

Science 10 (4.3) Chemical Equations

Name:

Date:

Block:

(Refer to pp. 202 - 215 of BC Science 10)

- A chemical change always involves the reaction between pure substances to form new pure substances with different properties.
 - This is because a chemical change is a change in the arrangement and connections between ions and atoms.
- Five clues that a chemical change has occurred are:
 1. Bubbles of gas form.
 2. New colours appear.
 3. Light, heat or sound energy may be produced or consumed.
 4. A solid precipitate forms in a liquid.
 5. Reaction is usually difficult to reverse.
- chemical reactions: one or more chemical changes that occur at the same time
 - reactants: original (starting) pure substances
 - products: new pure substances formed.
- Chemical reactions can be represented by chemical equations which may be written in 2 different ways:
 1. A word equation:

iron(III) chloride + sodium hydroxide → iron(III) hydroxide + sodium chloride

reactants

products.

2. A symbolic equation:

reactants → products

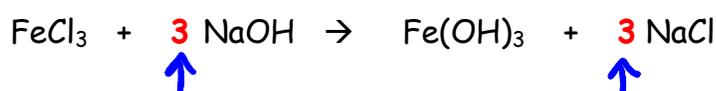


- Both show:

- reactants (arrow points away from them)
- products (arrow points to them)
- a reaction arrow pointing from reactants to products →
- addition signs

- Chemical equations may also show:

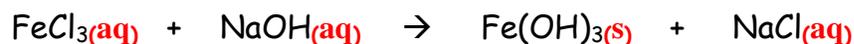
- coefficients: integers placed in front of the formula or chemical symbol



- used to determine the ratio between the various compounds in the reaction

Ex: 1:3:1:3

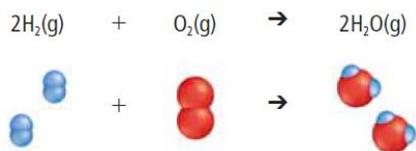
- states of matter: shown by letters written in brackets to the right of the formula or chemical symbol.



- (g) for gas
- (l) for liquid
- (s) for solid
- (aq) for aqueous (dissolved in water).

CONSERVATION OF MASS IN CHEMICAL CHANGE

- Chemical change means new compounds are created.



➤ No new matter is created or destroyed; atoms are just rearranged.

All matter in reactants = All matter in products

- This was realized by John Dalton, 200 years ago.
 - He imagined tiny particles called atoms rearranging themselves in new ways during chemical reactions; that no atoms were created or destroyed.



of atoms in reactants = # of atoms in products

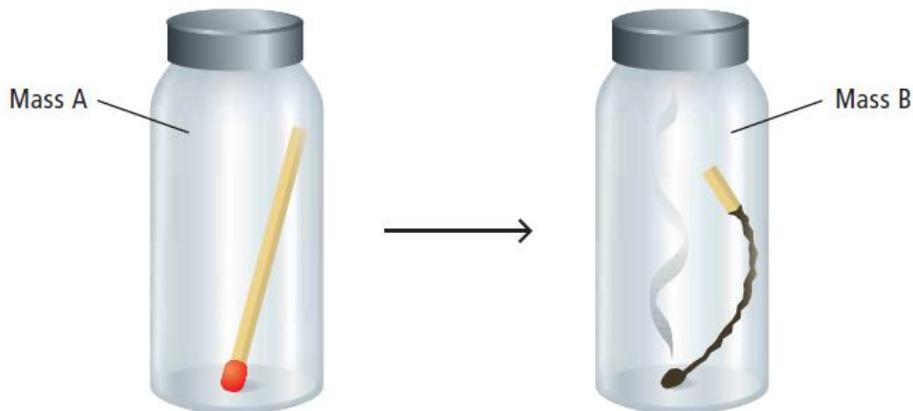


The law of conservation of mass states that:

- mass is conserved in a chemical reaction;
 - the total mass of the products is always equal to the total mass of the reactants.

Mass of the reactants = Mass of the products

Conservation of Mass



Mass A [wood + air] = Mass B [carbon + CO₂ + H₂O]

WRITING AND BALANCING CHEMICAL EQUATIONS

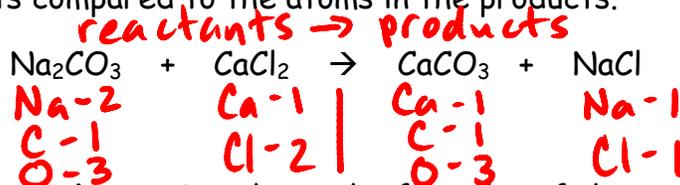
- The simplest form of chemical equation is a word equation

sodium carbonate + calcium chloride → calcium carbonate + sodium chloride



- A more useful way of representing a chemical equation is done by replacing the words with chemical symbols and formulas.
- A **skeleton equation** simply shows the formulas of the reactants and products.

