

GED Science Day 11



Essential Questions

Why is it important to study chemistry?

What chemical patterns are present in nature?

How does chemistry impact our daily lives?

The Structure of Matter

- How would you describe sugar?
- And how would you describe a single granule of sugar?

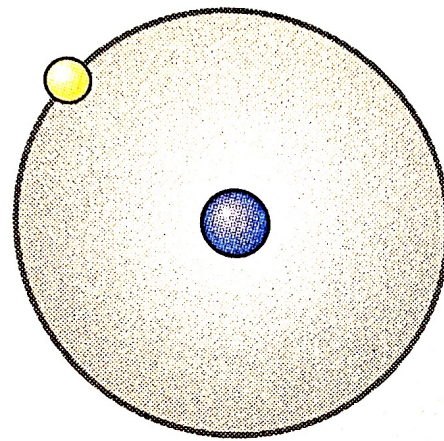


STRUCTURE OF MATTER

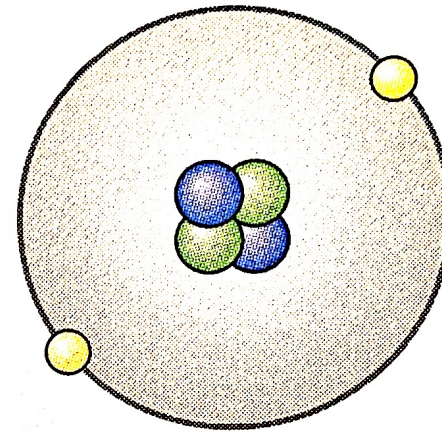
Matter is what makes up the observable universe. The elements, such as hydrogen, helium, and iron, are matter. Air, water, and soil are matter. Living things are matter. Manufactured objects are matter.

Matter is composed of atoms, which are made up of protons, neutrons, and electrons. Protons and neutrons form the nucleus, or small central region, of an atom. The nucleus is surrounded by a larger region where electrons are located.

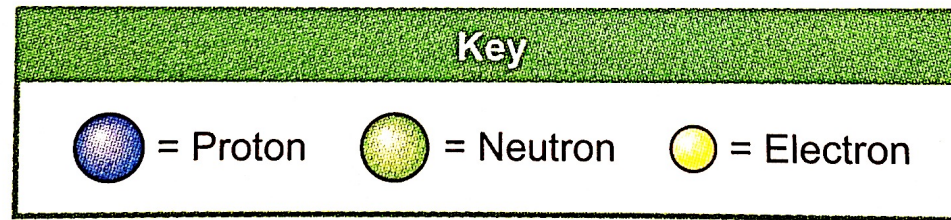
An element is matter made up of only one type of atom. Each element has a unique number of protons in its atoms. Hydrogen is the simplest element. The nucleus of a hydrogen atom has one proton. The illustrated model shows a hydrogen atom and a helium atom.



