Kickoff:

Directions: *Use the data on the left to complete the two element keys below.*

5. element name: **aluminum**

   element symbol: **Al**

   atomic number: **13**

   atomic mass: **26.982**

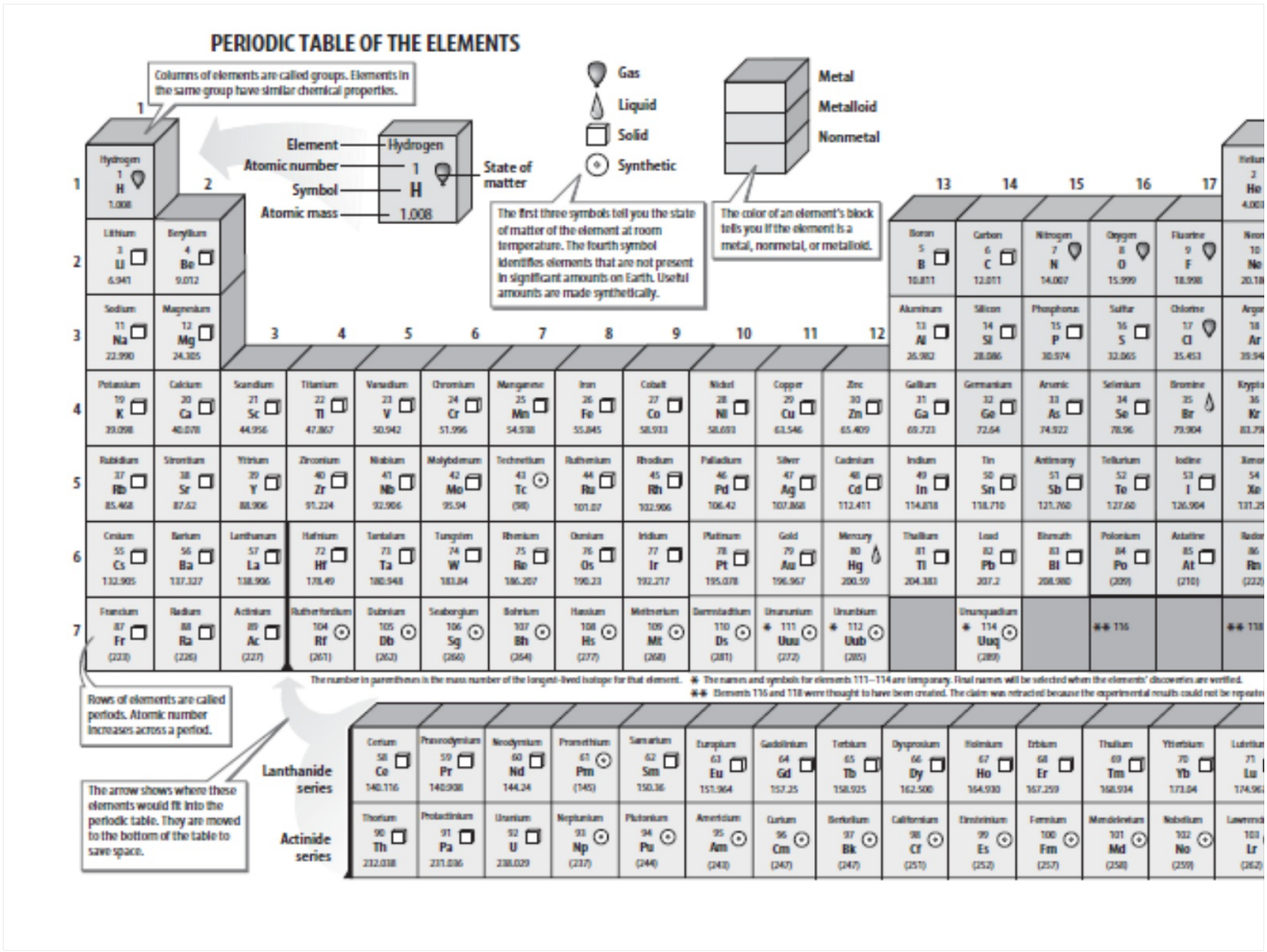
6. element name: **gold**

   element symbol: **Au**

   atomic number: **79**

   atomic mass: **196.967**

Kickoff:
How long (in years) would it take you to count to 3 billion if you counted every second without stopping?


