926 1. Classify the following unit cell into proper crystal system: \( a=1.08 \text{nm}, b=0.947 \text{nm}, c=0.52 \text{nm} \) and \( \alpha=41^\circ, \beta=82^\circ, \gamma=95^\circ \).
(a) triclinic  
(b) monoclinic  
(c) orthorhombic  
(d) hexagonal

927 2. Magnesium crystallizes in hcp structure. If the lattice constant is 0.32 nm, the nearest neighbour distance in magnesium is
(a) 0.32 nm  
(b) 0.64 nm  
(c) 0.16 nm  
(d) none of these

928 3. Which of the following metals crystallises in fcc structure?
(a) aluminium  
(b) zinc  
(c) sodium  
(d) caesium chloride

929 4. If 0.28 nm is the interionic distance in NaCl crystal, the lattice parameter is
(a) 0.14 nm  
(b) 0.56 nm  
(c) 0.08 nm  
(d) none of these

930 5. The number of ions in the unit cell of CsCl crystal is
(a) 1  
(b) 2  
(c) 3  
(d) 4

931 6. Metallic iron changes from bcc structure to fcc structure at 910 °C with an increase in the atomic radii. The density of iron in this structural:
(a) remains constant  
(b) increases  
(c) decreases  
(d) none of these

946 7. At equilibrium condition the atoms possess
(a) Minimum potential energy  
(b) Maximum potential energy  
(c) Maximum kinetic energy  
(d) Maximum total energy

947 8. The bonding between the atoms in the molecules HCL is
(a) Ionic  
(b) Covalent  
(c) Metallic  
(d) Vanderwaal's

948 9. X-Rays are used for different studies in crystal because
(a) The wavelength of radiation is of the same range as that of inter atomic spacing  
(b) X-rays penetrate the crystal  
(c) Crystals have atom /molecules capable of scattering x-rays  
(d) None of the above

949 10. Typical interatomic spacing in a crystal is
(a) 100 Å  
(b) 1000 Å  
(c) 10 Å  
(d) 2.3 Å

950 11. Which of the following methods uses X-rays of continuous wavelength for studying crystal diffraction?
(a) Laue method  
(b) Powder method  
(c) Rotating crystal method  
(d) None of the above

951 12. Which of the following elements is a covalently bonded crystals?
(a) Aluminium  
(b) Germanium  
(c) Sodium chloride  
(d) Lead

966 13. The free electron theory of metals was initiated by
(a) Fermi  
(b) Pauli  
(c) Lorentz and Drude  
(d) Sommerfeld

967 14. The average distance traveled by an electron between two successive collisions in the presence
(a) Mobility of electron  
(b) mean free path  
(c) drift velocity  
(d) None of these

968 15. According to the quantum theory of a free electron, energy of a free electron is given by
(a) \( E_n = n^2L^2/8\pi m^2 \)  
(b) \( E_n = n2h^2/8mL^2 \)  
(c) \( E_n = 8m^2h^2/n^2L^2 \)  
(d) \( E_n = 2hL^2/8m \)

969 16. Ohms law relates to the electric field \( E \), conductivity \( \sigma \) and current density \( j \) as
(a) \( J = E/\sigma \)  
(b) \( J = ?E \)  
(c) \( J = \sigma/E \)  
(d) \( J = \sigma E \)

970 17. If the fermi energy of a metal is 1.4 eV, then fermi temperature of the metal is approximately
(a) 1.5 x 10^3 K  
(b) 1.5 x 10^4 K  
(c) 1.6 x 10^4 K  
(d) 1.6 x 10^7 K

971 18. The spacing between nth energy level and next higher level in one dimensional potential box increases by
(a) \( 2n-1 \)  
(b) \( 2n+1 \)  
(c) \( (n+1) \)  
(d) \( n \)

986 19. Hard superconductors observe
(a) breakdown of silsbees rule  
(b) incomplete meissner effect  
(c) high critical field and transition temperature  
(d) all of these

