

Aluminium Chloride Chemistry Questions with Solutions

Q-1: Which of the following is produced by using aluminium chloride in electrophilic substitution reactions?

- a) Electron
- b) Electrophile
- c) Nucleophile
- d) Arenium Ion

Answer: b) Electrophile

Explanation: Aluminium chloride in electrophilic substitution reactions is used to generate electrophile.

Q-2: 3AlCl_3 represents

- a) 3 atoms of AlCl_3
- b) 3 molecules of AlCl_3
- c) 3 atoms of Al
- d) 3 moles of Cl

Answer: b) 3 molecules of AlCl_3

Explanation: 3AlCl_3 is three molecules or three moles of Aluminium Chloride, which contains three molecules or three moles of Aluminium and nine molecules or nine moles of Chlorine. We can't say three atoms of Aluminium Chloride because it's a compound made up of different atoms.

Q-3: Is AlCl_3 a homonuclear or heteronuclear compound?

Answer: A molecule can be homonuclear, which means it is made up of atoms from only one chemical element, or it can be heteronuclear, which means it is made up of atoms from more than one chemical element. Since AlCl_3 is made up of Aluminium and Chlorine atoms, therefore it's a heteronuclear compound.

Q-4: How does AlCl_3 overcome its electron deficiency?

Answer: AlCl_3 overcomes its deficiency by forming a dimer, as dimerisation results in the attainment of an octet of electrons in the valence shell of an aluminium atom.

Q-5: What happens when the aluminium chloride dimer is dissolved in water?

Answer: When the halides are dissolved in water, the high enthalpy of hydration is sufficient to break the covalent dimer into $[\text{M}.6\text{H}_2\text{O}]^{3+}$ and 3X^- ions.

Q-6: Which of the following holes is occupied by Al^{3+} at low temperatures?

- a) Tetrahedral
- b) Octahedral

- b) Both the above
- d) Cubical

Answer: b) Octahedral

Explanation: At low temperatures, AlCl_3 exists as a closed packed lattice of Cl^- with Al^{3+} occupying octahedral holes.

Q-7: What are the various uses of Aluminium Chloride?

Answer:

- It is used in the production of lubricants, rubber, paints, wood preservatives, and petrochemicals such as ethylbenzene.
- Aluminium chloride is used in the polymerization and isomerization of light-weighted hydrocarbons, such as the synthesis of ethylbenzene.
- Many chemical reactions use aluminium chloride as a catalyst. It is used to make anthraquinone from benzene and phosgene.
- To create arene metal complexes, aluminium chloride is combined with aluminium and arene.

Q-8: Can aluminium chloride undergo back bonding?

Answer: No, aluminium chloride cannot undergo back bonding because a second period element is required for back bonding to occur. Because aluminium and chlorine are both third period elements, backbonding cannot occur in this molecule.

Q-9: Aluminium Chloride is hygroscopic in nature because it can

- a) React with water
- b) Absorb moisture
- c) Sublime easily
- d) Absorb gases

Answer: b) Absorb moisture

Explanation: Hygroscopic refers to a matter's ability to absorb water from the surrounding environment. Aluminium chloride is deemed to be hygroscopic, where it can absorb moisture from the air.

Q-10: Is aluminium chloride dangerous to human beings?

Answer: Aluminium chloride is a highly corrosive and toxic substance. If inhaled or touched, it can cause severe damage to the eyes, skin, and respiratory systems.

Q-11: How many chlorine atoms are there in one mole of aluminium chloride?

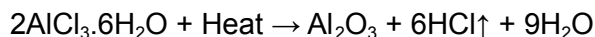
Answer: One mole of aluminium chloride contains Avogadro's number (6.022×10^{23}) of atoms. In AlCl_3 , there are three chlorine atoms. Thus, one mole of aluminium chloride will contain $3 \times 6.022 \times 10^{23}$ atoms = 18.066×10^{23} atoms of chlorine.

Q-12: Which gas is formed when aluminium chloride hexahydrate is heated?

- a) HCl
- b) H₂
- c) Cl₂
- d) O₂

Answer: a) HCl

Explanation: When aluminium chloride hexahydrate is heated, the following reaction takes place:



We can clearly see that HCl gas is being evolved out.

Q-13: In the gas phase, how does aluminium chloride exist?

- a) Polymer
- b) Dimer
- c) Tetramer
- d) None of the above

Answer: b) Dimer

Explanation: Aluminium chloride are dimers in the gas phase. Al₂Cl₆ is the dimer of aluminium chloride in the gas phase.

Q-14: Is AlCl₃ soluble in water?

Answer: AlCl₃ is a colourless crystalline solid which is soluble in water.

Q-15: Which of the following is an important Ziegler Natta catalyst?

- a) Solution of AlEt₃+ TiCl₄
- b) Solution of AlCl₃+ TiCl₃
- c) Solution of Al₂Cl₆+ TiCl₄
- d) Solution of Al₂(CH₃)₆+ TiCl₄

Answer: a) Solution of AlEt₃+ TiCl₄

Explanation: Ziegler Natta catalyst is used for the polymerisation of ethene to form polythene and a solution of AlEt₃+ TiCl₄ in a hydrocarbon solvent is an important Ziegler Natta catalyst.

Practice Questions on Aluminium Chloride

Q-1: Aluminium chloride is a _____.

- a) Bronsted Acid
- b) Bronsted Base
- c) Lewis Acid
- d) Lewis Base

Answer: c) Lewis Acid

Explanation: A Lewis acid is a chemical species with an empty orbital that can accept an electron pair from a Lewis base to form a Lewis adduct. Aluminium can accept electrons from the Lewis base because it has empty 3d orbitals. As a result, it acts as a Lewis acid.

Q-2: The reaction of benzene with ethanoyl chloride produces electrophile in the presence of Lewis acids, AlCl_3 . Show the mechanism for this.

Answer: The generation of electrophile by lewis acid (AlCl_3) is shown below:



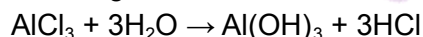
Q-3: What are the various physical properties of Aluminium Chloride?

Answer:

- Aluminium chloride has extremely low melting and boiling points.
- AlCl_3 is a poor conductor of electricity when molten.
- Although aluminium chloride is white in colour, it is frequently contaminated with iron trichloride, which causes it to turn yellow.
- Only at pressures greater than 2.5 atm and temperatures greater than 190°C is it liquid.

Q-4: What is the nature of the aqueous solution of Aluminium chloride?

Answer: Aluminium chloride aqueous solution is acidic in nature. This can be explained using the following reaction:



This HCl formation makes the solution acidic and the pH of the solution decreases gradually.

Q-5: Which of the following contains the 3c-4e bond?

- $\text{Al}_2(\text{CH}_3)_6$
- Al_2Cl_6
- AlCl_3
- All of the above

Answer: b) Al_2Cl_6

Explanation: Al_2Cl_6 contains a 3c-4e bond. The Al-Cl-Al bond is a 3c-4e bond. Remember that a 3c-4e bond can only exist if the bridging atom has a lone pair of electrons. Because chlorine has a lone pair of electrons, it can form a bridging Al-Cl-Al, a 3c-4e bond.