Hydrogen

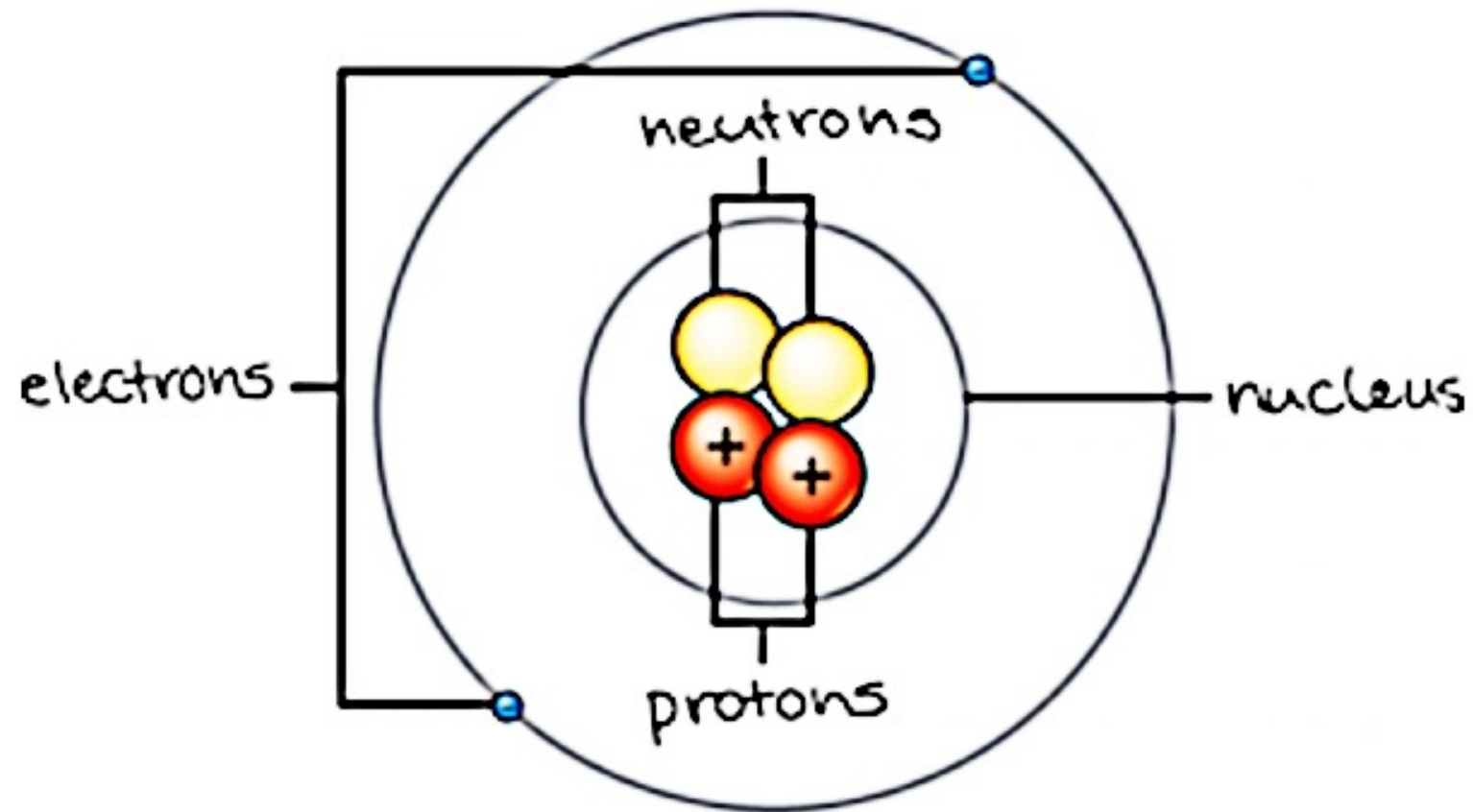


Helium



1. Based on the model, which statement describes a helium atom?
 - A. A helium atom has more protons than electrons.
 - B. The nucleus of a helium atom contains protons, neutrons, and electrons.
 - C. The number of protons in a helium atom is four.
 - D. A helium atom has one more proton than a hydrogen atom.

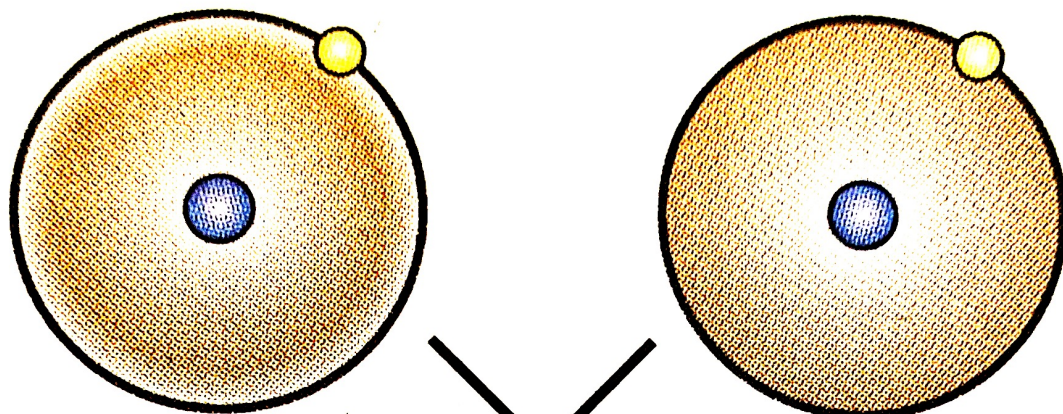
Atoms



MOLECULES



Most matter is a collection of atoms joined through the process of chemical bonding. One way atoms bond is by sharing electrons. A bond formed by sharing electrons is a covalent bond. When two or more atoms share their electrons in covalent bonds, they form a molecule. The illustrated model shows the process of two hydrogen atoms bonding to form a hydrogen molecule.

