

Chemical Reactions



What is a Chemical Reaction?

What Do You Think?

What do baking bread, riding in a car, and digesting food all have in common?



What is a Chemical Reaction?

Autumn Leaves



- The change that occurs as **chlorophyll** decomposes into new compounds is a **chemical reaction**

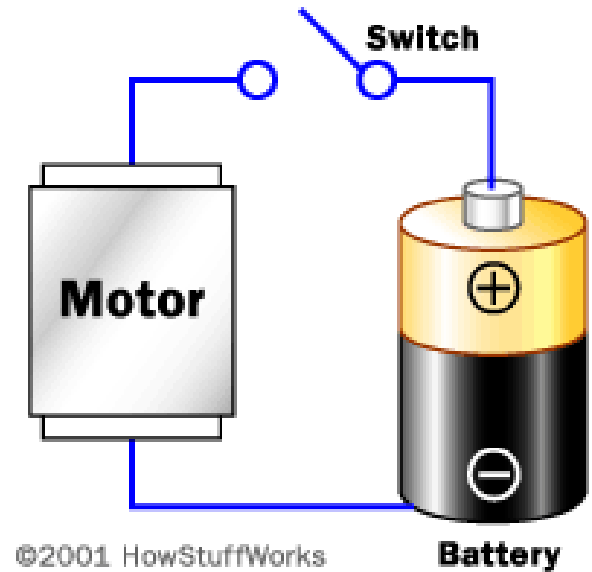
What is a Chemical Reaction?

Autumn Leaves



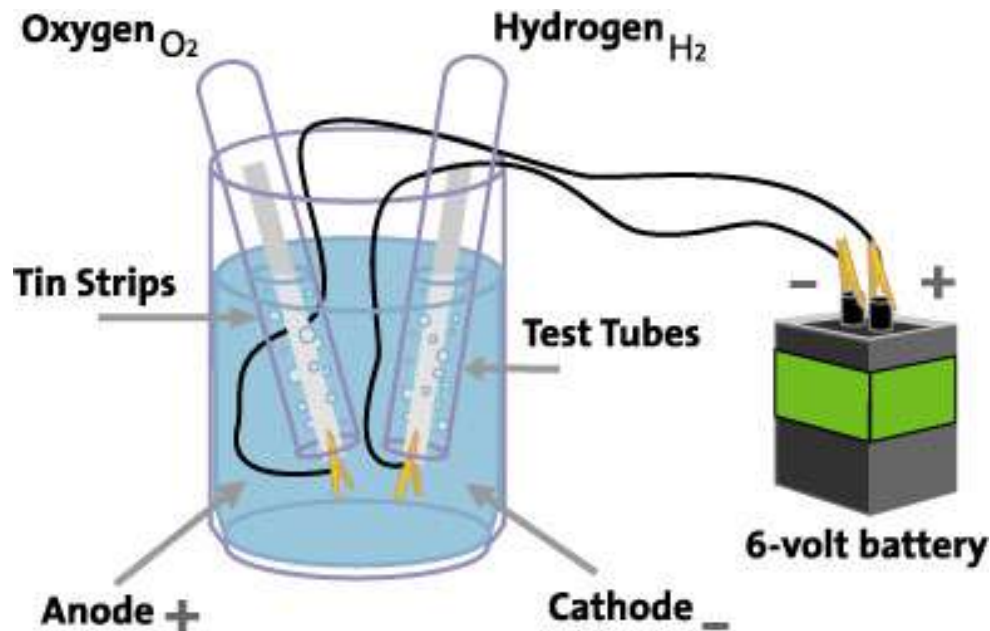
- A **chemical reaction** is the process by which one or more substances **changes** to produce one or more different substances

Examples of Chemical Reactions



Striking a match, baking bread, and using a battery are all examples of chemical reactions

