



Physical Science Chapter 19

Elements and Their Properties

Quick Notes

19:1

A. Metals conduct heat and electricity, reflect light (luster); are malleable (Can be hammered or rolled into sheets) are ductile (Can be drawn into wires) ionic bonding (combine with nonmetals by losing electrons),

[Video 1.a Metals 6.31](#)

19:1 Quick Notes

A. metallic bonding (positively charged metallic ions are surrounded by a cloud of electrons; ions are in sliding layers and electrons are weakly held; readily form ionic bonds with nonmetals.)

19:1 Quick Notes

B. Alkali Metals are softer and more reactive than other metals; highly reactive with oxygen & water; combine readily with other elements due to single electron in outer energy level; they have multiple use:

19:1 Quick Notes

a. Human health— sodium, potassium, and lithium compounds

b. Photocells— rubidium or cesium

c. Francium— A radioactive element which breaks down giving off particles and energy

19:1 Quick Notes

C. The Alkaline Earth Metals– are not found naturally in elemental form: two electrons in outer energy level.

19:1 Quick Notes

a. Applications— Strontium and magnesium found in fireworks; magnesium in vehicles, ladders, and bats; calcium in statues and countertops.

19:1 Quick Notes

b. Human body—Calcium in bones; barium in disease diagnoses; radium formerly used in cancer treatment.

19:1 Quick Notes

D. Transition Elements—often occur in nature as combined elements

A. Typically form colored compounds-- chromium

found in rubies and emeralds;

19:1 Quick Notes

b. Iron triad-- Iron, cobalt, and nickel

i. Iron -- most widely used of all metals and main ingredient in steel; abundant in Earth's crust.

ii. Cobalt and nickel – used in some steel

iii. Nickel used to coat other metals.

19:1 Quick Notes

c. Copper, silver, gold -- coinage metals since once were commonly used in coins.

i. Copper used in electrical wiring because it is a superior electricity conductor.

19:1 Quick Notes

ii. Silver used in photographic film and paper, jewelry.

iii. Gold used in jewelry.

19:1 Quick Notes

d. Zinc, cadmium, mercury—Group 12 on the periodic table.

i. Zinc and cadmium are often used to coat or plate other metals.

ii. Mercury only room temperature liquid metal; used in thermometers and batteries.

19:1 Quick Notes

E. Inner Transition Metals—seem disconnected from the rest of the periodic table.

a. The Lanthanides—include lanthanum, cerium, praseodymium, samarium, europium, gadolinium, and terbium.

19:1 Quick Notes

b. The Actinides --all are radioactive and unstable, uranium is the best known.

Why are copper, silver and gold so often used in coins?

[7 Lanthanide and Actinide Series .47](#)

19:2 Quick Notes

A. Properties of nonmetals— usually gases or brittle solids at room temperature; are not malleable or ductile; usually poor conductors of heat and electricity; usually not lustrous.

19:2 Quick Notes

a. Ionic compounds—form when nonmetals gain electrons from metals and become negative ions.

b. Covalent compounds-form when nonmetals share electrons with other nonmetals.

19:2 Quick Notes

B. Hydrogen -- most common element in the universe.

a. A Diatomic molecule -- two atoms of the same element in covalent bond.

19:2 Quick Notes

b. Highly reactive element found mostly on Earth as part of water.

c. Halogens --include bromine, iodine, fluorine, chlorine, and astatine.

How Chlorine Bonds

9 Halogens .44

10 Nobel Gases 1.15

19:2 Quick Notes

1. A salt forms when a halogen gains one electron from a metal.

19:2 Quick Notes

2. Uses of halogens

- i. Chlorine - disinfectant and bleach
- ii. Bromine dyes in cosmetics
- iii. Iodine hormone regulation.

19:2 Quick Notes

d. Sublimation a solid changes directly into a gas without first becoming a liquid.

19:2 Quick Notes

D. Noble Gases—exist as isolated, stable atoms.

a. helium --used in blimps and balloons.

b. Neon, argon, and krypton—used in lights.

19:3 Quick Notes

A. Properties of Metalloids --
form ionic and covalent bonds;
have some metallic and some
nonmetallic properties; partial
conduction gives them
 semiconductor characteristics.

19:3 Quick Notes

B. The Boron Group—
named for the first element in
Group 13.

a. Boron used in water
softening products, antiseptics
and fuels.

19:3 Quick Notes

b. Aluminum --abundant in Earth's crust; used in cans, foil wraps, pans, building materials, and aircraft.

19:3 Quick Notes

C. The carbon Group--
4 electrons in outer energy
level.

a. carbon found in coal,
oil, natural gas, and foods

13CarbonSiliconGermaniumTinLead 1.44 --

19:3 Quick Notes

b. Silicon occurs as an allotrope - same element with different molecular structures.

i. silicon found in sand, rocks and soil.

