CBSE Class 11 Chemistry Notes Chapter 10: Class 11 Chemistry, Chapter 10 talks about the s-Block elements. These elements are important because they help us understand the properties of alkali metals and alkaline earth metals.

The notes cover things like their electronic setup, where they're found, and what they're like physically and chemically.

We also learn about how they react with other elements and how their properties change in a group. These elements have many practical uses, so it is important to understand them well.

CBSE Class 11 Chemistry Notes Chapter 10 The s-Block Elements PDF

You can access the CBSE Class 11 Chemistry Notes for Chapter 10 on The s-Block Elements through the provided PDF link. These notes are a valuable resource for students studying this chapter as they cover important concepts, properties, and reactions of alkali metals and alkaline earth metals.

By referring to these notes, students can enhance their understanding of the s-Block elements and prepare effectively for their examinations.

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Alkali Metals (Group 1)

Alkali metals belong to Group 1 of the periodic table, which includes elements like lithium (Li), sodium (Na), potassium (K), rubidium (Rb), cesium (Cs), and francium (Fr). These metals are highly reactive and are typically soft, silvery-white metals.

They have low melting and boiling points compared to other metals and are excellent conductors of heat and electricity.

Alkali metals readily lose their outermost electron to form ions with a +1 oxidation state, making them highly reactive with water and oxygen. Their reactivity increases down the group, with francium being the most reactive alkali metal. Alkali metals are widely used in various applications, including the production of alkali metal compounds, batteries, and industrial processes.

Atomic Size

In Group 1 of the periodic table, the atomic size increases as you move down the group. This is because as you move down the group, additional electron shells are added, leading to an increase in the atomic radius. Therefore, the atoms become larger as you progress from the top to the bottom of the group.

Oxidation State

Elements in Group 1 typically exhibit a +1 oxidation state. This means that they tend to lose one electron to achieve a stable electron configuration. This common oxidation state is a characteristic feature of Group 1 elements.

Density

Alkali metals generally have low density due to their relatively large atomic size. Density is calculated by dividing the atomic mass by the atomic volume. As you move down Group 1, both the atomic mass and volume increase. However, the increase in atomic mass outweighs the increase in volume, leading to an overall increase in density from lithium to cesium. An exception to this trend is sodium, which has a higher density than potassium despite its position in the group.

Order of Density (from least to greatest):

Lithium < Potassium < Sodium < Rubidium < Cesium

Nature of Bonds

In Group 1 elements, the nature of bonding is predominantly metallic. This is because alkali metals have one valence electron, which is loosely held by the nucleus. As a result, these electrons are free to move throughout the metal lattice, creating a "sea of electrons" that can conduct electricity.

Alkali metals readily form ionic bonds with non-metals, particularly halogens (Group 17 elements). In these compounds, alkali metals lose their valence electron to form positively charged ions (cations), while non-metals gain electrons to form negatively charged ions (anions). The electrostatic attraction between these ions leads to the formation of ionic bonds.

Overall, the bonding in alkali metal compounds can be characterized by a combination of metallic bonding within the metal lattice and ionic bonding between the metal cations and non-metal anions.

Electrode Potential

The electrode potential of a metal in water gauges its inclination to donate electrons. Standard electrode potential is determined when the concentration of metal ions equals one. Lithium, despite having the highest ionization potential, also exhibits the highest electrode potential due to its significant hydration energy.

Hydration of Ions

Ions possess varying degrees of hydration depending on their size. Consequently, as one moves down the group from Li^+ to Cs^+, the degree of hydration decreases, leading to a decline in electrical conductivity as hydration increases.

Lattice Energy

Ionic solids constitute alkali metal salts, and the lattice energy of these salts with a common anion diminishes as the group descends.

Solubility in Liquid Ammonia

In dilute alkali metal solutions in liquid ammonia, the predominant species are solvated metal ions and solvated electrons. The presence of solvated electrons allows these solutions to conduct electricity, and their paramagnetic nature arises from the inclusion of free electrons. The blue coloration of the solution fades over time due to the formation of metal amide.

Basic Nature, Ionic Nature of the Oxides

Basic Nature:

The oxides of alkali metals are predominantly basic in nature. They readily react with water to form hydroxides, leading to an increase in the concentration of hydroxide ions in the solution. This property indicates their ability to accept protons, thus exhibiting basic behavior.

Ionic Nature:

Alkali metal oxides are primarily ionic compounds composed of metal cations and oxide anions. Due to the large difference in electronegativity between the metal and oxygen, electrons are transferred from the metal atoms to the oxygen atoms, resulting in the formation of ions. This ionic character contributes to their high melting and boiling points, as well as their tendency to form stable crystal lattices.

Compounds of Alkali Metal

Hydroxides: Alkali metals readily react with water to form hydroxides, such as sodium hydroxide ($NaOH$) and potassium hydroxide (KOH). These hydroxides are strong bases and are commonly used in various industrial processes and chemical reactions.

Halides: Alkali metals form halides, including fluorides, chlorides, bromides, and iodides. These compounds are highly ionic and soluble in water. For example, sodium chloride (NaCl) and potassium iodide (KI) are common halides of alkali metals.

