Inorganic and Organic Chemistry

- Organic chemistry
  - Study of the compounds of the element carbon
  - Includes naturally occurring biological molecules and nearly all synthetic polymers
- Inorganic chemistry
  - Study of all other elements other than carbon and their compounds

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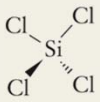
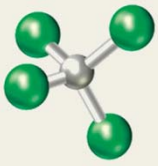
Inorganic Chemistry—Main Groups and Transition Metals

- Many inorganic compounds exist as relatively small molecules whose atoms are joined together through covalent bonds
  - Example
    - Silicon tetrachloride $SiCl_4$





- Other compounds of the main group elements form extended ionic structures, such as that of NaCl, LiCl, NaF, and KBr

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Inorganic Chemistry—Main Groups and Transition Metals

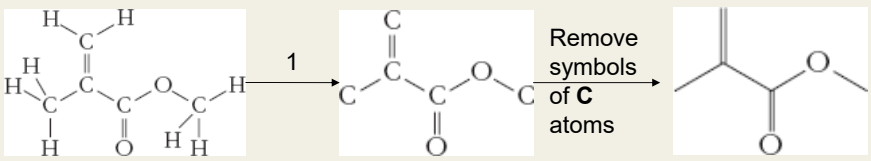
- Transition metal chemistry is more complicated than main group metal chemistry
- Transition metal cations have different charges
- Hence, they can form a variety of compounds with different chemical and physical properties
- Chemistry of transition metals does not vary as sharply from group to group
- Most transition metals can form cations with a 2+ charge

Iron(III) chloride, $FeCl_3$
(Here forming as the solid at the bottom of the test tube)
Orange-brown color
Density 2.90 g cm^{-3}
Melts at 306°C

Iron(II) chloride, $FeCl_2$
Greenish-yellow color
Density 3.16 g cm^{-3}
Melts at 670°C

Organic Chemistry

- Carbon atoms readily attach to one another to form chains
  - These chains can grow quite long to make polymers
- Carbon compounds can become very large and complex structures and are described simply using line structures
- Lines are used to depict bonds between atoms
- Symbols are written for any elements other than carbon (O, N) and hydrogen, as well as for any hydrogen atoms that are not directly attached to carbon



1. Remove **H**s directly bonded to **C**

Functional Groups

- Hydrocarbons
  - Molecules that contain only carbon and hydrogen atoms
  - Addition of functional groups to hydrocarbons results in more complex compounds
  - Chemical formulas are often written to emphasize functional groups
    - Methanol, an alcohol, is often written CH_3OH instead of CH_4O

Some Common Functional Groups

Functional Group	Class of Compounds	Example
	Alkenes	Ethylene
—C≡C—	Alkynes	Acetylene
—X (X = F, Cl, Br, I)	Organic halides	Methyl chloride
—OH	Alcohols, phenols	Ethanol, phenol
C—O—C	Ethers	Diethyl ether
	Amines	Methylamine
	Carboxylic acids	Acetic acid
	Amides	Acetanilide
	Aldehydes	Formaldehyde
	Ketones	Methyl ethyl ketone

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Chemical Nomenclature

- Naming chemical compounds
- Binary compounds contain only two elements
  - Covalent binary compounds are named differently from ionic binary compounds
  - Recognizing a compound as ionic or covalent assists in naming
    - A metal and a nonmetal generally combine to form ionic compounds
    - Two nonmetals combine to form a covalent compound
    - Presence of polyatomic ions often indicates ionic bonding

Common cations: (Table 2.5)

Sodium ion	Na^+
Magnesium ion	Mg^{2+}
Iron(II) ion	Fe^{2+}
Iron(III) ion	Fe^{3+}
Silver ion	Ag^+
Ammonium ion	NH_4^+
Potassium ion	K^+
Calcium ion	Ca^{2+}
Copper(I) ion	Cu^+
Copper(II) ion	Cu^{2+}
Zinc ion	Zn^{2+}
Hydronium ion	H_3O^+

Common anions (Table 2.6)

Halides	F^-, Cl^-, Br^-, I^-
Nitrate	NO_3^-
Phosphate	PO_4^{3-}
Carbonate	CO_3^{2-}
Sulfate	SO_4^{2-}
Hydroxide	OH^-
Cyanide	CN^-
Oxide	O^{2-}

Naming Covalent Compounds

- The first element in the formula retains its full name
- The second element is named by replacing the ending from its name with the suffix *-ide*
  - Both elements are preceded by a number-designating prefix except that when there is only one atom of the first element, it does not use the prefix mono-

Number	Prefix
One	Mono-
Two	Di-
Three	Tri-
Four	Tetra-
Five	Penta-
Six	Hexa-
Seven	Hepta-
Eight	Octa-
Nine	Nona-
Ten	Deca-

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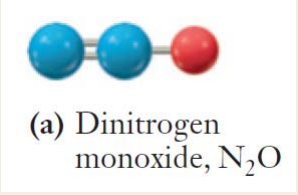
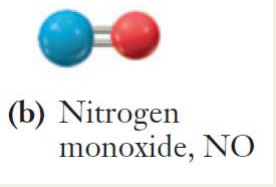
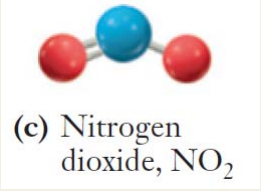
Naming Covalent Compounds (continued)



(a) Dinitrogen monoxide, N_2O

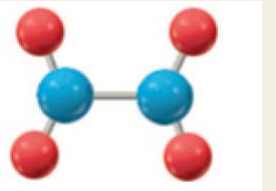


(b) Nitrogen monoxide, NO

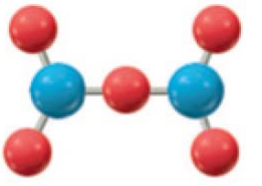


(c) Nitrogen dioxide, NO_2

(d) Dinitrogen trioxide, N_2O_3



(e) Dinitrogen tetroxide, N_2O_4



(f) Dinitrogen pentoxide, N_2O_5

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(Q. 12)

- What are the systematic names of the following compounds?
  - N_2O_5
  - PCl_3
  - P_4O_6

1) dinitrogen pentoxide

2) phosphorous trichloride

3) tetraphosphorus hexoxide

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Naming Ionic Compounds

- Cations with more than one charge (e.g., transition metals) are named using Roman numerals in parentheses indicating the charge, e.g., iron(II)
- Monatomic anions are named by replacing the ending of the element name with the suffix *-ide*, e.g., bromide
- A polyatomic cation or anion is named using its common name

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Table 2.5: Common Cations

Sodium ion	Na^+	Potassium ion	K^+
Magnesium ion	Mg^{2+}	Calcium ion	Ca^{2+}
Iron(II) ion	Fe^{2+}	Copper(I) ion	Cu^+
Iron(III) ion	Fe^{3+}	Copper(II) ion	Cu^{2+}
Silver ion	Ag^+	Zinc ion	Zn^{2+}
Ammonium ion	NH_4^+	Hydronium ion	H_3O^+

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Table 2.6: Naming Ionic Compounds

- The charge and chemical formula for each polyatomic ion should be memorized

Halides	F^-, Cl^-, Br^-, I^-	Sulfate	SO_4^{2-}
Nitrate	NO_3^-	Hydroxide	OH^-
Phosphate	PO_4^{3-}	Cyanide	CN^-
Carbonate	CO_3^{2-}	Hydrogen carbonate	HCO_3^-

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