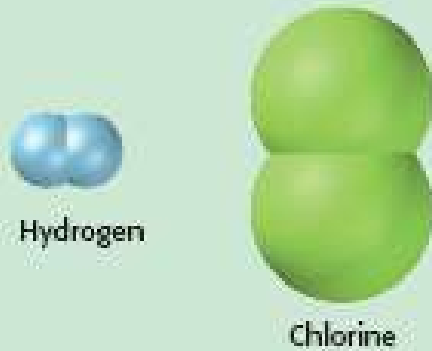
Clues to Chemical Reactions



Heat, Gas Formation, and a Change in Color are clues that a chemical reaction is going on

Reaction of Hydrogen and Chlorine

Breaking bonds



The elements hydrogen and chlorine are diatomic. Diatomic molecules are made of two atoms bonded together. For these molecules to react, the bonds joining the atoms must break.

Making bonds



Molecules of the new substance, hydrogen chloride, are formed as new bonds are made between hydrogen atoms and chlorine atoms.

In a Chemical Reaction, bonds are broken and new bonds are formed

Why are Chemical Formulas and Equations Important?

What Do You Think?

What are some problems you might face if you were asked to translate information from your language to another?



Chemical Formulas

Periodic Table of the Elements

1	IA																		0					
1	H																			He				
2	3	4																	5	6	7	8	9	10
2	Li	Be																	B	C	N	O	F	Ne
3	11	12	IIIB		IVB	VB	VIB	VII	VIIA		IIB		13	14	15	16	17	18						
3	Na	Mg																	Al	Si	P	S	Cl	Ar
4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36						
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr						
5	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54						
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe						
6	55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86						
6	Cs	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn						
7	87	88	89	104	105	106	107	108	109	110	111	112	113											
7	Fr	Ra	+Ac	Rf	Ha	Sg	Ns	Hs	Mt	110	111	112	113											
			* Lanthanide Series																					
			58	59	60	61	62	63	64	65	66	67	68	69	70	71								
			Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu								
			+ Actinide Series																					
			90	91	92	93	94	95	96	97	98	99	100	101	102	103								
			Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr								

- All substances are formed from about **100 elements** from the periodic table
- Each **element** has its own **chemical symbol**

Chemical Formulas

Periodic Table of the Elements

1	IA	H	2	0	He
3	IIA	Li	4		Ne
11		Na	12		Ar
19		K	20		Kr
37		Rb	38		Xe
55		Cs	56		Rn
87		Fr	88		

5	III A	B	6	IV A	C	7	V A	N	8	VI A	O	9	VII A	F
13		Al	14		Si	15		P	16		S	17		Cl
31		Ga	32		Ge	33		As	34		Se	35		Br
49		In	50		Sn	51		Sb	52		Te	53		I
81		Tl	82		Pb	83		Bi	84		Po	85		At
113														

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

* Lanthanide Series
+ Actinide Series

- The **chemical symbols** are all 1 or 2 letters long, and always begin with a capital letter

- H**- hydrogen

- He**- helium

- Li**- Lithium

Chemical Formulas

A Chemical Formula is an easy way to write a compound's name using chemical symbols and numbers to represent atoms



Chemical Formulas

A Chemical Formula shows how many of each kind of atom are present in a molecule of the compound



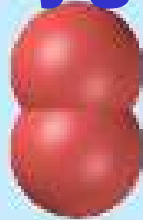
Chemical Formulas

Water



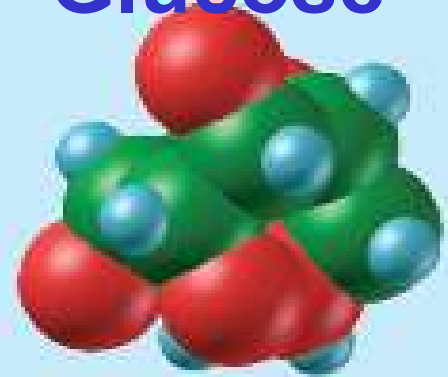
Water molecules are made up of 3 atoms—2 atoms of hydrogen bonded to 1 atom of oxygen.

Oxygen



Oxygen is a diatomic element. Each molecule of oxygen gas has 2 atoms of oxygen bonded together.

