Chemical Reactions

Chemistry

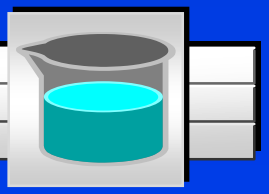
Hillgrove High School

How do you tell if it is a chemical reaction???????

- **Color change**
- **Gas Produced**
- **Precipitate (a solid that falls –like rain—out of a solution)**
- **Temperature change (heat, cold)**
- **Light given off**

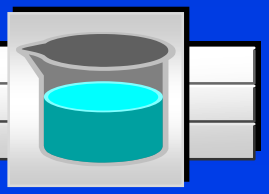
Physical or Chemical Change

- **Growth of a tree.** **Chemical**
- **Melting butter.** **Physical**
- **Fizzing soda** **Chemical**
- **Use of food by body** **Chemical**
- **Combustion of gas** **Chemical**
- **Separation of crude oil** **Physical**
- **Freezing pond** **Physical**
- Separation of water into Hydrogen and oxygen gas **Chemical**



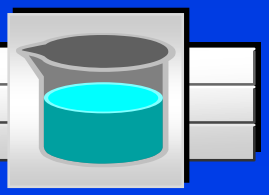
All chemical reactions

- have two parts
- **Reactants** - the substances you start with
- **Products**- the substances you end up with
- The reactants turn into the products.
- Reactants → Products



In a chemical reaction

- The way atoms are joined is changed
- Atoms aren't created or destroyed.
- Can be described several ways
- In a sentence
- Copper reacts with chlorine to form copper (II) chloride.
- In a **word equation**
- Copper + chlorine → copper (II) chloride



Symbols used in equations

- the arrow separates the reactants from the products
- Read “reacts to form”
- The plus sign = “and”
- (s) after the formula -solid
- (g) after the formula -gas
- (l) after the formula -liquid

Symbols used in equations

- **(aq) after the formula - dissolved in water, an aqueous solution.**
- **used after a product indicates a gas (same as (g))**
- **↓ used after a product indicates a solid (same as (s))**

Symbols used in equations

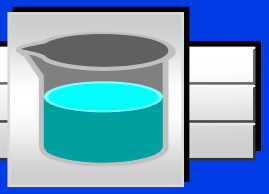
-  indicates a reversible reaction (More later)
-  ,  shows that heat is supplied to the reaction
-  is used to indicate a catalyst used supplied, in this case, platinum.

What is a catalyst?

- **A substance that speeds up a reaction without being changed by the reaction.**
- **Enzymes are biological or protein catalysts.**

Skeleton Equation

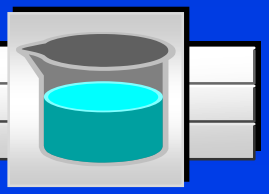
- Uses formulas and symbols to describe a reaction
- doesn’t indicate how many.
- All chemical equations are sentences that describe reactions.