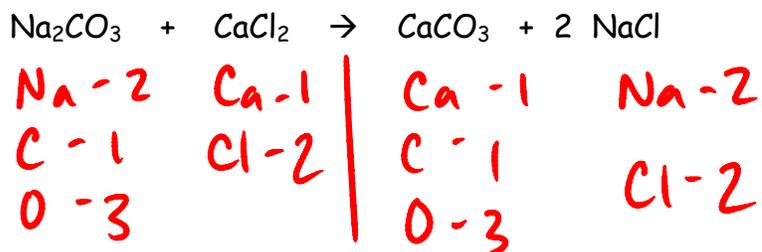
* ➤ It does not show the correct proportion of the atoms in the reactants compared to the atoms in the products.



- A **balanced chemical equation** shows the formulas of the reactants and the products, as well as matching the number of atoms of each element on both sides of the chemical equation.

➤ Balancing ensures that the number of each atom is the same on both sides of the reaction arrow.

- Can only add/change coefficients to balance.
- Always use the lowest whole-number ratio.



Complete RC p. 207



COUNTING ATOMS

We count atoms in the following way:

Reactants: $\text{Na}_2\text{CO}_3 + \text{CaCl}_2$

Na_2CO_3 means 1 molecule of Na_2CO_3 (1 x 2 Na, 1 C, and 1 x 3 O)

CaCl_2 means 1 molecule of CaCl_2 (1 x Ca and 1 x 2 Cl)

Products: $\text{CaCO}_3 + 2 \text{NaCl}$

CaCO_3 means 1 molecule of CaCO_3 (1 x 1 Ca, 1 C, and 1 x 3 O)

2 NaCl means 2 molecule of NaCl (2 x 1 Na and 2 x 1 Cl)

Complete PP p. 207

HINTS FOR WRITING WORD EQUATIONS

Word equations require careful examination to be written correctly.

Ex. Zinc metal and hydrochloric acid react to form zinc chloride and hydrogen gas.

word equation: zinc + hydrochloric acid → zinc chloride + hydrogen gas

Try to write the following chemical reaction as a word equation:

a) Aluminium metal and copper(II) chloride solution react to form copper metal and aluminium chloride.

word equation:

aluminium + copper (II) chloride → copper + aluminium chloride

b) Copper(II) chloride solution reacts with sodium hydroxide to form copper(II) hydroxide and sodium chloride.

word equation:

copper(II) chloride + sodium hydroxide \rightarrow copper(II) hydroxide + sodium chloride

HINTS FOR WRITING SKELETON EQUATIONS

- The chemical symbol is used for most elements when they are not in a compound.
- Remember the formulas for the three common compounds containing hydrogen; methane (CH_4), ammonia (NH_3), and water (H_2O).
- Be careful of polyatomic ions such as ammonium (NH_4^+), and carbonate (CO_3^{2-}).
- Be careful of the diatomic elements:

➤ The "special seven" are all diatomic elements

\rightarrow H_2 , N_2 , O_2 , F_2 , Cl_2 , Br_2 , I_2

word equation: HCl

zinc + hydrochloric acid \rightarrow zinc chloride + hydrogen gas

$\text{Zn} + \text{Cl}^-$
Reactants: Products:
 $\text{Zn} + \text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$

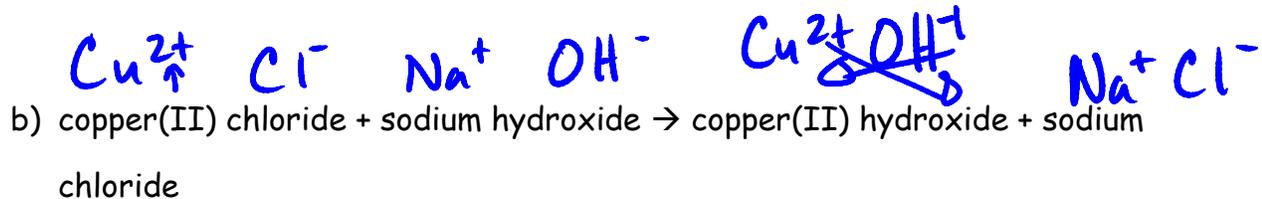
skeleton equation:

Try to write the following word equation as a skeleton equation:

* a) aluminium + copper(II) chloride solution \rightarrow copper + aluminium chloride

skeleton equation:

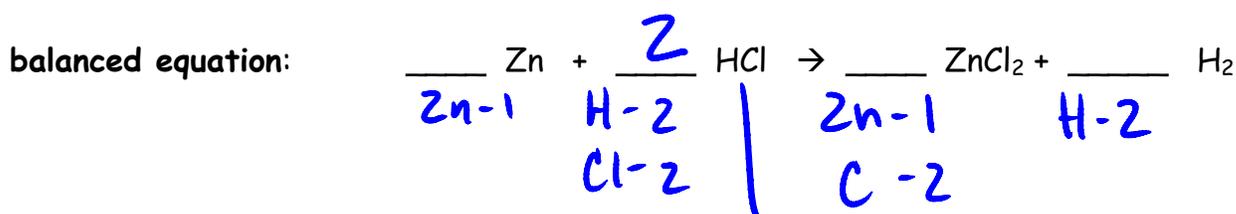
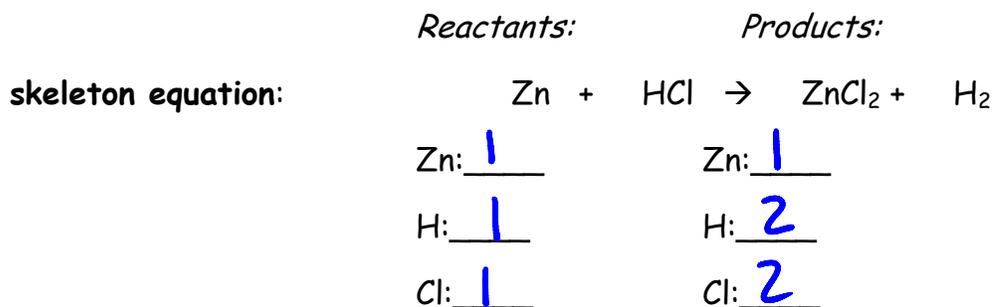
$\text{Al} + \text{CuCl}_2 \rightarrow \text{Cu} + \text{AlCl}_3$



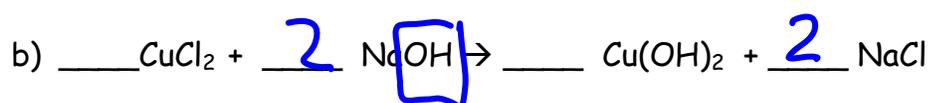
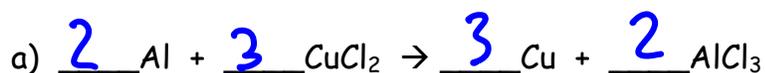
skeleton equation:



COUNTING ATOMS TO BALANCE EQUATIONS



Try to balance the following equations:



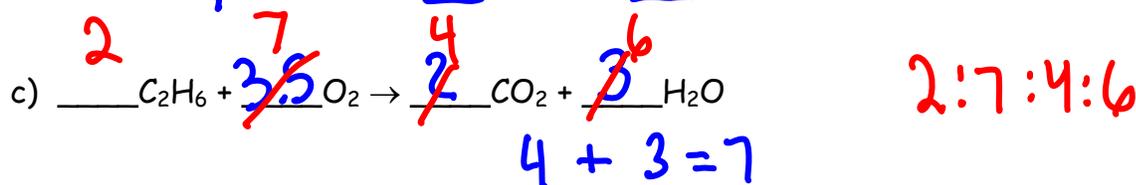
STRATEGIES FOR BALANCING EQUATIONS

Balance chemical equations by following these steps:

(Trial and error will work but can be very inefficient.)

1. Balance compounds first and single elements last.
2. Balance one compound at a time.
3. Only add coefficients; NEVER change subscripts.
4. If H and O appear in more than one place, attempt to balance them last.
5. Polyatomic ions (such as SO_4^{2-}) can often be balanced as a whole group.
6. ****Always double-check after you think you are finished!!

Try to balance these:



Complete the PP on p. 211

WB 4.3