## CHAPTER 1 Introduction to Chemistry 化学概论

### 1. 术语

Critical material – governments have identified certain materials as vitally important
Scientific method
Hypothesis 假设
Macroscopic perspective 宏观视角
Microscopic perspective (/particulate perspective) 微观视角
Symbolic perspective 符号视角
Matter
Physical property
Density (/mass density)
Chemical property
Combustion 燃烧
Corrosion 腐蚀
Malleability 延展性
Phase 相 – three common states of matter: solids, liquids, and gases
Solid
Liquid
Gas
Element
Atom
Molecule
Accuracy 准确度 – how close the observed value is to the "true" value
Precision 精密度 – the spread in values obtained from the measurement
Random error 随机误差
Systematic error 系统误差
Inductive reasoning 归纳推理
Deductive reasoning 演绎推理
Systems thinking 系统思维
Scientific model 科学模型
Scientific theory 科学理论
Unit
International System of Units (Système International d'Unités, SI)
Parts per million (ppm) 百万分之
Parts per billion (ppb) 十亿分之
Temperature scale 温标
Scientific notation 科学记数法
Significant figures 有效数字
Dimensional analysis (/factor-label method) 量纲分析
Vapor deposition 气相沉积

### 2. 表格

| SI base units | | |
|---|---|---|
| Symbol | Name | Quantity |
| s | second | time 时间 |

| | | |
|---|---|---|
| m | metre | length 长度 |
| kg | kilogram | mass 质量 |
| A | ampere | electric current 电流 |
| K | kelvin | thermodynamic temperature 热力学温度 |
| mol | mole | amount of substance 物质的量 |
| cd | candela | luminous intensity 发光强度 |

**Table 1.2** SI prefixes

| Factor | Name | Symbol | Factor | Name | Symbol |
|---|---|---|---|---|---|
| $10^{24}$ | yotta | Y | $10^{-1}$ | deci | d |
| $10^{21}$ | zetta | Z | $10^{-2}$ | centi | c |
| $10^{18}$ | exa | E | $10^{-3}$ | milli | m |
| $10^{15}$ | peta | P | $10^{-6}$ | micro | μ |
| $10^{12}$ | tera | T | $10^{-9}$ | nano | n |
| $10^{9}$ | giga | G | $10^{-12}$ | pico | p |
| $10^{6}$ | mega | M | $10^{-15}$ | femto | f |
| $10^{3}$ | kilo | k | $10^{-18}$ | atto | a |
| $10^{2}$ | hecto | h | $10^{-21}$ | zepto | z |
| $10^{1}$ | deka | da | $10^{-24}$ | yocto | y |

3. 公式

$$°F = (1.8 \times °C) + 32$$
$$°C = (°F - 32)/1.8$$

## CHAPTER 2 Atoms and Molecules 原子和分子

### 1. 术语

Polymer 聚合物
Monomer 单体
Polymer backbone – the carbon atoms are linked together in a long chain
Nucleus 原子核
Electron
Proton 质子
Neutron 中子
Atomic number 原子序数
Isotope 同位素
Atomic mass unit (amu) 原子质量单位
Mass number 质量数
Isotopic abundances 同位素丰度
Atomic weight 原子量
Monatomic ion 单原子离子
Polyatomic ion 多原子离子
Anion 阴离子
Cation 阳离子
Coulomb's law 库仑定律
Chemical bond
Chemical compound
Molecule
Chemical formula
Molecular formula
Empirical formula 实验式
Hydrate 水合物
Initiator 引发剂
Catalyst 催化剂
Lattice 晶格
Ionic bond 离子键
Formula unit – the smallest whole number ratio of atoms in an ionic compound
Metallic bond 金属键
Covalent bond 共价键
Periodicity 周期性
Periodic law 周期律
Period 周期 – the horizontal rows of the periodic table
Group 族 – the vertical columns of the periodic table
Alkali metal 碱金属
Alkaline earth metal 碱土金属
Halogen 卤素
Noble gas (/rare gas) 稀有气体
Representative element / main group element 主族元素
Transition metal 过渡金属

