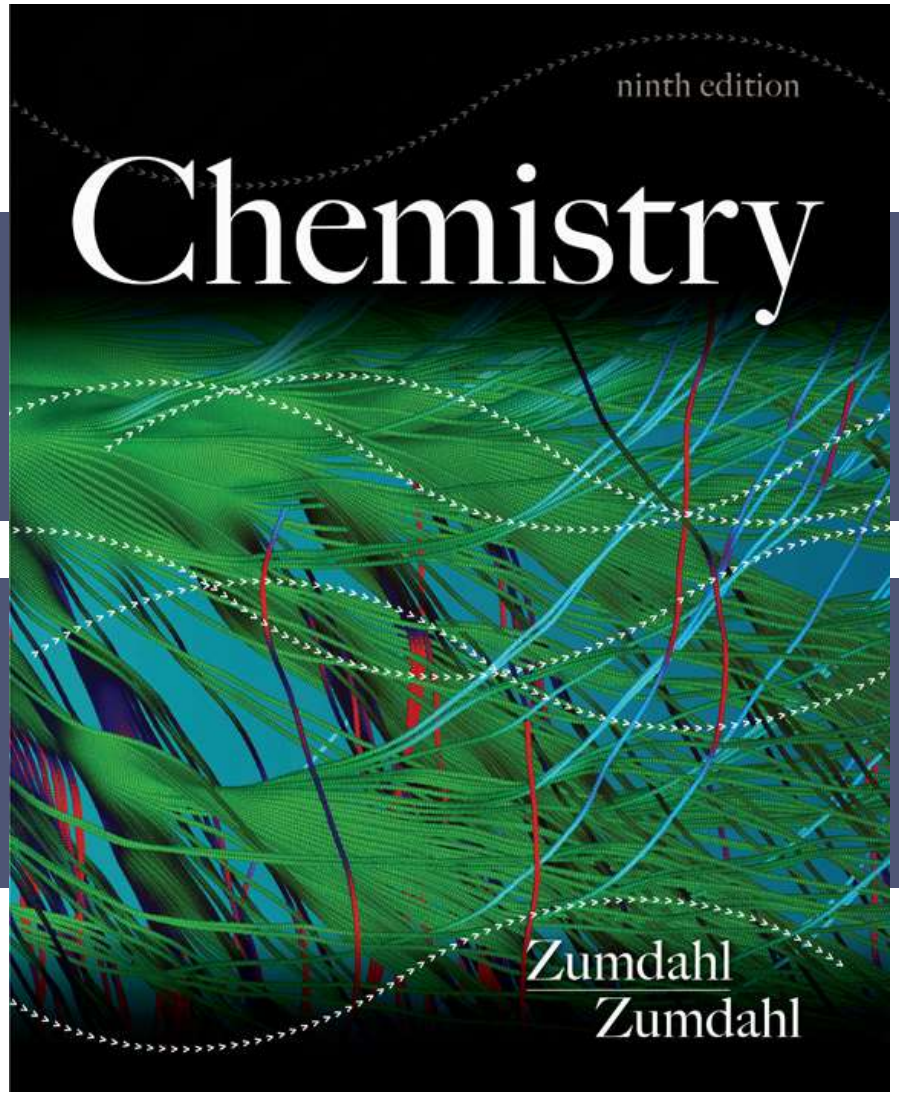


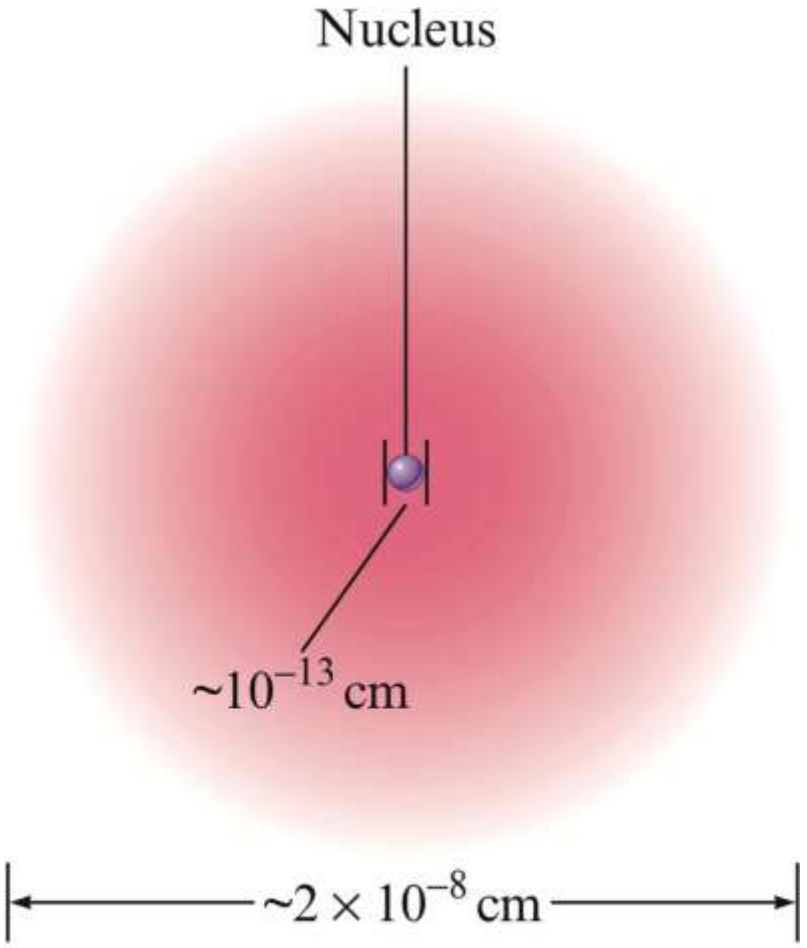
Chapter 2

Atoms, Molecules, and Ions

Section 2.5
The Modern View of Atomic Structure: An Introduction

- The atom contains:
  - Electrons: Found outside the nucleus; negatively charged.
  - Protons: Found in the nucleus; positive charge equal in magnitude to the electron's negative charge.
  - Neutrons: Found in the nucleus; no charge; virtually same mass as a proton.
- The nucleus is:
  - Small compared to the overall size of the atom.
  - Extremely dense; accounts for almost all of the atom's mass.

