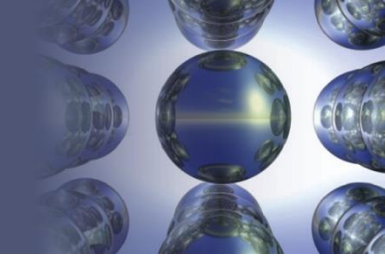


## Chapter 2

### *Atoms, Molecules, and Ions*

## Section 2.5

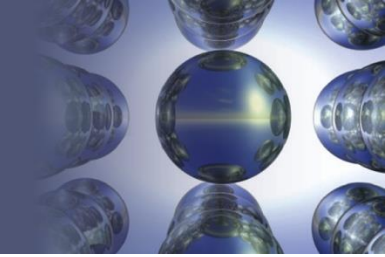
# *The Modern View of Atomic Structure: An Introduction*



- 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.

## Section 2.5

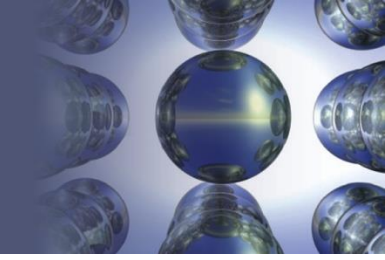
# *The Modern View of Atomic Structure: An Introduction*



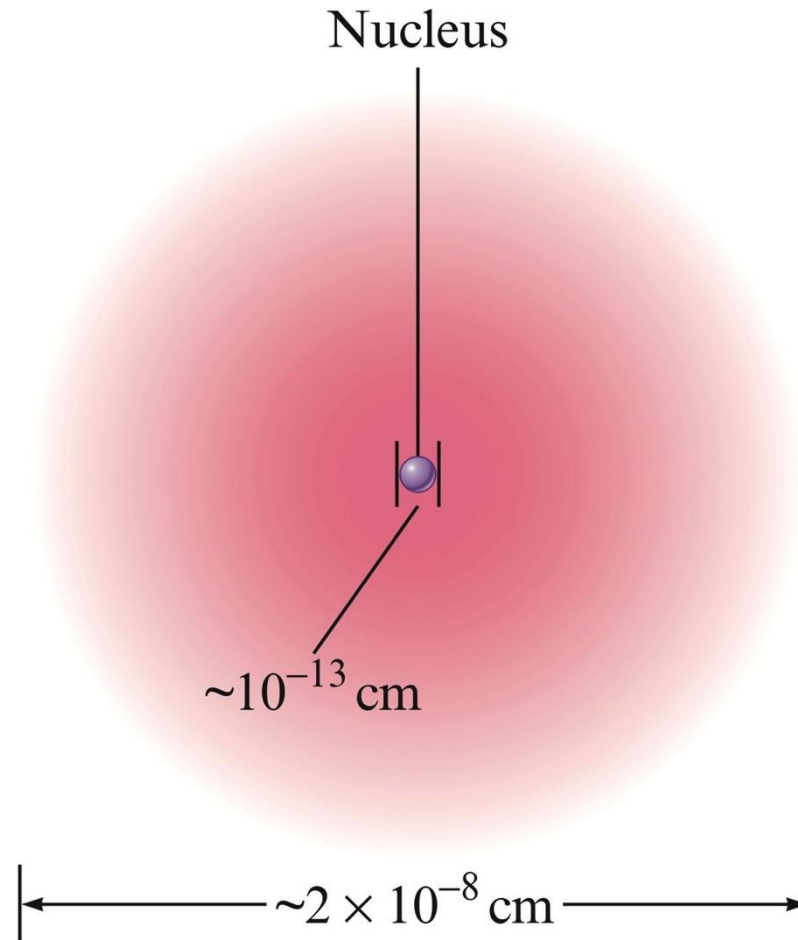
- The nucleus is:
  - Small compared with the overall size of the atom.
  - Extremely dense; accounts for almost all of the atom's mass.

