CHEMICAL REACTIONS

KEY

A. CHEMICAL REACTIONS = show the chemicals used up (REACTANTS) and produced (PRODUCTS) in a chemical equation

coefficient

$2H_2 + O_2 \longrightarrow 2H_2O$

Reactants product

Law of Conservation of Mass = total mass of a closed system does NOT change during a chemical reaction

Law of Conservation of Atoms = total number & types of atoms in a closed system does NOT change during a chemical reaction

Law of Conservation of Energy = total energy in closed system does NOT change during a chemical reaction

B. BALANCING CHEMICAL EQUATIONS

*mass, atoms & electrical charges must be conserved

*start with atom that is involved only once on each side

*keep polyatomic ions together if they stay together

4 Fe + 3 O_2 → 2 Fe_2O_3

R P

Fe x2 4 2 4

O 2×3=6 3×2=6

__ $CuCl_2$ + 2 NaOH → __ $Cu(OH)_2$ + 2 NaCl

Cu 1 1

Cl 2 x2

OH x2 2

Na 1 1

__ Zn + 2 HCl → __ $ZnCl_2$ + __ H_2

Zn 1 1

Cl x2 2

H x2 2

2 $Co(NO_3)_3$ + 3 $Ba(OH)_2$ → 2 $Co(OH)_3$ + 3 $Ba(NO_3)_2$

Co	x2	x2
(NO_3)	3 6	2 6
Ba	x3	x3
(OH)	2 6	3 6

C. OTHER STUFF ABOUT REACTIONS:

- phases can be indicated:
  - s = solid
  - l = liquid
  - g = gas
  - aq = aqueous → dissolved in water
- don't forget diatomic elements + others
  - end in "**gen**" including halo**gens** (7)
    - ($H_2, O_2, N_2, Cl_2, F_2, Br_2, I_2$)
  - phosphorus = P_4
  - sulphur = S_8
- crystals, powder, precipitate
  - all mean it is a solid
- solution
  - aqueous ex $NaCl_{(aq)}$ → salt water solution

lithium metal and water combine to form lithium hydroxide solution and hydrogen gas

$2\,Li_{(s)} + 2\,H_2O_{(l)} \longrightarrow 2\,LiOH_{(aq)} + H_{2(g)}$

H(OH)

sodium nitrate crystals and solid sodium metal react to form solid sodium oxide and nitrogen gas

$2\,NaNO_{3(s)} + 10\,Na_{(s)} \rightarrow 6\,Na_2O_{(s)} + N_{2(g)}$

D. Types of Chemical Reactions

p.114–118 Make your own NOTES!

1. Synthesis

a. Example: _____

b. What happens? _____

_____

c. How to identify? _____

_____

2. Decomposition

a. Example: _____

b. What happens? _____

_____

c. How to identify? _____

_____

3. Single Replacement

a. Example: _____

b. What happens? _____

_____

c. How to identify? _____

_____

4. Double Replacement

a. Example: _____

b. What happens? _____

_____

c. How to identify? _____

_____

d. Neutralization is _____

5. Combustion

a. Example: _____

b. What happens? _____

_____

c. How to identify? _____

_____

E. PREDICTING PRODUCTS

If you know the reactants of a chemical reaction, you should be able to predict the products of that reaction.

***Don't forget to write the formulae CORRECTLY before you balance the equation!*

Synthesis Reactions

element + element → compound

example: $3O_2 + 4Al \rightarrow 2Al_2O_3$

Decomposition Reactions

compound → element + element

example: $2H_2O \rightarrow 2H_2 + O_2$

Single Replacement Reactions (SRR)

element + cmpd → cmpd + element

example: $Zn + 2HCl \rightarrow H_2 + ZnCl_2$

Double Replacement Reactions (DRR)

cmpd + cmpd → cmpd + cmpd

example: $FeCl_3 + 3NH_4OH \rightarrow Fe(OH)_3 + 3NH_4Cl$

Neutralization Reactions - special DRR

acid + base → salt + H_2O

example: $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H(OH)$

Combustion Reactions

hydrocarbon + O_2 → CO_2 + H_2O

example: $2C_6H_6 + 15O_2 \rightarrow 12CO_2 + 6H_2O$

F. Energy in Chemical Reactions

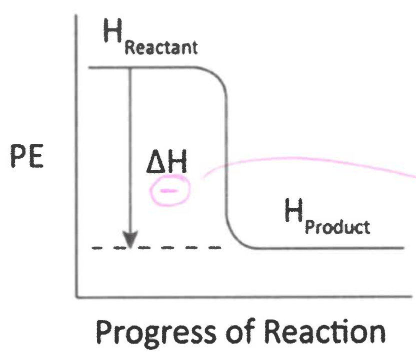
- breaking bonds takes energy
- bumping together may be enough
- sometimes, E needs to be added
- forming bonds releases energy
- difference between E needed and released determines net E of reaction
- enthalpy (H) = heat contained in a system

change → $\Delta H = H_{products} - H_{reactants}$

Exothermic = reaction that releases heat to surroundings
(exo = outside)

$$Mg + O_2 \longrightarrow MgO + \text{energy}$$

- products have lower energy than reactants
- surroundings feel warmer



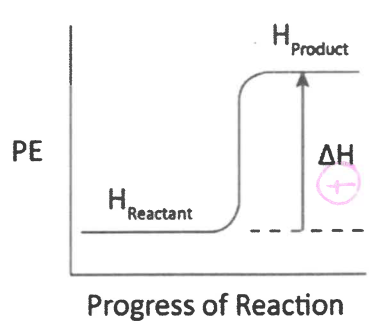
$Mg + O_2 \rightarrow MgO$ $\Delta H = -50kJ$

$\Delta H = \ominus$ for exothermic

Endothermic = reaction that absorbs energy from surroundings
(endo = inside)

$$\text{energy} + NaClO_3 \longrightarrow NaCl + O_2$$

- reactants have more energy than products
- surroundings feel cooler



$NaClO_3 \rightarrow NaCl + O_2$ $\Delta H = +100kJ$

$\Delta H = \oplus$ for endothermic