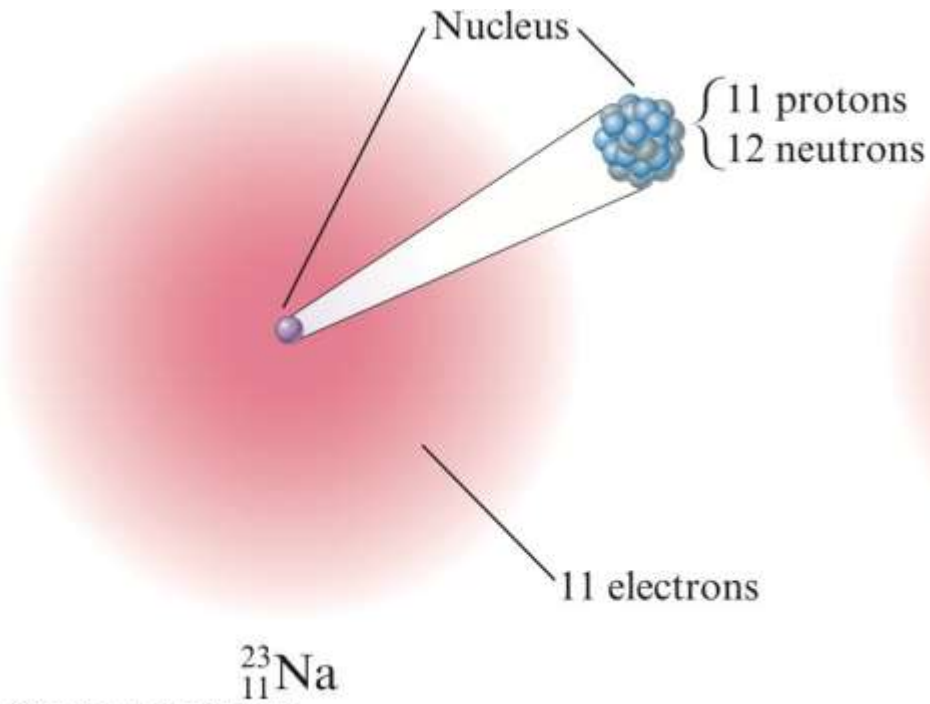
Cross-Section of the Nuclear Atom

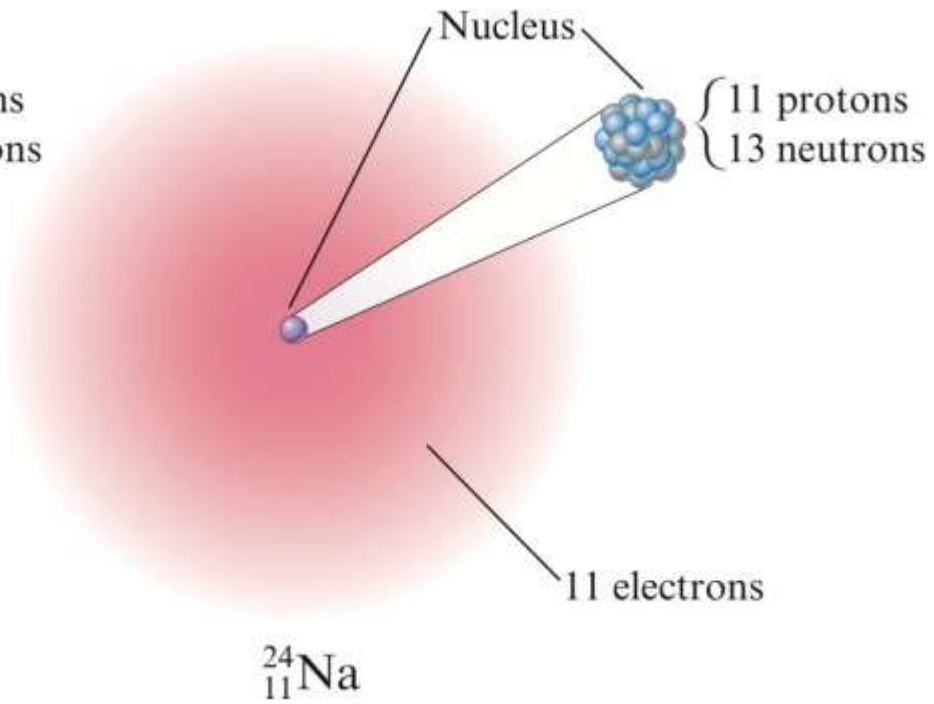


Isotopes:

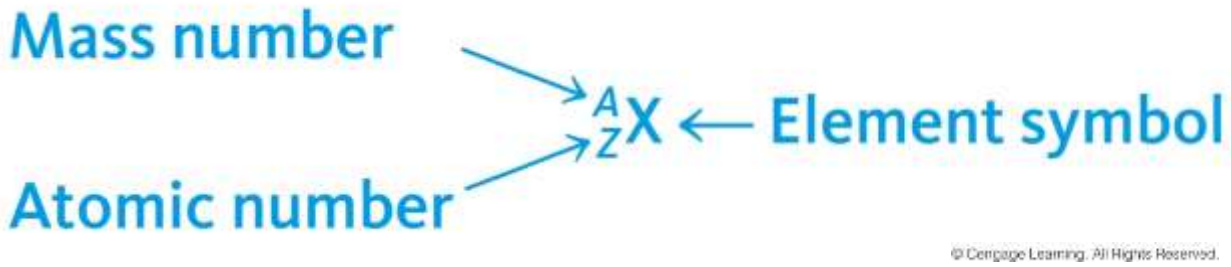
- Atoms with the same number of protons but different numbers of neutrons.
- Show almost identical chemical properties; the chemistry of an atom is due to its valence electrons.
- In nature most elements contain mixtures of isotopes.

Two Isotopes of Sodium:





- Isotopes are identified by:
  - Atomic Number (Z): Number of protons., P = Z
  - Mass Number (A): Number of protons plus number of neutrons (n). A = n + P



EXERCISE!

A certain isotope X contains 23 protons and 28 neutrons.

- What is the mass number of this isotope?
- Identify the element.

Mass Number = 51 (A = n + Z)

Vanadium, V (From the periodic table, it the element with atomic number (Z) of 23).

