

Reactivity of Alkali and Alkaline Earth Metals with Oxygen

Introduction

The problem at hand is to determine whether the reaction of alkali earth metals with oxygen is less or more volatile than the reaction of alkali metals with oxygen. Additionally, reasoning for this observation is required. This involves understanding the chemical properties and reactivity trends of alkali (Group 1) and alkaline earth metals (Group 2) with oxygen.

Step-by-Step Solution

1. Understanding Group Trends and Reactivity:

- Alkali metals (Group 1) include elements like lithium (Li), sodium (Na), potassium (K), etc.
- Alkaline earth metals (Group 2) include elements like beryllium (Be), magnesium (Mg), calcium (Ca), etc.

Supporting Statement and Explanation: Group 1 and Group 2 elements show differing reactivities due to their distinct positions in the periodic table, with Group 1 elements tending to be more reactive than Group 2 elements.

2. Reactivity Comparison with Oxygen:

- Alkali metals react vigorously with oxygen to form oxides such as Li_2O , Na_2O , and K_2O .
- Alkaline earth metals also react with oxygen to form oxides, but with lower volatility. Examples include MgO and CaO .

Supporting Statement and Explanation: The reactivity of alkali metals with oxygen is higher due to their single valence electron, which they easily lose to form a stable $(+1)$ oxidation state. This results in more pronounced and volatile reactions.

3. Ionization Energies and Bonding:

- Alkali metals have lower ionization energies compared to alkaline earth metals, meaning they more readily lose their valence electron.
- Alkaline earth metals require more energy to lose their two valence electrons, forming $(+2)$ ions less easily than alkali metals form $(+1)$ ions.

Supporting Statement and Explanation: The lower ionization energy of alkali metals results in a higher reactivity and volatility in their reactions with oxygen.

4. Reactivity Series and Products Formed:

- Alkali metals form a variety of oxides that are often more reactive (e.g., peroxides and superoxides in the case of Na, K).
- Alkaline earth metals typically form more stable oxides without proceeding to form superoxides or peroxides under normal conditions.

Supporting Statement and Explanation: Alkali metals, due to their high reactivity, tend to form multiple types of oxides, contributing to their higher volatility when reacting with oxygen.

Final Solution

The reaction of alkali earth metals with oxygen is **less** volatile than that of alkali metals with oxygen. The main reason is that alkali metals have a single valence electron and lower ionization energies, making them more reactive and capable of forming various oxides (including peroxides and superoxides) that make their reactions more volatile. In contrast, alkaline earth metals have higher ionization energies and form more stable and less volatile oxides.