# CHEMICAL BONDING

## 12. - IONIC BOND FORMATION AND PROPERTIES

## SOLUTIONS

## TEACHING TASK

## JEE MAINS LEVEL QUESTIONS

1. Which of the following factors is NOT favorable for high solubility of an ionic compound in a solvent?
   A)High dielectric constant of the solvent
   B)Low lattice energy of the ionic compound
   C)High hydration energy of the ions
   D)High covalent character in the ionic compound

**Answer:D**

Solution:High dielectric constant reduces ion-ion attraction → favorable.
Low lattice energy means ions are less strongly held in the solid → favorable.
High hydration energy means strong ion-solvent interaction → favorable.
High covalent character in the ionic compound reduces solubility in polar solvents (less dissociation) → not favorable.

2. The crystal structure of an ionic compound is characterized by:
   **(FA & SA- 2 Marks)**
   A) Discrete molecules held by van der Waals forces
   B) A network of atoms connected by covalent bonds
   C) A regular arrangement of ions held by electrostatic forces
   D) Randomly moving ions in a sea of electrons

**Answer:C**

Solution:Ionic compounds:
Composed of cations and anions
Ions are arranged in a regular, repeating 3D lattice
Held together by strong electrostatic forces of attraction (Coulombic forces)
Analysis of options:
A) Discrete molecules with van der Waals → covalent molecular solids, not ionic
B) Network of atoms with covalent bonds → covalent network solids (like diamond), not ionic
C) Regular arrangement of ions held by electrostatic forces → correct
D) Randomly moving ions in a sea of electrons → metallic bonding, not ionic

3. Which property is NOT typically associated with ionic compounds?
   A)Good thermal conductivity in solid state
   B) High melting and boiling points
   C) Electrical conductivity in molten state

D) Crystalline nature

**Answer:A**

Solution:Typical properties of ionic compounds:

High melting and boiling points → due to strong electrostatic forces

Crystalline nature → form a regular lattice

Electrical conductivity in molten or aqueous state → ions are free to move

Poor thermal/electrical conductivity in solid state → ions are fixed in lattice

4. Which factor is MOST favorable for the formation of a stable anion?

A) Large atomic size and low electron affinity

B) Small atomic size and high electron affinity

C)High ionization potential and large atomic size

D) Low electronegativity and small atomic size

**Answer:B**

SOlution:High (positive) electron affinity strongly favors gaining an electron; many small atoms (like F) with high EA form stable anions.

5. Which statement about ionic compounds is INCORRECT?

A) They generally dissolve in polar solvents like water

B) They undergo fast reactions in aqueous solutions

C) They exist as discrete molecules in solid state

D) They don't show space isomerism due to non-directional bonding

**Answer:C**

SOlution:In solid state they form a lattice, not discrete molecules.

6. Compared to covalent molecular compounds, ionic compounds typically have:

A) Lower melting points and higher electrical conductivity in solid state

B) Higher melting points and no electrical conductivity in solid state

C)Similar melting points but higher solubility in non-polar solvents

D)Lower boiling points and higher volatility

**Answer:B**

Solution:

Ionic compounds: high melting/boiling points (strong electrostatic forces), no electrical conductivity in solid state (ions fixed), but conduct when molten/ dissolved.

Covalent molecular compounds: low melting points (weak intermolecular forces), often soluble in non-polar solvents, poor conductors.

Match options

A – False: ionic compounds have higher melting points, not lower; conductivity in solid state is low.

B – True: higher melting points, no conductivity in solid state .

C – False: solubility in non-polar solvents is low for ionic compounds.

D – False: ionic compounds have low volatility, not higher.

7. The electrical conductivity of ionic compounds in molten state is due to:

A)Movement of electrons through the crystal lattice

B)Presence of free electrons in the metal ions

C)Mobility of ions carrying electric charge
D) Delocalized p-electrons in the structure

**Answer:C**

Solution:Mobility of ions carrying electric charge.