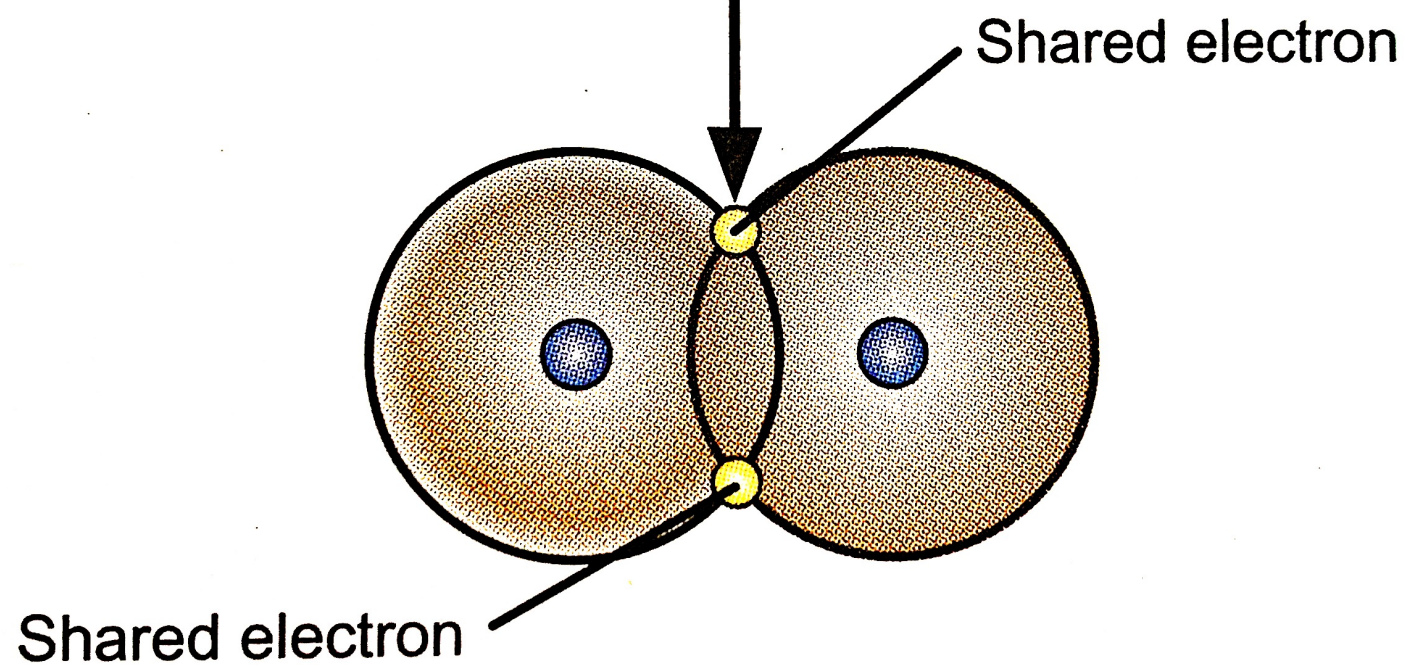
Individual atoms



Molecule

Key

-  = Electron
-  = Proton



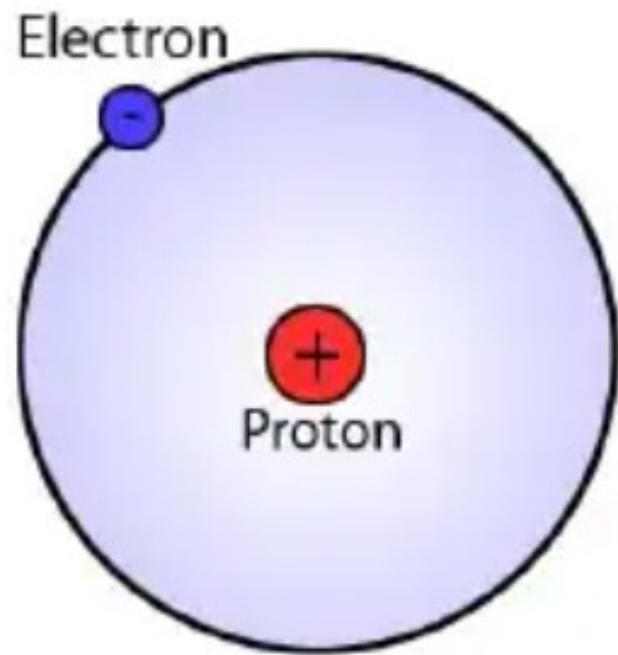
2. Based on the illustrated model, what happens to electrons when two atoms form a covalent bond?
- A. The number of electrons remains the same.
