

# Chemical Reactions

## Chemical Reactions

5 signs/evidence of chemical reactions:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

▪ **Chemical Reaction:** *a process in which one or more substances are converted into new substances with different chemical and physical properties*

▪ **Reactants** → **Products**

▪ → means “\_\_\_\_\_”

▪ chemical equation example:  $\text{Fe(s)} + \text{O}_2\text{(g)} \rightarrow \text{Fe}_2\text{O}_3\text{(s)}$

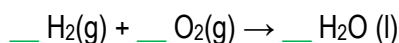
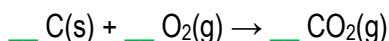
▪ **Balanced Equations** – both sides of the equation must have the same \_\_\_\_\_ for each element

▪ Law of Conservation of Mass

▪ only \_\_\_\_\_ may be adjusted to balance an equation

▪ NEVER change the \_\_\_\_\_ which identify the substance (ex:  $\text{H}_2\text{O}_2$  vs.  $\text{H}_2\text{O}$ )

▪ example:



# Types of Chemical Reactions

To help make sense of all the different chemical reactions that exist, we classify reactions into several types. There are five basic types of reactions.

Types	Pattern	Example
Synthesis	$X + Y \rightarrow XY$	$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
Decomposition	$AB \rightarrow A + B$	$\text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2$
Single Replacement	$XY + A \rightarrow AY + X$	$\text{Zn} + 2\text{HCl} \rightarrow \text{H}_2 + \text{ZnCl}_2$
Double Replacement	$XY + AB \rightarrow XB + AY$	$2\text{AgNO}_3 + \text{K}_2\text{CrO}_4 \rightarrow \text{Ag}_2\text{CrO}_4 + 2\text{KNO}_3$
Combustion	$\text{C}_x\text{H}_y + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$	$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$

Balance the equation and classify each reaction as **synthesis**, **decomposition**, **single-replacement**, or **double-replacement**.

Balance the equation...

...and classify it.



\_\_\_\_\_



\_\_\_\_\_



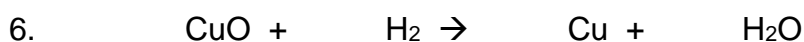
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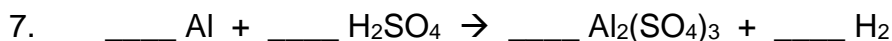
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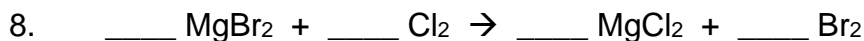
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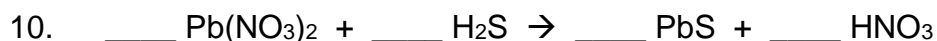
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\_\_\_\_\_



\_\_\_\_\_



\_\_\_\_\_



\_\_\_\_\_

13.  $\underline{\quad} \text{N}_2 + \underline{\quad} \text{H}_2 \rightarrow \underline{\quad} \text{NH}_3$  \_\_\_\_\_
14.  $\underline{\quad} \text{NaBr} + \underline{\quad} \text{Cl}_2 \rightarrow \underline{\quad} \text{NaCl} + \underline{\quad} \text{Br}_2$  \_\_\_\_\_
15.  $\underline{\quad} \text{Zn} + \underline{\quad} \text{AgNO}_3 \rightarrow \underline{\quad} \text{Zn}(\text{NO}_3)_2 + \underline{\quad} \text{Ag}$  \_\_\_\_\_
16.  $\underline{\quad} \text{Sn} + \underline{\quad} \text{Cl}_2 \rightarrow \underline{\quad} \text{SnCl}_4$  \_\_\_\_\_
17.  $\underline{\quad} \text{Ba}(\text{OH})_2 \rightarrow \underline{\quad} \text{BaO} + \underline{\quad} \text{H}_2\text{O}$  \_\_\_\_\_
18.  $\underline{\quad} \text{Mg}(\text{OH})_2 + \underline{\quad} \text{HCl} \rightarrow \underline{\quad} \text{MgCl}_2 + \underline{\quad} \text{H}_2\text{O}$  \_\_\_\_\_
19.  $\underline{\quad} \text{Na}_2\text{CO}_3 + \underline{\quad} \text{HCl} \rightarrow \underline{\quad} \text{NaCl} + \underline{\quad} \text{H}_2\text{CO}_3$  \_\_\_\_\_
20.  $\underline{\quad} \text{NH}_4\text{NO}_2 \rightarrow \underline{\quad} \text{N}_2 + \underline{\quad} \text{H}_2\text{O}$  \_\_\_\_\_
21.  $\underline{\quad} \text{N}_2 + \underline{\quad} \text{O}_2 \rightarrow \underline{\quad} \text{N}_2\text{O}_5$  \_\_\_\_\_
22.  $\underline{\quad} \text{MgCO}_3 \rightarrow \underline{\quad} \text{MgO} + \underline{\quad} \text{CO}_2$  \_\_\_\_\_
23.  $\underline{\quad} \text{KBr} + \underline{\quad} \text{Cl}_2 \rightarrow \underline{\quad} \text{KCl} + \underline{\quad} \text{Br}_2$  \_\_\_\_\_
24.  $\underline{\quad} \text{Zn} + \underline{\quad} \text{CuSO}_4 \rightarrow \underline{\quad} \text{Cu} + \underline{\quad} \text{ZnSO}_4$  \_\_\_\_\_
25.  $\underline{\quad} \text{P} + \underline{\quad} \text{O}_2 \rightarrow \underline{\quad} \text{P}_4\text{O}_6$  \_\_\_\_\_
26.  $\underline{\quad} \text{K} + \underline{\quad} \text{H}_2\text{O} \rightarrow \underline{\quad} \text{KOH} + \underline{\quad} \text{H}_2$  \_\_\_\_\_
27.  $\underline{\quad} \text{Al} + \underline{\quad} \text{Pb}(\text{NO}_3)_2 \rightarrow \underline{\quad} \text{Al}(\text{NO}_3)_3 + \underline{\quad} \text{Pb}$  \_\_\_\_\_
28.  $\underline{\quad} \text{Fe} + \underline{\quad} \text{O}_2 \rightarrow \underline{\quad} \text{Fe}_3\text{O}_4$  \_\_\_\_\_