987 20. Soft superconductors observe
(a) meissner effect  
(b) Silsbees rule  
(c) both a and b  
(d) none of these
The transition temperature of most superconducting elements lie in the range:

(a) 0K to 10K  
(b) 10K to 20K  
(c) 20K to 50K  
(d) above 50K

Wire wound crypton is a superconductor having:

(a) copper as control wire and tungsten as gate wire  
(b) niobium as control wire and tantalum as gate wire  
(c) nichrome as control wire and tungsten as gate wire  
(d) tungsten as control wire and nichrome as gate wire

A superconducting material on being subjected to the critical field changes to:

(a) critical conductivity  
(b) superconducting which is independent of temperature  
(c) normal state  
(d) remains and influenced

As the isotopic mass of mercury decreases:

(a) the critical temperature increases slightly  
(b) the critical temperature decreases slightly  
(c) remains constant  
(d) none of these

Each ferromagnetic material has characteristic temperature above which its properties are vitally different from those below it. This temperature is called:

(a) demagnetisation temperature  
(b) curch temperature  
(c) transition temperature  
(d) faradays temperature

The ferromagnetic curie temperature of iron is:

(a) 631K  
(b) 922K  
(c) 1428K  
(d) 1043K

The magnetic material in which permanent magnetic dipoles are already aligned due to bonding forces are known as:

(a) paramagnetic materials  
(b) ferromagnetic materials  
(c) ferrimagnetic materials  
(d) diamagnetic materials

Which of the following material does not have permanent magnetic dipoles:

(a) paramagnetic materials  
(b) diamagnetic materials  
(c) ferrimagnetic materials  
(d) antiferro magnetic

Ferromagnetic materials or ferrites are obtained from:

(a) copper  
(b) zinc  
(c) aluminium  
(d) none of these

The units of magnetic permeability are:

(a) henry/metre  
(b) henrymetre  
(c) webermetre  
(d) henry/second

The number of diad axes of symmetry elements that are present in a cubic crystal are ……………..
997 24. The width of the energy gap of a superconductor is maximum at ...............
1012 25. Interaction between neighboring is negligible in the case of a ...............
1013 26. For copper the resultant spin in bohr magneton is ...............
1014 27. Relative permeability of a medium is the permeability to that of ...............
1015 28. At curie temperature the spontaneous magnetisation for ferromagnetic materials is ...............
1016 29. Magnetic materials which can be readily magnetised in either direction are called ..................
1017 30. Diamagnetic materials possess ......................

940 1. Define Lattice point
941 2. Define Basis.
942 3. Define diamond crystal structure
943 4. Define packing factor
960 5. Define Covalent bond
961 6. Define the nature of binding CH4?
962 7. Define metallic bonding
963 8. Define cohesive energy of sodium chloride molecule
981 10. Define Fermi energy.
982 11. Define average energy of an electron.
983 12. Define Mobility
1000 13. Define transition temperature
1001 14. Define superconductivity
1002 15. Define coherence length of the paired electrons.
1020 17. Define relative permeability.
1021 18. Define Bohr magneton.
1023 20. Define neel temperature

938 1. A plane parallel to one of the coordinate axes has an intercept of infinity.
939 2. The miller indices of the plane parallel to y and z-axes are (100)
958 3. Bragg's equation 2d sin ?=n? has no solution for wavelength ?, when ?>2d
959 4. The radiation used for powder method is Continuous
978 5. If E? is the energy of lowest state of a one dimentional potentiol box of a length L and L? is the energy of the lowest state when the length of box is halved, then E2=4E1
979 6. At a finite temperature, the probability of finding an electron with energy equal to fermi energy is 0.5
998 7. Cooper pairs are formed at very low temperatures as thermal energy is not sufficient to disrupt the binding
999 8. Superconducting state is more ordered than the normal state for type I superconductors
1018 9. In induced dipole moment occurs in diamagnetic materials only
1019 10. The temperature below which certain materials are antiferro magnetic and above which they are paramagnetic is called curie temperature