 - B. The total number of electrons doubles.
 - C. Half the electrons become protons.
 - D. The electrons are destroyed.

3. Why is it clear that the atoms represented in the model are hydrogen atoms?

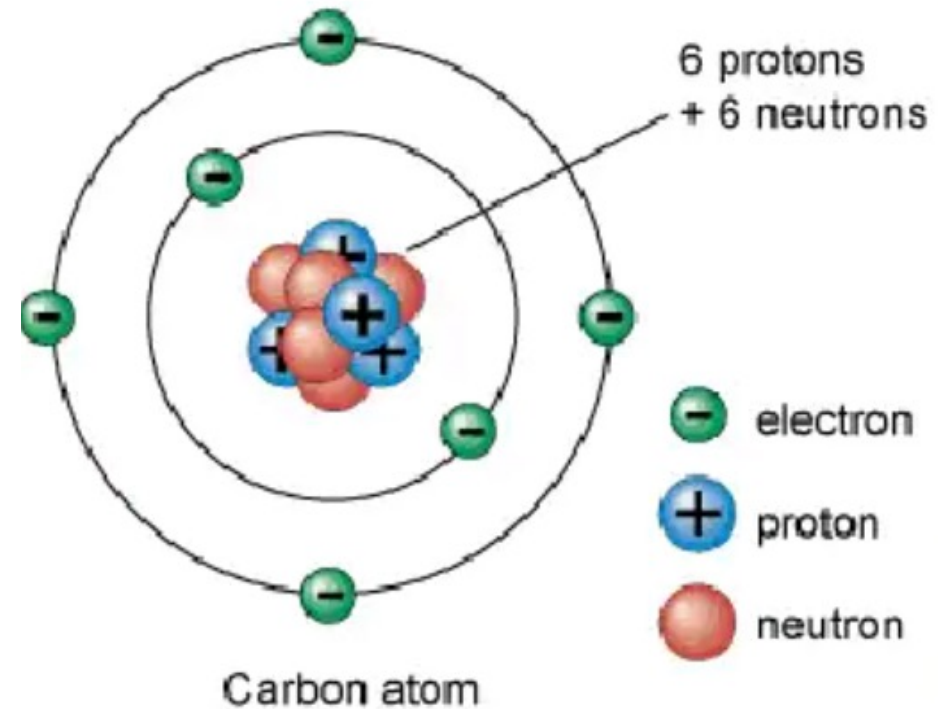
A. A nucleus is located in the center of each atom.

