

****Year 10 General Chemistry****

****Writing formulae, naming and balancing equations****





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 **Name: Solutions**

**Ionic Compounds**

Ionic compounds form when a **metal combines with a non-metal** e.g., sodium chloride - NaCl.

The exception is ammonium compounds, which are also ionic
e.g., ammonium chloride - NH4Cl

The metal will be a cation (positive ion), and the non-metal will be an anion (negative ion)

**Writing formulae for ionic compounds**

1. Identify the cation and write down its symbol and charge.
2. Identify the anion and write down its symbol and charge.

(Some ions are polyatomic e.g. ammonium, NH4+, and nitrate, NO3-. The polyatomic ions are found on the ions table.)

1. Combine the two ions to form an electrically neutral compound.

There are two ways to do this:

Method 1 - Decide how many of each ion is needed for the positive and negative charges to cancel each other out. (Lowest Common Multiple)

OR

Method 2 - Swap and drop (and simplify) the values of the charges.

* Example: Write the formulae for aluminum nitride and lithium oxide.

Method 1 – Lowest Common Multiple

|  |  |  |
| --- | --- | --- |
|  | aluminium nitride | lithium oxide |
| Identify the cation and anion. Write down their symbol and charge.  | Al+3 N-3 | Li+ O-2 |
| Use a multiplier for the cation and anion each to make the charges equal. | (+3) x 1 = (-3) x 1 | (+1) x 2 = (-2) x 1 |
| Write each multiplier as a subscript after the symbol. | Al1N1 | Li2O1 |
| Write the final formula. Leave out subscripts that are one. There must be no charges in the final formula. | AlN | Li2O |

Method 2 – Swap and Drop

|  |  |  |
| --- | --- | --- |
|  | aluminium nitride | lithium oxide |
| Identify the cation and anion. Write down their symbol and charge.  | Al+3 N-3 | Li+ O-2 |
| Swap only the charge number of the cation to become the subscript of the anion and vice versa. | Al3N3 | Li2O1 |
| Simplify to the lowest ratio. | Al1N1 | Li2O1 |
| Write the final formula. Leave out subscripts that are one. There must be no charges in the final formula. | AlN | Li2O |

**Naming ionic compounds**

1. The cation is named first, then the anion.
2. Names of ions can all be found on the ions table.
3. You do not need to indicate how many ions are present eg Na3N is named sodium nitride, it is **not** named trisodium nitride.

**Ionic compounds - writing formula and naming**

Remember, ionic compounds are formed between a metal (or ammonium) and a non-metal.

|  |  |
| --- | --- |
| **Name** | **Formula** |
| potassium chloride | KCl |
| magnesium chloride | MgCl2 |
| aluminium chloride | AlCl3 |
| sodium nitrate | NaNO3 |
| sodium carbonate | Na2CO3 |
| sodium phosphate | Na3PO4 |
| calcium nitrate | Ca(NO3)2 |
| calcium nitride | Ca3N­­2 |
| zinc sulfate | ZnSO4 |
| zinc sulfide | ZnS |
| iron (II) oxide | FeO |
| iron (III) oxide | Fe2O3 |
| copper (I) hydroxide | CuOH |
| copper (II) hydroxide | Cu(OH)2 |
| ammonium nitrate | NH4NO3 |
| ammonium iodide | NH4I |
| ammonium sulfate | (NH4)2SO4 |
| silver chloride | AgCl |
| silver acetate | AgCH3COO |
| silver oxide | Ag2O |
| magnesium oxide | MgO |
| magnesium phosphate | Mg3(PO4)2 |
| iron (II) carbonate | FeCO3 |
| iron (III) carbonate | Fe2(CO3)3 |
| sodium hydrogencarbonate | NaHCO3 |
| barium ethanoate | Ba(CH3COO)2 |
| chromium (III) sulfide | Cr2S3 |

**Covalent Compounds**

Covalent compounds form when **non-metal elements** combine
e.g., carbon dioxide - CO2.

