

Chemical Bonding

Ionic Bond Formation and Properties

Teaching Task

JEE Main Level Questions

Q1)

Ans:- 4

Solution:- In ionic compounds, if they have to dissolve in water, hydration energy must be greater than lattice energy of ionic compound. Lesser the lattice energy, more is the solubility.

Q2)

Ans:- 2

Solution:- Ionic compounds are solids held by the strong forces of attraction called electrostatic forces between the positive and negative ions.

Q3)

Ans:- 4.

Solution:- As the ionic bond is non-directional, ionic compounds do not show space isomerism or stereo isomerism.

Q4)

Ans:- 4.

Solution:- The atoms with high values of EN and EA form anion readily and hence form ionic compounds.

→ Anions with low low negative charge are more ionic.

→ Anions which have inert gases configuration in its valence shell readily form ionic compounds

Q5) Ans:- 3.

Solution:- Ionic compounds are generally soluble in water, but insoluble in organic solvents.

The principle involved is like dissolves like i.e, ionic compounds are polar & water is polar solvent.

Q6) Ans:- 4.

Solution:- As compared with covalent compounds, electrovalent compounds generally have high melting and high boiling points, due to strong electrostatic forces of attractions.

Q7) Ans:- 4.

Solution:- An electrovalent compound is made up of electrically charged ions or group of ions.

E.g:- NaCl made of Na^+ and Cl^- ions.

Q8) Ans:- 1.

Solution:- An atom which have low ionisation energy loses electrons to form cation readily and can form ionic compounds easily.

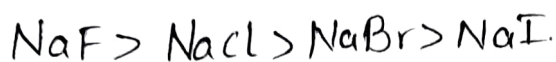
Q9) Ans:- 2

Solution:- Ionic character $\propto E.N$ ($F > Cl > Br > I$)
 $\propto \frac{1}{\text{size of atom.}} (F < Cl < Br < I)$

Q10)

Ans:-1

Solution:- Sodium fluoride is more ionic than other because of its higher E.N and small size.
Ionic character



JEE Advanced Level Questions

Q1)

Ans:- 1, 2

Solution:- Ionic compounds are hard solids due to strong electrostatic force of attraction b/w oppositely charged ions.

→ Ionic compounds can be broken down into small pieces by applying pressure or heat.

Q2) Ans:- 1, 2, 3.

Solution:- Ionic compounds exist as solids, they have high melting and boiling points.

→ Ionic reactions are fast in aqueous solution,

because no breaking of bond takes place as the ions are in free state.

Q3) Ans:- 1.

Solution:- KF is more ionic than NaCl, because

Compounds having large cation & small anion are more ionic than compounds having small cation & large anion.

Q4) Ans:- A.

Solution:- NaCl is a poor conductor of electricity in the solid state because the ions in solid NaCl are fixed in place in rigid lattice structure, and there are no free ions to move.

Q5) Ans:- a) 1 b) 2 c) 3 d) 4.

a) Ionic compounds in aqueous $\rightarrow$ 1) Good conductors of Electricity.

b) Ionic compounds in solid state $\rightarrow$ 2) Bad conductors of Electricity.

c) $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ & $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ $\rightarrow$ 3) Isomorphs
[They form the same type of crystals & have similar properties].

d) Best polar solvent $\rightarrow$ 4) Water.

Q6) Ans:- 2

Solution:- In AlF_3 , aluminium donates electrons to fluorine, forming ionic bonds.

Q7) Ans:- 1.

Solution:- KF is more ionic because the EN difference is high b/w potassium & Fluorine than other compounds.

Learner's Task

Conceptual Understanding Questions

Q1) Ans:- 1.

Solution:- Ionic bond is formed between a metal and a non-metal.

Q2) Ans:- 1.

Solution:- During the formation of an ionic bond, one atom donates an electron to form a cation (oxidation), while another atom accepts the electron (reduction). So ionic bond is a redox reaction.

Q3) Ans:- 2

Solution:- NaH , K_2O and CaCl_2 are ionic compounds. Carborundum (SiC) is a covalent molecule because electronegativity difference b/w silicon and carbon is very less.

Q4) Ans:- 4

Solution:- Smaller the size of cation, more is the polarising power of cation. Larger the size of the anion, more is its polarisability. Hence, lesser is the ionic character, more is the covalent character.

Q5) Ans:- 4.

Solution:- Al^{3+} is highly charged in nature & it can polarise the electron clouds of Cl to a large extent. So, electrons get shared b/w the two ions. Hence the compound is a covalent one, but the bond is polar covalent.

Q6) Ans:- 4.

