

## General Reactions

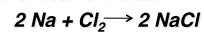
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## General Chemical Reactions

- ▶ Any chemical reaction can be described as a molecular or atomic change. It produces one or more observable changes.
- ✦ e.g. color change, gas bubbles, heat, etc.
- ✦ Reactions are generally described as **Reactant(s) → Product(s)**
- ✦ The reaction is written as a chemical equation with chemical formulas:



## The Reaction of Sodium & Chlorine

Formation of  
Sodium Chloride

## Chemical Equations

- Chemical equations describe the change(s) in Reactant(s) to Product(s) including physical state(s).
- ✦ Notations: **(g)**, **(l)**, **(s)**, **(aq)**
- ✦  $2 \text{Na}_{(s)} + \text{Cl}_{2(g)} \rightarrow 2 \text{NaCl}_{(s)}$
- ✦ Others:  
arrows for gas (↑) and solid (↓)  
Δ for heat, ⇌ for reversibility (equilibrium)



## *Types of Chemical Reactions*

- ✦ *Combination (Synthesis)*
- ✦ *Decomposition*
- ✦ *Single Displacement*
- ✦ *Double Displacement*
- ✦ *Combustion*
- ✦ *Others: Precipitation, Oxidation-Reduction, Neutralization*

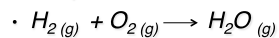


## *General Chemical Reactions*

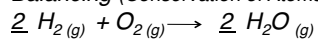


## *Chemical Reactions*

- ✦ *Combination (Synthesis)*
- ✦  $A + B \rightarrow C$
- ✦ *Example:*



*Balancing (Conservation of Atoms):*



## *Synthesis of Water*

Formation of Water

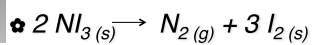
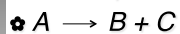
## An Unwanted Synthesis of Water

Combustion & the Hindenburg 1937



## Chemical Reactions

### ✧ Decomposition



Nitrogen Triiodide

## Decomposition

### ✧ Another example:

- Potassium chlorate (s) + heat  $\longrightarrow$  potassium chloride (s) + oxygen (g)
- Balanced equation: ?

## QUESTION

Ammonium nitrate, when heated, decomposes into nitrogen gas, oxygen gas, and water vapor. What is the sum of the coefficients in the balanced equation using smallest integer coefficients?

- A) 3      B) 5      C) 7      D) 9

## Chemical Reactions

- δ *Single Displacement*
- δ  $AB + C \longrightarrow CB + A$
- δ *Example:*
  - $HCl_{(aq)} + Mg_{(s)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$
  - *Balanced Equation: ?*

## Single Displacement

(Oxidation / Reduction)

- δ *Write a balanced equation for the following reaction:*

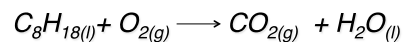
Formation of Silver Crystals

## Chemical Reactions

- ✦ *Double Displacement*
- ✦  $AB + CD \longrightarrow AD + CB$
- ✦ *Example:*
  - A solution of sodium phosphate reacts with a solution of silver nitrate to produce aqueous sodium nitrate and a precipitate of silver phosphate.
  - *Balanced equation: ?*

## Chemical Equations

- *Combustion:*



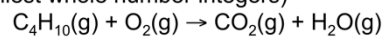
- ✦ *Oxygen reacts with octane to produce carbon dioxide and water.*

- ✦ *Reminder: the equation must balance:*



## QUESTION

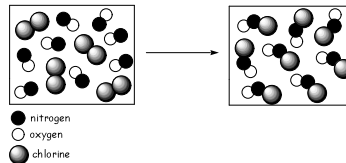
Determine the coefficient for  $O_2$  when the following equation is balanced in standard form (smallest whole number integers)



- A) 4
- B) 8
- C) 10
- D) 13
- E) 20

## QUESTION

Consider the molecular view of reactants converted to a product in the boxes shown below:



Which balanced equation best represents this reaction?

- A)  $NO + Cl_2 \rightarrow Cl_2NO$
- B)  $2 NO + Cl_2 \rightarrow 2 ClNO$
- C)  $N_2 + O_2 + Cl_2 \rightarrow 2 ClNO$
- D)  $NO + Cl \rightarrow ClNO$