# Section 2.5

## *The Modern View of Atomic Structure: An Introduction*

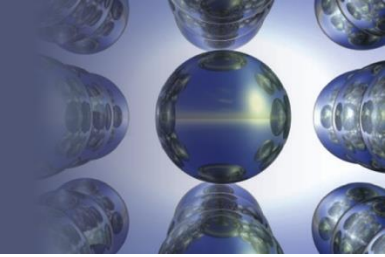


### Nuclear Atom Viewed in Cross Section



## Section 2.5

# *The Modern View of Atomic Structure: An Introduction*

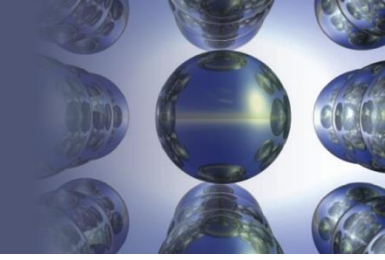


## Isotopes

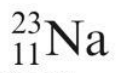
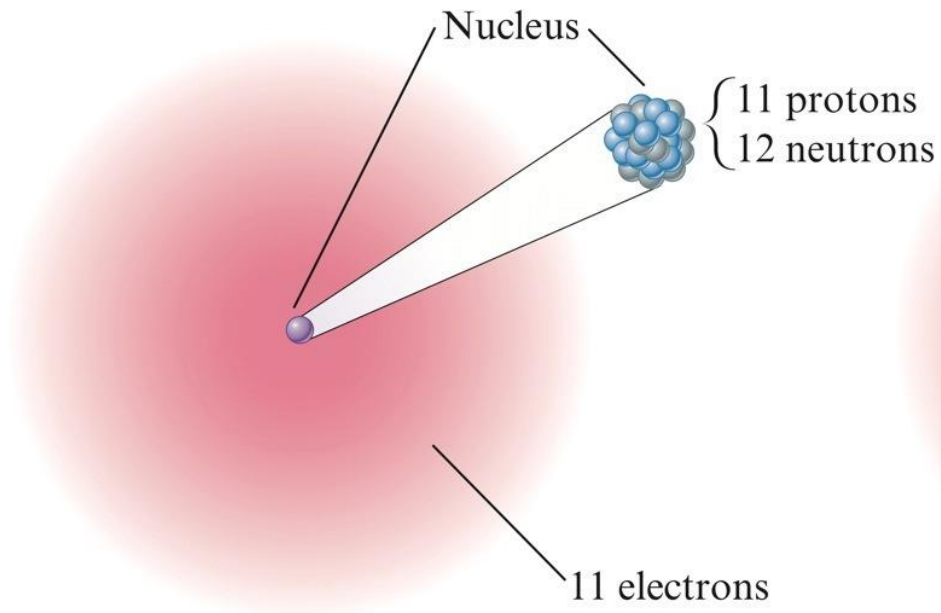
- Atoms with the same number of protons but different numbers of neutrons.
- Show almost identical chemical properties; chemistry of atom is due to its electrons.
- In nature most elements contain mixtures of isotopes.

# Section 2.5

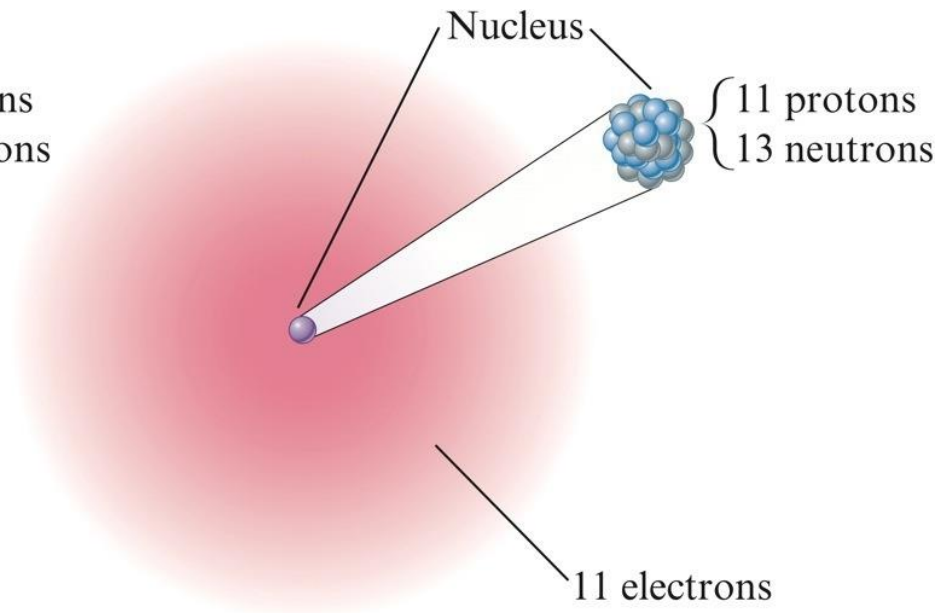
## *The Modern View of Atomic Structure: An Introduction*



