

Chapter 1

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Physical change

A physical change is a type of change in which the form of matter is altered but one substance is not transformed into another

Chemical reaction

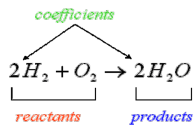
Chemical reactions are chemical changes in which reactants and products combine to form new substances.

Reactants

Substances that takes part in a reaction.

Products

Products are the substances formed from chemical reactions.



Features of a chemical equation:

- The reactants are written on the left hand side with a plus sign between them.
- The products are written on the right hand side with a plus sign between them.
- An arrow separates the reactants from the products. The arrow head points towards the products and indicates the direction of the reaction.

Word equation

A word equation is a chemical reaction written in words .

For example,



The above equation means: "Sodium reacts with chlorine to form sodium chloride."

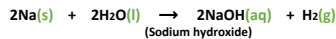
Skeletal chemical equation

A chemical equation which simply represents the symbols and formulas of reactants and products taking part in the reaction is known as skeletal chemical equation for a reaction.

For example: For the burning of Magnesium in the air, $Mg + O_2 \rightarrow MgO$ is the skeletal equation

Symbols of Physical States:

Common abbreviations include 's' for solids, 'l' for liquids, 'g' for gases, and 'aq' for substances dissolved in water.



Symbols of elements

A symbol is the chemical code for an element. Each element has one or two-letter atomic symbol, which is the abbreviated form of its name.

Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | |
|--------------------------|--------------------------|------------------------------|--------------------------|------------------------------|---------------------------|----------------------------|-------------------------|--------------------------|----------------------------|-----------------------------|---------------------------|--------------------------|-------------------------|--------------------------|---------------------------|--------------------------|------------------------|
| 1 H Hydrogen (1.008) | | | | | | | | | | | | | | | | | 2 He Helium (4.0026) |
| 3 Li Lithium (6.941) | 4 Be Beryllium (9.0122) | | | | | | | | | | | 5 B Boron (10.811) | 6 C Carbon (12.011) | 7 N Nitrogen (14.007) | 8 O Oxygen (15.999) | 9 F Fluorine (18.998) | 10 Ne Neon (20.180) |
| 11 Na Sodium (22.990) | 12 Mg Magnesium (24.305) | | | | | | | | | | | 13 Al Aluminium (26.982) | 14 Si Silicon (28.086) | 15 P Phosphorus (30.974) | 16 S Sulphur (32.06) | 17 Cl Chlorine (35.453) | 18 Ar Argon (39.948) |
| 19 K Potassium (39.098) | 20 Ca Calcium (40.078) | 21 Sc Scandium (44.956) | 22 Ti Titanium (47.88) | 23 V Vanadium (50.942) | 24 Cr Chromium (51.996) | 25 Mn Manganese (54.938) | 26 Fe Iron (55.845) | 27 Co Cobalt (58.933) | 28 Ni Nickel (58.693) | 29 Cu Copper (63.546) | 30 Zn Zinc (65.38) | 31 Ga Gallium (69.723) | 32 Ge Germanium (72.63) | 33 As Arsenic (74.922) | 34 Se Selenium (78.96) | 35 Br Bromine (79.904) | 36 Kr Krypton (83.8) |
| 37 Rb Rubidium (85.468) | 38 Sr Strontium (87.62) | 39 Y Yttrium (88.906) | 40 Zr Zirconium (91.224) | 41 Nb Niobium (92.906) | 42 Mo Molybdenum (95.94) | 43 Tc Technetium (98.906) | 44 Ru Rhodium (101.07) | 45 Rh Rhodium (101.07) | 46 Pd Palladium (106.32) | 47 Ag Silver (107.868) | 48 Cd Cadmium (112.414) | 49 In Indium (114.818) | 50 Sn Tin (118.710) | 51 Sb Antimony (121.757) | 52 Te Tellurium (127.6) | 53 I Iodine (126.905) | 54 Xe Xenon (131.29) |
| 55 Cs Caesium (132.905) | 56 Ba Barium (137.327) | 57 La Lanthanum (138.905) | 58 Ce Cerium (140.12) | 59 Pr Praseodymium (140.908) | 60 Nd Neodymium (144.24) | 61 Pm Promethium (144.913) | 62 Sm Samarium (150.36) | 63 Eu Europium (151.964) | 64 Gd Gadolinium (157.25) | 65 Tb Terbium (158.925) | 66 Dy Dysprosium (162.50) | 67 Ho Holmium (164.930) | 68 Er Erbium (167.257) | 69 Tm Thulium (168.934) | 70 Yb Ytterbium (173.054) | 71 Lu Lutetium (174.967) | 72 Hf Hafnium (178.49) |
| 73 Ta Tantalum (180.948) | 74 W Tungsten (183.84) | 75 Re Rhenium (186.207) | 76 Os Osmium (190.23) | 77 Ir Iridium (192.22) | 78 Pt Platinum (195.084) | 79 Au Gold (196.967) | 80 Hg Mercury (200.59) | 81 Tl Thallium (204.38) | 82 Pb Lead (207.2) | 83 Bi Bismuth (208.98) | 84 Po Polonium (209) | 85 At Astatine (210) | 86 Rn Radon (222) | 87 Fr Francium (223) | 88 Ra Radium (226) | 89 Ac Actinide | 89-103 |
| 89 Ac Actinide | 90 Th Thorium (232.038) | 91 Pa Protactinium (231.036) | 92 U Uranium (238.029) | 93 Np Neptunium (237.048) | 94 Pu Plutonium (244.064) | 95 Am Americium (243.061) | 96 Cm Curium (247.07) | 97 Bk Berkelium (247.07) | 98 Cf Californium (251.08) | 99 Es Einsteinium (252.083) | 100 Fm Fermium (257) | 101 Md Mendelevium (258) | 102 No Nobelium (259) | 103 Lr Lawrencium (262) | 104 Og Oganesson (284) | | |