B. Each atom has only one proton.

C. In each atom, the electron moves around the nucleus.



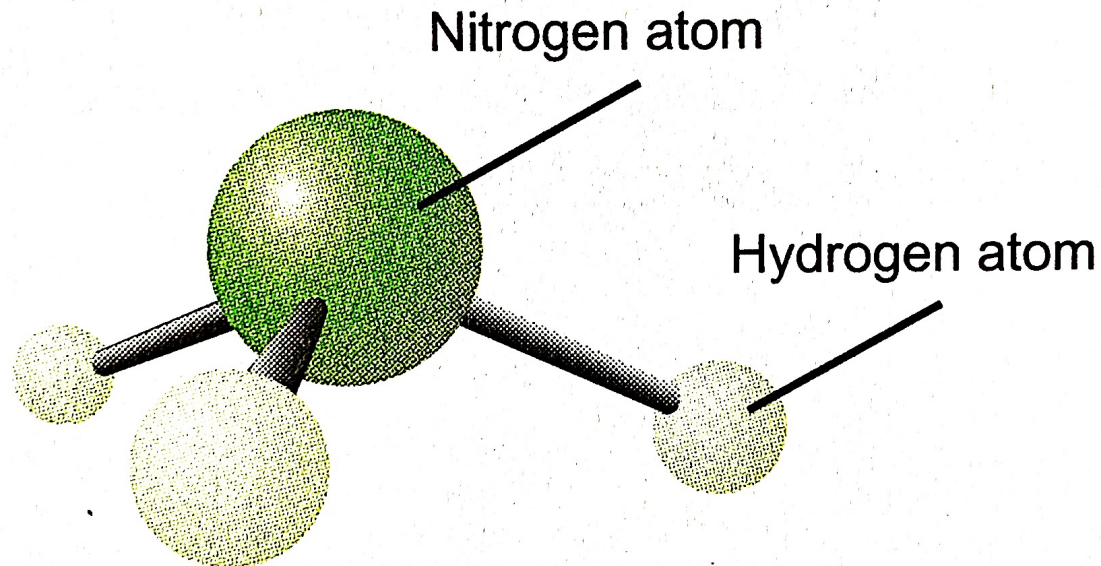
Hydrogen



Carbon

CHEMICAL COMPOUNDS

An element is composed of only one type of atom. A compound is composed of different types of atoms. Compounds containing covalent bonds are covalent compounds. Ammonia is a covalent compound made up of nitrogen and hydrogen atoms. The model represents an ammonia molecule.



4. What atoms make up the ammonia molecule?

A. one nitrogen atom and one hydrogen atom

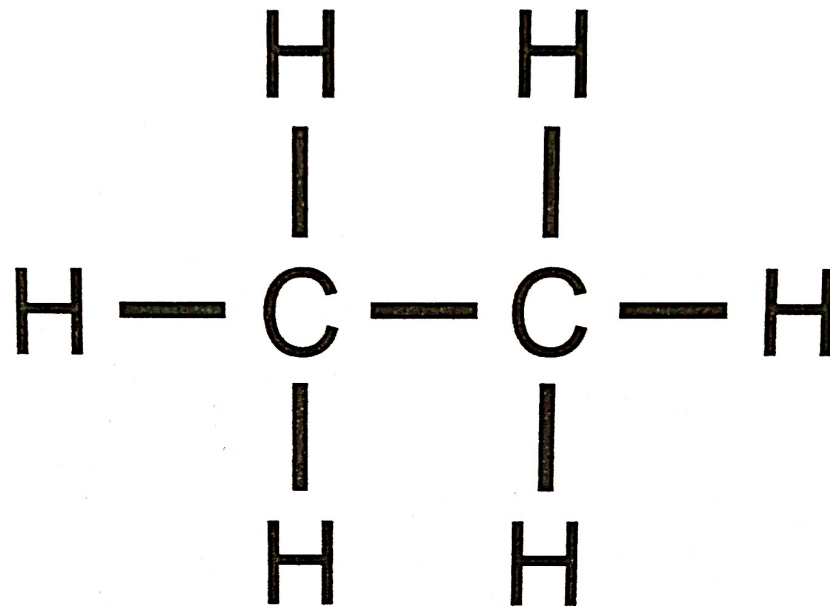
B. three hydrogen atoms

C. four ammonia atoms

D. one nitrogen atom and three hydrogen atoms

CHEMICAL AND STRUCTURAL FORMULAS

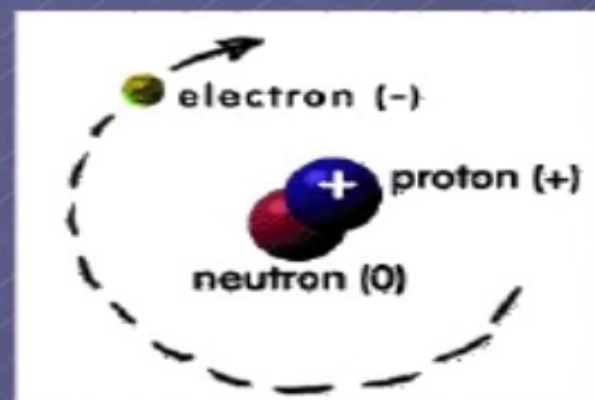
A chemical formula tells the number of atoms of each type in a molecule. The chemical formula for the hydrogen molecule is H_2 . H is the symbol for hydrogen; 2 represents the two hydrogen atoms that make up the molecule. A structural formula is a model of a chemical formula. Structural formulas help show the structures of molecules. The structural formula below is for ethane, a compound found in natural gas and made up of hydrogen (H) and carbon (C).



