Name: ___________________

CHAPTER 6.1 - REACTION TYPES

Chemical reactions can be classified based on atom arrangement. There are 6 main reaction types we will study in this section:

1) Synthesis
2) Decomposition
3) Single Replacement
4) Double Replacement
5) Neutralization (Acid-Base)
6) Combustion

In class you will be assigned to a reaction group, it is your job to create a 8-10 minute presentation to teach your classmates about that reaction type. You will be given one full class to work on the presentations.

In this document you will find summaries of each of the reaction types, as well as videos associated with that reaction-type.

Bill Nye Video on Chemical Reactions:
https://www.youtube.com/watch?v=66kuhJkQCVM

Criteria for Reaction-Type Presentations

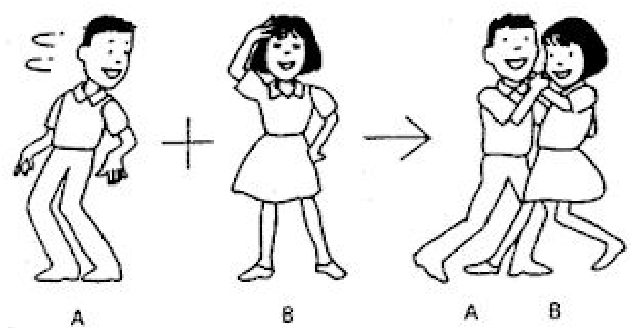
1. Well-researched, clear and informative presentation
2. Creativity and originality
3. Real life application
4. Summary notes for the rest of the class (can be projected onto screen for rest of class to copy, or emailed to teacher by 8am the morning of presentation to get printed)
5. Each group member must speak during the presentation
6. Discussion question for class engagement
7. Each student must ask at least 1 question to the group
8. The presentation should be from 8-10 minutes

***NOTE**: The presentation should not only be students copying down notes. There must be a creative portion to the presentation.*

Below Expectations (<B)	**Meets Expectations (B)**	**Exceeds Expectations (B+/A)**
	The reaction type is clearly well-researched, clear and informative	
	Presentation is creative, and engages their peers. It is clear that the group has put effort into this.	
	Presentation includes a real life application	
	Group provides clear notes for peers to copy, they are short and concise.	
	Each group member speaks during the presentation.	
	Student asks minimum of 1 question throughout the duration of presentations	
	Within time frame specified (8-10 minutes)	
	Thoughtful and engaging discussion questions posed to class	

Synthesis Reactions

During a synthesis reaction, two or more reactants **combine** to produce a new product. This can be represented symbolically by a general equation (letters A and B represent elements or compounds):



$$A + B \rightarrow AB$$

In words, the general form of a synthesis reaction is:

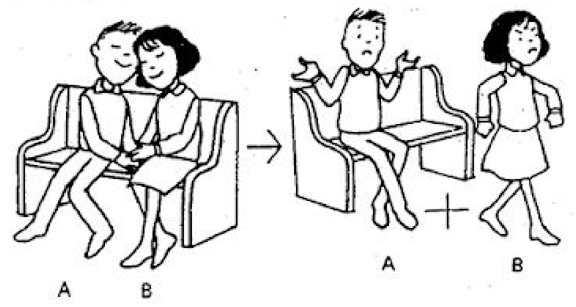
element or compound + *element or compound* → *compound*

Most often the reactants in a synthesis reaction are elements. Occasionally more than two elements or compounds may be involved as reactants, but these reactions are more rare. The majority of spontaneous synthesis reactions are exothermic.

Watch the following video: https://www.youtube.com/watch?v=MhlWTZwDHM8

Decomposition Reactions

In a decomposition reaction, a compound breaks down into two or more simpler compounds or elements. The general equation is



$$AB \rightarrow A + B$$

In words, the general form of a decomposition reaction is

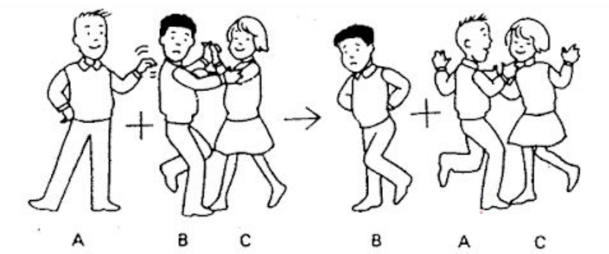
Compound → element or compound + element or compound

Many spontaneous decomposition reactions are endothermic. This is supported by the fact that most stable chemical substances will only break apart, or decompose, into simpler substances when energy, such as heat or electricity, is supplied.

