**Chemistry Unit C1: Structures, Trends, Chemical Reactions, Quantitative Chemistry and Analysis**

**C1.5 Symbols, formulae and equations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Content - CCEA Double Award Chemistry 1 – Fort Hill Integrated College** | Got it | Nearly | Haven’t a clue |
| **C1.5 Symbols, formulae and equations** | | | |
| Can you recognise symbols and names for common elements and recall the diatomic elements; |  |  |  |
| Can you interpret chemical formulae by naming the elements and stating the number of each type of atom present; |  |  |  |
| Can you write chemical formulae of compounds; |  |  |  |
| Can you demonstrate understanding that chemical reactions use up reactants and produce new substances called products; |  |  |  |
| Can you construct word equations to describe the range of reactions covered in this specification; |  |  |  |
| Can you recognise that in a chemical reaction no atoms are lost or made but they are rearranged, and as a result we can write balanced symbol equations showing the atoms involved; |  |  |  |
| Can you write balanced symbol equations for all reactions covered in this specification and for unfamiliar chemical reactions when the names of the reactants and products are specified; |  |  |  |
| **Can you** **write balanced ionic equations for reactions, including reactions covered in this specification;** |  |  |  |
| **Can you** **write half equations for reactions covered in this specification where appropriate;** |  |  |  |
| Can you demonstrate knowledge and understanding that in chemical equations the three states of matter are shown as (s), (l) and (g), with (aq) for aqueous solutions, and include appropriate state symbols in equations for the reactions in this specification. |  |  |  |

**C1.5 Symbols, formulae and equations**

**Elements** - consist of one type of atom. Every element has a symbol beginning with a capitol letter.

**Diatomic molecules** are 2identical atoms **covalently** bonded together e.g. O2 N2 H2 F2 Cl2 Br2 I2

**Compounds** – 2 or more elements chemically combined

**Interpreting formulae**

|  |  |  |  |
| --- | --- | --- | --- |
| **Formula of compound** | **Name of compound** | **Elements present** | **Number of each element** |
| CO2 |  |  |  |
| CO |  |  |  |
| H2O |  |  |  |
| CaCO3 |  |  |  |
| NH3 |  |  |  |
| HCl |  |  |  |
| HNO3 |  |  |  |
| H2SO4 |  |  |  |

Sometimes a formula includes brackets. This means the atoms inside the brackets are multiplied by the number outside the brackets (exactly the same as in maths). E.g. ammonium sulphate

|  |  |  |
| --- | --- | --- |
|  |  | 3 x 4 – 12 atoms of oxygen |
|  | **Al2(SO4)3** |  |
| 2 atoms of aluminium |  | 3 atoms of sulfur |

|  |  |  |  |
| --- | --- | --- | --- |
| Formula | Atoms present | | |
| HNO3 | 1 atom Hydrogen | 1 atom Nitrogen | 3 atoms oxygen |
| Ca(OH)2 |  |  |  |
| Cu(NO3)2 |  |  |  |
| H3PO4 |  |  |  |
| Fe2(CO3)3 |  |  |  |

**Ion charges**

Each Group in the Periodic table forms an ion with a different charge;

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Group | Charge on cation |  | Group | Charge on anion |
| 1 |  |  | 5 |  |
| 2 |  |  | 6 |  |
| 3 |  |  | 7 |  |

The charges of any **Transition metal ions** you need to know are provided on the data leaflet. So are those of the **molecular ions (charged particles containing more than one element)**.

**Test yourself**

1. What is the symbol of the following elements?

|  |  |  |
| --- | --- | --- |
| Potassium | Sulphur | Calcium |
| Phosphorus | Fluorine | copper |
| Silicon | Zinc | sodium |

1. Name four diatomic gases in the Periodic Table and write their formulae.

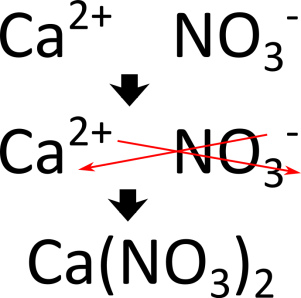
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1. Write the charge of the following ions:

|  |  |  |
| --- | --- | --- |
| chloride | oxide | Sulphide |
| nitride | aluminium | Magnesium |
| phosphide | Sulfate | Carbonate |
| dichromate | ethanoate | Lithium |
| Iron (II) | Ammonium | hydroxide |

**C1.5 Symbols, formulae and equations**

**Ionic formula**

The chemical formula of a compound tells us both the ………………… involved and also the simplest ……………….. of these elements in the compound. The ratio of the elements depends on how many ……………………… are needed to complete the outer shells. For ionic compounds we can work out the formula using the **‘……………. ………. ……..….’** rule. We use the ……………….. number (the number of electrons an atom can lose, gain or share).

What is the chemical formula for the following Ionic compounds?

1. Potassium chloride
2. Aluminium sulphide
3. Calcium nitrate
4. Sodium sulfate
5. Copper (II) sulfate
6. Aluminium dichromate
7. Magnesium hydroxide
8. Silver nitrate

**Equations**

**Chemical reactions** – we can describe what is happening in a chemical reaction using equations. These can be written as words or symbols. In chemical equations the three states of matter are shown as (s), (l) and (g), with (aq) for aqueous solutions

**reactant 🡪 product**

In a chemical reaction no atoms are lost or made (this means the mass on both sides is the same) but they are rearranged, and as a result we can write balanced symbol equations showing the atoms involved.