Glucose



Glucose molecules have 6 atoms of carbon, 12 atoms of hydrogen, and 6 atoms of oxygen. (Glucose is the sugar made by plants during photosynthesis.)

Chemical Equations

guitar
harp

Sheet music for guitar and harp, measures 1-4. The guitar part is in the treble clef and the harp part is in the bass clef. The key signature has two flats (B-flat and E-flat).

sustain for 8 measures

Sheet music for guitar and harp, measures 5-8. The guitar part is in the treble clef and the harp part is in the bass clef. The key signature has two flats (B-flat and E-flat).

Sheet music for guitar and harp, measures 9-12. The guitar part is in the treble clef and the harp part is in the bass clef. The key signature has two flats (B-flat and E-flat).

Sheet music for guitar and harp, measures 13-16. The guitar part is in the treble clef and the harp part is in the bass clef. The key signature has two flats (B-flat and E-flat).

* Good luck playing these 10ths. If you're not Rachmaninov, you might want to transpose the lower harmony up an octave to make 3rds.

•What does this sheet music say?

•If you are a musician, no matter what country you are from, you can read this

Chemical Equations

Carbon and Oxygen react to form Carbon Dioxide



- In the same way, chemists from around the world must communicate about **Chemical Reactions** clearly
- A **Chemical Equation** uses chemical formulas, plus signs, and arrows to describe a **Chemical Reaction**

Chemical Equations

Carbon and Oxygen react to form Carbon Dioxide



- The **Reactants**, carbon and oxygen, are the **starting materials** in this reaction
- The **Products**, in this case carbon dioxide, are the **substances formed** from a reaction

Chemical Equations

Carbon and Oxygen react to form Carbon Dioxide

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

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



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

The **arrow** is called the yields sign. It separates the formulas of the reactants from the formulas of the products.

Chemical Equations



Balancing Chemical Equations



- In a **Chemical Reaction**, every atom in the **reactants** becomes part of the **products**
- In a **Chemical Equation**, the atoms on each side need to be **counted and balanced**

Balancing Chemical Equations



- The **Law of Conservation of Mass** states that mass cannot be created or destroyed in chemical reactions
- A **Chemical Equation** must show the **same number and kind of atom** on both sides of the **arrow**

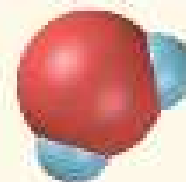
Balancing a Chemical Equation

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 products than in the reactants.

Reactants



Products



H = 2 O = 2

H = 2 O = 1

Balancing a Chemical Equation

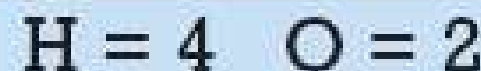
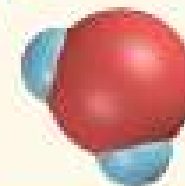
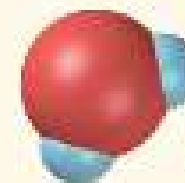
2

To balance the oxygen atoms, place the coefficient 2 in front of the formula for water. This gives you two oxygen atoms in both the reactants and the products. But now there are too few hydrogen atoms in the reactants.

Reactants



Products

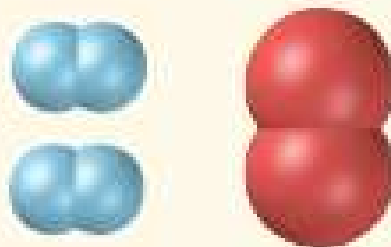


Balancing a Chemical Equation

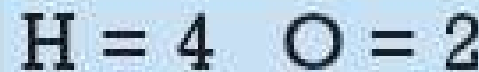
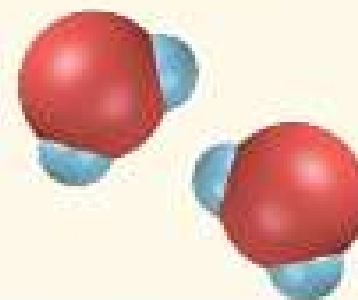
3

To balance the hydrogen atoms, place the coefficient 2 in front of hydrogen's formula. To be sure your answer is correct, always double-check your work!