Solution:- CsF is more ionic.

→ Larger cation and small anion forms most ionic bond.

Q7) Ans:- 2.

Solution:- The stability of an ionic compound is mainly influenced by lattice energy, which is the amount of energy required to break an ionic lattice into its constituent ions. The greater the lattice energy, the more stable the ionic compounds.

Q8) Ans:- 4.

Solution:- $H = 1s^1 \rightarrow$ It wants to gain 1 electron to get He configuration.

$Li = 1s^2 2s^1 \rightarrow$ It wants to lose 1 electron to get He configuration.

$Be = 1s^2 2s^2 \rightarrow$ Be wants to lose 2 electrons to get He configuration.

Q9) Ans:- 2

Solution:- Bond forms to get stability. Stability will be maximum at low potential energy. So, in bond formation, atoms lose their potential energy to get stabilized.

$$\text{Stability} \propto \frac{1}{\text{Energy}}$$

Q10) Ans:- 1.

Solution:- Ionic reactions are fast reactions since no breaking of bond takes place as the ions are in free state.

JEE Main level Questions

Q1) Ans:- 1, 2, 3.

Solution:- Favourable Conditions for Ionic bond

→ low ionisation potential.

→ High electron affinity.

→ Ionic bond formed b/w metals & non-metals.

→ Generally oxides (Na_2O), halides (NaCl), sulphides (CaS) of alkali and alkaline earth metals act as ionic bond.

Q2) Ans:- 1.

Solution:- Favourable conditions for ionic bond are,

→ Low charge on ions → Large Cation.

→ Small anion.

Q3) Ans:- 2.

Solution:- In aqueous solution (or) molten state, ionic compounds are good conductors of electricity due to presence of free ions. So fused NaCl is a good conductor of electricity.

Q4) Ans:- 3.

Solution:- Fused ionic compounds conduct electricity because they contain free ions.

Q5) Ans:- 1.

Solution:- The ionic bond is non directional, ionic compounds do not show space isomerism or stereo isomerism.

Q6) Ans:- 3.

Solution:- Higher lattice energy indicates stronger attraction b/w ions in the crystal lattice, requires more energy to break these bonds and melt the compound.

→ Lower lattice energy means weaker attractions b/w ions, so it has low melting point.

Q7) Ans:- 3.

Solution:- Because of strong electrostatic force of attractions b/w ions in ionic bond, ionic compounds have high melting and boiling points.

Q8) Ans:- 4.

Solution:- The favourable conditions to form cation are,

- Large atomic size
- Low charge on ion.
- Low ionisation potential.

Q9) Ans:- 1, 2, 3, 4.

Solution:- Atom can lose or gain a variable number of electrons, typically ranging from 1 to 4, depending on their position in the periodic table and their tendency to achieve a stable electronic configuration.

Q10) Ans:- 3, 4.

Solution:- The formation of a cation is an endothermic process, meaning it absorbs energy.

Q11) Ans:- 4.

Solution:- As the ionic bond is non directional, ionic compounds do not show space isomerism or stereo isomerism.

Q12) Ans:- 1

Solution:- Ca^{+2} ion is more stable than Zn^{+2} , it is due to the inert gas configuration in Ca^{+2} ion where as in Zn^{+2} ion pseudo inert gas configuration is present.

Q13)

Ans:- a) 2 b) 1 c) 4 d) 3.

Solution:-

a) Formation of Cation $\rightarrow$ 2) $Al^{+3} < Mg^{+2} < Na^{+}$.

b) Ionic bond $\rightarrow$ 1) Redox process.

c) Formation of anion $\rightarrow$ 4) $F^{-} > Cl^{-} > Br^{-} > I^{-}$

d) Lattice energy $\rightarrow$ 3) Energy released for stability.

Q14)

Ans:- 2

Solution:- The stability of ionic compounds is influenced by lattice energy, which is higher for ions with higher charges & smaller ionic radii. MgO has ions with higher charges (Mg^{2+} and O^{2-}) and smaller sizes compared to the other compounds listed.

Q15)

Ans:- 1

Solution:- Ionic compounds do not exhibit space isomerism because ionic bonds are non directional in nature.

Integer Type

Q16)

Ans:- 1

Solution:- NaF.

$Na = 11 = 1s^2 2s^2 2p^6 3s^1$, $F = 9 = 1s^2 2s^2 2p^5$.

Na gives 1 electron to F to get stable configuration.

Q17)

Ans:- 3.

Solution:- Aluminium Fluoride (AlF_3) is more electrovalency metal. The electrovalency of Al is +3.