Lanthanides 镧系
Actinides 锕系
Metal
Nonmetal
Metalloid / semimetal 准金属
Organic chemistry 有机化学
Inorganic chemistry 无机化学
Isomer 同分异构体
Line structure 键线式
Functional group 官能团
Addition reaction 加成反应
Hydrocarbon 碳氢化合物
Chemical nomenclature 化学命名法
Binary compound 二元化合物
Some common functional groups 一些常见官能团:
- Alkene 烯烃 – ethylene 乙烯
- Alkyne 炔烃 – acetylene 乙炔
- Organic halide 有机卤化物 – methyl chloride (/chloromethane) 氯甲烷
- Alcohol 醇 – ethanol 乙醇
- Phenol 苯酚
- Ether 醚 – diethyl ether 乙醚
- Amine 胺 – methylamine 甲胺
- Carboxylic acid 羧酸 – acetic acid 乙酸
- Amide 酰胺 – acetanilide 乙酰苯胺
- Aldehyde 醛 – formaldehyde 甲醛
- Ketone 酮 – methyl ethyl ketone 丁酮

Common cations 常见阳离子:
- 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 – $Cu^{2+}$
- inc ion – $Zn^{2+}$
- Hydronium ion – $H_3O^+$

Common anions 常见阴离子:
- Halides 卤离子 – $F^-$, $Cl^-$, $Br^-$, $I^-$
- Nitrate – $NO_3^-$
- Phosphate – $PO_4^{3-}$
- Carbonate – $CO_3^{2-}$
- Sulfate – $SO_4^{2-}$
- Hydroxide – $OH^-$
- Cyanide – $CN^-$
- Oxide – $O^{2-}$

Numerical prefixes 数字前缀:

1-Mono 2-Di 3-Tri 4-Tetra 5-Penta

6-Hexa 7-Hepta 8-Octa 9-Nona 10-Deca

Naming covalent compounds 共价化合物命名:

NO – nitrogen monoxide $CS_2$ – carbon disulfide $P_4O_6$ – tetraphosphorus hexoxide

Oxyanion 含氧酸根离子

Oxyanions of chlorine 绿的含氧酸根离子:

$ClO^-$ – hypochlorine

$ClO_2^-$ – chlorite

$ClO_3^-$ – chlorate

$ClO_4^-$ – perchlorate

Naming ionic compounds 离子化合物命名:

$Fe_2O_3$ – iron(III) oxide $Na_2O$ – sodium oxide $Ca(NO_3)_2$ – calcium nitrate

Free radical 自由基 – R•⟶R—

High-density polyethylene (HDPE) 高密度聚乙烯 – linear polyethylene

Low-density polyethylene (LDPE) 低密度聚乙烯 – branched polyethylene

Ultra-high molecular weight polyethylene (UHMWPE) 超高分子量聚乙烯 – extremely long linear polyethylene chains

Valence 化合价

**2. 表格**

**Table 2.3** Common monatomic ions

| Cation Name | Symbol | Anion Name | Symbol |
|---|---|---|---|
| Sodium ion | $Na^+$ | Fluoride ion | $F^-$ |
| Lithium ion | $Li^+$ | Chloride ion | $Cl^-$ |
| Potassium ion | $K^+$ | Bromide ion | $Br^-$ |
| Magnesium ion | $Mg^{2+}$ | Sulfide ion | $S^{2-}$ |
| Aluminum ion | $Al^{3+}$ | Nitride ion | $N^{3-}$ |

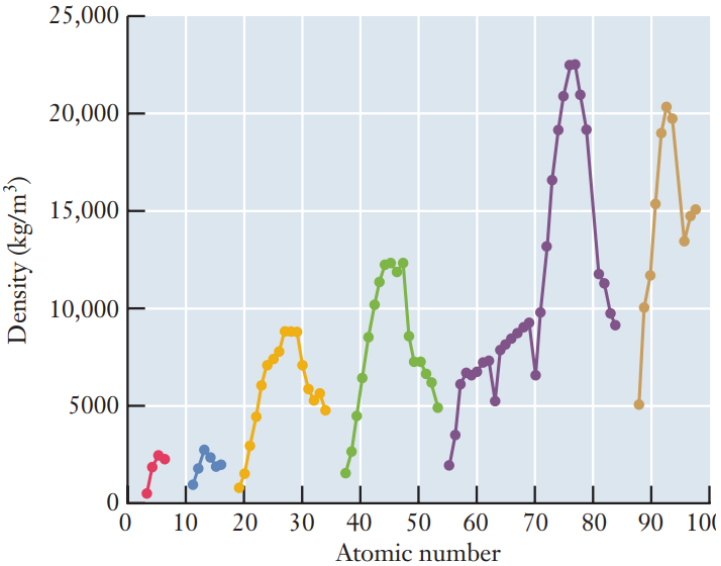
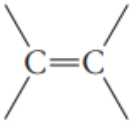
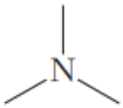
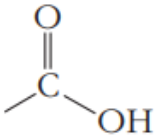
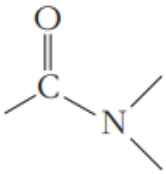
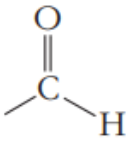
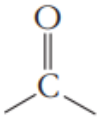