5. Based on the structural formula, what is the chemical formula of ethane?

- A. CH_3
- B. C_2H_6
- C. H_2C_6
- D. C_2H_4

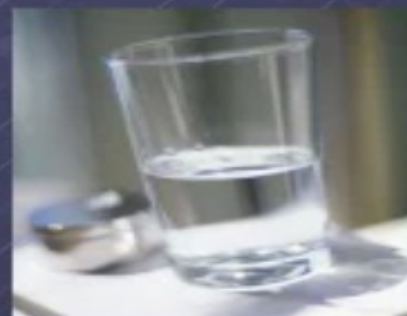
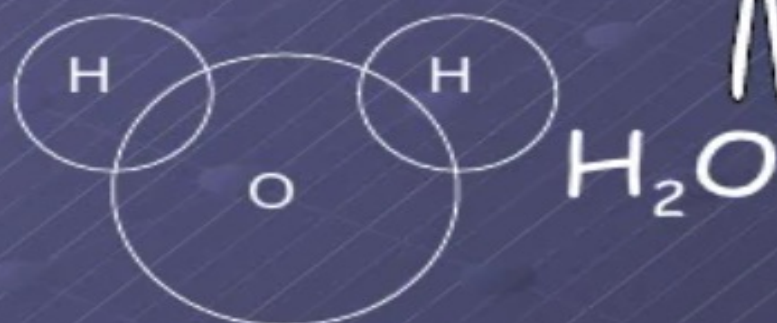
ATOMS



Elements

8 O 16.0	9 F 19.0	10 Ne 20.2
16 S 32.1	17 Cl 35.5	18 Ar 39.9
34 Se 79.0	35 Br 79.9	36 Kr 83.8

Molecules



Matter

Understanding Chemical Equations

Chemical equations use words, symbols, or other components to represent chemical reactions. The parts of a chemical equation identify the elements or compounds involved in a particular reaction.

An understanding of chemical equations also reinforces your grasp of an important scientific concept – conservation of mass.

Question: Have you even seen this table? What does each letter represent?

Periodic Table of the Elements

1A																	0																			
1	H											2	He																							
2	3	Li	4	Be									5	B	6	C	7	N	8	O	9	F	10	Ne												
3	11	Na	12	Mg	IIIB	IVB	VB	VIB	VII	VIIIB	IB	IIB	13	Al	14	Si	15	P	16	S	17	Cl	18	Ar												
4	19	K	20	Ca	21	Sc	22	Ti	23	V	24	Cr	25	Mn	26	Fe	27	Co	28	Ni	29	Cu	30	Zn	31	Ga	32	Ge	33	As	34	Se	35	Br	36	Kr
5	37	Rb	38	Sr	39	Y	40	Zr	41	Nb	42	Mo	43	Tc	44	Ru	45	Rh	46	Pd	47	Ag	48	Cd	49	In	50	Sn	51	Sb	52	Te	53	I	54	Xe
6	55	Cs	56	Ba	57	*La	72	Hf	73	Ta	74	W	75	Re	76	Os	77	Ir	78	Pt	79	Au	80	Hg	81	Tl	82	Pb	83	Bi	84	Po	85	At	86	Rn
7	87	Fr	88	Ra	89	+Ac	104	Rf	105	Ha	106	Sg	107	Ns	108	Hs	109	Mt	110	111	112	113														

* Lanthanide
Series

+ Actinide
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
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

The periodic table organizes elements based on their atomic structure. The periodic table has rows (called *periods*) and columns (called *groups*). The group tells you how many valence electrons the element possesses, whereas the period tells you how many energy levels the atom has. Here is a simplified periodic table showing the first three periods of the Group A elements:

1A							8A
1 H 1.01							2 He 4.00
3 Li 6.94	4 Be 9.01	5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3	13 Al 27.0	14 Si 28.1	15 P 30.1	16 S 32.1	17 Cl 35.5	18 Ar 39.9

1. How many valence electrons does a carbon atom (symbol C) have?

- A. 4
- B. 6
- C. 12
- D. 18

CHEMICAL REACTIONS

In chemical reactions, substances combine to form new substances. The substances that combine are reactants. The substances formed are products. Also, energy may be absorbed (endothermic reaction) or released (exothermic reaction). New substances are produced during chemical reactions because the atoms making up the reactants bond in new ways. This change in the ways the atoms bond changes the chemical makeup of the matter involved.

Many substances react chemically with each other to form new substances. For example, many elements react to produce compounds. Many compounds react to produce other compounds. A chemical reaction can be represented in the following ways:

Here, the same chemical equation is represented with words, symbols, and models. Always, the reactants are on the left, and the product is on the right, and an arrow meaning “yields” separates the two sides.

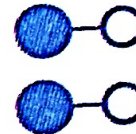
Magnesium + Oxygen → Magnesium oxide



+



→



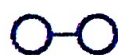
Key



Magnesium atom (Mg)



Oxygen atom (O)

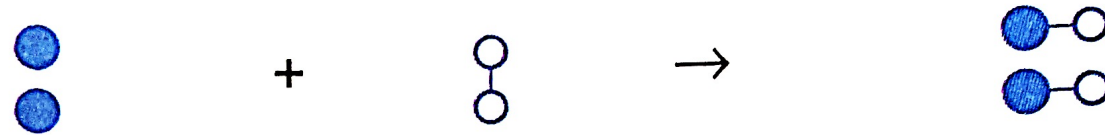


Oxygen molecule (O₂)



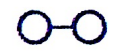
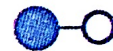


Magnesium oxide molecule (MgO)

Magnesium + Oxygen → Magnesium oxide



Key

-  Magnesium atom (Mg)
-  Oxygen atom (O)
-  Oxygen molecule (O₂)
-  Magnesium oxide molecule (MgO)

1. Which statement describes the chemical reaction represented by the three versions of the chemical equation?
 - A. Magnesium oxide is a reactant in the reaction.
 - B. Magnesium is a product of the reaction.
 - C. Oxygen is a product of the reaction.
 - D. Magnesium oxide is the product of the reaction.

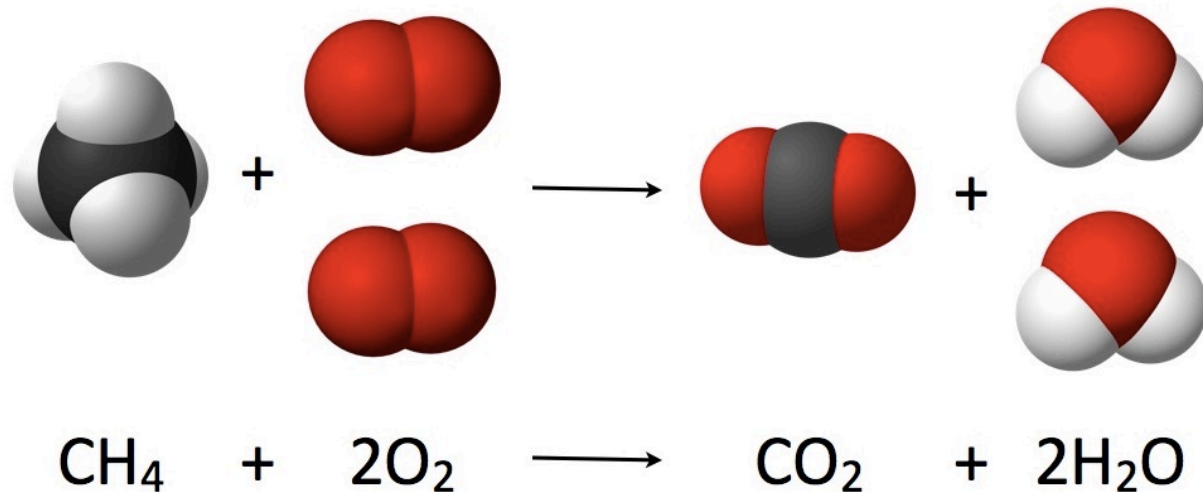
***VOCABULARY: How would you define
the following words?***

- Reactants
- Products
- Compounds

LAW OF CONSERVATION OF MASS AND BALANCED CHEMICAL EQUATIONS

During a chemical reaction, the arrangement of atoms in the matter involved changes. However, the total number of each type of atom does not change. This scientific concept is the law of conservation of mass.