944 1.
1) simple cubic a) 74
2) Body centered cubic b) 34
3) Face centered cubic c) 68
4) Diamond d) 52

(a) 1)-d, 2)-c, 3)-a, 4)-b (b) 1)-b, 2)-c, 3)-d, 4)-a (c) 1)-a, 2)-b, 3)-d, 4)-c (d) 1)-c, 2)-b, 3)-d, 4)-a

945 2.
1) Miller indices a) Primitive cell
2) Bravais Lattice b) Crystal direction
3) Tetrahedral void space c) 14 space lattices
4) Simple cubic d) Diamond

1) **Ionic bond**  
a) KBr  

2) **Metallic bond**  
b) Water  

3) **Hydrogen bond**  
c) Silicon  

4) **Covalent bond**  
d) Aluminium

(a) 1)-c, 2)-b, 3)-d, 4)-a  
(b) 1)-b, 2)-d, 3)-a, 4)-c  
(c) 1)-b, 2)-c, 3)-d, 4)-a  
(d) 1)-a, 2)-b, 3)-c, 4)-d

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1) **Bragg’s law**  
a) Diffraction  

2) **X-ray**  
b) Short wavelength  

3) **Cohesive energy**  
c) Ionic crystal  

4) **Bond energy**  
d) 4.5 eV

(a) 1)-c, 2)-b, 3)-d, 4)-a  
(b) 1)-a, 2)-b, 3)-c, 4)-d  
(c) 1)-b, 2)-c, 3)-d, 4)-a  
(d) 1)-a, 2)-b, 3)-c, 4)-d

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1) **Quantum theory**  
a) Sommerfeld  

2) **Fermi level**  
b) Highest occupied level  

3) **Free electron**  
c) Electron gas  

4) **Fermi-Dirac function**  
d) Probability distribution

(a) 1)-b, 2)-c, 3)-d, 4)-a  
(b) 1)-a, 2)-b, 3)-c, 4)-d  
(c) 1)-a, 2)-b, 3)-c, 4)-d  
(d) 1)-a, 2)-b, 3)-d, 4)-c

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1) **Wiedemann-Franz law**  
a) Absolute temperature  

2) **Thermal conductivity**  
b) Specific heat  

3) **Platinum**  
c) High resistivity  

4) **Zone theory**  
d) Energy bands

(a) 1)-a, 2)-b, 3)-d, 4)-c  
(b) 1)-b, 2)-c, 3)-d, 4)-a  
(c) 1)-a, 2)-b, 3)-c, 4)-d  
(d) 1)-c, 2)-b, 3)-d, 4)-a

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1) **Persistent current**  
a) 4.2K  

2) **Mercury**  
b) Cooper pair  

3) **BCS theory**  
c) Superconducting ring  

4) **Type-I superconductor**  
d) Meissner effect

(a) 1)-c, 2)-b, 3)-d, 4)-a  
(b) 1)-b, 2)-c, 3)-d, 4)-a  
(c) 1)-a, 2)-b, 3)-c, 4)-d  
(d) 1)-c, 2)-b, 3)-d, 4)-a

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1) **SQUID**  
a) Ultra sensitive  

2) **Levitation effect**  
b) Superconductor  

3) **Hard superconductor**  
c) Niobium  

4) **Type-II superconductor**  
d) Mixed state

(a) 1)-c, 2)-b, 3)-d, 4)-a  
(b) 1)-b, 2)-c, 3)-d, 4)-a  
(c) 1)-a, 2)-b, 3)-c, 4)-d  
(d) 1)-a, 2)-b, 3)-c, 4)-d

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1) **Bohr magneton**  
a) Angular momentum  

2) **Hysteresis**  
b) Ferrromagnetic material  

3) **Ferromagnetic**  
c) Low eddy current loss  

4) **Ferrites**  
d) Iron

(a) 1)-a, 2)-b, 3)-d, 4)-c  
(b) 1)-b, 2)-c, 3)-d, 4)-a  
(c) 1)-b, 2)-c, 3)-d, 4)-a  
(d) 1)-a, 2)-b, 3)-c, 4)-d