PERIODIC TABLE OF THE ELEMENTS
Columns of elements are called groups. Elements in the same group have similar chemical properties.
Element
Atomic number
Symbol
Atomic mass
Hydrogen
1
H
1.008
State of matter
Gas
Liquid
Solid
Synthetic
Metal
Metalloid
Nonmetal
The first three symbols tell you the state of matter of the element at room temperature. The fourth symbol identifies elements that are not present in significant amounts on Earth. Useful amounts are made synthetically.
The color of an element's block tells you if the element is a metal, nonmetal, or metalloid.
Rows of elements are called periods. Atomic number increases across a period.
The arrow shows where these elements would fit into the periodic table. They are moved to the bottom of the table to save space.
Lanthanide series
Actinide series
The number in parentheses is the mass number of the longest-lived isotope for that element.
* The names and symbols for elements 111–114 are temporary. Final names will be selected when the elements' discoveries are verified.
** Elements 116 and 118 were thought to have been created. The claim was retracted because the experimental results could not be repeate

Chemical Equations, *continued*

• **The Importance of Accuracy** The symbol or form for each substance in a chemical equation must be written correctly or it will not correctly describe the reaction. Some formulas and symbols can be confus

CO_2	CO	Co
The chemical formula for the compound **carbon dioxide** is CO_2. Carbon dioxide is a colorless, odorless gas that you exhale.	The chemical formula for the compound **carbon monoxide** is CO. Carbon monoxide is a colorless, odorless, and poisonous gas.	The chemical symbol for the element **cobalt** is Co. Cobalt is a hard, bluish gray metal.

Calculating molecular weight of a compound:

(formula)

example: NaCl

22.990 g/mol Na
+ 35.45 g/mol Cl
58.44 g/mol NaCl

H_2O

H: 1.008
H: 1.00
+ O: 16.
18 g/

mol (short for mole) = 6.022×10^{23}

602,200,000,000,000,000,000,000

Practice Calculating Formula Weights

Molecular

1. HCl
2. SiH_4
3. $C_3H_6O_2$
4. $Fe(NO_3)_3$
5. NaCl
6. $CaSO_4$

A note about fractions:

$\frac{1}{2} \times \frac{1}{4} \times \frac{2}{5} = \frac{2}{60}$

$\frac{1}{5} \times \frac{4}{4}$

$4 = \frac{4}{1}$

$\frac{\text{gram}}{\text{gram}} = 1$

$\frac{\text{gram}}{\text{mol}}$

Gram-mole Practice Problems

1. What is the weight of 5.5 mole of silicon?
2. How many moles are there in 45 g of Cl?
3. Change 3.4 moles of HCl to grams.

4. Change 8.5 g of SiH_4 to moles.
5. Change 5.20 moles of $C_3H_6O_2$ to grams.
6. Change 13.2 g of $Fe(NO_3)_3$ to moles.
7. Change 3.4 moles of NaCl to grams

Calculating solution concentration

Solution = Solute / Solvent

...add 2 ~~cups~~ of sugar to 2 liters of water.

Dimensional analysis:

50 mph

Molarity (M) is the concentration of a solution expressed as the number of moles of solute per liter of solution:

$$\text{Molarity (M)} = \frac{\text{moles solute}}{\text{liters solution}}$$

Concentration = $M = \frac{mol}{L}$ = molarity

$\frac{50 mi}{1 ho}$

$\frac{mol}{L} = M$

$0.5 \frac{mo}{L}$

0.5 M

Steps for calculating molarity [concentration]

1. Identify Knowns / What do they want?

2. Calculate molecular weight for compound $\frac{g}{mol}$

$M = ?$ $\frac{mol}{L}$

3. Use dimensional analysis (follow the units)

Example: What is the molarity of a solution prepared by dissolving 15.0 g of sodium hydroxide in enough water to make a total of 225 mL of solution? NaOH

$$\frac{15\ g\ NaOH}{1} \times \frac{1\ mol}{40\ g\ NaOH} \times \frac{1000\ mL}{1\ L} \times \frac{1}{225\ mL} = 1.67\ M$$

