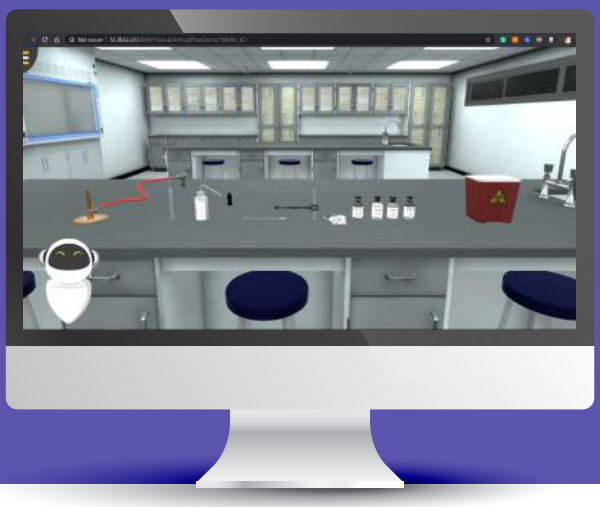
Chemistry | Inorganic Chemistry

Test for Potassium Radical



General Aim

Detection of the presence of potassium ion as a base radical in inorganic salts such as potassium chloride.

Method

Detection of the presence of potassium as a base radical using specific chemical reagents.

Learning Objectives (ILOs)

- Define and differentiate between members of the sixth group cations and those of other cation groups.
- Classify inorganic salts according to their base radicals.
- Compare between potassium containing salts and other members of the same group in terms of chemical structures, properties and reactions.
- Identify potassium radicals containing salts experimentally.
- Select the appropriate reagents to detect the presence of sodium radical.
- Balance the chemical equations of chemical reactions.

Theoretical Background/Context

- Potassium is the seventh abundant metallic element on Earth. It is a member of the alkali metals group that is located in the first group of the periodic table. Its chemical symbol is K. Potassium has a white silver metallic appearance. Pure potassium is highly oxidizable and it can react with air quickly leading to losing its metallic appearance. That is why it should be preserved using oil grease. Potassium compounds are used in various chemical reactions, preparation of chemicals and medications, etc.

Abundance of Potassium in Nature: Potassium is abundant in nature as potassium ions in mineral salts such as potassium chloride. It is commonly found as a constituent in Earth's crust.

Preparation of Potassium: Potassium can be prepared from some of potassium containing compounds such as potassium carbonate, potassium chloride and potassium nitride.

$$K2CO3+2C \rightarrow 3CO+2K$$

$$2KCl+CaC2 \rightarrow CaCl2+2C+K$$

$$2KN3 \rightarrow 3N2+2K$$

However, all of the previous reactions require high energy input and are considered to be highly expensive, so cheaper procedures are commonly followed to obtain pure potassium through reduction of some potassium salts such as potassium chloride.

$$KCl + Na \rightarrow K + NaCl$$

Properties and Uses of Potassium: Potassium as a metal has a boiling point of 63.65^{0}C. Therefore, its molten form can be used as a cooling agent for nuclear reactors. In addition, it is being used in the research of pharmaceutical industries as well as some energy applications. It is used as the basic radical for preparation of various chemicals that include potassium hydroxide, potassium carbonate, potassium permanganate, etc.

Theoretical Background/Context

Potassium Salts: Potassium containing compounds are used in different applications such as potassium hydroxide that is used in manufacturing of soaps and detergents, potassium carbonate that is used in glass manufacturing, and potassium chloride that is used in pharmaceutical preparations, baking, photography, tanning leathers and food additives. Potassium chloride whose chemical formula is KCl, is considered to be the most abundant potassium salt. It is composed of potassium and chloride ions in the ratio of 1:1.

Abundance of Natural Potassium Chloride: Potassium chloride is existent in nature as the mineral sylvite. It is easily and cheaply prepared as it can be prepared through treating any potassium base such as potassium hydroxide with hydrochloric acid.

$$KOH + HCl \rightarrow KCl + H2O$$

Properties and Uses of Potassium Chloride

- Potassium chloride is a white crystalline salt that is highly soluble in water producing colorless aqueous solutions.
- Potassium chloride has the chemical formula of KCl with molecular weight of 74.55 g/mol.
- Potassium chloride salt possesses a melting point and boiling point of 770 ^{0}C and 1420 ^{0}C, respectively.
- Potassium chloride plays an important role in manufacture of fertilizers.
- Like sodium chloride, potassium chloride regulates the muscle contractions, nerve impulses and represents a part of the body fluids.
- Potassium chloride is used in preparation of some medications and food additives.

Principle of Work

- In this experiment, potassium ion in potassium chloride is detected through some identification and confirmatory tests. The potassium radical is among the sixth group of basic radicals that are also called the soluble groups. This returns back to that all of the members remain soluble throughout most of their identifications tests.
- During the experiment, salt solubility in water will be tested. Then confirmatory tests will be carried out which are sodium cobalt nitrite test, perchloric acid and flame test.

First: Physical Appearance Test

In this test, the physical appearance of potassium salt is investigated in terms of color, odor, texture, etc.

Second: Solubility Test

In this test, a sample of the potassium chloride salt is tested for its solubility in cold and hot water.

Third: Sodium Cobalt Nitrite Test

It depends on the fact that sodium cobalt nitrite will react with potassium chloride as the cobalt nitrite would displace chloride in potassium. This will lead to formation of potassium cobalt nitrite as a yellow precipitate.

$$KCl + Na3[Co(NO2)6] \rightarrow 3NaCl + K3[Co(NO2)6] \downarrow$$

The yellow precipitate is not soluble in acetic acid.

Fourth: Perchloric Acid Test

It depends on the fact that chlorate ions could displace chloride ions in their salts leading to precipitation of potassium chlorate as a white precipitate.

$$HClO4+KCl \rightarrow HCL + KClO4 \downarrow$$

Fifth: Flame Test

It is also called a dry test as it uses the potassium chloride salt as it is without dissolving it in water. It depends on the fact that potassium chloride can change the non-luminous benzene flame into an ignited purple colored flame.