# Writing Word Equations

## Ionic Formulas

metal + nonmetal  
balance the charges  
example: aluminum oxide  
 $\text{Al}^{+3}$        $\text{O}^{-2}$   
 $\text{Al}_2\text{O}_3$

### key words:

yields or produces or forms  $\rightarrow$   
combines or combines +  
decomposes  $\rightarrow$  (for decomposition reactions)

- look out for "**HONCIBrIF**" elements! They are *diatomic* in their **pure** form.



### Write the formulas for the chemical reaction, balance, and classify the reaction type:

- Barium oxide reacts with water to form barium hydroxide.
- Iron reacts with sulfuric acid ( $\text{H}_2\text{SO}_4$ ) to form Iron (III) sulfate and hydrogen gas.
- Bromine reacts with sodium iodide to form sodium bromide and iodine.
- Aluminum and iron (III) oxide react to form aluminum oxide and iron metal.
- Silver nitrate and zinc chloride react to form zinc nitrate and silver chloride

6. Zinc and hydrochloric acid (HCl) react to form zinc chloride and hydrogen gas.
  
  
  
  
  
  
  
  
  
  
7. Sulfuric acid reacts with sodium hydroxide to produce sodium sulfate and water.
  
  
  
  
  
  
  
  
  
  
8. Aluminum chloride decomposes to produce aluminum metal and oxygen gas.
  
  
  
  
  
  
  
  
  
  
9. Lead (II) nitrate and potassium iodide react to form lead (II) iodide and potassium nitrate.
  
  
  
  
  
  
  
  
  
  
10. Magnesium metal reacts with iron (III) chloride to produce magnesium chloride and iron metal.

# Single Replacement Reactions

Use your activity series to verify whether a reaction actually occurs in each of the following reactions.

If no reaction occurs – write No RXN. If a reaction does occur, balance the equation.

- $\text{Ca(s)} + \text{ZnCl}_2(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{Zn(s)}$
- $\text{Ag(s)} + \text{Cu(NO}_3)_2(\text{aq}) \rightarrow \text{AgNO}_3(\text{aq}) + \text{Cu(s)}$
- $\text{Zn(s)} + \text{HCl(aq)} \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$
- $\text{Li(s)} + \text{CuSO}_4(\text{aq}) \rightarrow \text{Li}_2\text{SO}_4(\text{aq}) + \text{Cu(s)}$
- $\text{Fe(s)} + \text{Cu(NO}_3)_2(\text{aq}) \rightarrow \text{Fe(NO}_3)_2(\text{aq}) + \text{Cu(s)}$
- $\text{Li(s)} + \text{HCl(aq)} \rightarrow \text{LiCl(aq)} + \text{H}_2(\text{g})$
- $\text{Mg(s)} + \text{FeCl}_3(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{Fe(s)}$
- $\text{Cu(s)} + \text{AlCl}_3(\text{aq}) \rightarrow \text{Al(s)} + \text{CuCl}_2(\text{aq})$

For the reactions below: If there is no reaction write “No”.