19:3 Quick Notes

ii. The main component in semiconductors which conduct electricity under certain conditions.

c. Germanium is also used in semiconductors.

19:3 Quick Notes

d. Tin -- used to coat other metals.

e. Diamonds, graphite and buckminsterfullerene are all allotropes of carbon.

19:3 Quick Notes

D. The Nitrogen Group-- 5
electrons in outer energy level;
tend to form covalent bonds.

a. Nitrogen used to make
nitrates and ammonia.

14NitrogenGroup 1.22

19:3 Quick Notes

b. Phosphorus - used in water softeners, fertilizers, match heads, fine china.

c. Antimony and bismuth used with other metals to lower their melting points.

19:3 Quick Notes

E. The Oxygen Group or Group
16.

a. Oxygen makes up 20% of
air, is used by living things in
respiration and provides protection
from the sun's radiation.

[15OxygenFamily .58](#)

19:3 Quick Notes

b. Sulfur is used to form sulfides for pigment in paint.

c. Selenium is used in photocopiers and multivitamins.

d. Tellurium & polonium are also in the oxygen group.

19:3 Quick Notes

F. Synthetic Elements—
scientists create elements not
usually found on Earth; synthetic
elements usually disintegrate
quickly.

19:3 Quick Notes

a. Uranium can be made into neptunium which forms plutonium when it disintegrates.

b. Transuranium elements have more than 92 protons and are synthetic and unstable.

19:3 Quick Notes

- i. The study of synthesized elements help scientists to understand the forces holding the nucleus together.
- ii. Element 114 lasted for 30 seconds.

19:3 Quick Notes

iii. It combined 114 protons with 175 neutrons.

iv. It broke apart due to enormous repulsion between protons.

Extra Review

Fluorine is the most chemically reactive element of all elements.

When metals share their outermost electrons with a nonmetal the metal and nonmetal become more chemically stable.

Extra Review

Metals are good conductors of electricity because their outer-level electrons are weakly held.

The most reactive of all metals are the alkali.

*** Substances that conduct an electric current under certain conditions are metalloids.

Extra Review

In metallic bonding positively charged metallic ions are surrounded by a cloud of electrons.

Lanthanides are used to make compounds used in the motion picture industry.

**Metals can be used as wire because they are ductile_e.

Extra Review

A metal bolt with a mass of 26.6 g is placed in a 50 ml graduated cylinder containing water. The water level in the cylinder rises from 27.0 ml to 30.5 ml. What is the density of the bolt in g/cm^3 ?

$$D = M/V \quad V = 30.5 - 27 = 3.5 \quad D = 26.6 / 3.5 = 7.6 \text{ g/cm}^3$$

Extra Review

A person has a mass of 68.3 kg.
If 65% of the mass of a human
body is oxygen, what is the
mass of oxygen in this
person's body?

$$68.3 \times 65\% = 44.395 \text{ kg}$$

Review

At room temperature most metals are solids.

The process by which solid iodine particles change directly to gas without first becoming a liquid is called sublimation.

Elements that form salts by combining with metals are halogens

Review

Hydrogen is grouped with the alkali metals because it has one electron in its outer energy level.

A chemical family whose members exist as reactive diatomic molecules in the gaseous phase is the halogens

The elements in Groups 3 through 12 of the periodic table are the transition elements.

Review

A family of elements that has two _____ electrons in its outer energy level is the alkaline earth metals

Elements in which the outer electrons are not held tightly are most likely to form metallic bonds.

The only metal that is a liquid at room temperature is mercury.

Review

Cobalt, iron and nickle are known as the iron triad.

Three transition elements in Group 12 are mercury, zinc and cadmium.

Elements that lie along the stair-step line of the PT are metalloids.

A family of elements that contains the most reactive metals is the alkali metals.

Review

Elements that have more than 92 protons are known as the Transuranium elements.

Fluorine is the most chemically reactive element of all elements.

The most reactive of all metals are the alkali.

Lanthanides are used to make compounds used in motion pictures.

Review

Magnesium and strontium are found in fireworks and give them the brilliant white color.

Iron is a very hard metal used in steel production. Small amounts of this element is needed by the human body for healthy blood.

***The noble gases are in group 18.

Review

Ionic compounds form when nonmetals gain electrons from metals and become negative ions.

Hydrogen is the most common element in the universe.

Different forms of the same element that have different chemical arrangements are called allotropes.

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- ****Radioactive elements comprise a majority of the actinides.**
 - ****An element whose nucleus breaks down and emits particles and energy is a radioactive element.**