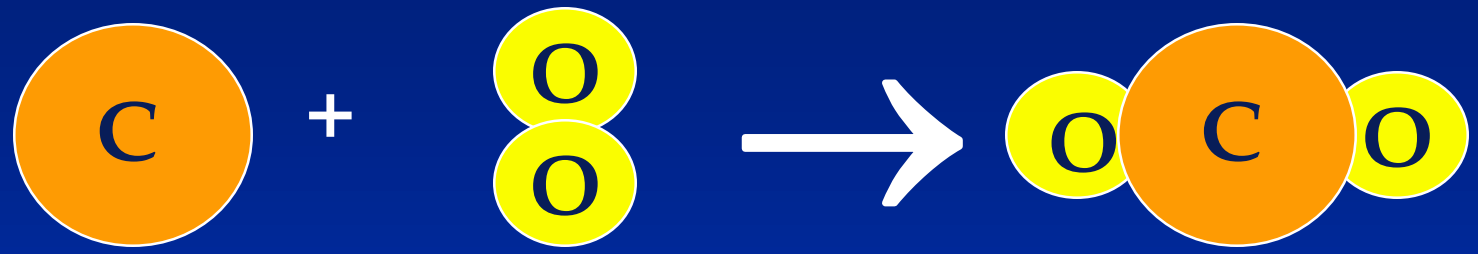


Balancing Chemical Equations

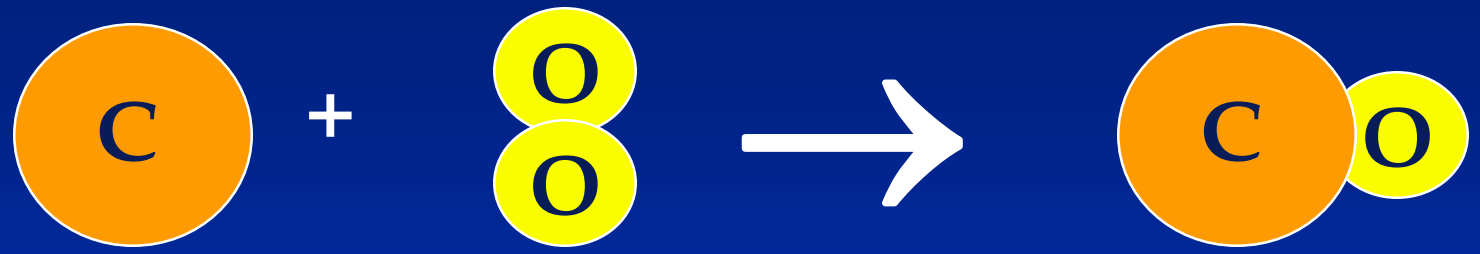
Balanced Equation

- Atoms can't be created or destroyed
- All the atoms we start with we must end up with
- A balanced equation has the same number of each element on both sides of the equation.