Reactants

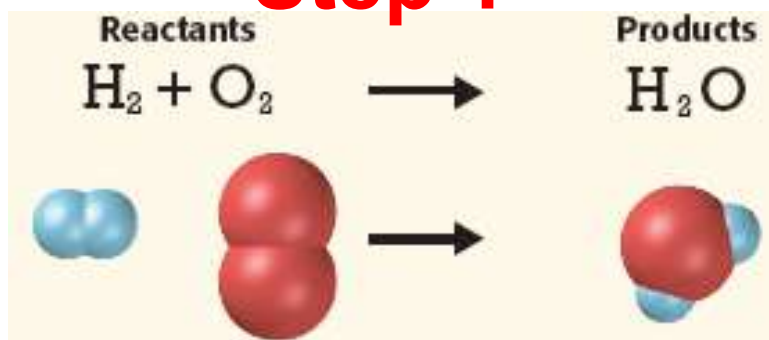


Products

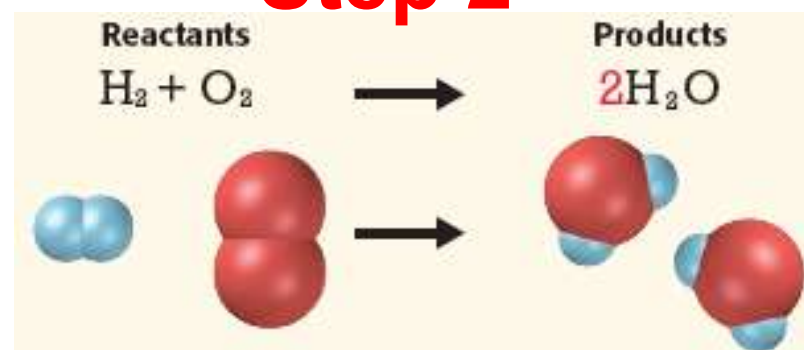


Balancing a Chemical Equation

Step 1



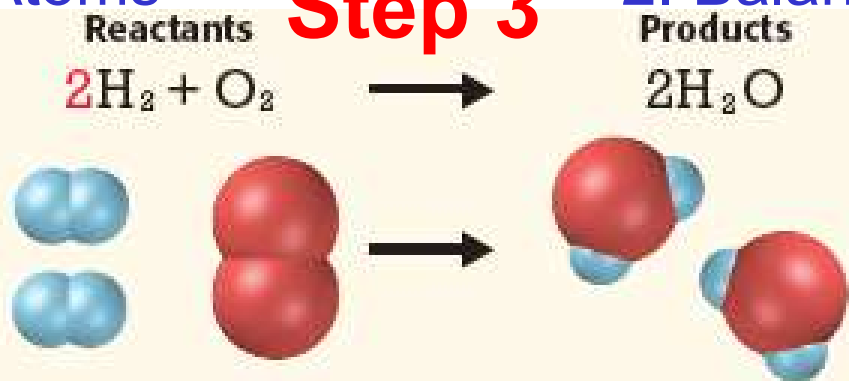
Step 2



1. Count the Atoms

Step 3

2. Balance the Oxygen



3. Balance the Hydrogen

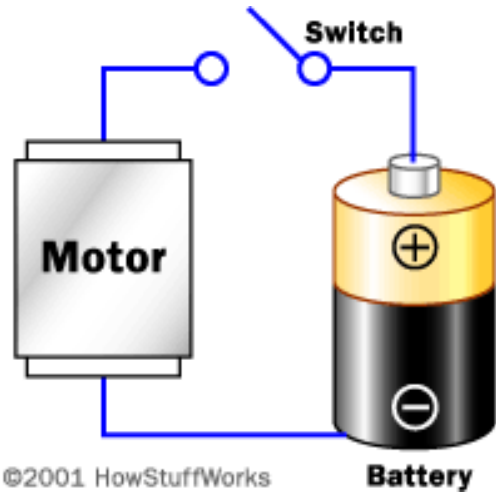
What is Energy?