Watch the following video: https://www.youtube.com/watch?v=1ocQhkHw_MM

Single Displacement Reactions

In a single displacement reaction, one element takes the place of (displaces) another element in a compound. There are two general symbolic forms of equations for a single displacement reaction:



$$A + BC \rightarrow B + AC \text{ or } AB+Y \rightarrow AY+X$$

In the general form, a metal A displaces another metal B that is already combined with a non-metal. In the second general form, a halogen X displaces another halogen Y that is already in combination with a metal.

Written in words, the general forms would be
metallic element + *compound* → *metallic element* + *compound*

or
halogen + *compound* → *halogen* + *compound*

The most common type of single displacement reaction involves one metal element displacing a second metal cation from a compound. For example:

$$Mg + CuCl_2 \rightarrow Cu + MgCl_2$$

This type of reaction proceeds because metals have different tendencies to lose electrons, forming cations. Magnesium tends to lose electrons more easily than copper, which makes magnesium more reactive. Therefore, in the reaction above, magnesium's higher activity level will allow it to replace copper in a compound with chlorine.

The second pattern of single displacement reaction involves a non-metal halogen (F, Cl, Br, I) displacing a second non-metal halogen anion from a compound. For example:

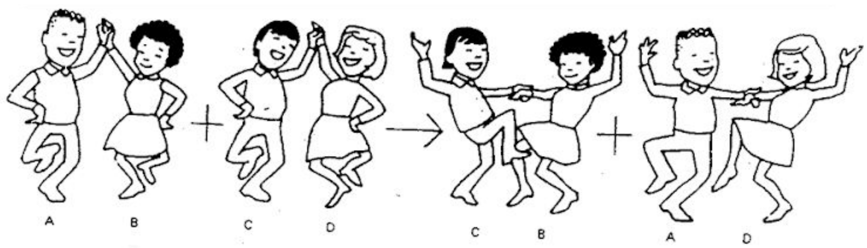
$$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$$

Because chlorine is a more active halogen, it will replace bromine in combination with potassium.

Watch the following video: https://www.youtube.com/watch?v=qhmTXdOKTBo

Double Displacement Reactions

In a double displacement reaction, the cations of two different compounds exchange places, forming two new compounds. The symbolic general form of the equation is:



$$AB + CD \rightarrow CB + AD$$

The general form of a double displacement reaction is:

compound + *compound* → *compound* + *compound*

In this type of reaction, of which there are literally hundreds of examples, the positive and negative portions of two compounds are interchanged. Double displacement reactions are often characterized by the reaction of two aqueous solutions producing an insoluble precipitate.

Watch the following video: https://www.youtube.com/watch?v=7hVKb4ROjZw

Neutralization (Acid-Base) Reactions

In neutralization, an acid and base are combined and they will react to form a salt and water as studied in Chapter 5.
Recall that an acid usually has an H on the left side of its chemical name and a base will have an OH group on the right side of its chemical name.

The general formula for neutralization is:

$$Acid + base \rightarrow salt + water$$

HCl	**+**	**NaOH**	**→**	**NaCl**	**+**	**H_2O**
Acid		Base		Salt		Water
HBr	**+**	**KOH**	**→**	**KBr**	**+**	**H_2O**
Acid		Base		Salt		Water

Watch the following video: https://www.youtube.com/watch?v=gtcE8TosEq4

Combustion Reactions

Combustion is the fast reaction of a compound or element with oxygen to form an oxide and produce heat.

For example, organic compounds such as methane, combust with oxygen to form carbon dioxide (the oxide of carbon) and water (the oxide of hydrogen).

The symbolic general formula for combustion is:

$C_XH_Y + O_2 \rightarrow CO_2 + H_2O$

(The subscripts x and y represent numbers)

Watch the following video: https://www.youtube.com/watch?v=sgHDzTH_GyU

More practice:

Synthesis:
Textbook Practice Problems page 259 #1 & 2 (Answers on page 592)

Decomposition
Textbook Practice Problems page 260 #1 & 2 (Answers on page 592)

Single Replacement
Textbook Practice Problems page 261 #1 & 2 (Answers on page 592)

Double Replacement
Textbook Practice Problems page 262 #1 & 2 (Answers on page 592)

Neutralization (Acid-Base)
Textbook Practice Problems page 263 #1 & 2 (Answers on page 592)

Combustion
Textbook Practice Problems page 264 #1 & 2 (Answers on page 592)

Mixed bag practice problems
Page 265-267
Workbook pages 105-112
Questions below

Refreshing your balancing skills
https://education.jlab.org/elementbalancing/

PRACTICE MAKES PERFECT

PART A:

Balance each of the following reactions, and classify it under one of the six reaction type categories - S (synthesis), SR (single replacement), DR (double replacement), D (decomposition), N (neutralization) (combustion).

