**Writing CHEMICAL FORMULAS**

Writing and understanding chemical formulas is one of the key basic skills in chemistry. A chemical formula shows the elements in a (molecule) group of atoms. Water has two hydrogen atoms and one Oxygen atoms, so it uses the symbols of H and O, and the number 2 to describe how many hydrogen there are… H2O. This may seem obvious, but it can get complicated, and being able to understand what the symbols and numbers and brackets mean in a chemical formula helps A LOT in understanding the basics of chemistry.

Firstly – the **symbols**. The easiest bit. The symbols are elements in the periodic table. Each capital letter is an element. So H is hydrogen, S is sulphur, C is Carbon, N is nitrogen, and so on (you need a periodic table, one is at the end of this handout). Any lower case letter goes with the capital before it, so Ca is Calcium, Li is Lithium, Cl is Chlorine.

Second – the **numbers**. The number are written as subscripts… slightly *below* the line, and *after* the symbol. An example is H2. The number is a count of how many of each symbol there are, so H2 means each molecule contains two hydrogen atoms.

Thirdly – the **brackets**. Simple molecules do not have brackets in their formulas – these molecules are formed from individual atoms forming bonds - easy as. But some molecules are formed by groups of atoms forming new bonds. These more complicated molecules have brackets to describe how many atoms are in them. For example: Ca(OH)2. This is a molecule where two OH molecules have bonded to one Ca atom. Because the OH came as a group together, we put brackets around them, and put the 2 after the (OH). Your teacher can explain why this is correct rather than CaO2H2.

An even more complicated example is Ca(NO3)2. In this molecule, two NO3 groups have bonded to one Ca atom – so there are 1 Ca atom, two (1 x 2) N atoms, and six (3 x 2) Oxygen atoms in this molecule.

**QUESTION 1 – COUNTING ATOMS**

In the list of molecules below, identify (count) each type of atom in the molecule. A periodic table is at the back of this document. You can find the names of each element in there.

|  |  |
| --- | --- |
| Chemical formula | Name and number of each type of atom |
| NaOH | *1 Sodium atom, 1 Oxygen atom, 1 Hydrogen atom* |
| ZnO |  |
| CaNO3 |  |
| K2S |  |
| NH4F |  |
| AlCl3 |  |
| Al(OH)3 |  |
| Na2SO4 |  |
| CuSO4 |  |
| Al2(SO4)3 |  |

**WRITING CHEMICAL FROMULAS**

You also need to be able to write chemical formulas as well. To write a chemical formula you need to know the positive and negative charges on the atoms which make up the molecule. These charges are usually given to you in the question. Writing chemical formulas is not so hard, as long as you follow a couple of basic rules.

There are two ways to learn how to write formulas so first you have to pick a method to learn. Read both the titles below and choose which one you want to read more. Follow the guidelines and complete question 2.

**Method 1** – balancing charges – for “*Chemistry”* students

A molecule forms by positively charged atoms being attracted to negatively charged atoms and these being stuck together because of their positive/negative attraction. So an atom (or group of atoms) attracts other atoms so long as it has a positive or negative charge. IMPORTANTLY – when the positive and negative charges balance out, the molecule becomes neutral and stops attracting atoms. The chemical formula for the molecule is now set as the numbers of atoms in the molecule will not change any more once the positive and negative charges balance to make it neutral.

So what does this look like? Say you want to write the chemical formula for calcium hydroxide.

The calcium has a 2+ charge (Ca2+ - look it up in the tables at the end) and the Hydroxide has a 1- charge (OH- - it is Oxygen and hydrogen combined, with an overall 1- charge).

So: Ca+2 attracts two OH**-**

 2+ from one Ca, balances 2- from two OH

 Ca(OH)**2** *(we don’t write in the 1 for Ca)*

**Method 2** – translating charges – for “*I just want to pass the exam*” students

1. Write both parts of the molecule with their charges (which you get in the Q or in a table).

2. *Warning this sounds difficult, but is exceptionally easy.* Transfer the number of the charge to the subscript position (bottom right) of the other part of the molecule.

3. Check if one of parts is a group of atoms (it has more than one capital letter). If it has put brackets around it.

So: Calcium hydroxide becomes… Ca+2 OH-1

If the **charge number is greater than 1** take the number and transfer it. If the **charge number is 1**, just write the symbols, there is no need to transfer the 1.

 Ca (OH) 2

**Question 2 – Writing Formulas**

Wirte the correct formulas into each empty box of the table. The charges of each part of the molecule are given to you in the table and a couple are done as examples

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Cl -** | **O -2** | **N-3** | **OH -** | **NO3 -** | **SO4-2** | **PO4-3** |
| **K+** |  | K2O |  |  |  |  |  |
| **Mg+2** |  |  |  |  |  |  |  |
| **Na+** |  |  |  |  |  |  |  |
| **Fe+2** |  |  |  |  | Fe(NO3)2 |  |  |
| **Al+3** |  |  |  |  |  |  |  |
| **NH4+** |  |  |  |  |  |  |  |



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Name** | **Ion Charge** | **Symbol** |  | **Name** | **Ion Charge** | **Symbol** |
| Aluminium | 3+ | Al3+ |  | Bromide | 1- | Br1- |
| Ammonium | 1+ | NH41+ |  | Carbonate | 2- | CO32- |
| Barium | 2+ | Ba2+ |  | Chlorate | 1- | ClO31- |
| Calcium | 2+ | Ca2+ |  | Chloride | 1- | Cl1- |
| Chromium III | 3+ | Cr3+ |  | Fluoride | 1- | F1- |
| Copper I | 1+ | Cu1+ |  | Hydrogen carbonate (bicarbonate) | 1- | HCO31- |
| Copper II | 2+ | Cu2+ |  |
| Gold | 3+ | Au3+ |  | Hydrogen sulfate (bisulfate) | 1- | HSO4- |
| Hydrogen | 1+ | H1+ |  |
| Iron II | 2+ | Fe2+ |  | Hydroxide | 1- | OH1- |
| Iron III | 3+ | Fe3+ |  | Iodide | - | I1- |
| Lead | 2+ | Pb2+ |  | Nitrate | 1- | NO31- |
| Magnesium | 2+ | Mg2+ |  | Nitrite | 1- | NO21- |
| Mercury II | 2+ | Hg2+ |  | Oxide | 2- | O2- |
| Nickel | 2+ | Ni2+ |  | Phosphate | 3- | PO43- |
| Potassium | 1+ | K1+ |  | Sulfate | 2- | SO42- |
| Silver | 1+ | Ag1+ |  | Sulfide | 2- | S2- |
| Sodium | 1+ | Na1+ |  | Sulfite | 2- | SO32- |
| Tin II | 2+ | Sn2+ |  |  |  |  |
| Zinc | 2+ | Zn2+ |  |  |  |  |