Examples

1. Combustion of Magnesium

Magnesium + Oxygen 🡪 Magnesium oxide

Mg(s) + O2 (g) 🡪 MgO(s)

1. Magnesium and Acid

Magnesium + Hydrochloric acid 🡪

1. Combustion of Methane

Methane + Oxygen 🡪

1. Potassium and Water

Potassium + Water 🡪

1. Neutralisation

Hydrochloric acid + Sodium Hydroxide 🡪

**Balancing equations**

In a chemical reaction no atoms are lost or made but they are rearranged. This means that chemical equations have equal numbers of each atom on each side of the equation.

|  |  |  |
| --- | --- | --- |
| CaCO3 | 🡪 | CaO + CO2 |
| 1 | Ca | 1 |
| 1 | C | 1 |
| 3 | O | (1+2) = 3 |

**When balancing equations, you can only add BIG numbers (you can’t mess about with the little numbers)**

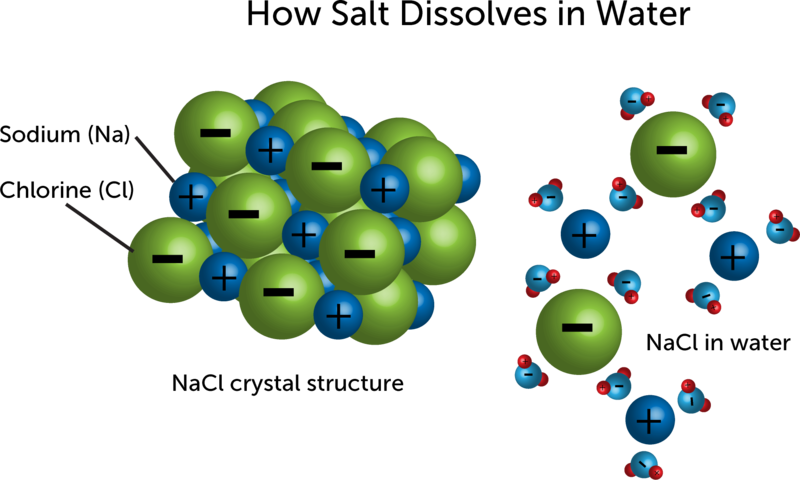
**Test yourself**

Balance the following equations

1. Mg + N2 🡪 Mg3N2
2. Na + O2 🡪 Na2O
3. Ca(OH)2 + NH4Cl 🡪 CaCl2 + NH3 + H2O
4. SO2 + O2 🡪 SO3
5. Fe + O2 🡪 Fe2O3
6. C2H6 + O2 🡪 CO2 + H2O
7. Na + Cl2 🡪 NaCl
8. Pb + O2 🡪 Pb3O4
9. Zn + HCl 🡪 ZnCl2 + H2
10. KHCO3 + H2SO4 🡪 K2SO4 + CO2 + H2O

**Ionic equations (Higher tier)**

Ionic compounds consist of positive ions and negative ions strongly bonded together in a lattice. When an ionic compound dissolves in water the lattice breaks up and the ions separate out and become surrounded by water molecules.

[](https://www.google.co.uk/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=2ahUKEwjhoqenn7TkAhULfMAKHVfpBSQQjRx6BAgBEAQ&url=https://www.saddlespace.org/whittakerm/science/cms_page/view/7795247&psig=AOvVaw1-rU0hX1Nw_uCCSfPiRmD_&ust=1567586032375619)

When dissolved, ionic compounds react. However, only some of the ions react; others do not react and remain unchanged. These ions are called **spectator ions**. Spectator ions are ions that do not take part in a reaction and are not shown in the ionic equation for the reaction.

**Ionic equations** only show what happens to the ions that react. Ionic equations can be written for different types of reactions:

* Neutralisation
* *~~Precipitation~~ (Yr12)*
* Displacement

1. **Neutralisation**

H+ (aq) + OH-(aq) 🡪 H2O(l)

1. **Displacement** – when a more reactive metal displaces a less reactive metal from a metal compound.

e.g. magnesium added to copper (II) sulfate

Mg(s) + Cu2+(aq) 🡪 Cu(s) + Mg2+(aq)

Test yourself

Write an ionic equation with state symbols, for each of the following reactions.

1. Hydrochloric acid (aq) + sodium hydroxide (aq)
2. Nitric acid (aq) + potassium hydroxide (aq)
3. Silver nitrate (aq) + magnesium
4. Sulfuric acid (aq) + calcium hydroxide (aq)
5. Zinc sulfate (aq) + aluminium

**Half equations**

Half equations describe the movement of electrons in chemical reactions. As electrons are not elements, their symbol is **e-.**

**To write half equations the method is:**

|  |  |
| --- | --- |
| **Step 1** | Write down the reactant and product |
| **Step 2** | Balance the atoms |
| **Step 3** | Write the total charge underneath each part in the equation |
| **Step 4** | Balance the total charge on both sides by adding electrons |

e.g. The conversion of hydrogen ions into a hydrogen molecule

|  |  |  |
| --- | --- | --- |
| **Step 1** | **H+ 🡪 H2** |  |
| **Step 2** | **2H+ 🡪 H2** |  |
| **Step 3** | **2H+ 🡪 H2**  ***Charge +2 0*** |  |
| **Step 4** | **2H+ + 2e- 🡪 H2**  Charge **+2 -2 🡪 0**  **0 = 0** | (both sides equal charge) |

Test yourself – write balanced half equations for each of the following conversions:

1. Mg2+ 🡪 Mg b. K+ 🡪 K c. O2- 🡪 O2
2. Li 🡪 Li+ e. Fe2- 🡪 Fe f. Ca 🡪 Ca2+