

1. We have been symbolizing chemical substances by writing chemical formulas. On the list below, circle one word from each pair listed that best describes the substance that best describes it.
- |   |                     |                                |                                  |
|---|---------------------|--------------------------------|----------------------------------|
| a. Water – H <sub>2</sub> O                             | element or compound | ionic or molecular or metallic | atom or molecule or formula unit |
| b. Aluminum nitrate – Al(NO <sub>3</sub> ) <sub>3</sub> | element or compound | ionic or molecular or metallic | atom or molecule or formula unit |
| c. Iron – Fe  | element or compound | ionic or molecular or metallic | atom or molecule or formula unit |
| d. Ammonia – NH <sub>3</sub>                            | element or compound | ionic or molecular or metallic | atom or molecule or formula unit |
| e. Chlorine – Cl <sub>2</sub>                           | element or compound | ionic or molecular or metallic | atom or molecule or formula unit |
| f. Barium fluoride – BaF <sub>2</sub>                   | element or compound | ionic or molecular or metallic | atom or molecule or formula unit |

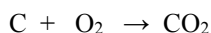
2. List some observations that you might notice that could signal that a chemical reaction is possibly occurring.

_____	_____
_____	_____
_____	_____

3. Since we use chemical formulas to represent atoms and molecules, we will use chemical formulas when we represent chemical reactions. Write the chemical formulas for:

- |                 |                          |
|-----------------|--------------------------|
| i. carbon _____ | iii. oxygen gas _____    |
| ii. iron _____  | iv. carbon dioxide _____ |

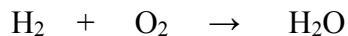
- Recall that the Law of Conservation of Mass states that the mass of the products of a chemical reaction will always be equal to the starting mass of the reactants. sometimes this law is called the Law of Conservation of Matter.
- These statements lead to the reason that the “symbol sentence” that is written to represent a chemical reaction is called a chemical *equation*. The equation below represents the reaction of carbon with oxygen gas to produce carbon dioxide.



4. In a chemical equation, we write the reactants on the \_\_\_\_\_ side of the arrow to represent the substances that you begin with, and the products on the \_\_\_\_\_ side of the arrow to represent the substances that you end up with.
5. The \_\_\_\_\_ in the middle (which could be thought of as an equal sign) is interpreted as meaning “yields” or “produces” or “decomposes” or “forms” or “results in.”
6. Let’s freshen up on the meaning of the numbers in chemical formulas.
- |  |                                       |
|--|---------------------------------------|
| a. In the box A, the _____ is a subscript, and the _____ is a coefficient.                       | A: 3Na <sub>2</sub> O                 |
| b. In the box B, what is the total number of magnesium chloride units (molecules) present? _____ | B: 4MgCl <sub>2</sub>                 |
| c. In box C, what is the total number of nitrite ions present? _____                             |                                       |
| d. In box B, what is the total number of magnesium ions present? _____                           | C: 4Al(NO <sub>2</sub> ) <sub>3</sub> |
| e. In box C, what is the total number of oxygen atoms present? _____                             |                                       |
| f. In box C, what is the total number of nitrogen atoms present? _____                           |                                       |

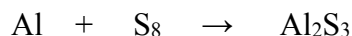
7. Balancing equations is done to satisfy the Law of Conservation of Mass and make the number of atoms the same on both sides of an equation. You can balance only by putting coefficients in front of the formulas. You can NOT change the subscripts. Write and then balance the equations for the reactions listed below.

- a. hydrogen and oxygen gas react to form water:

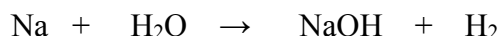


- b. nitrogen trihydride (ammonia) decomposes into its element gases: (*Don't forget which elements are diatomic!*)
- first write out the formulas in the “skeleton” equation, then balance.

- c. aluminum reacts with octahedral solid sulfur to make aluminum sulfide:



- d. solid sodium dropped into water reacts to form sodium hydroxide and hydrogen gas:



**ANSWERS**

- element or compound    ionic or molecular    atom or molecule (formula unit).
  - Water –  $\text{H}_2\text{O}$  is a compound, a molecular compound, made of molecules
  - Aluminum nitrate –  $\text{Al}(\text{NO}_3)_3$  is a compound, an ionic compound, made of formula units (*affectionately known as ionicules*)
  - Iron – Fe is an element, made of atoms, and metals have their own form of bonding - the array of inner core electrons and nucleus surrounded by a delocalized sea of electrons
  - Ammonia -  $\text{NH}_3$  is a compound, a molecular compound, made of molecules.
  - Chlorine –  $\text{Cl}_2$  is an element, a molecular element, made of diatomic molecules
  - barium fluoride –  $\text{BaF}_2$  is a compound, an ionic compound, made of formula units (*affectionately known as ionicules*)
- Many indicators could signal that a chemical reaction is possibly occurring, some indicators may just be a physical change. It can be difficult to distinguish a physical change from a chemical change.
 

color change	odor change
formation of a gas (bubbles or foam)	formation of a solid (called a precipitate)
energy exchange (gets hot or cold)	formation of a liquid (from two solids)
presence of a flame (or explosion)	texture change
- Since we use chemical formulas to represent atoms and molecules, we will use them when we represent chemical reactions.
  - Write the chemical formulas for:
    - carbon C
    - iron Fe
    - oxygen gas  $\text{O}_2$              $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
    - carbon dioxide  $\text{CO}_2$
- In a chemical equation, we write the reactants on the LEFT side to represent the substances that you begin with, and the products on the RIGHT side to represent the substances that you end up with.
- The ARROW in the middle (which could be thought of as an equal sign) is interpreted as meaning “yields” or “produces” or “decomposes” or “forms” or “results in.”
- Just like algebra, distribute the number outside the parentheses through the entire inside. A coefficient out front refers to the entire compound as if it were in parentheses, like this:  $3(\text{Na}_2\text{O})$  or this  $4(\text{MgCl}_2)$ 
  - In the box A, the 2 is a subscript, and the 3 is a coefficient.
  - In the box B, what is the total number of magnesium chloride units (molecules) present? 4
  - In box C, what is the total number of nitrite ions present?  $4 \times 3 = 12$
  - In box B, what is the total number of magnesium ions present? 4
  - In box C, what is the total number of oxygen atoms present?  $4 \times 3 \times 2 = 24$
  - In box C, what is the total number of nitrogen atoms present?  $4 \times 3 = 12$
- Balancing equations to satisfy the law of conservation of matter
  - hydrogen and oxygen gas react to form water:
    - $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
  - nitrogen trihydride (ammonia) decomposes into its element gases:
    - skeleton:  $\text{NH}_3 \rightarrow \text{N}_2 + \text{H}_2$
    - $2\text{NH}_3 \rightarrow \text{N}_2 + 3\text{H}_2$
  - aluminum reacts with octahedral solid sulfur to make aluminum sulfide:
    - $16\text{Al} + 3\text{S}_8 \rightarrow 8\text{Al}_2\text{S}_3$
  - solid sodium dropped into water reacts to form sodium hydroxide and hydrogen gas:
    - skeleton:  $\text{Na} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2$
    - $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$