Types of Chemical Bonds

- Covalent Bonds: Bonds form between atoms by sharing electrons to form molecules. H_2O
- Ionic Bonds: Bonds form due to force of attraction between oppositely charged ions. Ex: NaCl

Definitions:

- **Ion:** atom or group of atoms that has a net positive or negative charge. (poly atomic ions), Mg^{2+}, S^{2-}, CO_3^{2-}.
- **Cation:** positive ion; lost electron(s).
- **Anion:** negative ion; gained electron(s).

EXERCISE!

A certain isotope M^+ contains 54 electrons and 78 neutrons.

- What is the element and mass number of this isotope?

Z = 54 + 1 = 55 (from the periodic table, it is Cesium, Cs)

A = Z + n = 55 + 78 = 133

S(2-)

The Periodic Table

- Metals, Nonmetals, metalloides: (see the next two slides)
- Groups or Families: Elements in the same vertical columns; have similar chemical properties

Groups like: Alkaline metals, alkaline earth metals, Halogens, noble gases.

- Periods: horizontal rows of elements.
- Representative Elements.
- Transition Elements.
- Lanthanides and actinides.
- Metals, nonmetal, metalloids

Ionic Charges, Group Number, and Ionic Compounds:

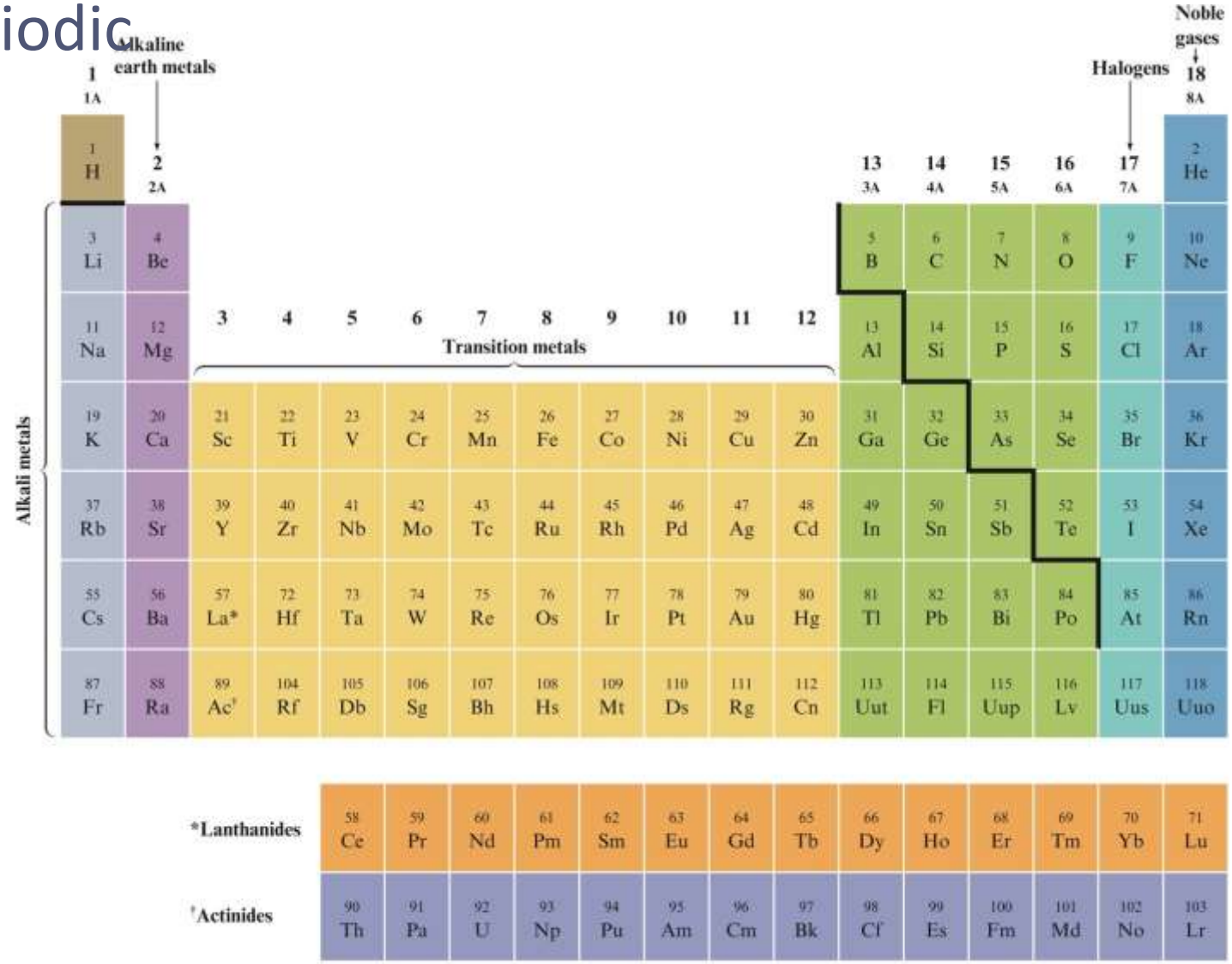
- G IA : +1 charge, Na^{+}, K^{+}, Cs^{+}, . . .
- GIIA: +2 charge, Mg^{2+}, Ca^{2+}, Ba^{2+}, . . .
- G IIIA: +3 charge like Al^{3+},
- G VIIA: -1 charge, F^{-}, Cl^{-}, Br^{-}, I^{-}, ..
- GVIA: -2 charge, $O^{=}$, $S^{=}$, …
- GVA: -3 charge, N^{-3}, P^{-3}, …