Na = 23 g/mol

O = 16 g/mol

H = 1 g/mol

1. Sea water contains roughly 28.0 g of NaCl per liter. What is the molarity of sodium chloride i sea water?

2. What is the molarity of 245.0 g of H_2SO_4 dissolved in 1.00 L of solution?

3. What is the molarity of 5.30 g of Na_2CO_3 dissolved in 400.0 mL solution?

4. What is the molarity of 5.00 g of NaOH in 750.0 mL of solution?

5. How many moles of Na_2CO_3 are there in 10.0 L of 2.0 M soluton?

6. How many moles of Na_2CO_3 are in 10.0 mL of a 2.0 M solution?

How many grams of potassium carbonate, K_2CO_3, are needed to make 250 mL of a 2.
solution?

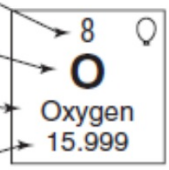
How many liters of 4.0 *M* solution can be made using 125 grams of lithium bromide, LiB

What is the concentration of a solution that has a volume of 2.5 L and contains 660 grams calcium phosphate, $Ca_3(PO_4)_2$?

List the steps required to make 250 ml of 0.5M NaOH solution.

atomic number | atomic mass | element name | element symbol

1. _____
2. _____
3. _____
4. _____



Parts of a chemical equation

Chemical reactions can be written as word equations. For example, the combustion reaction that occurs in a propane barbecue grill is written as follows:

propane + oxygen ⟶ carbon dioxide + water

This word equation can be written as a chemical equation:

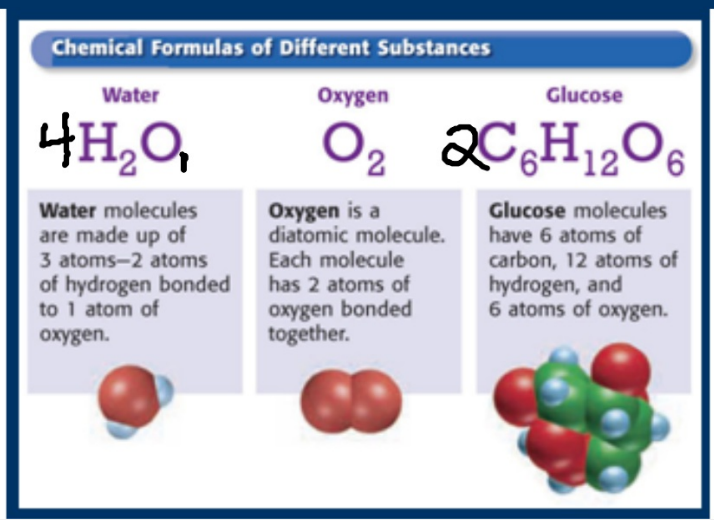
$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

A **chemical equation** uses chemical symbols and formulas to describe a chemical reaction.

A note about chemical formulas...

Chemical Formulas

• A **chemical formula** is a combination of chemical symbols and numbers to represent a substance. A chemical formula shows how many atoms of each kind are present in a molecule.



$1x = 1$

Writing Chemical Formulas and Equations

Writing Formulas for Covalent Compounds

electrons are shared

Carbon dioxide

CO_2

The *absence of a prefix* indicates one carbon atom.

The prefix *di-* indicates two oxygen atoms.

Dinitrogen monoxide

N_2O

The prefix *di-* indicates two nitrogen atoms.

The prefix *mono-* indicates one oxygen atom.

The formulas of these covalent compounds can be written by using the prefixes in the names of the compounds.

Writing Formulas for Ionic Compounds

donate/receive elec

Mg at

Cl

Cl

Sodium chloride

$NaCl$

A sodium ion has a 1+ charge.

A chloride ion has a 1− charge.

One sodium ion and one chloride ion have an overall charge of (1+) + (1−) = 0

Magnesium chloride

$MgCl_2$

A magnesium ion has a 2+ charge.

A chloride ion has a 1− charge.

One magnesium ion and two chloride ions have an overall charge of (2+) + 2(1−) = 0.

