Ionic Compounds



 Chemical compounds are all around us, and exist in incredible abundance. Over 10 million chemical compounds have already been identified and more are discovered or created each and every day. There are two main types of chemical compounds, molecular compounds In this activity you will learn about how one type: Ionic Compounds are formed.



A chemical compound is a chemical substance made up of two or more different elements chemically bonded to each other. This chemical bond describes the force of attraction between two atoms or ions that holds them together. A chemical bond is an invisible force that acts as a sort of glue, holding atoms together in a compound in two different ways: as ionic bonds or as covalent bonds.





Ionic compounds form as a result of ionic bonds formed between ions. Recall that ions form when neutral atoms gain or lose electrons and certain elements are more likely to either gain or lose electrons depending on their valence electron arrangement.



Metals in the first 2 groups of the periodic table, such as sodium and potassium are more likely to lose electrons to form positively charged cations. While other elements, such as the **non-metals**, like oxygen and chlorine, in groups 15-17 are likely to gain electrons, forming negatively charged anions.



 One of the most common ionic compounds is called sodium chloride (NaCl), otherwise known as table salt. Sodium chloride is formed between postivie ions of sodium (Na⁺) and negatively charged ions Chloride (Cl⁻). The formation of these ions can be represented using Lewis symbols:



Click to See Formation of Na⁺ ion

Sodium is a metal that tends to lose electrons, forming an Cation:

$Na \longrightarrow [Na]^+ + e^-$

Chlorine is a non-metal that tends to gain electrons, forming an anion.

Click to See Formation of Cl⁻ ion

Sodium is a metal that tends to lose electrons, forming an **cation**. When cations are formed, the ion is shown in square brackets with the charge as a superscript:

$Na \longrightarrow [Na]^+ + e^-$

Chlorine is a non-metal that tends to gain electrons, forming an **anion**. When anions are formed, the ion is shown in square brackets with the full octetet represented and the charge written as a superscript:



 An ionic bond forms when a non-metal atom removes an electron from a metal atom. When this transfer of electrons occurs, a cation and anion are formed, the two are then attracted to each other due to the force of attraction between positive and negatively charged atoms. The bond between a positive ion and a negative ion is called an IONIC BOND.



What happens when ionic bonds form between atoms that lose or gain more than one electron? For example, consider an ionic compound forming between magnesium and chlorine. Magnesium tends to lose 2 electrons, forming [Mg]²⁺ while chlorine only tends to gain 1 electron, forming [Cl]⁻. What type of ionic compound will these ions form?