A balanced chemical equation reflects the law of conservation of mass and provides accurate quantitative information about a chemical reaction. It tells not only the way that atoms are rearranged during the reaction but also the relative amounts of the substances that make up the reactants and products.



An equation is balanced when the number of atoms of each type on one side equals the number of atoms of each type on the other side. The diagram identifies the parts of a balanced chemical equation. The equation represents the reaction of methane (CH_4) and oxygen (O_2) to produce carbon dioxide (CO_2) and water (H_2O).

**Element
symbol**

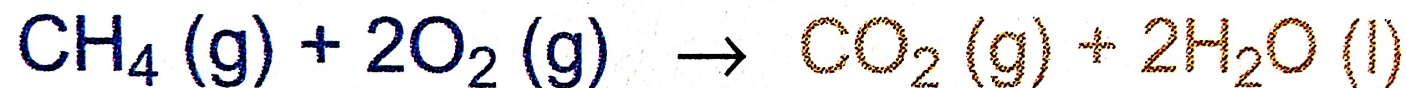
Identifies
element

**State
symbol**

Indicates
state of
substance

**Directional
arrow**

Indicates
direction
of reaction



Subscript

Indicates
number of
atoms of a
particular
element

Coefficient

Indicates
ratio of
reactant or
product

■ Reactants

■ Products

Chemical Reactions



2. Which statement conveys information provided by the equation?

- A. The reactants are a gas and a liquid.
- B. The proportion of carbon dioxide molecules to water molecules produced is 1:2.
- C. The products contain fewer atoms of hydrogen than the reactants.
- D. The products represented can react with each other to form the reactants represented.

TYPES OF REACTANTS

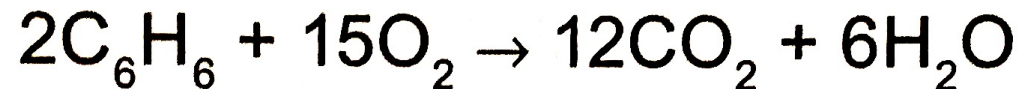
Different types of chemical reactions occur. In synthesis, two or more reactants combine to form a single product. The general form equation for this reaction type is $A + B \rightarrow AB$. In decomposition, a single reactant forms two or more products ($AB \rightarrow A + B$). In single displacement, one element replaces another in a compound ($AB + C \rightarrow AC + B$). In double displacement, two reactants form two new products ($AB + CD \rightarrow AD + CB$).

3. In the general form equation for a single displacement reaction, what does AC represent?

- A. an atom
- B. an element
- C. a reactant
- D. a product

LIMITING REACTANTS

Depending on the amount of each reactant involved in a chemical reaction, a limiting reactant can exist. A limiting reactant limits the amount of product that can be formed because the reaction stops when all the limiting reactant is consumed. Consider the equation that represents the reaction of benzene (C₆H₆) and oxygen (O₂) to produce carbon dioxide (CO₂) and water (H₂O):



As with any reaction, depending on the amounts of certain substances involved, the reaction represented by the equation can be limited.

4. Which statement describes the potential role of a limiting reactant in the reaction represented by the equation?

- A. The amount of carbon dioxide may limit the amount of benzene that can be formed.
- B. Either carbon dioxide or water may limit the amount of product that can be formed.
- C. Either benzene or oxygen may limit the amount of product that can be formed.
- D. Whenever benzene and oxygen combine, the reaction will have a limiting factor.

Homework!

Active Assignments



Week 11

To begin, select an activity from All Activities

[Select New Activity](#) 



All Activities

Completion: 0/5 (0%)



No Due Date