**Writing covalent formulae**

1. Write down the symbol of the first element named followed by the symbol of the second element named.
2. Use numerical prefixes to identify the number of atoms of each element in the molecule of the compound.

|  |  |
| --- | --- |
| Prefix on the name of the element | Number of atoms in compound |
| mono | 1 |
| di | 2 |
| tri | 3 |
| tetra | 4 |
| penta | 5 |
| hexa | 6 |
| hepta | 7 |
| octa | 8 |
| nona | 9 |
| deca | 10 |

* Example: Write the formula of sulfur trioxide and dinitrogen pentoxide

|  |  |  |
| --- | --- | --- |
|  | sulfur trioxide | dinitrogen pentoxide |
| Write down the symbol of the first element named followed by the symbol of the second element named.  | S O | N O |
| Use numerical subscripts to identify the number of atoms of each element. | SO3 | N2O5 |

**Naming covalent compounds**

1. Name the first element listed in the compound.
2. Name the second element listed and give it the suffix ‘*ide’*.
3. Use numerical prefixes to specify the number of atoms in the molecule of the compound. No prefix is given to the first element’s name if there is only one atom e.g., CO2 is named carbon dioxide, not monocarbon dioxide.

**Covalent compounds -** **writing formulae and naming**

Remember covalent compounds are formed when non-metals combine.

|  |  |
| --- | --- |
| **Name** | **Formula** |
| sulfur dioxide | SO2 |
| sulfur trioxide | SO3 |
| carbon monoxide | CO |
| carbon dioxide | CO2 |
| trisulfur octaoxide | S3O8 |
| diphosphorous hexafluoride | P2F6 |
| dinitrogen pentoxide | N2O5 |
| dinitrogen trioxide | N2O3 |

**Covalent compounds known by their **common name** are:**

**Water H2O**

**Ammonia NH3**

****Organic compounds** like methane CH4 are named by a system you will learn in Upper school.**

****Acids** have their own names, which can be found on the ions table:**

**Hydrochloric acid HCl**

**Ethanoic (acetic) acid CH3COOH**

**Nitric acid HNO3**

**Sulfuric acid H2SO4**

**Carbonic acid H2CO3**

**Diatomic elements**

Some elements exist as molecules of two atoms and are called diatomic elements. They are hydrogen, nitrogen, oxygen, fluorine, chlorine, bromine and iodine and in chemical equations are written as: H2, N2, O2,F2, Cl2, Br2 & I2

**Naming summary**

**Covalent**

**Step 2:** look up names of elements on periodic table, write in order

**Step 3:** change ending of last element to ‘ide’

**Step 4:** add prefixes to show how many of each element there are

1 – mono 6 - hexa

2 – di 7 - hepta

3 – tri 8 - octa

4 – tetra 9 - nona

5 – penta 10 - deca

Only contains non-metals

**Ionic**

**Step 2:** look up first symbol on ions table, write name

**Step 3:** look up the rest of the formula on ions table, write name

First symbol is a metal (or starts with NH4)

Only one symbol

**Element**

**Step 2:** look up name of element on periodic table

**Step 1:** Element, Ionic or Covalent?

**Chemical Equations**

In a chemical reaction, atoms are rearranged to change one or more substances into one or more new substances. This can be shown using a chemical equation.

The starting substances are known as reactants and are shown before the arrow. The final products are shown after the arrow.

Substances are shown as formulae, with coefficients in front to show how many of that substance is involved. If no coefficient is written, there is only one of that substance.

For example, the fuel propane can be burnt with oxygen to create water and carbon dioxide:

C3H8 + 5O2 → 3CO2 + 4H2O

The subscript numbers are part of the formulae, e.g., water is H2O, it is made of two hydrogens with one oxygen.

