Date : **TEST ID: XIICH0101**
Marks : **CHEMISTRY**

THE SOLID STATE

Single Correct Answer Type

1. Schottky defect generally appears in
   a) NaCl b) KCl c) CsCl d) All of these
2. Which arrangement of electrons leads ferromagnetism?
   a) ↑↑↑↑ b) ↑↓↑↓ c) ↑↑↑↓↓ d) None of these
3. The crystal are bounded by plane faces (f), straight edges (e) and interfacial angel (c). The relationship between these is :
   a) $f + c = e + 2$ b) $f + e = c + 2$ c) $c + e = f + 2$ d) None of these
4. The melting point of RbBr is 682°C, while that of NaF is 988°C. The principle reason that melting point of NaF is much higher than that of RbBr is that :
   a) The two crystals are not isomorphous
   b) The molar mass of NaF is smaller than that of RbBr
   c) The internuclear distance $r_c + r_a$ is greater for RbBr than for NaF
   d) The bond is RbBr has more covalent character than the bond in NaF.
5. If a crystal lattice of a compound, each corner of a cube is enjoyed by sodium, each edge of a cube has oxygen and centre of a cube is enjoyed by tungsten (W), then give its formula
   a) Na_2WO_4 b) $NaWO_3$ c) Na_3WO_3 d) Na_2WO_3
6. In antifluorite structure, the negative ions:
   a) Occupy tetrahedral voids
   b) Occupy octahedral voids
   c) Are arranged in ccp
   d) Are arranged in hcp
7. An insulator oxide is :
   a) CuO b) C_OO c) Fe_2O_3 d) All of these
8. A solid with high electrical and thermal conductivity from the following is :
   a) Si b) Li c) NaCl d) ice
9. The radius ratio $\left(\frac{r_+}{r_-}\right)$ of an ionic solid (A^+B^-) is 0.69. What is the coordination number of B^-?
   a) 6 b) 8 c) 2 d) 10
10. The axial angles in triclinic crystal system are
    a) $\alpha = \beta = \gamma = 90°$ b) $\alpha = \gamma = 90°, \beta \neq 90°$ c) $\alpha \neq \beta \neq \gamma \neq 90°$ d) $\alpha = \beta = \gamma \neq 90°$
11. In NaCl crystal each Cl^- ion is surrounded by
    a) 4 Na^+ ions b) 6 Na^+ ions c) 1 Na^+ ion d) 2 Na^+ ions
12. For an ionic crystal of the general formula A^+B^- and co-ordination number 6, the radius ration will be :
    a) Greater than 0.73
    b) Between 0.73 and 0.41
    c) Between 0.41 and 0.22
    d) Less than 0.22
13. The ratio of cations to anion in a octahedral close packing is :
    a) 0.414 b) 0.225 c) 0.02 d) None of these
14. Electrons in a paramagnetic compound are
    a) Shared b) Unpaired c) Donated d) Paired
15. Crystals which are good conductor of electricity and heat are known as :
    a) Ionic crystals b) Covalent crystals c) Metallic crystals d) Molecular crystal
16. An element has bcc structure having unit cells 12.08×10^{23}. The number of atoms in these cells is :
    a) 12.08×10^{23} b) 24.16×10^{23} c) 48.38×10^{23} d) 12.08×10^{22}

17. Among the following types of voids, which one is the largest void?
a) Triangular b) Cubic c) Tetrahedral d) Octahedral

18. The crystalline structure of NaCl is
a) Hexagonal close packing b) Face centred cubic
c) Square planar d) Body centred cubic

19. Metals have conductivity of the order of ($ohm^{-1}\ cm^{-1}$) :
a) 10^{12} b) 10^{8} c) 10^{2} d) 10^{-6}

20. Of the elements Sr, Zr, Mo, Cd and Sb, all of which are in V period, the paramagnetics are:
a) Se, Cd and Sb b) Zr, Mo and Cd c) Sr, Zr and Cd d) Zr, Mo and Sb

21. The radius ratio of CsCl is 0.93. The expected lattice structure is
a) Tetrahedral b) Square planar c) Octahedral d) Body centred cubic

22. Which one of the following defects in the crystals lowers its density?
a) Frenkel defect b) Schottky defect c) F-centres d) Interstitial defect

23. The yellow colour of ZnO and conducting nature produced in heating is due to:
a) Metal excess defects due to interstitial cation
b) Extra positive ions present in an interstitial site
c) Trapped electrons
d) All of the above

24. A metal has bcc structure and the edge length of its unit cell is 3.04 Å. The volume of the unit cell in cm^3 will be
a) $1.6 \times 10^{-21}\ cm^3$ b) $2.81 \times 10^{-23}\ cm^3$ c) $6.02 \times 10^{-23}\ cm^3$ d) $6.6 \times 10^{-24}\ cm^3$

25. The edge length of a face centred cubic cell of an ionic substance is 508 pm. If the radius of the cation is 110 pm, the radius of the anions is
a) 288 pm b) 398 pm c) 618 pm d) 144 pm

26. An ionic compound is expected to have tetrahedral structure if r_+/r_- lies in the range of
a) 0.414 to 0.732 b) 0.225 to 0.414 c) 0.155 to 0.225 d) 0.732 to 1

27. The interparticle forces in solid hydrogen are :
a) Hydrogen bonds b) Covalent bonds c) Co-ordinate bonds d) Van der Waals' forces

28. If Z is the number of atoms in the unit cell that represents the closest packing sequence $-ABC\ ABC\ -$, the number of tetrahedral voids in the unit cell is equal to :
a) Z b) 2Z c) $\frac{Z}{2}$ d) $\frac{Z}{4}$