### Two Isotopes of Sodium



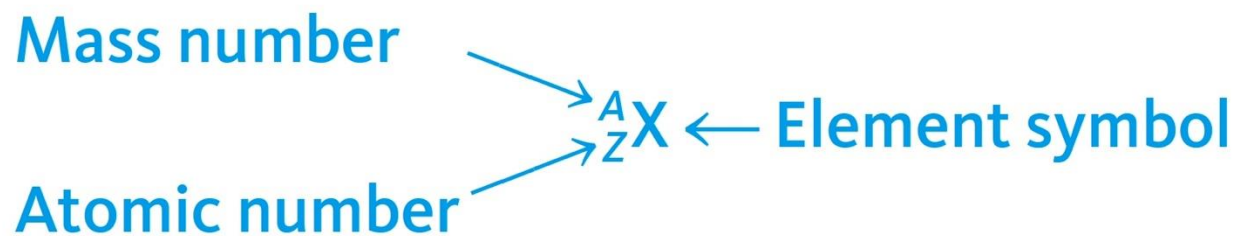
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## Section 2.5

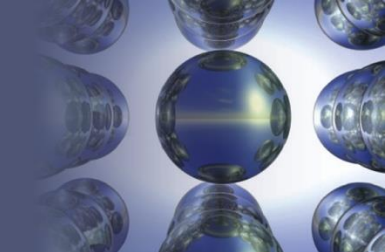
# *The Modern View of Atomic Structure: An Introduction*

- Isotopes are identified by:
  - Atomic Number (Z) – number of protons
  - Mass Number (A) – number of protons plus number of neutrons



## Section 2.5

# *The Modern View of Atomic Structure: An Introduction*



### ***EXERCISE!***

A certain isotope X contains 23 protons and 28 neutrons.

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

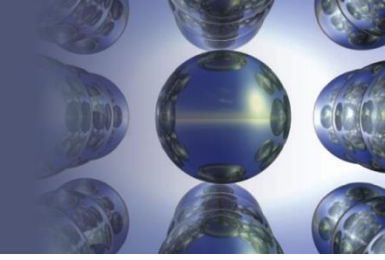
**Mass Number = 51**

**Vanadium**



# Section 2.6

## *Molecules and Ions*

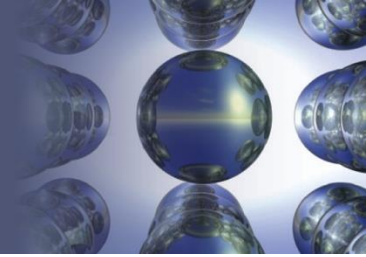


### Chemical Bonds

- Covalent Bonds
  - Bonds form between atoms by sharing electrons.
  - Resulting collection of atoms is called a molecule.

## Section 2.6

### *Molecules and Ions*

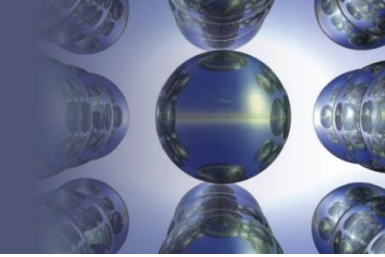


## Chemical Bonds

- Ionic Bonds
  - Bonds form due to force of attraction between oppositely charged ions.
  - *Ion* – atom or group of atoms that has a net positive or negative charge.
  - *Cation* – positive ion; lost electron(s).
  - *Anion* – negative ion; gained electron(s).

## Section 2.6

### *Molecules and Ions*



### ***EXERCISE!***

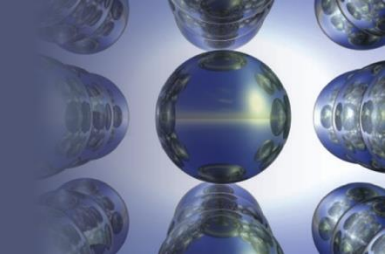
A certain isotope  $X^+$  contains 54 electrons and 78 neutrons.

- What is the **mass number** of this isotope?

133

## Section 2.6

### *Molecules and Ions*



### **CONCEPT CHECK!**

Which of the following statements regarding Dalton's atomic theory are still believed to be **true**?

I. Elements are made of tiny particles called atoms.

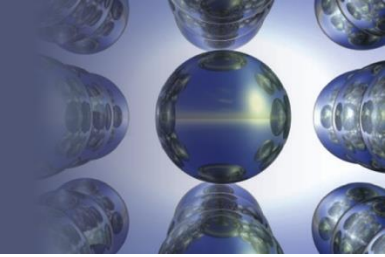
II. All atoms of a given element are identical.