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1) **Intensity of magnetisation**  
a) Soft magnetic material  

2) **Weiss theory**  
b) Paramagnetism  

3) **Hard magnetic material**  
c) Ampere/meter  

4) **Low hysteresis loss**  
d) Tungsten steel alloy

(a) 1)-c, 2)-b, 3)-d, 4)-a  
(b) 1)-a, 2)-b, 3)-c, 4)-d  
(c) 1)-b, 2)-c, 3)-d, 4)-a  
(d) 1)-a, 2)-b, 3)-d, 4)-c

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**Section B**

1026.1. Define the following terms in crystal structure study: (i) Lattice, (ii) Primitive cell and unit cell.

1027.2. Define crystal lattice, basis and crystal structure?
Explain the terms: symmetry elements and Bravais lattices?

Enumerate the characteristics of various crystal systems?

What is meant by the atomic radii in a crystal?

How many atoms are there in the unit cell of Diamond?

Explain the terms primitive cell and unit cell?

What is co-ordination number? What factors control the coordination number?

What are Miller indices? How are they determined?

What is meant by the atomic packing factor in cubic lattices?

Classify the various type of inter atomic bonds?

Discuss Ionic bonding. Write down the characteristics of ionic solids?

What is covalent bond? Give the structure of crystal having this bond?

Distinguish between covalent and ionic bond; include examples?

Describe the salient features of metallic bonded crystals?

Describe the salient features of molecular of van der waals bonding?

Discuss hydrogen bonding?

What do you mean by Madelung constant? Calculate its value in case of NaCl?

Explain the basic principle involved in the diffraction of X-rays?

Explain b Archd's law of X-ray diffraction?

What are the main drawbacks of classical free electron theory?

Discuss relaxation time, collision time and mean free path of free electron in metal?

Briefly described Drude's free electron theory of metals?

Explain the term "mobility of charge carriers"?

Explain Wiedemann-Franz law?

Outline vonomorfeld's quantum theory of electrical conductivity of metals?

What is fermi energy? Write down its relation with the concentration of electron in metal?

Obtain the expression for Debye's frequency?

How did the Einstien's theory explain the failure of Dulong and Petit's law?

Give an account of Einstien's theory of specific heat of solid?

What are practical uses of of superconductors?

Explain the effect of isotopes on superconductors.

Define critical magnetic field

How does critical magnetic field vary with temperature in type II superconductors?

Give salient features of BCS theory of superconductors

How does zone explain the electrical behaviour of metals, semiconductors, and insulators.

What are Brillouin Zones?

Based on band theory of solids, explain the nature of conductors, semiconductors and insulators.

What is superconductivity? Outline the experimental facts about this phenomenon.

How does superconducting transition temperature vary with magnetic field.

Give the dimensions of magnetic susceptibility

What is the value of magnetic dipole moment associated with a loop carrying current?

Give the relation between magnetic susceptibility, magnetisation, magnetic field?

What is Bohr magneton?

What is the order of susceptibility of a diamagnetic material?

What is meant by hysteresis in magnetic materials?
Section -C

1072 47. Explain the origin of diamagnetism in a free atom?
1073 48. Give a few examples and the uses of high permeability materials?
1074 49. What is curie-weiss law?
1075 50. Discuss the various uses of ferrites.