Ionic Compounds: NaCl, MgO, Al_2O_3, $MgCl_2$, $AlCl_3$, K_2O, Na_2

. .

Section 2.7
An Introduction to the Periodic Table

The Periodic Table



Section 2.8
Naming Simple Compounds

Naming Compounds:

- Binary Compounds:
  - Composed of two elements.
  - Ionic and covalent compounds included.
- Binary Ionic Compounds:
  - Metal with nonmetal (Type I and II).
- Ionic compounds with polyatomic ions. NH_4^+
- Binary Covalent Compounds: (Type III)

  Nonmetal with another nonmetal.

Binary Ionic Compounds (Type I)

Naming of the Compound:

- The cation is always named first and the anion second.
- The name of the cation simply is the name of the positively charge ion.
- The anion is named by taking the root of the element's name and adding –ide. NaCl: Sodium Chloride
- Sodium (name of the cation)
- Chlorine (roote of the name of the aninon)
- Chloride (-ide is added)

Binary Ionic Compounds (Type I)

- Examples:

KCl	Potassium chloride
$MgBr_2$	Magnesium bromide
CaO	Calcium oxide

Binary Ionic Compounds (Type II)

- Metals in these compounds form more than one positive charge (Fe: +2 and +3; Cu: +1 and +2 . . . .)
- Charge on the metal ion must be specified.
- Roman numeral indicates the charge of the metal cation.
- Transition metal cations usually require a Roman numeral (I, II, III, IV, V, VI, VII,VIII, IX, X, ...)
- Elements that form only one cation do not need to be identified by a roman numeral.

Binary Ionic Compounds (Type II)

- Examples:

CuBr	Copper(I) bromide	
$CuBr_2$	Copper(II) bromide	
FeS	Iron(II) sulfide	
PbO_2	Lead(IV) oxide	
Al_2O_3	Aluminum (III) Oxide	X
	Aluminum Oxide	*(correct name)*

Ionic Compounds with Polyatomic Ions

- Must be memorized (see Table 2.5 on pg. 65 in text).
- Examples of compounds containing polyatomic ions:

NaOH	Sodium hydroxide
$Mg(NO_3)_2$	Magnesium nitrate
$(NH_4)_2SO_4$	Ammonium sulfate
$K_2Cr_2O_7$	Potassium dichromate
Na_2SO_3	Sodium Sulfite

(Show the list of the polyatomic ions to the students)

Binary Covalent Compounds (Type III)

- Formed between two nonmetals.

1. The first element in the formula is named first, using the full element's name.
2. The second element is named as if it were an anion.
3. Prefixes are used to denote the numbers of atoms present. (mono, di, tri, tetra, penta, hexa, hepta, octa, nona, deca …)
4. The prefix *mono-* is <u>never</u> used for naming the first element.

Binary Covalent Compounds (Type III)

- Examples:

CO_2 Carbon dioxide

SF_6 Sulfur hexafluoride

N_2O_4 Di nitrogen tetr ox ide

CO

(Show a list of polyatomic ions)