The full-size numbers in front are the coefficients, they indicate how many of that substance is present, this equation says that one propane can be burnt with five oxygen to produce three carbon dioxide and four water.

**The Law of Conservation of Mass**

In a chemical reaction, atoms are not created or destroyed, they are only rearranged to produce new products. Therefore, there must be the same number of atoms in the reactants as in the products. This is shown by a balanced chemical equation and is known as the law of conservation of mass which states that “the mass of the reactants in a chemical reaction is equal to the mass of the products”.

Determine the number of each of the different types of atoms in the reactants and the products and then decide if the equation is balanced or unbalanced.

1. C3H8 + 5O2 → 3CO2 + 4H2O
 propane oxygen carbon dioxide water

**Reactants: Products:**
Carbon (C) = 3 Carbon (C) = 3
Hydrogen (H) = 8 Hydrogen (H) = 8

Oxygen (O) = 10 Oxygen (O) = 10

Balanced or unbalanced: balanced

1. H2SO4 + 2NaOH → Na2SO4 + H2O
 sulfuric acid sodium hydroxide sodium sulfate water

**Reactants: Products:**
Sodium (Na) = 2 Sodium (Na) = 2
Sulfur (S) = 1 Sulfur (S) = 1
Hydrogen (H) = 4 Hydrogen (H) = 2

Oxygen (O) = 6 Oxygen (O) = 5

Balanced or unbalanced: unbalanced

1. SO3 + H2O → H2SO4 sulfur trioxide water sulfuric acid

**Reactants: Products:**
Sulfur (S) = 1 Sulfur (S) = 1
Hydrogen (H) = 2 Hydrogen (H) = 2

Oxygen (O) = 4 Oxygen (O) = 4

Balanced or unbalanced: balanced

1. C4H10 + 6O2 → 4CO2 + 5H2O
 butane oxygen carbon dioxide water

**Reactants: Products:**
Carbon (C) = 4 Carbon (C) = 4
Hydrogen (H) = 10 Hydrogen (H) = 10

Oxygen (O) = 12 Oxygen (O) = 13

Balanced or unbalanced: unbalanced

**Balancing chemical equations**

An unbalanced equation can be balanced by adding or changing coefficients in front of the formulae:

 H2 + N2 → NH3 is unbalanced

3H2 + N2 → 2NH3 is balanced

It is important that you only change the coefficients, you cannot change the formulae at this stage, do not change or add subscript numbers.

General method:

1. Pick an element (leave oxygen until last and hydrogen until second last).
2. Determine how many of that element there are in the reactants, and how many there are in the products.
3. Add or change coefficients so that the numbers of the element on either side of the arrow becomes equal.
4. Repeat the process for each element in the reaction until all are equal.

Balance the chemical equations below by filling in the blanks.

1. 3H2 + N2­ → 2NH3 hydrogen nitrogen ammonia
2. ­­­ 6Mg + P4 → 2Mg3P2 magnesium phosphorous magnesium phosphide
3. 2HCl + CuSO4­ → H2SO4 + CuCl2 hydrochloric acid copper (II) sulfate sulfuric acid copper (II) chloride
4. 2Al + 3CuO → Al2O3 + 3Cu
 aluminium copper (II) oxide aluminium oxide copper
5. 3C + 4HNO3 → 3CO2 + 2H2O + 4NO
 carbon nitric acid carbon dioxide water nitric oxide

