**Purpose** To practice naming ionic compounds and writing their formulas.

**Background Information**

Ionic compounds are composed of charged particles called **ions.** Positively charged ions are called **cations,** and negatively charged ions are called **anions.** Although ionic compounds are composed of ions, they are electrically neutral. **The sum of the positive charges of the cations and the negative charges of the anions is zero.** The formula of an ionic compound can be determined from the ratio of cations and anions needed to produce a total charge equal to zero. The symbol for the cation always appears first in the formula.

The names of ionic compounds are based on the names of their ions. For most cations, the name of the cation is the same name as the element name. However, many transition metals form more than one ion. For these ions, a Roman numeral is used to show the charge. For

example, Fe2+ is iron(II) and Fe3+ is iron(III). Anions are named by combining part of the name of the element and the ending *–ide.* For example, the name for O2– is oxide. A covalently bonded group of atoms that has a positive or negative charge is called a **polyatomic ion.** These ions have names that reflect their composition.

**Hypothesis**

If a cation is chemically combined with an anion, then it will produce an ionic compound with the name ending in -ide.

**Procedures**

1. Print out the Cation Sheet, Cation Name Sheet, Anion Sheet, and Anion Name Sheet. If possible, use card stock paper so the cards will be more rigid (optional).

2. Cut out all the individual cations, cation names, anion names, and anions. There are forty cations and 40 anions, 10 cation names and 10 anion names. That’s 100 individual cards! You might want to get some help or use a paper cutter.

3. Separate the four groups of cards into piles. Shuffle each pile and place the **Cation Name** and **Anion Name** cards face down in front of you. The cation and anion piles can be face up.

Anion

Pile

Cation

Pile

Cation Name

Pile

Anion Name

Pile

4. Draw one Cation Name card and one Anion Name card.

5. Find the corresponding cation and anion for the Name cards you drew from the piles.

6. Create an ionic compound, placing the cations FIRST and the anions SECOND (see sample in Data Table). You may need more than one cation or anion to make a proper formula.

7. Complete the Data Table in the Calculations and Data (*refer to section 6.3 in text*).

8. Create ionic compounds for all the cations.

|  |  |  |
| --- | --- | --- |
| **Compound Name** (cation, anion) | **Compound Formula** (How many of each did you use?) | **Drawing, sketch, image** (using the cation and anion cards) |
| Lithium Sulfate | Li2SO4 | Li1+SO42-Li1+ |
|  |  |  |
|  |  |  |
|  |  |  |
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|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Print out the following Cation Sheet (if possible, use “stock” paper).

Cut out each square. You will have 40 “cards”.

|  |  |  |  |
| --- | --- | --- | --- |
| Na+ | Na+ | Na+ | Na+ |
| K+ | K+ | K+ | K+ |
| Mg2+ | Mg2+ | Mg2+ | Mg2+ |
| Ca2+ | Ca2+ | Ca2+ | Ca2+ |
| Al3+ | Al3+ | Al3+ | Al3+ |
| Fe2+ | Fe2+ | Fe2+ | Fe2+ |
| Fe3+ | Fe3+ | Fe3+ | Fe3+ |
| Cu+ | Cu+ | Cu+ | Cu+ |
| Cu2+ | Cu2+ | Cu2+ | Cu2+ |
| Zn2+ | Zn2+ | Zn2+ | Zn2+ |

Print out the following Cation / Anion Name Sheet (if possible, use “stock” paper).

Cut out each square. You will have 40 “cards”.

|  |  |  |
| --- | --- | --- |
| Sodium |  | Fluoride |
| Potassium |  | Chloride |
| Magnesium |  | Oxide |
| Calcium |  | Sulfide |
| Aluminum |  | Phosphate |
| Iron(II) |  | Carbonate |
| Fe(III) |  | Nitrate |
| Cu(I) |  | Nitride |
| Cu(II) |  | Bromide |
| Zinc |  | Hydroxide |

Print out the following Anion Sheet (if possible, use “stock” paper).

Cut out each square. You will have 40 “cards”.

|  |  |  |  |
| --- | --- | --- | --- |
| F- | F- | F- | F- |
| Cl- | Cl- | Cl- | Cl- |
| O2- | O2- | O2- | O2- |
| S2- | S2- | S2- | S2- |
| PO43- | PO43- | PO43- | PO43- |
| CO32- | CO32- | CO32- | CO32- |
| NO3- | NO3- | NO3- | NO3- |
| N3- | N3- | N3- | N3- |
| Br- | Br- | Br- | Br- |
| OH- | OH- | OH- | OH- |

## **Conclusions and Questions**

1. Describe how to determine the correct ratio of ions in a compound and how to write it into a chemical formula. [*Hint: include net charge and subscripts*]

2. Explain why it is not possible to write a formula for a compound of sodium and calcium (both cations) or a compound of fluoride and chloride (both anions).

3. How are the name and formula of an ionic compound determined?

8. Sample Answers of ionic compounds.

|  |  |  |
| --- | --- | --- |
| **Compound Name** (cation, anion) | **Compound Formula** (How many of each did you use?) | **Drawing, sketch, image** (using the cation and anion cards) |
| Lithium Sulfate | Li2SO4 | SO42-Li1+Li1+ |
| Calcium nitrate  | Ca(NO3)2 | NO3-Ca2+NO3- |
| Iron(III) carbonate  | Fe2(CO3)3 | CO32-CO32-CO32-Fe2+Fe2+ |
| Sodium chloride  | NaCl | SO42-Li1+ |
| Aluminum bromide  | AlBr3 | Br-Br-Br-Al3+ |
| Zinc Hydroxide | Zn(OH)2 | (OH)2-Zn2+(OH)2- |

## **Conclusions and Questions**

1. Describe how to determine the correct ratio of ions in a compound and how to write it into a chemical formula. [*Hint: include net charge and subscripts*]

*Use the ratio of cations to anions that produces a* ***net charge of zero****. If there is more than one cation or anion, this is indicated by using* ***subscripts*** *AFTER the cation or anion. E.g. zinc hydroxide: Zn2+(OH)2-. Since zinc (cation) has a +2 charge, it must be balanced by a -2 charge, meaning TWO hydroxide anions are needed.*

2. Explain why it is not possible to write a formula for a compound of sodium and calcium (both cations) or a compound of fluoride and chloride (both anions).

*Ionic compounds are formed by “electrostatic attractions”, meaning a* ***positively charged ion and a negatively charged ion are attracted*** *to form a bonded compound. When an ionic compound forms, one element must lose electrons becoming a cation, and one element must gain electrons becoming an anion during the transfer of electrons. Like charges repel and* ***unlike charges attract****. Therefore, an ionic compound forms between two unlike charges (cation + anion). Two cations (positive ions) would repel each other. Similarly, two anions (negative ions) would also repel each other.*

3. How are the name and formula of an ionic compound determined?

*In the name of an ionic compound, the name of the cation is followed by the name of the anion. The formula of an ionic compound can be determined from the ratio of cations and anions needed to produce a total charge equal to zero. The symbol for the cation always comes first in the formula****.***

**Bibliography**

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