8. Which factor would make cation formation LEAST favorable?

**(FA & SA- 3 Marks/4 Marks)**

A) Large atomic size
B) Low ionization potential
C) High nuclear charge with small size
D)Inert gas configuration after electron loss

**Answer:C**

Solution:A) Large atomic size → outer electron far from nucleus, less tightly held → ionization energy low → favorable for cation formation.
B) Low ionization potential → easy to remove electron → favorable.
C) High nuclear charge with small size → electron held tightly → high ionization energy → **unfavorable** for cation formation.
D) Inert gas configuration after electron loss → actually favorable due to stability, but here the loss itself may require high energy if it breaks an inert gas configuration — but the option says after loss, inert gas config → that's favorable (e.g., $Na^+$). So not the least favorable.

9. The most ionic compound would be formed between:

**(FA & SA- 5 Marks/8 Marks)**

A)Cs and I B)Li and I C)Cs and F D)Li and F

**Answer:C**

Solution:Larger difference in electronegativity → more ionic.
Also, according to Fajans' rule: small cation + large anion → covalent character increases; large cation + small anion → more ionic.
Electronegativity values (Pauling scale)
Cs: 0.79,Li: 0.98,F: 3.98, I: 2.66
Electronegativity differences:
Cs–I: I = 2.66, Cs = 0.79 → difference = 1.87
Li–I: Li 0.98, I 2.66 → difference = 1.68
Cs–F: Cs 0.79, F 3.98 → difference = 3.19
Li–F: Li 0.98, F 3.98 → difference = 3.00
So largest electronegativity difference is Cs–F.
$Cs^+$ is large cation, $F^-$ is small anion → ionic character maximum.

10. Among the following, which ionic compound would be expected to have the LOWEST melting point?

A)Magnesium Oxide (MgO) B)Sodium Chloride (NaCl)
C) Potassium Bromide (KBr) D)Cesium Iodide (CsI)

**Answer:D**

Solution:Melting point increases with higher charges and smaller ions.
MgO ($Mg^{2+}$, $O^{2-}$) → very high m.p.

NaCl → high m.p.
KBr → larger ions than NaCl → lower m.p.
CsI → largest ions here → lowest lattice energy → lowest m.p.

## JEE ADVANCED LEVEL QUESTIONS

**Multi correct answer type:**

1. Which of the following statements is/are TRUE regarding the electrical properties of ionic compounds?
A)They are good conductors of electricity in the solid state.
B) They conduct electricity in the molten state due to the movement of ions.
C)Their aqueous solutions can conduct electricity.
D)They are good conductors of electricity due to the presence of free electrons.

**Answer:B,C**

Solution:

A) In solid state, ions are fixed in lattice and cannot move, so poor conductors.

B) Ions become mobile when molten.

C) Ions dissociate and move in water.

D) Ionic compounds do not have free electrons (that's for metals)

2. Which of the following factors favor the formation of a stable ionic compound?
A) A large difference in electronegativity between the combining atoms.
B) Low lattice energy for the resulting crystal.
C)The formation of cations and anions with noble gas configurations.
D)Small size of the cation and large size of the anion.

**Answer:A,C**

Solution:A) True. This makes electron transfer favorable.

B) High lattice energy makes the ionic solid more stable (higher melting point, more stable crystal).

C) Ions with noble gas configurations are generally more stable (e.g., $Na^+$, $F^-$).

D) False. Small cation & large anion → high polarizability → covalent

character increases (Fajans' rule), so less ionic stability in terms of lattice energy. Actually, for maximum lattice energy (most stable ionic compound), small ions of opposite charge are best. But if the cation is small and anion large, lattice energy decreases ? less stable ionic compound. So D does not favor stability.

**Statement Type:**

A) Both statement I and II are correct and statement II is correct explanation of statement I.
B) Both statement I and II are correct and statement II is not correct explanation of statement I.
C) Statement I is correct and statement II is incorrect.

D) Statement I is incorrect and statement II is correct.

3. **Statement I** : The melting point of Magnesium Oxide (MgO) is higher than that of Sodium Chloride (NaCl).
   **Statement II** : The lattice energy of an ionic compound increases with the charge on the ions.