**Table 2.4** Some common functional groups

| 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 |

**3. 公式**

$^{A}_{Z}X$ X - atomic symbol A - mass number Z - atomic number

Coulomb's law 库仑定律 $F = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2}$

## CHAPTER 3 Molecules, Moles, and Chemical Equations 分子、摩尔和化学方程式

### 1. 术语

Biomass 生物质 – biological material from plants
Photosynthesis 光合作用
Biofuel 生物燃料
Chemical equation 化学方程式
Reactant 反应物
Product 产物
Photochemical reaction 光化学反应
Law of conservation of matter 物质守恒定律 – matter is neither created or destroyed
Stoichiometry 化学计量学
Stoichiometric coefficient 化学计量系数 – the numbers used to balance a chemical equation
Solution 溶液
Solvent 溶剂
Solute 溶质
Concentration 浓度
Concentrated solution 浓溶液
Dilute solution 稀溶液
Solubility 溶解度
Soluble 可溶的
Insoluble 不溶的
Saturated solution 饱和溶液
Electrolyte 电解质
Nonelectrolyte 非电解质
Strong electrolyte 强电解质
Weak electrolyte 弱电解质
Dissociation reaction 解离反应
Molecular equation
Total ionic equation
Spectator ion – ions that are uninvolved in the chemistry
Net ionic equation
Acid
Base 碱
Neutralization 中和反应
Salt
Precipitation reaction 沉淀反应
Mole
Avogadro's number 阿伏伽德罗常数
Molar mass 摩尔质量
Mole ratio
Elemental analysis 元素分析
Molarity / molar concentration 体积摩尔浓度
Carbon sequestration – the process of removing carbon from the atmosphere or from gases that are entering the atmosphere

2. 表格

**Table 3.1** Solubility rules

| Solubility guidelines for ionic compounds in water at room temperature | |
|---|---|
| **Usually Soluble** | **Exceptions** |
| Group 1 cations ($Li^+$, $Na^+$, $K^+$, $Rb^+$, $Cs^+$), ammonium ($NH_4^+$) | No common exceptions |
| Nitrates ($NO_3^-$), nitrites ($NO_2^-$) | Moderately soluble: $AgNO_2$ |
| Chlorides, bromides, iodides ($Cl^-$, $Br^-$, $I^-$) | Insoluble: AgCl, $Hg_2Cl_2$, $PbCl_2$, AgBr, $Hg_2Br_2$, $PbBr_2$, AgI, $Hg_2I_2$, and $PbI_2$ |
| Fluorides ($F^-$) | Insoluble: $MgF_2$, $CaF_2$, $SrF_2$, $BaF_2$, $PbF_2$ |
| Sulfates ($SO_4^{2-}$) | Insoluble: $BaSO_4$, $PbSO_4$, $HgSO_4$<br>Moderately soluble: $CaSO_4$, $SrSO_4$, $Ag_2SO_4$ |
| Chlorates ($ClO_3^-$), perchlorates ($ClO_4^-$) | No common exceptions |
| Acetates ($CH_3COO^-$) | Moderately soluble: $AgCH_3COO$ |
| **Usually Insoluble** | **Exceptions** |
| Phosphates ($PO_4^{3-}$) | Soluble: $(NH_4)_3PO_4$, $Na_3PO_4$, $K_3PO_4$ |
| Carbonates ($CO_3^{2-}$) | Soluble: $(NH_4)_2CO_3$, $Na_2CO_3$, $K_2CO_3$ |
| Hydroxides ($OH^-$) | Soluble: LiOH, NaOH, KOH, $Ba(OH)_2$<br>Moderately soluble: $Ca(OH)_2$, $Sr(OH)_2$ |
| Sulfides ($S^{2-}$) | Soluble: $(NH_4)_2S$, $Na_2S$, $K_2S$, MgS, CaS |

