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Naming binary ionic compounds examples

Introduction to Chemistry The chapter focuses on compounds and bonds, building on the concepts of valence electrons, electron dot structures, and molecular shapes. **Valence Electrons and Electron Dot Structures** * Valence electrons are found in the outermost energy level of an atom. * The octet rule states that atoms tend to gain or lose electrons to achieve a full outer shell with eight electrons. * Ionic compounds form when metals lose electrons to become cations, while nonmetals gain electrons to become anions. **Molecular Shapes and Polarity** * Electron dot structures show the arrangement of valence electrons in a molecule. * Molecular shapes are determined by the number and arrangement of electron pairs around the central atom. * Polar molecules have a partial positive charge on one end and a partial negative charge on the other end, due to unequal sharing of electrons. **Ion Formation** * Metals tend to lose electrons to form cations (positive ions). * Nonmetals tend to gain electrons to form anions (negative ions). * The formation of ionic bonds occurs when oppositely charged ions attract each other. **Common Ions and Representative Elements** * A table lists common ions and representative elements, along with their possible charges. * Transition metal ions have multiple possible charges. Note: This paraphrased version does not include all the details from the original text, but rather summarizes the main points. The text discusses various types of compounds, including polyatomic ions, ionic compounds, and covalent bonds. Polyatomic Ions: The first section introduces polyatomic ions, which are ions composed of multiple atoms. The example given is Ferric Chloride, also known as Iron(III) Chloride. Ionic Compounds: The second section covers ionic compounds, which are formed when a metal and a nonmetal combine to form ions. Examples include Sodium Sulfate, Ammonium Phosphate, and Magnesium Oxide. Covalent Bonds: The third section focuses on covalent bonds, where two or more atoms share electrons to form a molecule. Examples include carbon monoxide (CO) and silicon dioxide (SiO2). Naming Covalent Compounds: The fourth section provides rules for naming binary compounds containing two nonmetals. The rules involve using prefixes to indicate the number of atoms of each element. Bond Polarity and Electronegativity: The final sections discuss bond polarity, which is the unequal sharing of electrons between atoms in a covalent bond. This results in polar bonds. Electronegativity is also introduced as a measure of an atom's ability to attract shared electrons. The text provides a table ranking the electronegativity values for various elements. The main points of this text can be summarized as: * Polyatomic ions are formed when multiple atoms combine. * Ionic compounds are formed when metals and nonmetals combine to form ions. * Covalent bonds involve the sharing of electrons between atoms. * Naming covalent compounds follows specific rules involving prefixes and suffixes. * Bond polarity is the unequal sharing of electrons, resulting in polar bonds. **Molecular Geometry** * Molecular shape is determined by the number of electron pairs around the central atom * Electron pair geometry affects polarity, solubility, and other properties * Common geometries include linear, trigonal planar, tetrahedral, bent, and pyramidal **Polarity and Solubility** * A molecule must have polar bonds and proper geometry to be polar * Polarity determines solubility, with like molecules dissolving in each other * Types of intermolecular attractions include dipole-dipole, hydrogen bonding, and van der Waals forces **Boiling and Melting Points** * Ionic compounds have high melting and boiling points, while covalent compounds have lower points * Chemical bond type affects these physical properties **Learning Checks** * Review the chapter by trying the learning checks, which cover topics such as element groups, molecule types, and physical properties. Note: The text appears to be from a chemistry textbook or course material, covering topics like molecular geometry, polarity, solubility, and physical properties. 1. Aluminum reacts with acid to produce aluminum salt and hydrogen gas. 2. The density of aluminum at 25º C is 2.70 g/cm3. 3. Acetone is a flammable liquid, not a physical property. 4. Dry ice sublimates, which is a chemical change. 5. The correct formula for silver sulfide is Ag2S, not AgS or AgS2. 6. The correct name for CdF2 is cadmium fluoride, not Cadmium flourine or Cadmium flouride. 7. CuCl2 is copper(II) chloride, not Copper (I) chloride or Copper chloride (II). 8. HgS is mercury(I) sulfide, not mercury(II) sulfide or mercurous sulfide. 9. Arsenic pentachloride is AsCl5, not As5Cl or As2Cl5. 10. Sulfur dioxide is SO2, and the compound FeSO4 is iron(II) sulfate. The rules for converting a chemical formula into a written compound name are as follows: First, balance the chemical formula for mass and charge. Then, write the element name of the cation first. If the element has multiple possible oxidation states, include them in parentheses with Roman numerals. Metals in groups 1 and 2 do not use Roman numerals. The anion name follows the cation, and if it's a binary compound or polyatomic ion, add its ending to the element name. Examples: SrCl2 - strontium chloride CuCl - copper(I) chloride Mg(OH)2 - magnesium hydroxide Pt3(AsO2)4 - platinum(II) arsenate The naming of ionic compounds has evolved over time, and the new system is more accurate. The old system did not cover some oxidation states, such as Cr6+ (hexavalent chromium). The International Union of Pure and Applied Chemistry (IUPAC) has established guidelines for naming chemical compounds, including binary ionic compounds. According to IUPAC recommendations, the name of a metal atom should be followed by the nonmetal with an appropriate suffix. This nomenclature system is crucial in science and other situations where precise names are required. When generating a proper name for an ionic compound, it's essential to combine the name of the cation and the name of the anion, omitting the word "ion." For example, NaCl is named sodium chloride, while MgO is magnesium oxide. However, when naming compounds with multiple ions necessary to balance charges, numerical prefixes should be avoided. In cases where cations can have more than one possible charge, the charge must be included in parentheses and in roman numerals as part of the name. For instance, FeS is iron(II) sulfide, while Fe2S3 is iron(III) sulfide. The