**Answer:A**

Solution:MgO has much higher melting point than NaCl because $Mg^{2+}$ and $O^{2-}$ give a much larger lattice energy (lattice energy scales roughly with the product of ionic charges), so II correctly explains I

4. **Statement I** : Cesium Iodide (CsI) is less ionic than Cesium Fluoride (CsF).
   **Statement II** : A large anion is more easily polarized by a cation than a small anion.

**Answer:A**

Solution:CsI is less ionic than CsF because $I^-$ is much larger and more polarizable than $F^-$; large anions are more easily polarized by the cation, increasing covalent character — so II explains

**Matrix Matching Type:**

5.

| **Column-I** | **Column-II** |
|---|---|
| a) Ionic compounds in molten state | 1.Good conductor of electricity |
| b) Ionic compounds in non-polar solvent (like $CCl_4$) | 2.Do not dissolve easily |
| c) $K_2SO_4$ and $(NH_4)_2SO_4$ | 3.Isomorphs |
| d) Universal solvent | 4. Water |

**Answer:a-1,b-2,c-3,d-4**

Solution:

| | |
|---|---|
| a) Ionic compounds in molten state | 1.Good conductor of electricity |
| b) Ionic compounds in non-polar solvent (like $CCl_4$) | 2.Do not dissolve easily |
| c) $K_2SO_4$ and $(NH_4)_2SO_4$ | 3.Isomorphs |
| d) Universal solvent | 4. Water |

**Comprehension Type:**

**Definition:**

An ionic bond is the strong electrostatic attraction between two oppositely charged ions, formed due to the transfer of electrons from one atom to an other.

Usually occurs between a metal and a non-metal.

The atom that loses electrons $\rightarrow$ cation

The atom that gains electrons $\rightarrow$ anion

Formation of an ionic bond is a redox process because one atom is oxidized and the other is reduced.

6. The fundamental reason an ionic bond forms is:

A)The sharing of electrons between two non-metal atoms.

B)The strong electrostatic attraction between positively and negatively charged

ions.
C)The transfer of protons from one atom to another.
D)The formation of a sea of delocalized electrons.

**Answer:B**

Solution:Ionic bonds form due to electrostatic attraction, not because of sharing (covalent) or delocalized electrons (metallic).

7. In the formation of an ionic compound, the atom that gains electrons:
A)Is oxidized and forms a cation.
B) Is reduced and forms a cation.
C)Is oxidized and forms an anion.
D)Is reduced and forms an anion.

**Answer:D**

Solution:Gains electrons $\rightarrow$ Reduction $\rightarrow$ Becomes negatively charged $\rightarrow$Forms anion

8. Ionic bonding most commonly occurs between:
A) Two metals
B) A metal and a non-metal
C) Two non-metals
D)A metalloid and a non-metal

**Answer:B**

Solution:Metals lose electrons $\rightarrow$form cations
Non-metals gain electrons $\rightarrow$ form anions
Opposite charges attract $\rightarrow$ Ionic bond

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## LEARNER'S TASK

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## CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ'S)

1. The driving force for the formation of an ionic bond is:
A)The mutual sharing of electron pairs
B)The attainment of a stable noble gas configuration by both atoms
C)The strong electrostatic force of attraction between cations and anions
D)The overlapping of atomic orbitals

**Answer:C**

Solution:Ionic bond forms due to transfer of electrons from a metal to a non-metal. After electron transfer: cation and anion are held together by strong electrostatic attraction.

2. In the ionic compound Magnesium Chloride ($MgCl_2$), the magnesium atom:
A) Gains two electrons and is reduced
B) Loses two electrons and is oxidized
C) Gains two electrons and is oxidized
D) Loses two electrons and is reduced

**Answer:B**

Solution:Magnesium loses 2 electrons to form $Mg^{2+}$.
Loss of electrons = oxidation.
So: loses two electrons and is oxidized.

3. Which of the following pairs of elements is MOST LIKELY to form an ionic compound?
   A)Carbon and Oxygen B)Sodium and Fluorine
   C) Nitrogen and Hydrogen D)Silicon and Chlorine

**Answer:B**

Solution:Large electronegativity difference (metal + non-metal) $\rightarrow$ ionic bonding is most likely

4. According to Fajans' rules, which factor INCREASES the covalent character in an ionic compound?
   A) Large cation size and small anion size
   B) Small cation size and large anion size
   C) Low positive charge on the cation
   D)High negative charge on the anion

**Answer:B**

Solution:Small highly polarizing cations and large easily polarizable anions increase covalent character (Fajans' rules).