**Table 3.2** Common acids and bases

| Strong and weak acids and bases | | | |
|---|---|---|---|
| **Strong Acids** | | **Strong Bases** | |
| HCl | Hydrochloric acid | LiOH | Lithium hydroxide |
| $HNO_3$ | Nitric acid | NaOH | Sodium hydroxide |
| $H_2SO_4$ | Sulfuric acid | KOH | Potassium hydroxide |
| $HClO_4$ | Perchloric acid | $Ca(OH)_2$ | Calcium hydroxide |
| HBr | Hydrobromic acid | $Ba(OH)_2$ | Barium hydroxide |
| HI | Hydroiodic acid | $Sr(OH)_2$ | Strontium hydroxide |
| **Weak Acids** | | **Weak Bases** | |
| $H_3PO_4$ | Phosphoric acid | $NH_3$ | Ammonia |
| HF | Hydrofluoric acid | $CH_3NH_2$ | Methylamine |
| $CH_3COOH$ | Acetic acid | | |
| HCN | Hydrocyanic acid | | |

# CHAPTER 4 Stoichiometry 化学计量

## 1. 术语

Alkane 烷烃:

$CH_4$ – methane
$C_2H_6$ – ethane
$C_3H_8$ – propane
$C_4H_{10}$ – butane
$C_5H_{12}$ – pentane
$C_6H_{14}$ – hexane
$C_7H_{16}$ – heptane
$C_8H_{18}$ – octane
$C_9H_{20}$ – nonane
$C_{10}H_{22}$ – decane

Isomer 同分异构体
Mole ratio 摩尔比
Limiting reactant – the reactant completely consumed in the reaction
Side reaction 副反应
Theoretical yield 理论产率
Actual yield 实际产率
Percentage yield 产率
Titration 滴定
Indicator 指示剂
Fuel additive 燃料添加剂
Oxygenate – adding ethanol to increase the oxygen content of gasoline
Oxygenated fuel 含氧燃料
Reformulated gasoline (RFG) – gasoline containing at least 2% oxygen by weight
MTBE (methyl tert-butyl ether) $(CH_3)_3COCH_3$ 甲基叔丁基醚

## CHAPTER 5 Gases 气体

### 1. 术语

Natural gas liquid (NGLs) 液化天然气
Hydraulic fracturing (/fracking) 水力压裂
Ideal gas law 理想气体状态方程 – Pv = nRT
Universal gas constant 气体常数(R)
Pressure
Barometer 气压表
Pascal (Pa)
Torr – 1 torr = 1 mm Hg
Atmosphere (atm)
Charles's law 查理定律 – $V \propto T$
Boyle's law 波义耳定律 – $V \propto 1/P$
Avogadro's law 阿伏伽德罗定律 – $V \propto n$
Absolute temperature / thermodynamic temperature 热力学温度
Partial pressure 气体分压
Dalton's law of partial pressures 道尔顿分压定律 – the pressure of a mixture of gases is the sum of the partial pressures of the component gases
Mole fraction 摩尔分数
Standard temperature and pressure (STP) – 0℃, 1 atm ≈22.41 L
Kinetic-molecular theory 分子运动理论
Distribution function 分布函数
Maxwell-Boltzmann distribution 麦克斯韦-玻尔兹曼分布 – the distribution function that describes the speeds of a collection of gas particles
Average speed
Root-mean-square speed 方均根速率
Mean free path 平均自由程 – the average distance a particle travels between collisions with each other particles 气体分子两次碰撞之间的时间内经过的路程的统计平均值
Van der Waals equation 范德华方程
Capacitance manometer 电容压力计
Thermocouple gauge – used to measure pressures between 0.01 and about 1.0 torr (thermocouple – 热电偶)
Ionization gauge – used to measure pressures as low as $10^{-11}$ torr (ionization – 电离)

### 2. 表格

**Table 5.1** The approximate composition of natural gas

| Gas | Formula | Percentage Range |
|---|---|---|
| Methane | $CH_4$ | 70–90% |
| Ethane, propane, butane | $C_2H_6$, $C_3H_8$, $C_4H_{10}$ | 0–20% |
| Carbon dioxide | $CO_2$ | 0–8% |
| Hydrogen sulfide | $H_2S$ | 0–5% |
| Nitrogen | $N_2$ | 0–5% |
| Oxygen | $O_2$ | 0–0.2% |
| Noble gases | He, Ne, Ar, Xe | Trace |

**Table 5.2** Van der Waals constants

| Gas | *a* (atm $L^2$ $mol^{-2}$) | *b* (L $mol^{-1}$) |
|---|---|---|
| Ammonia, $NH_3$ | 4.170 | 0.03707 |
| Argon, Ar | 1.345 | 0.03219 |
| Carbon dioxide, $CO_2$ | 3.592 | 0.04267 |
| Helium, He | 0.034 | 0.0237 |
| Hydrogen, $H_2$ | 0.2444 | 0.02661 |
| Hydrogen fluoride, HF | 9.433 | 0.0739 |
| Methane, $CH_4$ | 2.253 | 0.04278 |
| Nitrogen, $N_2$ | 1.390 | 0.03913 |
| Oxygen, $O_2$ | 1.360 | 0.03183 |
| Sulfur dioxide, $SO_2$ | 6.714 | 0.05636 |
| Water, $H_2O$ | 5.464 | 0.03049 |

