Molecules of Elements and Compounds

- L Molecules are combinations of atoms tightly bound together to form discreet, chemically identifiable units.
- Many elements are composed of molecules, but not all.

Cl₂, S₈ - molecules C(graphite) - no molecules (network solid) Cu - no molecules (metallic structure)

- L Molecules of elements are *homonuclear*, because they are composed of only one kind of atom.
- Many compounds are composed of molecules, but not all.

 H_2O , CH_4 - molecules NaCl - no molecules (ionic solid) SiO₂(s) - no molecules (network solid)

L Molecules of compounds are *heteronuclear*, because they are composed of two or more different kinds of atoms.

Molecular Formulas

- L For a molecular substance (elements or compounds), the composition of the molecules is indicated by a *molecular formula*, which shows the kinds and numbers of each atom in the molecule.
 - P₄ phosphorus molecule made up of 4 P atoms



CH₄ methane molecule made up of 1 C atom and 4 H atoms



Common Elements Composed of Molecules

Formula	Room Temperature Form
H_2	colorless gas
O ₂	colorless gas
N_2	colorless gas
P_4	white solid
S ₈	yellow solid
F_2	pale yellow gas
Cl ₂	pale green gas
Br ₂	dark red liquid
I_2	violet solid

Network Solids

Graphite and Diamond (carbon *allotropes*)



Graphite



Diamond

Molecular Formulas vs. Empirical Formulas

L An empirical formula indicates the lowest, wholenumber ratio of the atoms in a compound, regardless of whether or not it contains molecules.

Molecular Formula	Empirical Formula
H ₂ O	H ₂ O
H_2O_2	HO
CH_4	CH_4
C_2H_4	CH_2
C_4H_8	CH ₂
$C_{6}H_{12}$	CH ₂
NO ₂	NO ₂
N_2O_4	NO ₂

L For molecular compounds, all the subscripts in the molecular formula are a whole-number multiple (1, 2, 3, etc.) of those in the empirical formula.

Structural Formulas of Some Molecular Compounds With the Empirical Formula CH₂



C₂H₄





 $C_{6}H_{12}$

Ways of Depicting Molecules

Methanol, $CH_4O = CH_3OH$



Space Filling Model