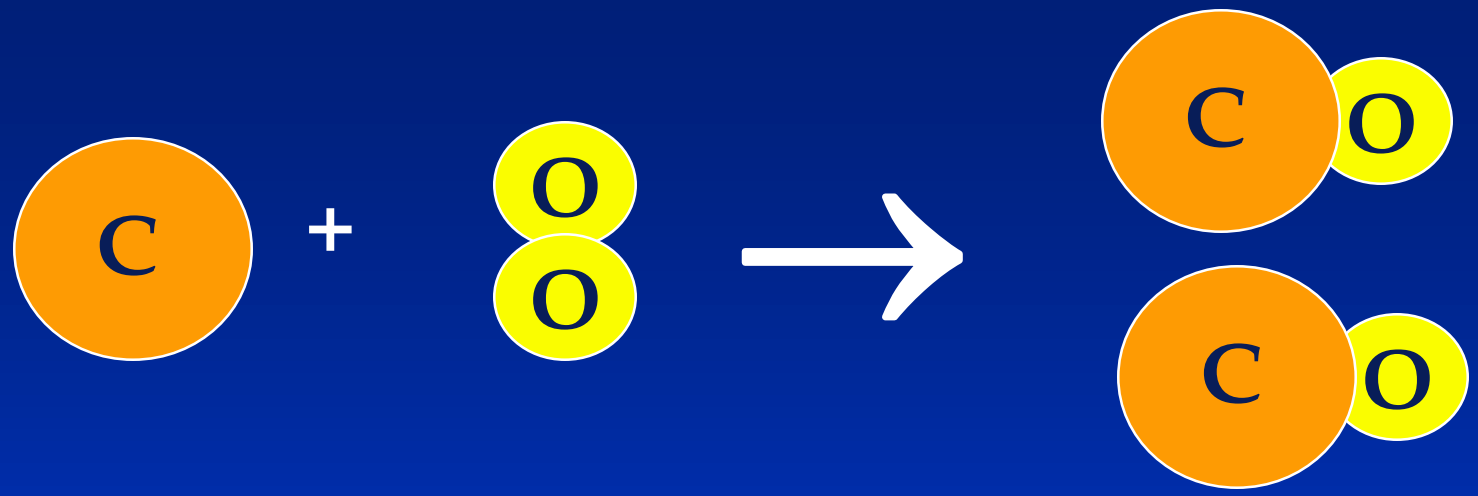




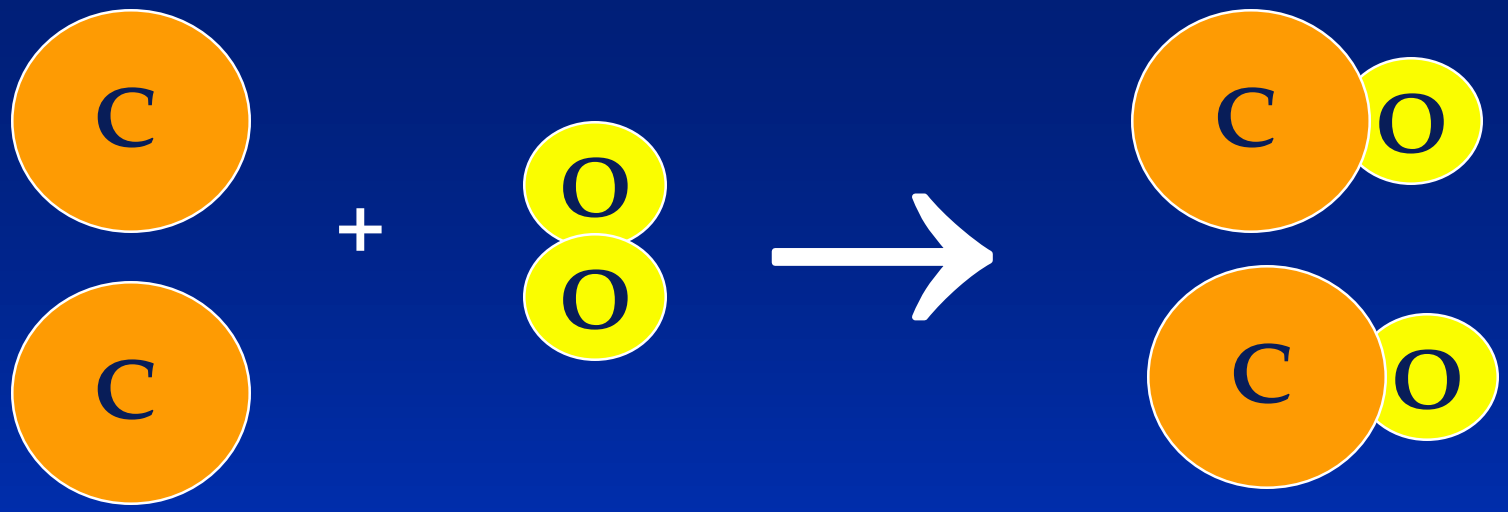
- $C + O_2 \rightarrow CO_2$
- This equation is already balanced
- What if it isn't already?



- $C + O_2 \rightarrow CO$
- We need one more oxygen in the products.
- Can't change the formula, because it describes what is



- Must be used to make another CO
- But where did the other C come from?



- Must have started with two C
- $2\ C + O_2 \rightarrow 2\ CO$

Rules for balancing

1. **Write the correct formulas for all the reactants and products**
2. **Count the number of atoms of each type appearing on both sides**
3. **Balance the elements one at a time by adding coefficients (the numbers in front). Start with the highest subscript . Save oxygen for last and hydrogen for next to last.**
4. **Check to make sure it is balanced.**

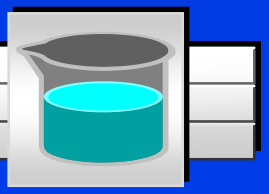
Never

- Change a subscript to balance an equation.
- If you change the formula you are describing a different reaction.
- H_2O is a different compound than H_2O_2
- Never put a coefficient in the middle of a formula
- 2 NaCl is okay, Na2Cl is not.

Example

$$H_2 + O_2 \rightarrow H_2O$$

Make a table to keep track of where you are.



Example

$$H_2 + O_2 \rightarrow H_2O$$

R		P
2	H	2
2	O	1

Need twice as much O in the product

Example

$$H_2 + O_2 \rightarrow 2\,H_2O$$

R		P
2	H	2
2	O	1

Changes the O

Example

$$H_2 + O_2 \rightarrow 2\,H_2O$$

R		P	
2	H	2	
2	O	~~1~~	2

Also changes the H

Example

$$H_2 + O_2 \rightarrow 2\,H_2O$$

R		P	
2	H	~~2~~	4
2	O	~~1~~	2

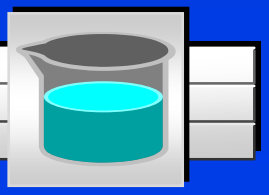
Need twice as much H in the reactant

Example

$$2\,H_2 + O_2 \rightarrow 2\,H_2O$$

R		P	
2	H	~~2~~	4
2	O	~~1~~	2

Recount



Example

$$2\,H_2 + O_2 \rightarrow 2\,H_2O$$

	R		P	
4	~~2~~	H	~~2~~	4
2		O	~~1~~	2

The equation is balanced, has the same number of each kind of atom on both sides

~~Example~~

$$2\,H_2 + O_2 \rightarrow 2\,H_2O$$

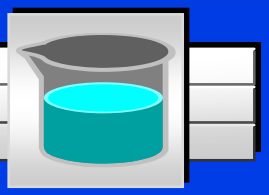
	R		P
4	~~2~~	H	~~2~~ 4
2		O	~~1~~ 2

This is the answer

Not this

#1 Combination Reactions or Synthesis

- **Combine - put together**
- **2 elements, or compounds combine to make one compound.**
- **$Ca + O_2 \rightarrow CaO$**
- **$SO_3 + H_2O \rightarrow H_2SO_4$**
- **We can predict the products if they are two elements.**
- **$Mg + N_2 \rightarrow$**