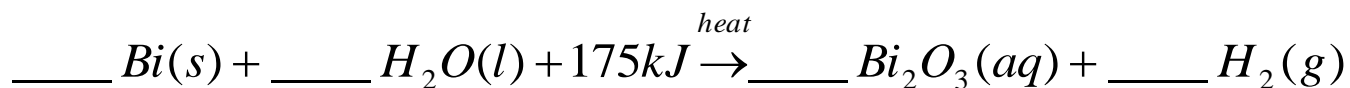
If there is a reaction write “Yes”.

- $\text{Al(s)} + \text{HCl(aq)} \rightarrow ?$
- $\text{Pb(s)} + \text{Ca(NO}_3)_2(\text{aq}) \rightarrow ?$
- $\text{Mg(s)} + \text{Zn(NO}_3)_2(\text{aq}) \rightarrow ?$
- $\text{K(s)} + \text{H}_2\text{O(l)} \rightarrow ?$
- $\text{Au(s)} + \text{HCl(aq)} \rightarrow ?$
- $\text{Al(s)} + \text{H}_2\text{O(l)} \rightarrow ?$
- $\text{Na(s)} + \text{Ag(NO}_3)(\text{aq}) \rightarrow ?$
- $\text{Ag(s)} + \text{H}_2\text{O(l)} \rightarrow ?$

**Activity Series\*\***

Most	Metals	Nonmetals	Most
↓	Li	F <sub>2</sub>	↓
	Rb	Cl <sub>2</sub>	
	K	Br <sub>2</sub>	
	Cs	I <sub>2</sub>	
	Ba		
	Sr		
	Ca		
	Na		
	Mg		
	Al		
	Ti		
	Mn		
	Zn		
	Cr		
	Fe		
	Co		
	Ni		
	Sn		
	Pb		
**H <sub>2</sub>			
Cu			
Ag			
Au			
Least		Least	

# Interpreting Balanced Chemical Equations



1. Balance this equation.
2. What type of equation is it? \_\_\_\_\_

3. Is this endothermic or exothermic? (circle)

Exothermic:

Endothermic:

4. What are the states of the reactants? (list them in order) \_\_\_\_\_

5. What are the states of the products? (list them in order) \_\_\_\_\_

States of Matter:

s:

l:

g:

aq:

6. What is the ratio of bismuth to hydrogen? \_\_\_\_\_

*use coefficients as ratios to solve*

7. What is the ratio of bismuth to bismuth oxide? \_\_\_\_\_

8. If you use 6 moles of bismuth, how many moles of hydrogen are released?

9. If you use 6 moles of bismuth, how many moles of bismuth oxide are released?

10. If you use 1 mole of bismuth, how many moles of hydrogen are released?

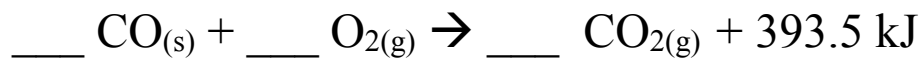
11. If you use 1 mole of bismuth, how many moles of bismuth oxide are released?

12. What is the ratio of hydrogen to energy? \_\_\_\_\_

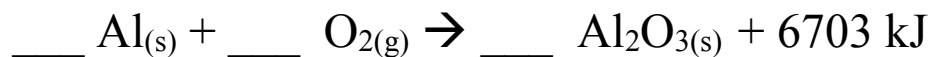
13. If 6 moles of hydrogen are released, how much energy is needed?

14. If 1 mole of hydrogen is released, how much energy is needed?

# Interpreting Balanced Chemical Equations



1. Is this reaction endothermic or exothermic?
  2. What are the states of the reactants?
  3. What are the states of the products?
  4. What is the ratio of CO to CO<sub>2</sub>?
  5. If 11 moles of CO are consumed, how many moles of CO<sub>2</sub> are released?
  6. What is the ratio of O<sub>2</sub> to CO<sub>2</sub>?
  7. If 7 moles of O<sub>2</sub> is consumed, how many moles of CO<sub>2</sub> are released?
  8. What is the ratio of CO to energy?
  9. If 2 moles of CO are burned, how much energy is released?
  10. If 3 moles of CO are burned, how much energy is released?
- 



11. Is this reaction endothermic or exothermic?
12. What are the states of the reactants?
13. What are the states of the products?
14. What is the ratio of Al to Al<sub>2</sub>O<sub>3</sub>?
15. If 5.5 moles of Al are consumed, how many moles of Al<sub>2</sub>O<sub>3</sub> are made?
16. What is the ratio of O<sub>2</sub> to Al<sub>2</sub>O<sub>3</sub>?
17. If 7 moles of O<sub>2</sub> is consumed, how many moles of Al<sub>2</sub>O<sub>3</sub> are made?
18. What is the ratio of Al to energy?
19. If 2 moles of Al are used, how much energy is released?