Legend: Alkali Metal, Alkaline Earth, Transition Metal, Basic Metal, Semiconductor, Nonmetal, Halogen, Noble Gas, Lanthanide, Actinide

Balancing of chemical equations:

Conservation of mass

No atoms can be created or destroyed in a chemical reaction, so the number of atoms for each element in the reactants side has to balance the number of atoms that are present in the products side.

Balanced chemical equation

A balanced equation is a chemical equation in which number of atoms of each element is equal on both sides of the equation.(i.e, the reactant side and the product side)

Example: $2 Mg + O_2 \rightarrow 2 MgO$

Methods to solve :

- Hit and trial Method
- Algebraic method

Hit and trial-

- Step 1: Write the correct skeleton equation.
- Step 2: Start with the compound that has the maximum atoms or maximum kinds of atoms and the atoms present in it are balanced first.
- Step 3: Balance elements that appear only once on each side of the arrow first. Then balance elements that appear more than once on a side.

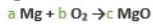
Step 4: Elementary substances are balanced last of all.

Step 5: If required the whole equation is multiplied by some suitable number in order to make all the coefficients whole numbers.

Algebraic Method-

Step 1 : write the skeletal equation

Step 2: Assign variables for the substances as shown below:



Step 3: write equation based on the number of atoms in the LHS and RHS.

$$\begin{matrix} \text{Mg} & a=c \\ \text{O} & 2b=c \end{matrix}$$

Step 4: Assign a =1, using this find the values of rest of the variables :

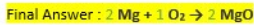
$$\begin{matrix} a=1 \\ c=1 \\ b=1/2 \end{matrix}$$

Step 5 : Remove the fractions :

Here multiplying all by 2,

$$\begin{matrix} a=2 \\ c=2 \\ b=1 \end{matrix}$$

Step 6: Give values for the variables in the skeletal equation:

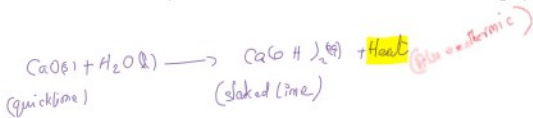


Types of chemical reactions:

- Combination
- Decomposition
- Exothermic

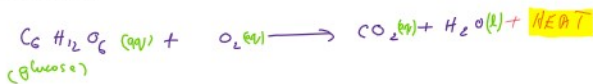
Combination reaction

In a combination reaction, two or more reactants combine to form one single product.