III. A given compound always has the same relative numbers and types of atoms.

IV. Atoms are indestructible.

## Section 2.7

# *An Introduction to the Periodic Table*



## The Periodic Table

- *Metals vs. Nonmetals*
- *Groups or Families* – elements in the same vertical columns; have similar chemical properties
- *Periods* – horizontal rows of elements

# Section 2.7

## An Introduction to the Periodic Table

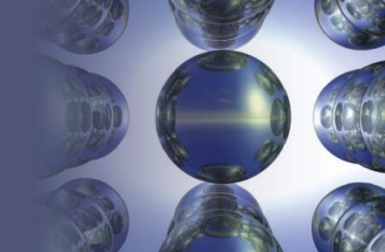
### The Periodic Table

	1 1A	Alkaline earth metals											13 3A	14 4A	15 5A	16 6A	17 7A	Halogens	18 8A	Noble gases		
	1 H	2 2A											3 3A	4 4A	5 5A	6 6A	7 7A	8 8A	9 9A	10 10A	11 11A	12 12A
	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne				
Alkali metals	11 Na	12 Mg	Transition metals										13 Al	14 Si	15 P	16 S	17 Cl	18 Ar				
	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				
	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				
	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				
	87 Fr	88 Ra	89 Ac†	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo				

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

## Section 2.7

### *An Introduction to the Periodic Table*



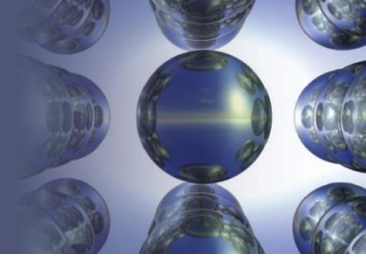
## Groups or Families

- Table of common charges formed when creating ionic compounds.

Group or Family	Charge
Alkali Metals (1A)	1+
Alkaline Earth Metals (2A)	2+
Halogens (7A)	1-
Noble Gases (8A)	0

## Section 2.8

# *Naming Simple Compounds*



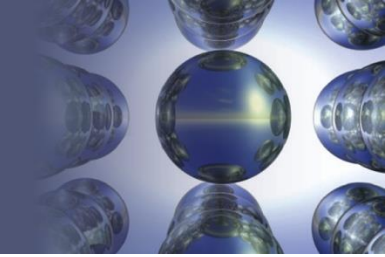
## Naming Compounds

- Binary Compounds
  - Composed of two elements
  - Ionic and covalent compounds included
- Binary Ionic Compounds
  - Metal—nonmetal
- Binary Covalent Compounds
  - Nonmetal—nonmetal



## Section 2.8

# *Naming Simple Compounds*

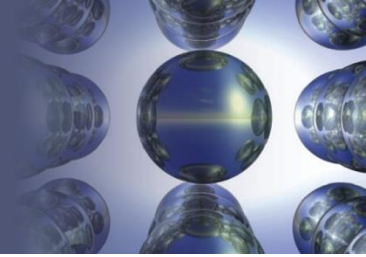


### Binary Ionic Compounds (Type I)

1. The cation is always named first and the anion second.
2. A monatomic cation takes its name from the name of the parent element.
3. A monatomic anion is named by taking the root of the element name and adding *-ide*.

## Section 2.8

### *Naming Simple Compounds*



#### Binary Ionic Compounds (Type I)

- Examples:

KCl

Potassium chloride

MgBr<sub>2</sub>

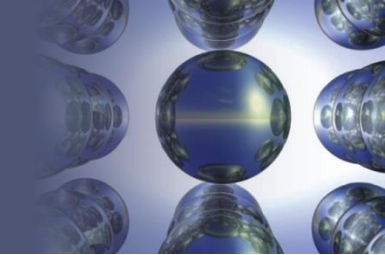
Magnesium bromide

CaO

Calcium oxide

## Section 2.8

### *Naming Simple Compounds*

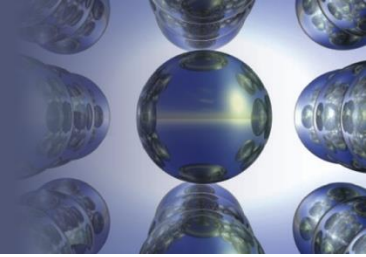


#### Binary Ionic Compounds (Type II)

- Metals in these compounds form more than one type of positive ion.
- 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.
- Elements that form only one cation do not need to be identified by a roman numeral.