5. Which ionic compound would be expected to have the LOWEST melting point?
   A) Lithium Fluoride (LiF) B) Sodium Chloride (NaCl)
   C) Potassium Bromide (KBr) D)Rubidium Iodide (RbI)

**Answer:D**

Solution:Larger ions $\rightarrow$ lower lattice energy $\rightarrow$ lower melting point.
RbI has larger ions than LiF, NaCl, KBr.

6. The compound with the HIGHEST percentage of ionic character is:
   A) Aluminum Fluoride ($AlF_3$) B)Aluminum Chloride ($AlCl_3$)
   C)Aluminum Bromide ($AlBr_3$) D)Aluminum Iodide ($AlI_3$)

**Answer:A**

Solution:The compound with the highest percentage of ionic character is A) Aluminum Fluoride ($AlF_3$).
The percentage of ionic character in a chemical bond is directly related to the difference in electronegativity between the two bonded atoms. The greater the difference, the more ionic the bond. Fluorine is the most electronegative element, and the difference in electronegativity between aluminum and fluorine is greater than the difference between aluminum and any of the other halogens (chlorine, bromine, or iodine).

7. Which energy factor is NOT directly involved in the Born-Haber cycle for ionic compound formation?
   A) Ionization energy B)Electron affinity

C) Lattice energy D)Bond dissociation energy

**Answer:D**

Solution:Ionization energy, electron affinity and lattice energy are core to the Born–Haber cycle; bond dissociation may appear only when you start from diatomic elements (so it's not a universally required term), hence it's the one listed that's not always directly involved.

8. Which of the following ions has a different noble gas configuration from the others?

A)$Na^+$ B)$F^-$ C)$O^{2-}$ D)$Ca^{2+}$

**Answer:D**

Solution:Let's check electron counts:

$Na^+$: 10 $e^-$ $\rightarrow$ Ne configuration

$F^-$: 10 $e^-$ $\rightarrow$ Ne configuration

$O^{2-}$: 10 $e^-$ $\rightarrow$ Ne configuration

$Ca^{2+}$: 18$e^-$ $\rightarrow$ Ar configuration

$Ca^{2+}$ is different.

9. During the formation of an ionic bond from gaseous ions, the potential energy of the system:

A) Increases continuously
B) Decreases and reaches a minimum at equilibrium bond distance
C) Remains constant throughout
D) Shows random fluctuations

**Answer:B**

Solution:When ions approach from infinity, attraction lowers potential energy until a minimum at equilibrium distance; closer than that, nuclear repulsion increases PE.
So: decreases and reaches a minimum at equilibrium bond distance.

10. Ionic reactions in aqueous solutions are typically fast because:

A)They involve the formation of covalent bonds
B) They occur between pre-formed ions that simply associate or dissociate
C) They require high activation energy
D)They involve complex reaction mechanisms

**Answer:B**

Solution:Ionic reactions involve pre-formed ions in solution
They simply collide and react, no need to break strong bonds
Low activation energy $\rightarrow$ fast reaction

## JEE MAINS LEVEL QUESTIONS

1. Which of the following pairs of elements is most likely to form an ionic compound?
   A) Carbon and Oxygen
   B) Sodium and Fluorine
   C) Nitrogen and Hydrogen
   D) Silicon and Chlorine

**Answer:B**

Solution:Ionic compounds typically form between metals and nonmetals.

A) Carbon and Oxygen → both nonmetals → covalent.

B) Sodium and Fluorine → metal + nonmetal → ionic.

C) Nitrogen and Hydrogen → both nonmetals → covalent.

D) Silicon and Chlorine → metalloid + nonmetal → usually covalent.

Sodium (metal) and Fluorine (nonmetal) form NaF, a strongly ionic compound.