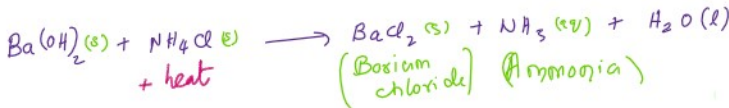
Exothermic reaction

When heat is evolved during a reaction it is called as Exothermic Reaction. Most of the combination reactions are exothermic.



Endothermic reaction

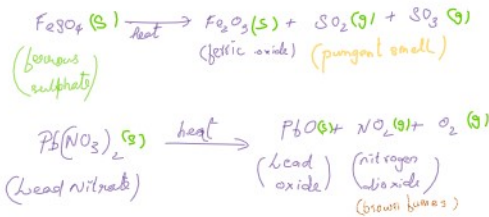
When heat is absorbed during a reaction it is called as Exothermic Reaction.



Decomposition reaction

A single reactant decomposes on the application of heat or light or electricity to give two or more products.

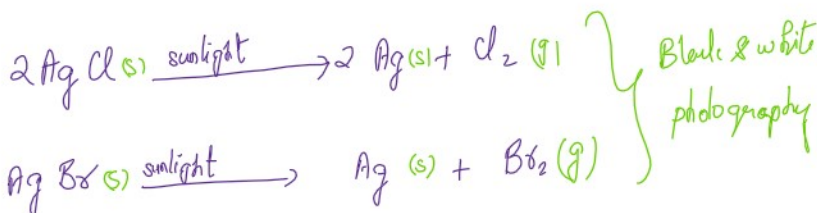
a. **Decomposition reactions which require heat** : Thermal decomposition, thermolytic decomposition or thermolysis. (different names)



b. **Decomposition reactions which require Electricity** : Electrolytic decomposition reaction

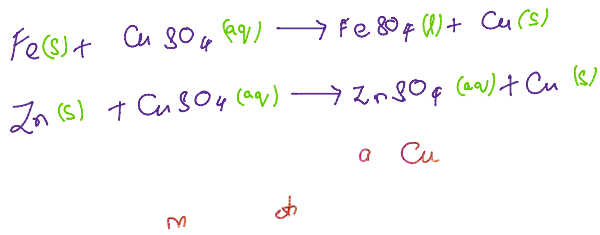


c. **Decomposition reactions which require light** : Photo decomposition reaction.



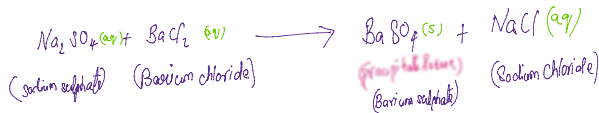
Single Displacement reaction

More reactive element displaces a less reactive element from its compound or solution. Only a metal can replace another metal and only a non-metal can replace another non-metal.



Double Displacement reaction

Between two aqueous ionic compounds, there is a precipitation reaction to form a new insoluble ionic compound.



OXIDATION AND REDUCTION:

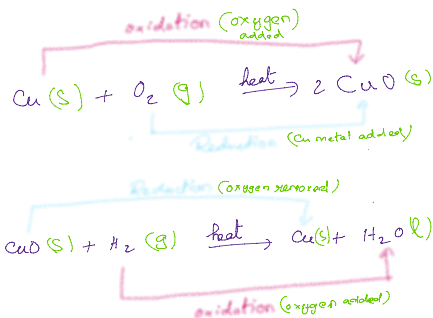
Redox reaction

Oxidation and reduction takes place simultaneously.

Oxidising agent – a substance that oxidises another substance and self-gets reduced.

Reducing agent – a substance that reduces another substance and self-gets oxidised.

| Oxidation | Reduction |
|---|---|
| <ul style="list-style-type: none"> • addition of oxygen • removal of hydrogen • addition of non-metal or electronegative element • removal of metal or electropositive element • loss of electrons | <ul style="list-style-type: none"> • addition of hydrogen • removal of oxygen • addition of metal or electropositive element • removal of non-metal or electronegative element • gain of electrons |
| OIL: Oxidation is loss of electrons | RIG: Reduction is gain of electrons |



Neutralization reaction

An acid and a base react to form water and a salt



Corrosion

Wearing away of metals due to Chemical Reactions. In this process, metals lose their metallic properties.

Example: Rusting of Iron

Rancidity

When the substance containing oils and fats are exposed to air they get oxidised and their smell, taste and colour change.

Example: butter is kept open for a long time then its smell and taste gets changed.