Determine the atomic radius, coordination number and packing factor for BCC and FCC structures?
1077 2. a) Describe the structure of HCP Crystal b) Calculate the axial ratio (c/a) and atomic packing factor for HCP structure?
1078 3. Show that packing fraction for simple cubic is 52%
1079 4. Show that packing fraction for body centered cubic is 68%
1080 5. Show that packing fraction for face centered cubic is 74%
1081 6. What are miller indices? Write the procedure for finding Miller indices?
1082 7. Write a short note on (i) Diamond Structure (ii) NaCl structure (iii) Bravais lattice?
1083 8. Explain various types of defects in crystals in detail
1084 9. Explain Bravais lattices?
1085 10. Give the account pf (a) ionic (b) covalent (c) metallic (d) hydrogen bonding in crystals, with examples?
1086 11. What do you mean by cohesive energy of a crystal? calculate it for NaCl crystal explaining its various term?
1087 12. What are ionic crystal? explain the formation of ionic crystal and obtain an expression for it cohesive energy?
1088 13. Discuss the various types of bonding in crystal along with their characteristics feature?
1089 14. Explain the formation of ionic crystal. Derive an expression for the cohesive energy of an ionic crystal?
1090 15. What is bragg's law? how wavelength of x ray can be determined using Bragg's x-ray spectrometer?
1091 16. Describe and explain bragg's x-ray spectrometer method of determining the wavelength of x-rays?
1092 17. Explain the powder method of crystal analysis?
1093 18. Derive expression for (i) electrical conductivity and (ii) thermal conductivity on the basis of classical free electron theory. Ends obtain Wiedemann-Franz law
1094 19. Assume the electron in a metal to behave like classical glass, classical gas deduce Wiedemann-Franz relation
1095 20. Explain drift velocity and relaxation time of free electron in metals. Discuss the various drawbacks of classical free electron theory of metal and explain the assumption made in quantum theory to overcome the drawbacks
1096 21. Explain relaxation time, collision time and mean free path as applied to free electrons. Describe the "free electron" model of a metal introduced by Sommerfeld. What are the achievements of this model? where did it fail?
1097 22. Calculate the contribution made by free electrons to the specific heat of a metal on the basis of classical free electron of Drude and Lorentz. Does the result agree with experiments?
1098 23. What are density of energy state in metals? Derive a expression for density of energy state an hence obtain fermi energy of a metal
1099 24. Explain Fermi-Dirac distribution for electrons in a metal. Obtain the expression for Fermi energy \( E_f \) at temperature \( T=0 \), and relate it fermi energy \( E_f \) at non zero temperature \( T \), where \( T \) is such that \( K_B T \ll E_f \)
1100 25. State Dulong-Petits law and show how the departure from this law at lower temperature has been explained Einstein theory?
1101 26. Discuss the variation of the specific heat capacity of a solid?
1102 27. What are superconductors? Mention the important property changes that occur in materials when they change from normal to superconducting state.
1103 28. Explain the term critical magnetic field in a superconductor. How does the critical magnetic field vary with temperature in Type I and Type II superconductors.

1104 29. What is superconductivity? Give an account of the occurrence, properties, and uses of superconductors.

1105 30. Briefly outline BCS theory of superconductivity and describe one experimental evidence for the existence of energy gap.

1106 31.Write a short essay on superconductivity.

1107 32. What is superconductivity? Explain Meissner effect. What are the possible applications of superconductors.

1108 33. Give an elementary account of superconductivity and its applications.

1109 34. Discuss Kornig-penny model for the motion of an electron in a periodic potential.

1110 35. How does the band theory of solid lead to the classification of solids into conductors, semiconductors and insulators.

1111 36. What are Brillouin Zones? Illustrate your answer by constructing two Brillouin zones for a square lattice.

1112 37. What are paramagnetic and diamagnetic materials? Give examples.

1113 38. Discuss the temperature variation of paramagnetic and diamagnetic susceptibilities of materials.


1115 40. Explain the physical basis of diamagnetism and paramagnetism of materials.

1116 41. Describe the Weiss molecular field theory of ferromagnetism and derived Curie-Weiss law.

1117 42. Describe the behaviour of magnetic substances with reference to their Curie points.

1118 43. Give an account of the origin of atomic magnetism. Which source is important in the case of ferromagnetics?

1119 44. Discuss the Weiss theory of ferromagnetism bringing out its merits and demerits.

1120 45. Give an account of Neel's theory of ferromagnetism and show how the ferromagnetic behaviour of ferrites can be explained from Neel's theory.

1121 46. Give an account of Weiss theory of ferromagnetism. On the basis of this theory how will you explain hysteresis and Curie point.