2. The high solubility of Ionic compounds like Potassium Iodide (KI) in water is primarily due to: **(FA & SA- 2 Marks)**
   A) The covalent character of the bond in KI.
   B) The high lattice energy of KI.
   C) The strong ion-dipole interactions between $K^+/I^-$ ions and water molecules.
   D) The low melting point of KI.

**Answer:C**

Solution:Ionic compounds dissolve in water because water molecules stabilize the ions through ion-dipole interactions.

Lattice energy must be overcome, but hydration energy compensates for it

3. The correct order of increasing melting points for the following ionic compounds is:
   A) MgO < CaO < SrO < BaO
   B) BaO < SrO < CaO < MgO
   C)SrO < BaO < MgO < CaO
   D)CaO < BaO < SrO < MgO

**Answer:B**

Solution: All are $M^{2+}O^{2-}$; smaller cation → stronger lattice (higher melting). $Mg^{2+}$ (smallest) → highest mp, $Ba^{2+}$ (largest) → lowest mp.

4. An ionic compound $A^+B^-$ has a lattice energy of -800 kJ/mol. If the same cation $A^+$ forms a compound with a smaller anion $C^-$ ($A^+C^-$), its lattice energy would be: **(FA & SA- 3 Marks/4 Marks)**
   A) Less negative than -800 kJ/mol
   B) Exactly -800 kJ/mol
   C) More negative than -800 kJ/mol
   D) Impossible to predict without more data

**Answer:C**

Solution:Smaller anion → smaller interionic distance → more negative (larger

magnitude) lattice energy.

5. Among the following, the compound with the highest percentage of ionic character is:
A) $AlCl_3$ B) LiF C) CsI D)BeO

**Answer:B**

Solution:LiF: small cation, small anion, large electronegativity difference $\rightarrow$most ionic.

BeO has higher charge but more covalent due to polarization.

6. The Born-Haber cycle is used for the calculation of:
A)The electron affinity of an atom.
B)The covalent bond energy in a molecule.
C)The lattice energy of an ionic compound.
D)The ionization potential of a gaseous atom.

**Answer:C**

Solution:The Born–Haber cycle is a thermodynamic cycle that applies Hess's law to calculate the lattice energy of an ionic compound from other measurable quantities (ionization energy, electron affinity, sublimation energy, bond dissociation energy, and enthalpy of formation).

7. Which of the following statements correctly explains why Calcium Oxide (CaO) has a higher melting point than Potassium Chloride (KCl)?
A)The $K^+$ ion is smaller than the $Ca^{2+}$ ion.
B) The $O^{2-}$ ion has a higher charge magnitude than the $Cl^-$ ion.
C)The lattice energy of CaO is lower than that of KCl due to a larger interionic distance.
D)The lattice energy of CaO is higher than that of KCl due to higher charges on the ions ($Ca^{2+}$ and $O^{2-}$).

**Answer:D**

Solution: The lattice energy of CaO is higher than that of KCl due to higher charges on the ions ($Ca^{2}$+ and $O^{2}$-)
Explanation:
Lattice energy: This refers to the energy required to completely separate one mole of a solid ionic compound into its gaseous ions.
Higher charge = stronger attraction: Ions with higher charges exert a stronger electrostatic attraction towards each other, resulting in a higher lattice energy.

8. According to Fajans' rule, an ionic compound is likely to develop significant covalent character if:
A)The cation is small and has a high positive charge.
B)The anion is large and has a high negative charge.
C)Both (1) and (2) are correct.

**Answer:C**

Solution:Small, highly charged cations (high polarizing power) and large, highly charged anions (high polarizability) both increase covalent character.

9. The covalent character in an ionic compound is influenced by polarizing power and polarizability. For the compounds LiCl, NaCl, and KCl, the correct order of increasing covalent character is: **(FA & SA- 5 Marks/8 Marks)**

A) LiCl < NaCl < KCl
B) KCl < NaCl < LiCl
C) NaCl < KCl < LiCl
D) LiCl < KCl < NaCl

**Answer:B**

Solution:Covalent character increases as cation size decreases ($Li^+$ most polarizing $\rightarrow$ LiCl most covalent

10. The theoretical and experimental lattice energy values for Silver Chloride (AgCl) and Sodium Chloride (NaCl) were compared. It was found that the difference between the two values is significantly larger for AgCl than for NaCl. This observation is best explained by:

A)AgCl has a lower melting point than NaCl.
B)$Ag^+$ ion has a higher polarizing power than $Na^+$, introducing greater covalent character in AgCl.
C)The ionic radius of $Ag^+$ is much larger than that of $Na^+$.
D)Chloride ion ($Cl^-$) is more easily polarized by $Na^+$ than by $Ag^+$.