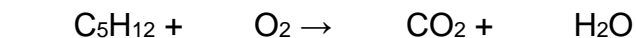
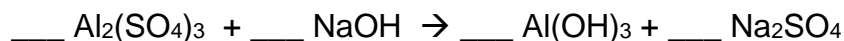
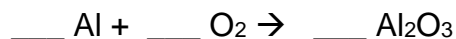
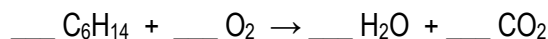
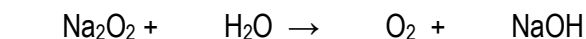
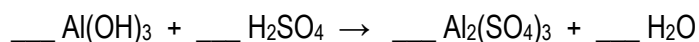


20. If 8 moles of Al are used, how much energy is released?

## Academic Chemical Reactions Test Review

1. What is a chemical reaction? Why do chemical reactions occur?
2. How does the law of conservation of matter relate to balanced equations?
3. What are 5 signs (evidence) that a chemical reaction has occurred?
4. Recognize the following terms and symbols as they relate to chemical reactions:  
reactant, product, subscript, coefficient, s, l, g, aq,  $\rightarrow$ , diatomic element

**Balance the following equations:**



**Classify the following reaction types:**

1.  $\text{S} + \text{Cl}_2 \rightarrow \text{SCl}_2$  \_\_\_\_\_
2.  $\text{K} + \text{MgBr}_2 \rightarrow \text{KBr} + \text{Mg}$  \_\_\_\_\_
3.  $\text{AgNO}_3 + \text{MgCl}_2 \rightarrow \text{AgCl} + \text{Mg(NO}_3)_2$  \_\_\_\_\_
4.  $\text{C}_4\text{H}_{10} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$  \_\_\_\_\_
5.  $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$  \_\_\_\_\_

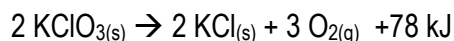
**Write the following word equations and then balance each equation:**

1. Silver nitrate and sodium chloride react to form silver chloride and sodium nitrate.
2. Bromine reacts with sodium iodide to form sodium bromide and iodine.

**Single replacement reactions:**

1. List one metal that would be able to displace Al in  $\text{Al}(\text{NO}_3)_3$
2. What is an activity series?
3. Predict if the following single replacement reactions will occur:
  - a.  $\text{Li} + \text{CuSO}_4 \rightarrow \text{Li}_2\text{SO}_4 + \text{Cu}$
  - b.  $\text{Mg} + \text{FeCl}_3 \rightarrow \text{MgCl}_2 + \text{Fe}$
  - c.  $\text{Mg} + \text{CuSO}_4 \rightarrow \text{MgSO}_4 + \text{Cu}$
  - d.  $\text{Cu} + \text{MgSO}_4 \rightarrow \text{CuSO}_4 + \text{Mg}$

**Energy of Reactions**



1. Is this reaction endothermic or exothermic?
2. What are the states of the reactants? Products?
3. What is the ratio of potassium chlorate to oxygen?
4. What is the ratio of potassium chlorate to potassium chloride?
5. If 12 moles of  $\text{KClO}_3$  are consumed, how many moles of  $\text{O}_2$  are released?
6. If 1 mole of  $\text{KClO}_3$  is consumed, how many moles of  $\text{KCl}$  are released?
7. What is the ratio  $\text{KClO}_3$  to energy?
8. If 6 moles of  $\text{KClO}_3$  are consumed, how much energy is generated?

# Chemical Reactions

Learning Target	Learning Activities	Progress Reflection (date each entry)
		Self-reflect and evaluate yourself as Beginning, Developing, Accomplished, or Exemplary  What evidence supports that I am <u>meeting</u> the target? <i>or</i> What are my next steps for growth to meet the target?
I can describe evidence of a <i>chemical</i> reaction from experimental observations.	Demo/ Experimental Observations	
I can balance chemical equations to fulfill the Law of Conservation of Mass.	PhET Virtual Balancing Problem Set	
<b>Balancing Equations Quiz (1/26 odd block, 1/27 even block)</b>		
I can write chemical reactions by interpreting word equations.	Problem Set	
I can interpret chemical equations to find chemical ratios, states of matter, and energy.	Problem Set	
I can classify reaction types (synthesis, decomposition, single replacement, double replacement, combustion).	Reaction Type Demos	
I can predict single replacement reactions.	Single Replacement Demos	

## Ch 9 Test (2/4)

**Beginning** = I need more help on this - I don't really understand it at all!

**Developing** = I kind of understand, but I need to spend more time reviewing/practicing.

**Accomplished** = I understand! I'm confident and can explain what I've learned on a test.

**Exemplary** = I could teach someone who knows nothing about this target everything they need to know.