29. Quartz is an example of :
a) Chain silicate b) Infinite sheet silicate c) Framework silicate d) Cyclic silicate

30. For AX ionic crystal to exist in bcc structure, the ratio of radii $\left(\frac{r_{cation}}{r_{anions}}\right)$ should be
a) Between 0.41 and 0.73 b) Greater then 0.73
c) Less than 0.41 d) Equal to 1.0

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ANSWER KEY

1)	d	2)	a	3)	a	4)	c
5)	b	6)	c	7)	d	8)	b
9)	a	10)	c	11)	b	12)	b
13)	a	14)	b	15)	c	16)	b
17)	d	18)	b	19)	b	20)	d
21)	d	22)	b	23)	d	24)	b
25)	d	26)	b	27)	d	28)	b
29)	c	30)	b				

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: HINTS AND SOLUTIONS :

1 **(d)**
Schottky defect arises when equal number of a cations and anions are missing from their sites. This defect is generally found in ionic compounds like NaCl, KCl, CsCl, etc.

2 **(a)**
Ferromagnetism is due to spontaneous alignment of the magnetic dipoles in same direction.

3 **(a)**
$f + sc = e + 2$; where f is plane faces, c is interfacial angle and e is straight edges.

4 **(c)**
This leads to stronger coulombic forces of attractions in NaF.

5 **(b)**
No. of Na atoms present at each corner $= 8 \times \frac{1}{8} = 1$
No. of O atoms present at the centre of edges $= 12 \times \frac{1}{4} = 3$
No. of W atoms present at the centre of cube $= 1$
Formula of the compound $= NaWO_3$

6 **(c)**
In antifluorite crystal (Na_2O) the anions are arranged in cubic close packing while the cations occupy all the tetrahedral voids.

7 **(d)**
All are insulator

8 **(b)**
In the given choices lithium has high thermal and electrical conductance.

9 **(a)**
Relation between radius ratio and coordination number

$\frac{r_c}{r_a}$	**Coordination number**
$0.155 - 0.225$	3
$0.225 - 0.414$	4
$0.414 - 0.732$	6
$0.732 - 1$	8

10 **(c)**
The axial angles in triclinic crystal system are different and none is perpendicular to any of the others $i.e., \alpha \neq \beta \neq \gamma \neq 90°$.

11 **(b)**
In NaCl crystal, Cl^- ions adopt cubic close packed arrangement and Na^+ ions occupy all the octahedral sites. Therefore, Na and Cl have 1 : 1 stoichiometry. In other words, each Na^+ ion is surrounded by six Cl^- ions which are disposed towards the corners of a regular octahedron. Similarly, each Cl^- ion is surrounded by six Na^+ ions.

12 **(b)**
The radius ratio for co-ordination and has 4, 6, and 8 lies in between the ranges $[0.225 - 0.414]$, $[0.414 - 0.732]$ and $[0.732 - 1]$ respectively.

13 **(a)**
$\frac{r^+}{r^-}$ for octahedral void $= 0.414$; $\frac{r^+}{r^-}$ for cubic $= 0.732 - 1$

15 **(c)**

Metallic crystals are good conductor of heat and current due to free electrons on them.

16 **(b)**

One unit cell of bcc has atoms = 2. Hence 12.08×10^{23} unit cells will have atoms

$= 2 \times 12.08 \times 10^{23}$

$= 24.16 \times 10^{23}$

17 **(d)**

The vacant spaces between the spheres in closed packed structures is called void. The voids are of two types, tetrahedral voids and octahedral voids. Also, radius of tetrahedral voids and octahedral voids are $r_{\text{void}} = 0.225 \times r_{\text{sphere}}$ and $r_{\text{void}} = 0.414 \times r_{\text{sphere}}$ respectively. Thus, octahedral void is larger than tetragonal void.

18 **(b)**

Sodium chloride (NaCl) has face centred cubic structure. It contains 4 Na^+ and 4 Cl^- in the unit cell. Each Na^+ is surrounded by 6 Cl^- ions and $vice - versa.$

19 **(b)**

The conductance order of metals is 10^6 to 10^8 $ohm^{-1}cm^{-1}$

20 **(d)**

Each possess unpaired electrons.

21 **(d)**

The radius ratio of CsCl is 0.93 hence, its structure is body centred cubic.

22 **(b)**

Schottky defects - This defect is due to vacancy at a cation site accompanied by vacancy at an anion site so that the electrical neutrality of the system is maintained. Due to this defect, density decreases.

23 **(d)**

These are characteristics of metal excess defects due to interstitial cation.

24 **(b)**

Edge length $\alpha = 3.04$ Å

$= 3.04 \times 10^{-8}$ cm

Volume of bcc (cubic) cell $= a^3$

$= (3.04 \times 10^{-8})^3$

$= 2.81 \times 10^{-23}$ cm^3

25 **(d)**

For fcc arrangement

$2(r^+ + r^-) =$ edge length

$2(110 + r^-) = 508$

So, $r^- = 114$ pm

26 **(b)**

Radius ratio(r_+/r_-)	**Structure**
< 0.155	linear
$0.155 - 0.225$	planar triangular
$0.225 - 0.414$	tetrahedral
$0.414 - 0732$	octahedral
$0.732 - 1$	bcc

27 **(d)**

Solid hydrogen involves van der Waals' forces.

28 **(b)**

In ccp or fcc and hcp, number of tetrahedral voids is double the number of atoms forming the main lattice.

29 **(c)**

Quartz is a covalent crystal having a framework of silicates, i.e., a three dimensional network when all the four oxygen atoms of each of SiO_4 tetrahedron are shared.

30 **(b)**

For body centred cubic (bcc) structure, the ratio of radii (r_+/r_-) lies in between $0.732-1.00$.

$\therefore$ The ratio of radii for bcc is greater than 0.73.