## Section 2.8

### *Naming Simple Compounds*



#### Binary Ionic Compounds (Type II)

- Examples:

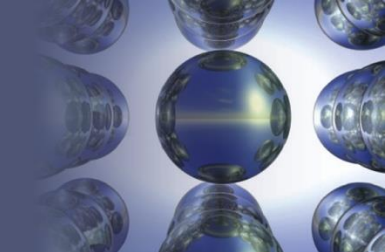
$\text{CuBr}$                   Copper(I) bromide

$\text{FeS}$                       Iron(II) sulfide

$\text{PbO}_2$                     Lead(IV) oxide

## Section 2.8

# *Naming Simple Compounds*



### Polyatomic Ions

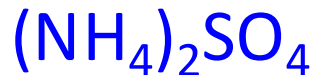
- Must be memorized (see Table 2.5 on pg. 65 in text).
- Examples of compounds containing polyatomic ions:



Sodium hydroxide



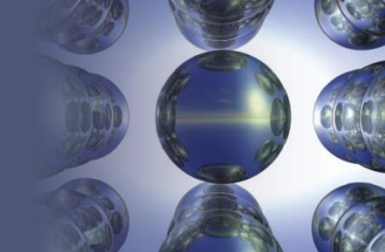
Magnesium nitrate



Ammonium sulfate

## Section 2.8

### *Naming Simple Compounds*



#### Binary Covalent Compounds (Type III)

- Formed between two nonmetals.
1. The first element in the formula is named first, using the full element name.
  2. The second element is named as if it were an anion.
  3. Prefixes are used to denote the numbers of atoms present.
  4. The prefix *mono-* is never used for naming the first element.

## Section 2.8

# Naming Simple Compounds

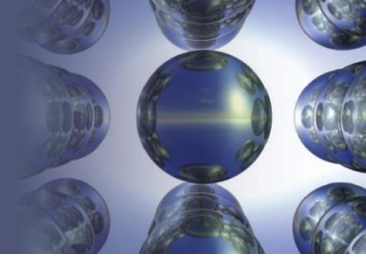
## Prefixes Used to Indicate Number in Chemical Names

**Table 2.6** | Prefixes Used to Indicate Number in Chemical Names

Prefix	Number Indicated
<i>mono-</i>	1
<i>di-</i>	2
<i>tri-</i>	3
<i>tetra-</i>	4
<i>penta-</i>	5
<i>hexa-</i>	6
<i>hepta-</i>	7
<i>octa-</i>	8
<i>nona-</i>	9
<i>deca-</i>	10

## Section 2.8

### *Naming Simple Compounds*



#### Binary Covalent Compounds (Type III)

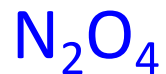
- Examples:



Carbon dioxide



Sulfur hexafluoride



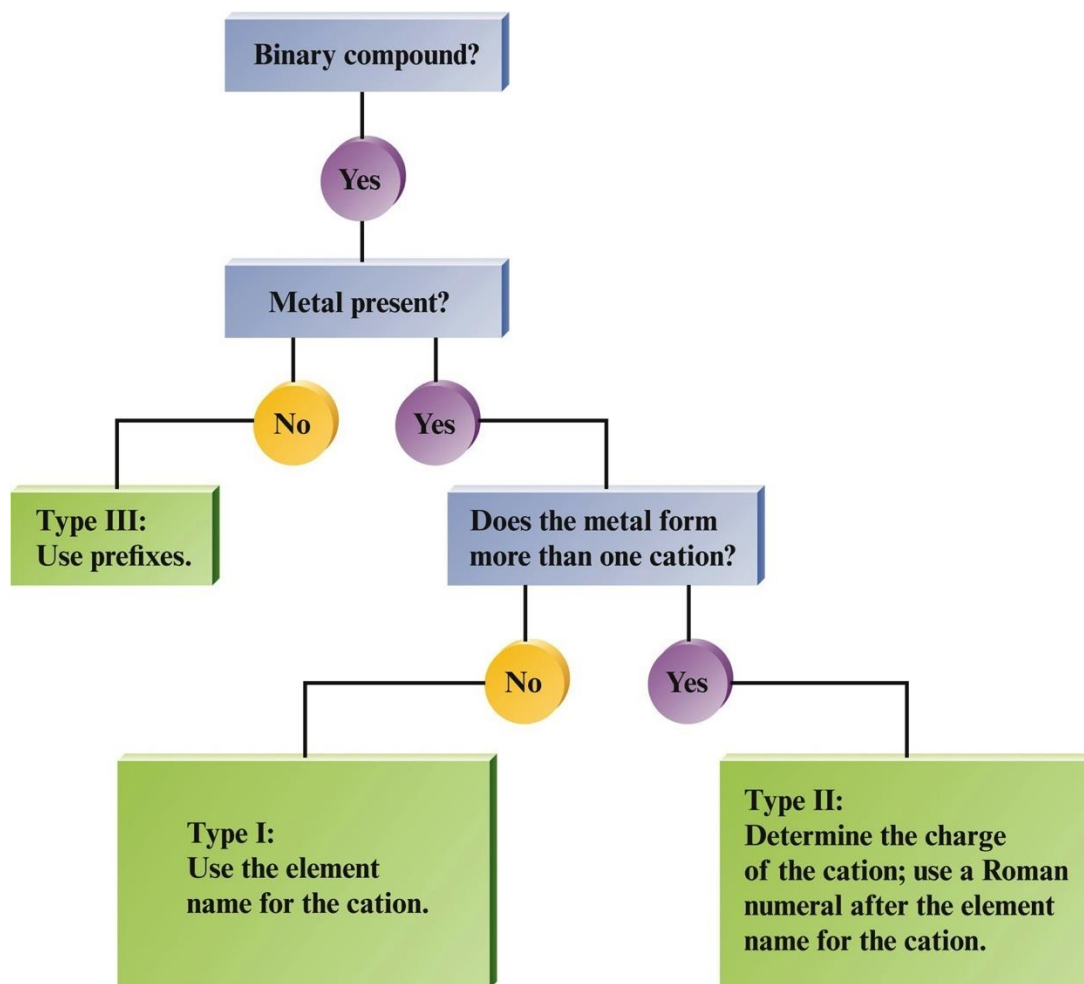
Dinitrogen tetroxide



# Section 2.8

## *Naming Simple Compounds*

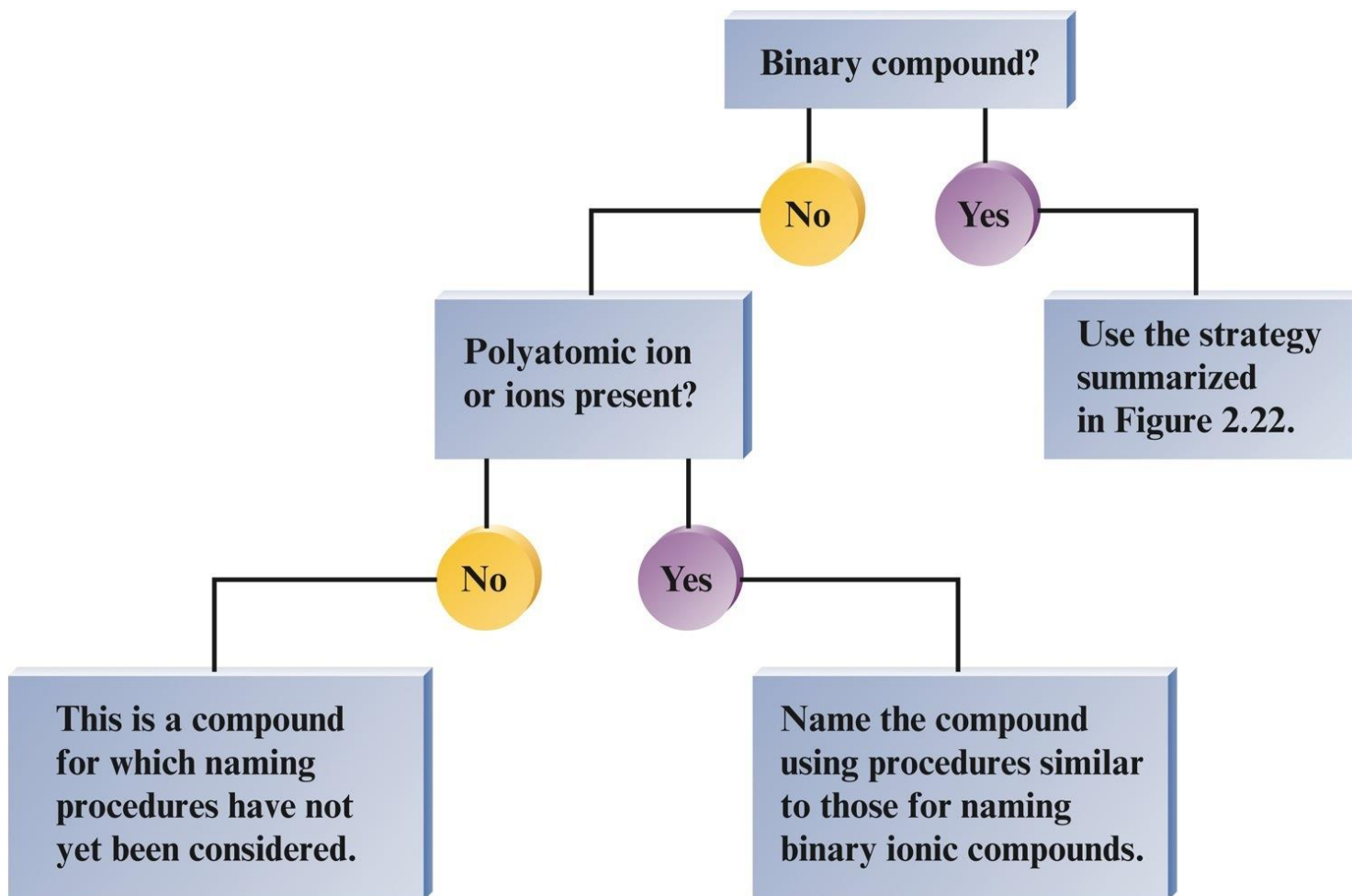
### Flowchart for Naming Binary Compounds