___ Cu + ___ O_2 → ___ CuO

___ H_2O → ___ H_2 + ___ O_2

___ Fe+ ___ H_2O → ___ H_2 + ___ Fe_3O_4

___ $AsCl_3$ + ___ H_2S → ___ As_2S_3 + ___ HCl

___ KNO_3 → ___ KNO_2 + ___ O_2

___ Fe_2O_3 + ___ H_2 → ___ Fe + ___ H_2O

___ $CaCO_3$ → __ CaO + ___ CO_2

___ Fe + ___ S_8 → ___ FeS

___ H_2S + ___ KOH___ → H_2O + ___ K_2S

___ NaCl___ → Na + ___ Cl_2

___ Al + ___ H_2SO_4 → ___ H_2 + ___ $Al_2(SO_4)_3$

___ H_3PO_4 +___ NH_4OH → ___ H_2O+___ $(NH_4)_3PO_4$

___ C_3H_8 + ___ O_2 → ___ CO_2 + ___ H_2O

___ Al + ___ O_2 → __ Al_2O_3

___ CH_4 + ___ O_2 →___ CO_2 + ___ H_2O

___ C_5H_{12} + ___ O_2 →___ CO_2 + ___ H_2O

___ K_2SO_4 + ___ $BaCl_2$ →___ KCl + ___ $BaSO_4$

___ KOH + ___ H_2SO_4 →___ K_2SO_4 + ___ H_2O

PART B:

___ $Ca(OH)_2$ + ___ NH_4Cl →___ NH_4OH +__ $CaCl_2$

___ C + ___ SO_2 →___ CS_2 + ___ CO

___ Mg_3N_2 + ___ H_2O →___ $Mg(OH)_2$ + ___ NH_3

___ V_2O_5 + ___ Ca →___ CaO + ___ V

___ Na_2O_2 + ___ H_2O →___ NaOH + ___ O_2

___ Fe_3O_4 + ___ H_2 →___ Fe + ___ H_2O

___ Cu +___ H_2SO_4 →___ Cu_sO_4 +___ H_2O +___ SO_2

___ Al + ___ H_2SO_4 →___ H_2 + ___ $Al_2(SO_4)_3$

___ Si_4H_{10} + ___ O_2 →___ SiO_2 + ___ H_2O

___ NH_3 + ___ O_2 →___ N_2H_4 + ___ H_2O

___ $C_{15}H_{30}$ + ___ O_2 →___ CO_2 + ___ H_2O

___ BN + ___ F_2 →___ BF_3 + ___ N_2

___ $C_{12}H_{26}$ + ___ O_2 →___ CO_2 + ___ H_2O

___ $C_7H_6O_3$ + ___ O_2 →___ CO_2 + ___ H_2O

___ Na + ___ ZnI_2 →___ NaI + ___ Zn

___ CH_3NO_2 + ___ Cl_2 →___ CCl_3NO_2 + ___ HCl

___ $Ca_3(PO_4)_2$ + ___ SiO_2 + ___ C →___ $CaSiO_3$ + ___ CO + ___ P

___ Al_2C_6 + ___ H_2O →___ $Al(OH)_3$ + ___ C_2H_2

___ NaF + ___ CaO + ___ H_2O →___ CaF_2 + ___ NaOH

___ LiH + ___ $AlCl_3$ →___ $LiAlH_4$ + ___ LiCl

___CaF_2+___H_2SO_4+___SiO_2 →___CaSO4+___SiF4+___H_2O

___ $CaSi_2$ + ___ $SbCl_3$ ___→ Si + ___ Sb + ___ $CaCl_2$

___ TiO_2 + ___ B_4C + ___ C→___ TiB_2 + ___ CO

___ NH_3 + ___ O_2 ___ → ___NO + ___ H_2O

___ SiF_4 + ___ NaOH→___ Na_4SiO_4 + ___ NaF + ___ H_2O

___ NH_4Cl + ___ CaO→___ NH_3 + ___ $CaCl_2$ + ___ H_2O

___ NaPb + ___ C_2H_5Cl→___ $Pb(C_2H_5)_4$ + ___Pb + ___ NaCl

___ Be_2C + ___ H_2O→___ $Be(OH)_2$ + ___ CH_4

___ NpF_3 + ___ O_2 + ___ HF→___ NpF_4 + ___ H_2O

___ NO_2 + ___ H_2O→___ HNO_3 + ___ NO

___ $LiAlH_4$ + ___ BF→___ LiF + ___ AlF_3 + ___ B_2H_6