Year 10 General Chemistry Quiz

 Total: /20

1. Name the following substances. (6 marks)
2. MgO magnesium oxide
3. SrSO4 strontium sulfate
4. N2 nitrogen
5. CO carbon monoxide
6. FeN iron (III) nitride
7. AgHSO4 silver hydrogensulfate
8. Write the formula for the following substances. (10 marks)
9. calcium sulfide CaS
10. chromium (III) hydroxide Cr(OH)3
11. lithium hydrogencarbonate LiHCO3
12. tetrasulfur hexafluoride S4F6
13. barium nitrate Ba(NO3)2
14. sulfuric acid H2SO4
15. zinc phosphate Zn3(PO4)2
16. nickel (II) chloride NiCl2
17. aluminium carbonate Al2(CO3)3
18. potassium sulfate K2SO4
19. Balance the following equations. (4 marks)
20. 2C(s) + O2(g) → 2CO(g)
21. 2Fe(s) + 3I2(g) → 2FeI3(s)
22. 2C6H14(g) + 19O2(g) → 12CO2(g) + 14H2O(*l*)
23. B2Br6(s)+ 6HNO3(*aq*) → 2B(NO3)3(s) + 6HBr(aq)

Year 10 General Chemistry Quiz

Total: /24

1. Name the following substances. (6 marks)
2. Ag2O silver oxide
3. CaCO3 calcium carbonate
4. NH3 ammonia
5. N2O4 dinitrogen tetroxide
6. Cr2S3 chromium (III) sulfide
7. H2CO3 carbonic acid
8. Write the formula for the following substances. (10 marks)
9. potassium nitrate KNO3
10. strontium phosphate Sr3(PO4)2
11. copper (I) nitrate CuNO3
12. triphosporus pentoxide P3O5
13. manganese (II) ethanoate Mn(CH3COO)2
14. phosphoric acid H3PO4
15. gold (I) sulfite Au2SO3
16. nickel (II) nitride Ni3N2
17. calcium hydrogensulfate Ca(HSO4)2
18. ammonium iodide NH4I
19. Balance the following equations. (4 marks)
20. 2H2(g) + O2(g) → 2H2O(g)
21. N2(g) + 3H2(g) → 2NH3(g)
22. 2C4H10(g) + 13O2(g) → 8CO2(g) + 10H2O(*l*)
23. 2NaMnO4(aq)+ H2O2(*l*) + 3H2SO4(aq) → 2MnSO4(aq) + Na2SO4(aq) + 3O2(g) + 4H2O(*l*)
24. Write fully balanced chemical equations for the following reactions. (4 marks)
25. Lithium oxide reacts with water to produce lithium hydroxide

Li2O + H2O → 2LiOH

1. Strontium bromide reacts with ammonium carbonate to produce strontium carbonate and ammonium bromide

SrBr2 + (NH4)2CO3 → SrCO3 + 2NH4Br

Year 10 Practice Chemistry Quiz

Total: /21

1. Name the following substances. (6 marks)
2. MnCO3 manganese (II) carbonate manganese carbonate
3. CuNO3 copper (II) nitrate
4. N2O4 dinitrogen tetroxide
5. Sr(HSO4)2 strontium hydrogensulfate
6. NH4F ammonium fluoride
7. Ni(CH3COO)2 nickel (II) ethanoate
8. Write the formula for each of the following substances. (8 marks)
9. sodium nitrate NaNO3
10. iron (III) phosphate FePO4
11. calcium nitride Ca3N2
12. iron (III) sulfide Fe2S3

1. aluminium iodide AlI3

1. disulfur pentafluoride S2F5
2. copper (II) chloride CuCl2
3. zinc hydrogensulfate Zn(HSO4)2
4. Balance the following equations. (3 marks)
5. 2HgO(s) → 2Hg(s) + O2(g)
6. 2C3H6(g) + 9O2(g) → 6CO2(g) + 6H2O(*l*)
7. 4FeS(s)+ 7O2(g) → 2Fe2O3(s) + 4SO2(g)
8. Write fully balanced chemical equations for the following reactions (you do not have to include states). (4 marks)
9. Calcium metal reacts with water to produce calcium hydroxide and hydrogen gas

Ca + 2H2O → Ca(OH)2 + H2

1. Chromium (III) hydrogencarbonate decomposes to produce chromium (III) oxide, carbon dioxide and water.

2Cr(HCO3)3 → Cr2O3 + 6CO2 + 3H2O