**Answer:B**

Solution:$Ag^+$ (with its relatively small size and filled $d^{10}$ configuration) strongly polarizes $Cl^-$, distorting its electron cloud. This increases covalent character in AgCl, making the experimental lattice energy lower than the purely ionic theoretical value. Hence, the discrepancy is larger.

## JEE ADVANCED LEVEL QUESTIONS

**Multi correct answer type:**

11. Which of the following statements is/are correct about the properties of ionic compounds?

A) They are generally soluble in non-polar solvents like benzene.
B) They conduct electricity in the molten state.
C) They have high melting and boiling points.
D) The bond formed is non-directional.

**Answer:B,C,D**

Solution:A) False (soluble in polar solvents, not non-polar).
B) True (ions are mobile).
C) True (strong electrostatic forces).
D) True (electrostatic attraction acts in all directions).

12. For the ionic compound Magnesium Oxide (MgO), which of the following factor(s) contribute to its very high lattice energy?

A) The small ionic radius of the $Mg^{2+}$ ion.
B) The small ionic radius of the $O^{2-}$ ion.

C) The +2 charge on the cation.
D) The -2 charge on the anion.

**Answer:A,B,C,D**

Solution:A) Small ionic radius of $Mg^{2+}$ → True (small cation increases lattice energy).
B) Small ionic radius of $O^{2-}$ → True (small anion increases lattice energy).
C) +2 charge on cation → True (higher charge increases lattice energy).
D) –2 charge on anion → True (higher charge increases lattice energy).

**Statement Type:**

A) Both statement I and II are correct and statement II is correct explanation of statement I.
B) Both statement I and II are correct and statement II is not correct explanation of statement I.
C) Statement I is correct and statement II is incorrect.
D) Statement I is incorrect and statement II is correct.

13. **Statement I** : The melting point of Magnesium Oxide (MgO) is higher than that of Sodium Chloride (NaCl).
**Statement II** : The lattice energy of MgO is significantly higher than that of NaCl due to the higher magnitude of charges on its ions.

**Answer:A**

Solution:MgO has $Mg^{2+}$ and $O^{2-}$ (±2 charges) while NaCl has ±1 charges. Lattice energy scales with the product of ionic charges, so MgO's lattice energy is much larger — this higher lattice energy explains its higher melting point.

14. **Statement I** : Silver Chloride (AgCl) has a much lower solubility in water than Sodium Chloride (NaCl).
**Statement II** : The $Ag^+$ ion has a high polarizing power which introduces significant covalent character in the Ag-Cl bond, reducing its interaction with polar water molecules.

**Answer:A**

Solution:$Ag^+$ is a relatively polarizing cation (smallish and with electronic structure that polarizes $Cl^-$), which induces partial covalent character in AgCl. That increased covalency reduces effective ion–dipole interactions with water and lowers solubility compared with the more purely ionic NaCl

**Matrix Matching Type:**

**14.**

| **Column-I** | **Column-II** |
|---|---|
| (a) Correct order of polarizing power | (1) LiF < LiCl < LiBr < LiI |
| (b) Correct order of covalent character | (2) $Li^+ > Mg^{2+} > Al^{3+}$ |
| (c) Correct order of lattice energy | (3) MgO > CaO > SrO |
| (d) Correct order based on Fajans' rule for a common anion | (4) $Na^+ < Mg^{2+} < Al^{3+}$ |

**Answer:a-4,b-1,c-3,d-2**

Solution:

| | |
|---|---|
| (a) Correct order of polarizing power | (4) $Na^+ < Mg^{2+} < Al^{3+}$ |
| (b) Correct order of covalent character | (1) LiF < LiCl < LiBr < LiI |
| (c) Correct order of lattice energy | (3) MgO > CaO > SrO |
| (d) Correct order based on Fajans' rule for a common anion | (2) $Li^+ > Mg^{2+} > Al^{3+}$ |