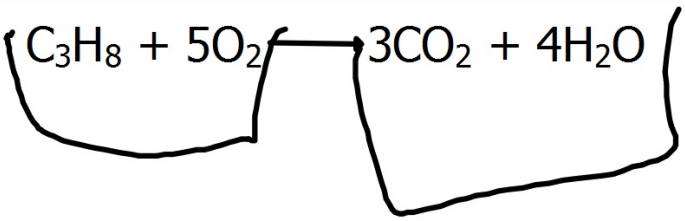
The formula of an ionic compound is written by using enough of each ion so that the overall charge is 0.

Chemical Equations *(continued)*

Chemical Equations

- **Describing Reactions by Using Equations** A **chemical equation** uses chemical symbols and formulas as a shortcut to describe a chemical reactio

- **From Reactants to Products** The starting materia in a reaction are **reactants.** The substances formed from a reaction are **products.**



The Parts of a Chemical Equation

Charcoal is used to cook food on a barbecue grill. When carbon in charcoal reacts with oxygen in the air, the primary product is carbon dioxide, as shown by the chemical equation.

The formulas of the **reactants** are written before the arrow.

The formulas of the **products** are written after the arrow.

$$C + O_2 \rightarrow CO_2$$

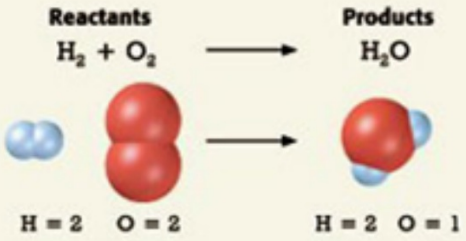
A **plus sign** separates the formulas of two or more reactants or products from one another.

The **arrow,** also called the *yields sign,* separates the formulas of the reactants from the formulas of the products.

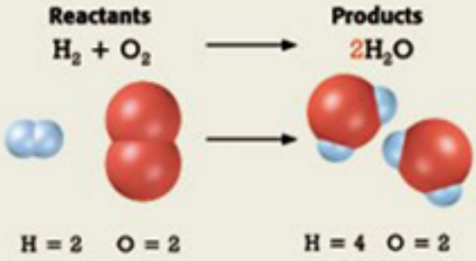
Balancing a Chemical Equation

Follow these steps to write a balanced equation for $H_2 + O_2 \longrightarrow H_2O$.

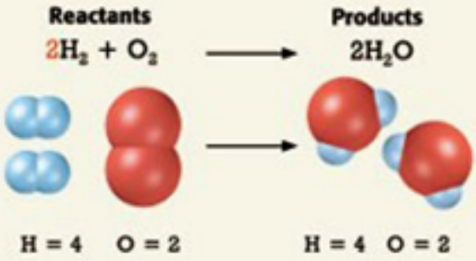
1 Count the atoms of each element in the reactants and in the products. You can see that there are fewer oxygen atoms in the product than in the reactants.



2 To balance the oxygen atoms, place the coefficient 2 in front of H_2O. Doing so gives you two oxygen atoms in both the reactants and the products. But now there are too few hydrogen atoms in the reactants.



3 To balance the hydrogen atoms, place the coefficient 2 in front of H_2. But to be sure that your answer is correct, always double-check your work!



Kickoff: Balance the following equations

1. $Cl_2 + NaBr \rightarrow NaCl + Br_2$

2. $\mathbf{Al_2O_3 \rightarrow Al + O_2}$

3. $H_2 + N_2 \rightarrow NH_3$

4. $CuCl_2 + H_2S \rightarrow CuS + HCl$

5. $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$

Begin in your notes:

Let's practice balancing some equations.

1. $Na + Cl_2 \rightarrow NaCl$

2. $C_2H_4 + O_2 \rightarrow CO_2 + H_2O$

3. $Fe + O_2 \rightarrow FeO$

4. $Al + CuSO_4 \rightarrow Al_2(SO_4)_3 + Cu$

5. $Ba(CN)_2 + H_2SO_4 \rightarrow BaSO_4 + HCN$

1. What is the weight of 0.30 mole of sulfur?
2. What is the weight of 5.5 mole of silicon?
3. How many moles are there in 45 g of Cl?
4. Change 34 g of lithium to moles.
5. What is the weight of 4.30 mole of sodium?
6. What is the weight of 1.75 mole of Ca?
7. How many moles are there in 85.3 g of P?
8. Change 0.566 g of silver to moles.