to sum of the radii of the  
A) Cation                      B) Anion                      C) Both A) and B) D) None of these
36. Not a Hume-Ruthery condition  
A) Crystal structure of each element of solid solution must be the same  
B) Size of atoms of each two elements must not differ by more than 15%  
C) Elements should form compounds with each other  
D) Elements should have the same valence
37. In phase diagram studies the overall phase transformation rate changes with temperature as follows  
A) Monotonically decreases with temperature  
B) First increases, then decreases  
C) Initially it is slow, and then picks-up  
D) Monotonically increases with temperature
38. During homogeneous nucleation, critical size of a particle \_\_\_\_\_ with increase in rate of under-cooling.  
A) Increases                      B) Decreases                      C) Won't Change D) Not related
39. Not a typical site for nucleation during solid state transformation  
A) Container wall                      B) Grain boundaries  
C) Stacking faults                      D) Dislocations
40. The boundary line between (liquid+solid) and (solid) regions must be part of  
A) Solvus                      B) Solidus                      C) Liquidus                      D) Tie-line
41. Which atomic orbital is described by the quantum numbers  $n = 4, l = 1, m_l = 0$  ?  
A) 4s                      B) 4p                      C) 4d                      D) 4f
42. The Wt.% of carbon in mild steels  
A)  $<0.008$                       B)  $0.008 - 0.3$                       C)  $0.3 - 0.8$                       D)  $0.8 - 2.11$
43. Both nucleation and growth require change in free energy to be  
A) Negative                      B) Zero                      C) Positive                      D) Any
44. In crystal lattice ions are arranged in  
A) One dimensions                      B) Two dimensions  
C) Three dimensions                      D) Four dimensions



45. The plane (1–11) is parallel to  
A) (–11–1)                      B) (–1–11)                      C) (111)                      D) (1–11)
46. The Bragg formulation of X-ray scattering is defined in terms of scattering from \_\_\_\_\_, whereas the Von Laue formulation is defined in terms of scattering from  
A) Planes of lattice; Points of the lattice  
B) Points of lattice; Planes of the lattice  
C) Points of lattice; Planes of the reciprocal lattice  
D) Points of reciprocal lattice; Planes of the lattice
47. The geometrical structure factor  
A) Expresses the extent to which waves scattered from different types of ions within the basis interfere destructively  
B) Expresses the extent to which waves scattered from different types of ions within the basis interfere constructively  
C) Expresses the extent to which waves scattered from identical ions within the basis affects the Braggs peak intensity  
D) Has nothing to do with Braggs peak intensity
48. Bloch's theorem  
A) Cannot be proven conclusively  
B) Says that the eigenstates of the Hamiltonian in the case of periodic potential can be written as a product of a plane wave and a function with the periodicity of the reciprocal lattice  
C) Says that the eigenstates of the Hamiltonian in the case of periodic potential can be written as a product of a plane wave and a function with the periodicity of the Bravias lattice  
D) Introduces a wave vector  $k$  which is proportional to the electronic momentum
49. In tight binding method,  
A) The periodic-wave function solutions are not Bloch wave-functions  
B) Energy bandwidth is not proportional to an overlap integral  
C) The eigen energy solutions are independent of  $k$   
D) The starting point for the periodic wave function solutions are localized atomic orbital wave functions



50. Nose of a isothermal transformation diagram (C-curve) represents
- A) Shortest time required for specified fraction of transformation
  - B) Longest time required for specified fraction of transformation.
  - C) Average time required for specified fraction of transformation.
  - D) No information regarding time required for specified fraction of transformation.
51. If the Miller indices of two planes are (211) and (422), then they are
- A) Parallel
  - B) Perpendicular
  - C) At an angle of  $45^\circ$
  - D) None of these
52. Which of the following is the adiabatic process ?
- A)  $\Delta U = 0$
  - B)  $W = 0$
  - C)  $Q = 0$
  - D)  $\Delta V = 0$
53. According to kinetic theory of gases, the absolute zero temperature is attained when
- A) Volume of gas is Zero
  - B) Pressure of gas is Zero
  - C) Kinetic energy of the molecule is Zero
  - D) Specific heat of the gas is Zero
54. Intensive property of a system is whose value
- A) Depends on the mass of the system, like volume
  - B) Does not depend on the mass of the system, like temperature, pressure etc.
  - C) Does not dependent on the path followed but on the state
  - D) Depends on the path followed and not on the state
55. Work done is zero for the following process.
- A) Constant Volume
  - B) Free expansion
  - C) Throttling
  - D) All the above
56. The process of heat transfer from one object to another because of molecular motion and interaction is called
- A) Convection
  - B) Conduction
  - C) Radiation
  - D) Induction
57. A container with rigid walls filled with a sample of ideal gas. The absolute temperature of the gas is doubled. What happens to the pressure of the gas ?
- A) Doubles
  - B) Quadruples
  - C) Triples
  - D) Decreased to one-half