**Comprehension Type:**

1) Ionic compounds exist as solids. since electrostatic forces of attraction are extending in all directions, each ion tends to gather as many of opposite kind ions around it self.
2) A nonbonding array of alternate positive and negative ions exist. As a result no isolated decrete molecule exist in the Crystal in lattice, gaint molecules are formed in the crystal.
3) Ionic compounds have high melting points and high boiling points. (Melting pint of NaCl = 803°C)
4) Ionic compounds dissolve in polar solvents.
5) Ionic compounds are good electrical conductors in molten state (or) in aqueous solutions.

15. The fundamental reason why ionic compounds, such as Sodium Chloride (NaCl), exist as solids at room temperature and form a giant crystal lattice is:
A) They have low melting and boiling points.
B)The electrostatic forces of attraction between ions extend in all directions.
C) They are composed of discrete, isolated molecules.
D) They are highly soluble in non-polar solvents.

**Answer:B**

Solution:A) Low melting/boiling points → false (they have high m.p./b.p.).
B) Electrostatic forces extend in all directions →true (this leads to a 3D lattice).
C) Composed of discrete molecules → false (they form a lattice, not molecules).
D) Highly soluble in non-polar solvents → false (soluble in polar solvents).

16. Which of the following statements correctly explains the electrical conductivity of ionic compounds?
A) They are good conductors in the solid state due to the presence of free electrons.
B) They are good conductors in the molten state or in aqueous solution due to the presence of mobile ions.
C) They are poor conductors in aqueous solution because the ions are neutralized by water.
D) They are good conductors in all states due to their metallic character.

**Answer:B**

Solution:A) Good conductors in solid state due to free electrons →false (ions fixed in solid state; no free electrons).
B) Good conductors in molten state or aqueous solution due to mobile ions →true.
C) Poor conductors in aqueous solution because ions are neutralized by water → false (ions are mobile in water, conductivity is high).
D) Good conductors in all states due to metallic character → false (not metallic).

**Integer type:**

17. The total number of electrons lost by one atom of Aluminum (Al) to form an $Al^{3+}$ ion is _____.

**Answer:3**

Solution:Aluminum has atomic number 13 $\rightarrow$ electronic configuration: 2, 8, 3
It loses 3 valence electrons to achieve the stable noble gas configuration (Ne)

18. In the formation of the ionic compound Magnesium Nitride ($Mg_3N_2$), the total number of electrons transferred to form one formula unit of the compound is _____.

**Answer:6**

Solution:Magnesium Nitride: $Mg_3N_2$
$Mg \rightarrow Mg^{2+}$ (loses 2 electrons each)
$N \rightarrow N^{3-}$ (gains 3 electrons each)
For $Mg_3N_2$:
3 Mg atoms lose: 3 × 2 = 6 electrons
2 N atoms gain: 2 × 3 = 6 electrons
Total electrons transferred = 6

## KEY

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|---|---|---|---|---|---|---|---|---|---|
| | | | TEACHING TASK | | | | | | |
| | | | JEE MAINS LEVEL QUESTIONS | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| D | C | A | B | C | B | C | C | C | D |
| | | | JEE ADVANCED LEVEL QUESTIONS | | | | | | |
| 1 | 2 | 3 | 4 | 5 | | 6 | 7 | 8 | |
| B,C | A,C | A | A | a-1,b-2,c-3,d-4 | | B | D | B | |
| | | | | LEARNER'S TASK | | | | | |
| | | | CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ'S) | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| C | B | B | B | D | A | D | D | B | B |
| | | | JEE MAINS LEVEL QUESTIONS | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| B | C | B | C | B | C | D | C | B | B |
| | | | JEE ADVANCED LEVEL QUESTIONS | | | | | | |
| 11 | 12 | 13 | 14 | 14 | | 15 | 16 | 17 | 18 |
| B,C,D | AB,C,D | A | A | a-4,b-1,c-3,d-2 | | B | B | 3 | 6 |