number of ions in a formula is determined by balancing positive and negative charges. IUPAC's guidelines for nomenclature also cover compounds containing metal ions with variable charges, such as transition metals that can form two or more cations with different charges. In the Stock system, an ion's positive charge is indicated by a roman numeral in parentheses after the element name, followed by the word "ion." For example, Fe2+ is called the iron(II) ion, while Fe3+ is referred to as the iron(III) ion. Chemistry texts like Zumdahl's "Chemistry" and Kotz's "Chemistry and Chemical Reactivity" provide comprehensive guidance on chemical nomenclature. By following these guidelines, scientists can ensure accurate and consistent naming of chemical compounds, which is essential for effective communication in scientific research and applications. In chemistry, ions with multiple charges are denoted using a specific system. This system uses Roman numerals in parentheses to indicate the charge of the ion. For example, iron has two common positive ions: ferrous (2+) and ferric (3+). The modern system assigns names based on the Latin name of the element and the charge of the ion. In contrast, the common system uses suffixes (-ic and -ous) to indicate higher or lower charges. Both systems recognize that some metals have two common cations, with the -ic suffix representing the greater charge and the -ous suffix representing the lesser charge. The naming conventions for compounds containing these metals follow a specific pattern. The compound's name includes the metal's name, followed by the anion's name. If the metal has multiple charges, the charge is indicated using Roman numerals in parentheses. For instance, iron(II) chloride (FeCl2) and iron(III) chloride (FeCl3) are unambiguously named. which consist of a metal that can have multiple ionic charges: Fe2S3 CuSe GaN CrCl3 Ti2(SO4)3 Solution In these compounds, the anions possess fixed negative charges (S2−, Se2− , N3−, Cl−, and SO42−), and the compounds must be neutral. Since the total number of positive charges in each compound must equal the total number of negative charges, the metal ions must be Fe3+, Cu2+, Ga3+, Cr3+, and Ti3+. These charges are incorporated into the names of the metal ions: iron(III) sulfide copper(II) selenide gallium(III) nitride chromium(III) chloride titanium(III) sulfate Write the formulas for the following ionic compounds: mercury(II) sulfide manganese(II) phosphate copper(I) oxide chromium(VI) fluoride Erin Brockovich, a legal file clerk turned environmental advocate, discovered high rates of serious illnesses in Hinckley, California. Her investigation linked these illnesses to contaminated groundwater caused by Cr(VI), used by Pacific Gas & Electric (PG&E) to combat corrosion in a nearby natural gas pipeline. As portrayed in the film Erin Brokovich, Erin and lawyer Edward Masry sued PG&E for contaminating the water near Hinckley in 1993. The settlement they won in 1996 was $333 million, the largest ever awarded for a direct-action lawsuit at that time. Chromium compounds are widely used industrially, such as chrome plating, dye-making, and preservatives. In the environment, chromium exists primarily in either the Cr(III) or Cr(VI) forms. Exposure to small amounts of Cr(VI) can damage various bodily systems and organs. Despite cleanup efforts, Cr(VI) groundwater contamination remains a problem globally. A 2010 study by the Environmental Working Group found that among 35 US cities tested, 31 had higher levels of Cr(VI) in their tap water than the public health goal set by the California Environmental Protection Agency. Naming Molecular Compounds How do you know whether a formula—and by extension, a name—is for a molecular compound or an ionic compound? Molecular compounds form between two or more nonmetals, while ionic compounds form between metals and nonmetals. Molecules are multiatom combinations that behave as single particles. Many elements exist as molecules that contain two atoms of the same element, such as H2, O2, and N2. These diatomic molecules have a specific molecular formula, which lists the number of atoms in each molecule. For instance, the symbol for hydrogen is H, with a subscript 2 indicating there are two atoms of this element in the molecule. Other elements, like sulfur and phosphorus, exist as larger molecules, S8 and P4 respectively. We'll assume that single-element compounds consist of individual atoms unless stated otherwise. In this chapter, we will focus on naming binary compounds, which contain only two elements. To do this, we follow these steps: 1. Identify the elements in the molecule from its formula. 2. Start the name with the element name of the first element, using a numerical prefix to indicate the number of atoms if there's more than one (e.g., di-, tri-, etc.). 3. Name the second element by combining a numerical prefix indicating the number of atoms, the stem of the element name, and the suffix –ide (e.g., ox for oxygen, chlor for chlorine). 4. Combine the two words, leaving a space between them. Table 6.3d provides the list of numerical prefixes used in naming molecular compounds: | Number of Atoms | Prefix | |-----------------|--------| | 1 | mono- | | 2 | di- | | 3 | tri- | | 4 | tetra- | | 5 | penta- | | 6 | hexa- | | 7 | hepta- | | 8 | octa- | | 9 | nona- | | 10 | deca- | By following these steps, we can assign a unique name to each binary compound. The system of chemical nomenclature provides a unique name for each binary compound based on the elements it contains and their quantities. Let's consider an example with the molecular formula SO2, which consists of one sulfur atom and two oxygen atoms. First, we identify the first element in the name, which is sulfur. Since it is not the first element, we do not use the "mono-" prefix. Next, we apply the numerical prefix di- (meaning two) to the stem ox-, resulting in dioxide. Combining this with sulfur, we obtain the unique compound name: sulfur dioxide. This system allows us to distinguish between compounds that have different molecular formulas and properties, such as SO3, which contains three oxygen atoms and has a different chemical formula: sulfur trioxide. The rules for naming binary compounds provide clarity and consistency in communicating their compositions. The 4.3 Chemical Nomenclature from General Chemistry 1 & 2 by Rice University, and licensed under CC BY 4.0, explains the rules for naming compounds containing two different elements, such as those that produce H3O+ when dissolved in water, and denotes a cation's charge using roman numerals.