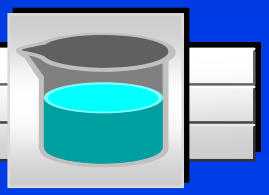


#2 Decomposition Reactions

- **decompose = fall apart**
- **one reactant falls apart into two or more elements or compounds.**
- $NaCl \xrightarrow{\text{electricity}} Na + Cl_2$
- $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

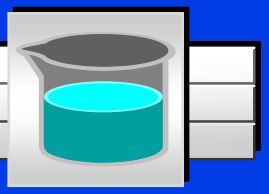
#2 Decomposition Reactions

- Can predict the products if it is a binary compound
- Made up of only two elements
- Falls apart into its elements
- $H_2O \xrightarrow{\text{electricity}}$
- $HgO \xrightarrow{\Delta}$



#2 Decomposition Reactions

- When the reactant has a polyatomic ion they break apart in a special way
- You have to know how 3 special polyatomic ions decompose
- Carbonates, chlorates and hydroxides

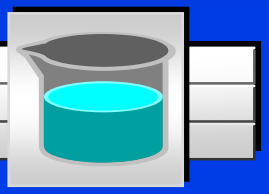


#3 Single Replacement

- One element replaces another
- Reactants must be an element and a compound.
- Products will be a different element and a different compound.
- $Na + KCl \rightarrow K + NaCl$
- $F_2 + LiCl \rightarrow LiF + Cl_2$

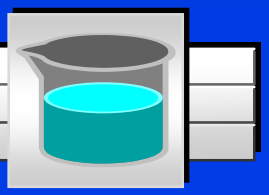
#3 Single Replacement

- **Metals replace metals (and hydrogen)**
- **K + AlN →**
- **Zn + HCl →**
- **Think of water as HOH**
- **Metals replace one of the H, combine with hydroxide.**
- **Na + HOH**



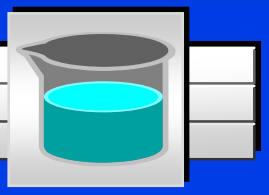
#4 Double Replacement

- Two things replace each other.
- Reactants must be two ionic compounds or acids.
- Usually in aqueous solution
- $NaOH + FeCl_3 \rightarrow$
- The positive ions change place.
- $NaOH + FeCl_3 \rightarrow Fe^{+3} OH^- + Na^{+1}Cl^{-1}$
- $NaOH + FeCl_3 \rightarrow Fe(OH)_3 + NaCl$



#4 Double Replacement

- **Will only happen if one of the products**
  - **doesn't dissolve in water and forms a solid**
  - **or is a gas that bubbles out.**
  - **or is a covalent compound, usually water.**



Last Type: Combustion

- A compound composed of only C H and maybe O is reacted with oxygen
- If the combustion is complete, the products will be CO_2 and H_2O.
- If the combustion is incomplete, the products will be CO and H_2O.

Examples

- $C_4H_{10} + O_2 \rightarrow$ (complete)
- $C_4H_{10} + O_2 \rightarrow$ (incomplete)
- $C_6H_{12}O_6 + O_2 \rightarrow$ (complete)
- $C_8H_8 + O_2 \rightarrow$ (incomplete)

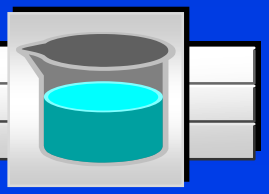
Chemical Rxn Summary

An equation

- Describes a reaction
- Must be balanced because to follow Law of Conservation of Energy
- Can only be balanced by changing the coefficients.
- Has special symbols to indicate state, and if catalyst or energy is required.

Reactions

- Come in 5 types.
- Can tell what type they are by the reactants.
- Single Replacement happens based on the activity series using activity series.
- Double Replacement happens if the product is a solid, water, or a gas.



The Process

- Determine the type by looking at the reactants.
- Put the pieces next to each other
- Use charges to write the formulas
- Use coefficients to balance the equation.