Carbonates and Bicarbonates: Alkali metals react with carbon dioxide to form carbonates (e.g., sodium carbonate, Na_2CO_3) and bicarbonates (e.g., sodium bicarbonate, $NaHCO_3$). These compounds are important in various applications, such as in baking and as antacids.

Nitrates: Alkali metals form nitrates, such as sodium nitrate ($NaNO_3$) and potassium nitrate (KNO_3). These compounds are commonly used in fertilizers and as oxidizing agents in various chemical processes.

Sulfates: Alkali metals react with sulfuric acid to form sulfates, such as sodium sulfate (Na_2SO_4) and potassium sulfate (K_2SO_4). These compounds have various industrial applications, including in the manufacture of detergents and as electrolytes in batteries.

Oxides: Alkali metals react with oxygen to form oxides, such as sodium oxide (Na_2O) and potassium oxide (K_2O). These compounds are basic in nature and react with water to form hydroxides.

Carbonates and Bicarbonates

Solid bicarbonates are formed by Group 1 metals ($MHCO_3$), while M_2CO_3 carbonates are formed by all alkali metals. The carbonates and bicarbonates of alkali metals are extremely heat-stable due to their electropositive character, although Li_2CO_3 decomposes easily under heat.

The unusual behavior of Li_2CO_3 can be explained by lithium's small size and high polarization, which disrupts the electron cloud of the nearby oxygen atom of the large CO_3^{2-} ion, weakening the carbon-oxygen bond.

$Li_2CO_3 \rightarrow Li_2O + CO_2$ $Li_2CO_3 \rightarrow Li_2O + CO_2$

When a smaller carbonate ion replaces a larger one, the lattice energy increases, favoring breakdown.

$M_2CO_3 \rightarrow M_2O + CO_2\uparrow$ $M_2CO_3 \rightarrow M_2O + CO_2\uparrow$

Sodium carbonate (Na_2CO_3) is used as washing soda, while sodium bicarbonate ($NaHCO_3$) is used in baking. Both $NaHCO_3$ and $KHCO_3$ have hydrogen bonds in their crystal structures. The HCO_3^- in $NaHCO_3$ forms an endless chain, whereas $KHCO_3$ forms a dimeric anion.

Reactions:

$\mathbf{2HNO_3 + K_2CO_3 \rightarrow 2KNO_3 + CO_2 + H_2O}$ $\mathbf{2HNO_3 + K_2CO_3 \rightarrow 2KNO_3 + CO_2 + H_2O}$

$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$2NaHCO3→Na2CO3+H2O+CO2

$M_2CO_3 + H_2O \rightleftharpoons 2M^+ + HCO_3^- + OH^-$M2CO3+H2O⇌2M++HCO3−+OH

Anomalous Behaviour of Lithium

Although lithium shares many properties with other Group I elements, it also exhibits several distinctive characteristics due to its incredibly small size. The high charge density of the lithium ion, stemming from its small size, grants it the most polarizing power among all alkali metal ions.

This strong polarizing power exerts a significant distorting effect on negatively charged ions, leading to a pronounced propensity for solvation and the formation of covalent bonds. Interestingly, lithium's polarizing power resembles that of the magnesium ion, resulting in similar properties between the two elements.

In comparison to other Group I elements, lithium presents notable differences. It is significantly harder, akin to magnesium, and possesses higher melting and boiling points. Lithium is also the least reactive of the group, remaining unaffected by air, decomposing water slowly, and exhibiting rare reactions with bromine.

When lithium burns in oxygen, it forms only the monoxide Li_2O, while other group members also produce peroxides. Similarly, lithium reacts with nitrogen to form nitride (Li_3N), akin to magnesium.

Moreover, lithium compounds, such as Li_2CO_3 and LiOH, are less stable compared to those of other alkali metals, resembling the behavior of magnesium compounds. Many lithium salts are insoluble in water, resembling magnesium salts, while sodium and potassium salts are soluble. Additionally, lithium halides and alkyls dissolve in organic solvents, similar to magnesium compounds.

Furthermore, lithium compounds exhibit some hydrolysis in hot water, akin to magnesium compounds, and lithium sulfate does not form alums, unlike other alkali metal sulfates. The partially covalent nature of lithium compounds, particularly lithium halides, is attributed to the strong polarizing power of lithium ions, resulting in smaller dipole moments than expected.

Lastly, ions and compounds of alkali metals, including lithium, tend to be more hydrated than those of other alkali metals, akin to magnesium.

Benefits of CBSE Class 11 Chemistry Notes Chapter 10 The s-Block Elements

Comprehensive Coverage: These notes cover the entire Chapter 10, providing a comprehensive overview of the s-Block Elements as per the CBSE Class 11 curriculum.

Simplified Concepts: The notes present complex concepts in a simplified manner, making it easier for students to understand and grasp the fundamental principles of the s-Block Elements.

Structured Format: The notes are well-structured, organized, and easy to follow, allowing students to navigate through the content seamlessly.

Key Points Highlighted: Important points, formulas, and definitions are highlighted throughout the notes, helping students identify and focus on the essential information.

Visual Aids: Where applicable, diagrams, illustrations, and tables are included to enhance understanding and facilitate visual learning.

Practice Questions: The notes may include practice questions, problems, and examples to reinforce learning and allow students to test their understanding of the material.