# Section 2.8

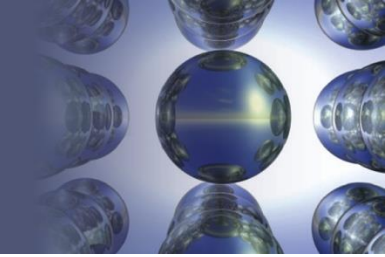
## *Naming Simple Compounds*

### Overall Strategy for Naming Chemical Compounds



## Section 2.8

# *Naming Simple Compounds*

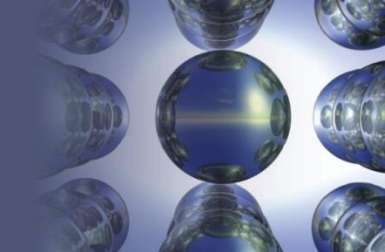


## Acids

- Acids can be recognized by the hydrogen that appears first in the formula—HCl.
- Molecule with one or more  $\text{H}^+$  ions attached to an anion.

## Section 2.8

# *Naming Simple Compounds*



## Acids

- If the anion does *not* contain oxygen, the acid is named with the prefix *hydro-* and the suffix *-ic*.

- Examples:

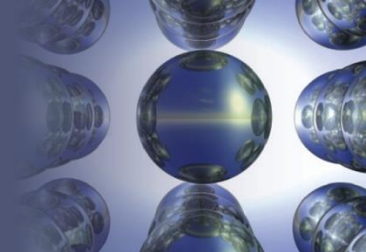
HCl                      Hydrochloric acid

HCN                     Hydrocyanic acid

H<sub>2</sub>S                     Hydrosulfuric acid

## Section 2.8

# *Naming Simple Compounds*



## Acids

- If the anion *does* contain oxygen:
  - The suffix *-ic* is added to the root name if the anion name ends in *-ate*.

- Examples:

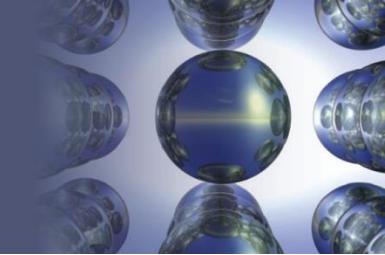
$\text{HNO}_3$       Nitric acid

$\text{H}_2\text{SO}_4$       Sulfuric acid

$\text{HC}_2\text{H}_3\text{O}_2$       Acetic acid

## Section 2.8

# *Naming Simple Compounds*



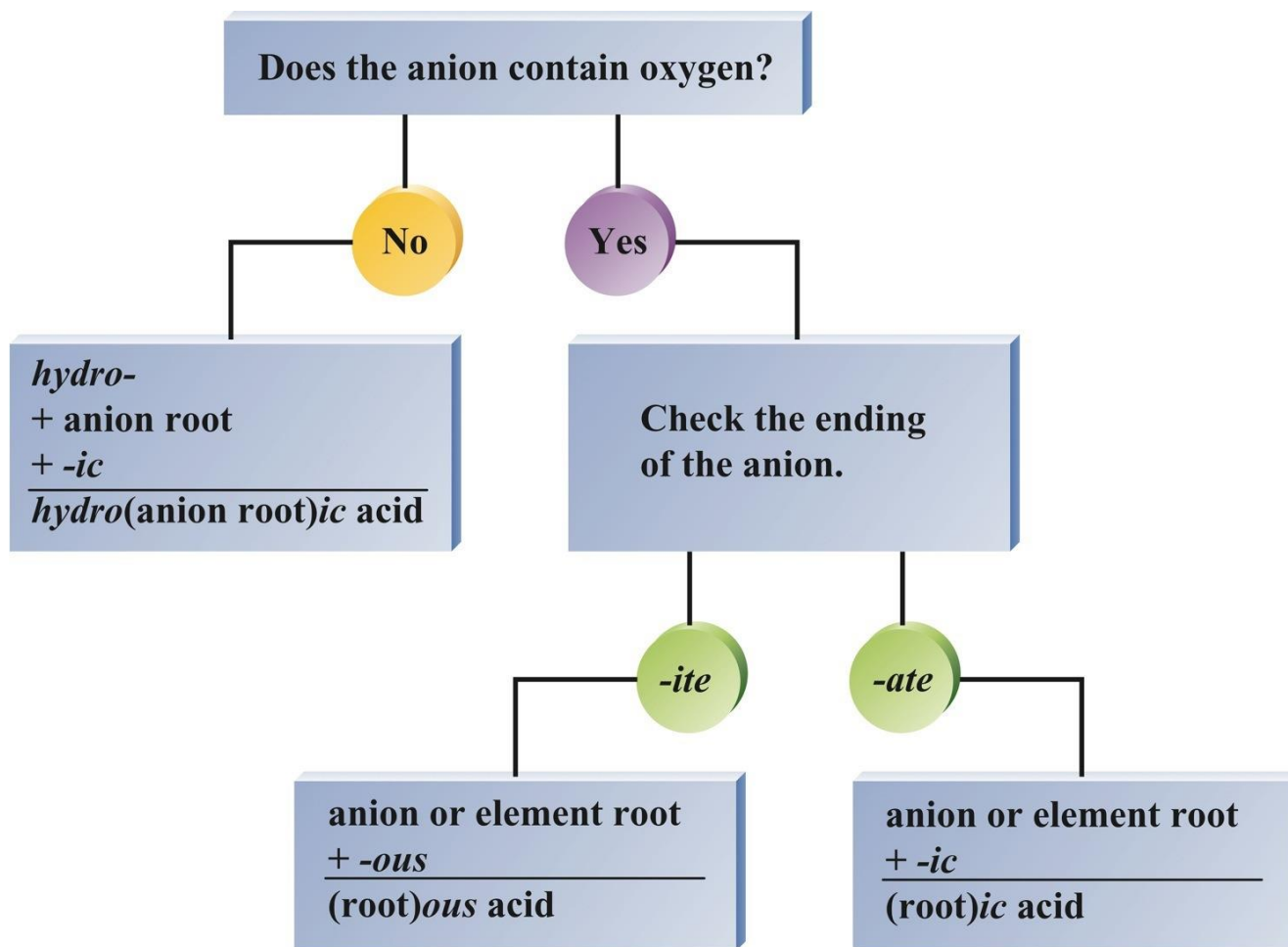
## Acids

- If the anion *does* contain oxygen:
  - The suffix *-ous* is added to the root name if the anion name ends in *-ite*.
- Examples:
  - $\text{HNO}_2$  Nitrous acid
  - $\text{H}_2\text{SO}_3$  Sulfurous acid
  - $\text{HClO}_2$  Chlorous acid

# Section 2.8

## Naming Simple Compounds

### Flowchart for Naming Acids



## Section 2.8

### *Naming Simple Compounds*

#### **EXERCISE!**

Which of the following compounds is named **incorrectly**?

- |                      |                         |
|----------------------|-------------------------|
| a) $\text{KNO}_3$    | potassium nitrate       |
| b) $\text{TiO}_2$    | titanium(II) oxide      |
| c) $\text{Sn(OH)}_4$ | tin(IV) hydroxide       |
| d) $\text{PBr}_5$    | phosphorus pentabromide |
| e) $\text{CaCrO}_4$  | calcium chromate        |