| 1 | group | 1 | | | | | | | | | | | | | | | | | | 18 |
|--------------|-------------------|----------------------|-----------|--------------------|---|----------------------|-------------|----------------------|-------------|---------------|-------------|-------------|-------------|------------------------------|-----------------------|-----------------------|-------------------------|--|--------------|----------------------|
| | 1.0079 | 94 1 | | | | | | | | | | | | | | | | | | 4.002602 2 |
| period 1 | Η | | | | average mass (in u) 55.845 76 atomic number | | | | | | | | | | | | | | He | |
| | Hydro | ogen | 2 | | | | | | | 4 | 20 | | | | 13 | 14 | 15 | 16 | 17 | Helium |
| - | 0.941 T • | 3 | 9.012182 | 4 | | | , | | . T | 20 | | | | | 10.811 5 | 6 | 14,0067 7 | 15.9994 8 | 18.998403 9 | 20.1797 10 |
| 2 | L1 | L | Ве | | | | ch | emical symb | | 'e | | | | | В | C | N | 0 | F | Ne |
| | Lithiu: 22.989 | m 976 11 | eryllium | 12 | | | | Date | | n | | | | | 26.98153 13 | Carbon 28.0855 1 / | Nitrogen 30.97696 15 | Oxygen 32.065 16 | 55,453 17 | Neon 39.948 18 |
| 3 | NL | <u> </u> | Ma | 12 | | | | | | | | | | | A1 | C: 17 | D | C 10 | | h 10 |
| - | IN a | | Magnesium | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Aluminium | Silicon | F Phosphorus | Sulfur | Chlorine | Argon |
| | 39.098 | ⁸³ 19 | 40 | 20 | 44.95591 21 | 47.867 22 | 50.9415 23 | 51.9962 24 | 54.93804 25 | 55.845 26 | 58.93319 27 | 58.6934 28 | 63.546 29 | 65.38 30 | ^{69.723} 31 | 72.64 32 | 74.92160 33 | 78.96 34 | 7.01 | 83.798 36 |
| 4 | K | | Ca | | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr |
| | Potass | ium | Calcium | | Scandium | Titanium | Vanadium | Chromium | Manganese | Iron | Cobalt | Nickel | Copper | Zinc | Gallium | Germanium | Arsenic | Selenium | Bromine | Krypton |
| | 85.467 | 78 37 | 87.62 | 38 | ^{88,90585} 39 | ^{91.224} 40 | 92.90638 41 | 95.96 42 | (98) 43 | 101.07 44 | 102.9055 45 | 106.42 46 | 107.8682 47 | ^{112,441} 48 | ^{114,818} 49 | 118.710 50 | 121.760 51 | 127.60 52 | 126.9044 53 | 131.293 54 |
| 5 | Rł | b | Sr | | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I | Xe |
| | Rubidi | ium | Strontium | | Yttrium | Zirconium | Niobium | Molybdenum | Technetium | Ruthenium | Rhodium | Palladium | Silver | Cadmium | Indium | Tin | Antimony | Tellurium | Iodine | Xenon |
| | 132.90 | ⁰⁵⁴ 55 | 137.327 | 56 | ^{174,9668} 71 | 178,49 72 | 180.9478 73 | 183.84 74 | 186.207 75 | 190.23 76 | 192.217 77 | 195.084 78 | 196.9665 79 | 200.59 80 | 204.3833 81 | 207.2 82 | 208.9804 83 | (210) 84 | (210) 85 | (220) 86 |
| 6 | C | S | Ba | | Lu | Ht | Ta | W | Re | Os | lr | Pt | Au | Hg | TI | Pb | B1 | Ро | At | Rn |
| | (223) | m 87 | (226) | 88 | (262) 103 | (261) 104 | (262) 105 | (266) 106 | (264) 107 | (277) 108 | (268) 100 | (271) 110 | (272) 111 | (285) 112 | (284) 113 | (289) 114 | (288) 115 | (292) 116 | Astatine 117 | (294) 118 |
| 7 | Fr | • • • • | Pa | | I r | D f | Dh | Sa | Bh | He | Mt | De | Ra | Cn | Int | FI | Llun | IV | Ilue | Lluo |
| | Franci | ium | Radium | | Lawrencium | Rutherfordium | Dubnium | Seaborgium | Bohrium | Hassium | Meitnerium | Darmstadium | Roentgenium | Copernicium | Ununtrium | Flerovium | Ununpentium | Livermorium | Ununseptium | Ununoctium |
| | | _ | | | | | | | | | | | | | | | | | | |
| 128 005 | | 140.116 | 50 140 | 0076 50 | 141212 60 | | 100.10 | 10.000 60 | 10200 64 | 100000 60 | 102.000 | 164.0303 | 1/2 2/2 | 100000 000 | 171011 80 | 1 | ollasti - | - stale | - matallaida | |
| 158.9054 | • 57 | 140.110 | 58 140. | ⁹⁰⁷⁸ 59 | 144.242 60 | (145) 61 | 130.36 62 | ¹³¹³⁶⁴ 63 | 137.23 64 | 138.9235 65 | 102.300 66 | 164.9505 67 | 107-239 68 | 108.9542 69 | × 71 | | alkalin | t metals | nonmetals | |
| La | | Ce | P | r Iodumium | Na | Pm | Sm | Eu | Gadalinium | 1D Tarbium | Dy | HO | Er | Im | YD | | other m | ictals | halogens | |
| (227) | 89 | 232.0380 | 90 231 | 0358 Q1 | 238.0289 Q2 | (237) Q3 | (244) Q4 | (243) Q5 | (247) 96 | (247) 97 | (251) Q8 | (252) QQ | (257) 100 | (258) 101 | (259) 102 | | transiti | on metals | noble gases | |
| Ac | Ac Th | | h Pa | | U Nn | | Du | ۸m | Cm | BL | Cf | Fe | Em | Md | No | | lanthan | oids | unknown el | lements |
| Actinium The | | Thorium Protactinium | | ectinium | Uranium | Neptunium | Plutonium | Americium | Curium | Berkelium | Californium | Einsteinium | Fermium | Mendelevium | Nobelium | | actinoi | tinoids redicactive ciements masses in parenthese | | ents izo e theses |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |

Click for the Step-by-Step Solution

Step 1. Wrote the Lewis structure for each atom of the combining elements.



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Mg•

Step 2. Determine how many electrons each atom is likely to gain or lose to form a full valence shell.



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$$Mg \bullet \longrightarrow [Mg]^{2+} \bullet \bigcup^{\bullet} \bullet \bigoplus^{\bullet} [: \bigcup^{\bullet} \bullet]^{-}$$

Step 3. Determine the ratio of each ion needed to produce a neutral molecule.



Step 3. Determine the ratio of each ion needed to produce a neutral molecule:



Since each magnesium ion has a charge of +2 and each chloride ion has a charge of -1, 2 chloride ions are required for every 1 magnesium ion to produce a neutral molecule.

> Click to See Lewis Structures of this Compound Forming

Formation of MgCl₂:

$Mg \bullet +2 \bullet C \stackrel{\bullet}{:} \longrightarrow [:C]:]^{-}[Mg]^{2+}[:C]:]^{-}$

Step 4. Write the chemical formula for the ionic compound. The symbol for the metal (Mg) is written first followed by the symbol for the non-metal (Cl). The number of each of the ions required to produce the neutral molecule is written as a subscript. (Note: If the ratio of one of the ions is 1, no number subscript is necessary)

Click to See Chemical Formula

Step 4. Write the chemical formula for the ionic compound. Since this ionic compound requires 2 Cl⁻ ions for each Mg²⁺ion, the chemical formula is:



Click for a Sample Question to Test Your Understanding

Test your understanding

- 1. Draw Lewis symbols to show the formation of bonds within an ionic compound of potassium oxide.
- 2. Write the chemical formula for potassium oxide.

Click for the Solution

1. Draw Lewis symbols to show the formation of bonds within an ionic compound of potassium oxide.



2. Write the chemical formula for potassium oxide.



Success!

You have reached the end of this activity. You will know that you have achieved the goals for this activity when you can describe how ionic compounds form through ionic bonding. You will also be able to determine the chemical formulae for ionic compounds and draw Lewis structures representing the formation of ionic compounds.



Back to Start