58. In a single-component condensed system, if degree of freedom is zero, maximum number of phases that can co-exist  
A) 0                      B) 1                      C) 2                      D) 3
59. An invariant reaction that produces a solid up on cooling two liquids  
A) Eutectic              B) Peritectic              C) Monotectic              D) Syntectic
60. Phase formed of diffusion-less reaction  
A) Pearlite              B) Lower Bainite              C) Upper bainite              D) Martensite
61. Sum of these is unity  
A) Reflectivity + Transmittivity  
B) Reflectivity + Refractivity  
C) Reflectivity + Refractivity + Transmittivity  
D) Refractivity + Transmittivity
62. Sky looks blue because the sun light is subjected to  
A) Rayleigh scattering                      B) Compton scattering  
C) Both                      D) None
63. Detrimental property of a material for shock load applications  
A) High density                      B) Low toughness  
C) High strength                      D) Low hardness
64. Luminescence is because of  
A) Photons emitted while excited electrons drops down  
B) Knocking out of electrons by photons  
C) Photons stimulated by photons  
D) All
65. Pyrometer works based on  
A) Laser technology                      B) Photo-conduction  
C) Thermal emission                      D) Tyndall effect
66. Refractive index of materials is approximately equal to square root of  
A) electrical permittivity  
B) magnetic permeability  
C) electrical permittivity x magnetic permeability  
D) none





67. Magnetic susceptibility of para-magnetic materials in the order of  
A)  $+10^{-5}$                       B)  $-10^{-5}$                       C)  $10^5$                       D)  $10^{-5}$  to  $10^{-2}$
68. Typical size of magnetic domains \_\_\_\_\_ (mm).  
A) 1–10                      B) 0.1–1                      C) 0.05                      D) 0.001
69. Typical thickness of Bloch walls \_\_\_\_\_ (nm).  
A) 0.1–1                      B) 1–10                      C) 10–50                      D) 100
70. Example for magnetic material used in data storage devices  
A) 45 Permalloy      B)  $\text{CrO}_2$                       C) Cunife                      D) Alnico
71. In a magnetic materials hysteresis loss takes place primarily due to  
A) Rapid reversal of its magnetism  
B) Flux density lagging behinds its magnetizing force  
C) Molecular friction  
D) Its high retentivity
72. Hard steel is suitable for making permanent magnets because  
A) It has good residual magnetism  
B) Its hysteresis loss has large area  
C) Its mechanical strength is high  
D) Its mechanical strength is low
73. Reciprocal of reluctance is  
A) Reluctivity                      B) Permeance  
C) Permeability                      D) Susceptibility
74. Relative Magnetic Permeability ( $\mu_r$ ) =  
A)  $1 - \chi$                       B)  $\chi - 1$                       C)  $\chi - H$                       D)  $1 + \chi$
75. The quantity of magnetism retained by a magnetic material after withdrawal of the magnetizing force is called  
A) Leftover magnetism                      B) Hysteresis  
C) Residual magnetism                      D) Coercivity



76. Bauschinger effect can be considered as
- A) Hysteresis loss during loading and unloading
  - B) Anelastic deformation
  - C) Dependence of yield stress on path and direction
  - D) None of these
77. Shape of true stress-strain curve for a material depends on
- A) Strain
  - B) Strain rate
  - C) Temperature
  - D) All
78. According to distortion-energy criterion, yielding occurs when
- A) Distortion energy reaches a critical value
  - B) Second invariant of the stress deviator exceeded some critical value
  - C) Octahedral shear stress reaches a critical value
  - D) All the above
79. Engineering stress-strain curve and true stress-strain curve are equal up to
- A) Proportional limit
  - B) Elastic limit
  - C) Yield point
  - D) Tensile strength point
80. What is the effect to aluminum with copper as alloying element ?
- A) Increase strength up to about 12%
  - B) Reduces shrinkage
  - C) Improves machinability
  - D) Increases fluidity in casting
81. Nanoscience can be studied with the help of
- A) Quantum mechanics
  - B) Newtonian mechanics
  - C) Macro-dynamics
  - D) Geophysics
82. Which of the following is monosaccharides ?
- A) Glucose
  - B) Lactose
  - C) Cellulose
  - D) Maltose
83. Hall-petch equation is relation of yield strength to
- A) Grain Size
  - B) Volume
  - C) Fatigue
  - D) Surface area
84. Crevice corrosion occurs due to
- A) Oxygen deficiency
  - B) Residual stress
  - C) Low Melting point
  - D) Alloy formation





93. For silicon doped with trivalent impurity  
A)  $n_e \gg n_h$                       B)  $n_e > n_h$                       C)  $n_h \gg n_e$                       D)  $n_h > n_e$
94. Metallic bond is not characterized by  
A) Ductility                      B) High conductivity                      C) Directionality                      D) Opacity
95. Which of these is at the nanoscale (between 1 -100 nm) ?  
A) The head of a pin                      B) DNA  
C) A red blood cell                      D) A hydrogen atom
96. Which one of these statements is not true ?  
A) Silicon at the nanoscale is an insulator  
B) Gold at the nanoscale is red  
C) Copper at the nanoscale is transparent  
D) Band gap increases with decrease in particle size
97. In how many dimension are quantum dot excitons confined ?  
A) One                      B) Two                      C) Three                      D) Zero
98. Fermi energy level for p-type extrinsic semiconductors lies  
A) At middle of the band gap                      B) Close to conduction band  
C) Close to valence band                      D) None
99. What does the effective mass of a photon describe ?  
A) Photons only have a rest mass of zero  
B) It has mass-like properties because photons move at the speed of light  
C) Effective mass occurs because photons warp the space-time continuum  
D) Photons have no effective mass as they are massless
100. Which one of these forces dominate at the deep Nano scale level ? (10 nm or less) ?  
A) Gravitational force  
B) Nuclear force  
C) Van der Waals force  
D) Electromagnetic force
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SPACE FOR ROUGH WORK