What Do You Think?

How is energy involved when you digest a cheeseburger?



Energy and Reactions



- Chemical Energy is part of all Chemical Reactions
- Energy is absorbed to break bonds
- When new bonds form, energy is given off

Exothermic Reactions

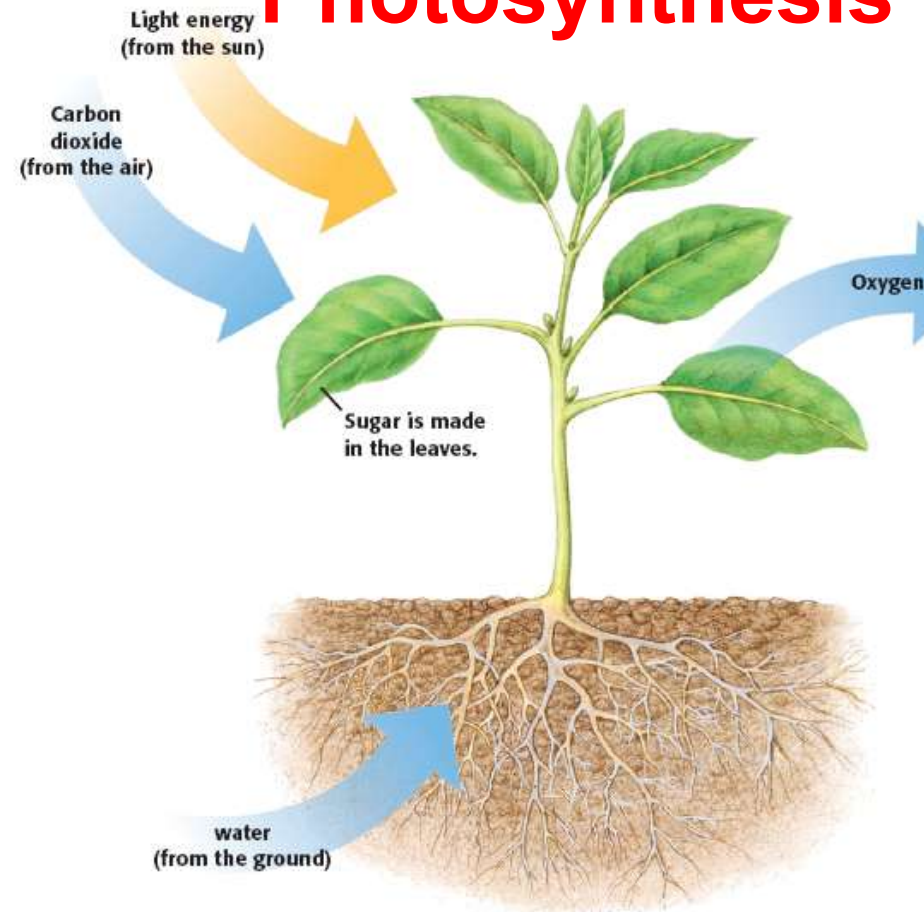


- If the **chemical energy** of the **reactants** is greater than that of the **products**, the reaction gives off energy

- This reaction is called **Exothermic**, which means “energy goes out”

Endothermic Reactions

Photosynthesis



- If the **chemical energy** of the **reactants** is less than that of the **products**, the reaction takes in energy
- This reaction is called **Endothermic**, which means “energy goes in”

Activation Energy



- **Activation Energy** is the smallest amount of energy needed for chemicals to react
- **Electricity, light, heat,** or any other form of energy can provide the **Activation Energy** for a reaction

Let's Review!

- 1 -

What are some examples of chemical reactions?

What are some clues that a chemical reaction has taken place?

Let's Review!

- 2 -

Explain how a balanced chemical equation illustrates that mass is never lost or gained in a chemical reaction.

Let's Review!

- 3 -

What is an Endothermic reaction?

What is an Exothermic reaction?

What is Activation Energy?