**3. 公式**

Ideal gas law 理想气体状态方程 $PV = nRT$

Average kinetic energy 平均动能 $KE_{avg} = \frac{1}{2}mv_{rms}^2$

Van der Waals equation 范德华方程 $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$

## CHAPTER 6 The Periodic Table and Atomic Structure 元素周期表和原子结构

### 1. 术语

Trace analysis 痕量分析
Nondestructive testing 无损检测
Atomic absorption spectroscopy (AAS) 原子吸收光谱
X-ray fluorescence (XRF) X 射线荧光
Visible light
Electromagnetic spectrum 电磁波谱
Wave length 波长
Amplitude 振幅
Frequency
Adjacent 邻近的
Oscillating 振荡的
Refraction 折射
Photoelectric effect 光电效应
Wave-particle duality 波粒二象性
Photon 光子
Binding energy 结合能
Atomic spectrum 原子光谱
Prism 棱镜
Quantized 量子化的
Bohr model 玻尔模型
Excited state 激发态
Ground state 基态
Orbital 轨道
Diffraction 衍射
Wave function
Schrödinger equation 薛定谔方程
Operator 算子 – designates a complicated series of mathematical operations to be carried out
Quantum number 量子数
Principal quantum number (n) 主量子数 → shell 电子层 → principle energy level 能层
Secondary quantum number (l) (Azimuthal quantum number) 角量子数 → subshell 电子亚层 → subenergy level 能级
Magnetic quantum number ($m_l$) 磁量子数 → orbital 电子轨道
Spin quantum number ($m_s$) 自旋量子数 → electron 电子
Node (/nodal plane) – a plane in which there is no probability of finding an electron
Uncertainty principle 不确定性原理
Pauli exclusion principle 泡利不相容原理 – no two electrons in an atom may have the same set of four quantum numbers
Spin paired – one with spin up and the other with spin down
Shielding 屏蔽
Effective nuclear charge 有效核电荷
Electron configuration 电子排布

Aufbau principle 能量最低原则
Hund's rule 洪特规则 – within a subshell, electrons occupy orbitals individually and with parallel spins whenever possible
Core electrons 原子实 – the inner electrons which lie closer to the nucleus
Valence electron 价电子 – outer electrons
Ionization energy 电离能
Electron affinity 电子亲和能
Light-emitting diode (LED) 发光二极管
Laser
Monochromatic 单色的
Coherent 相干的 – all of the waves are perfectly in phase and go through maxima and minima together

**2. 表格**

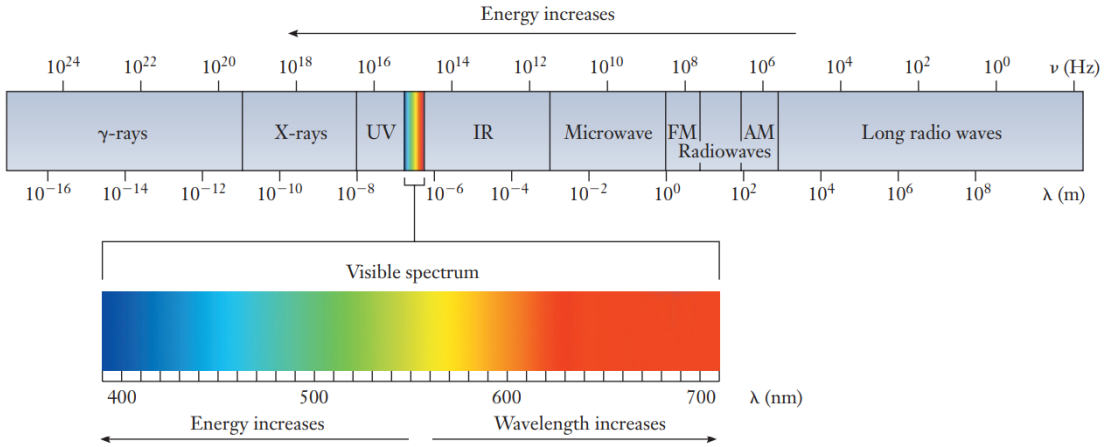
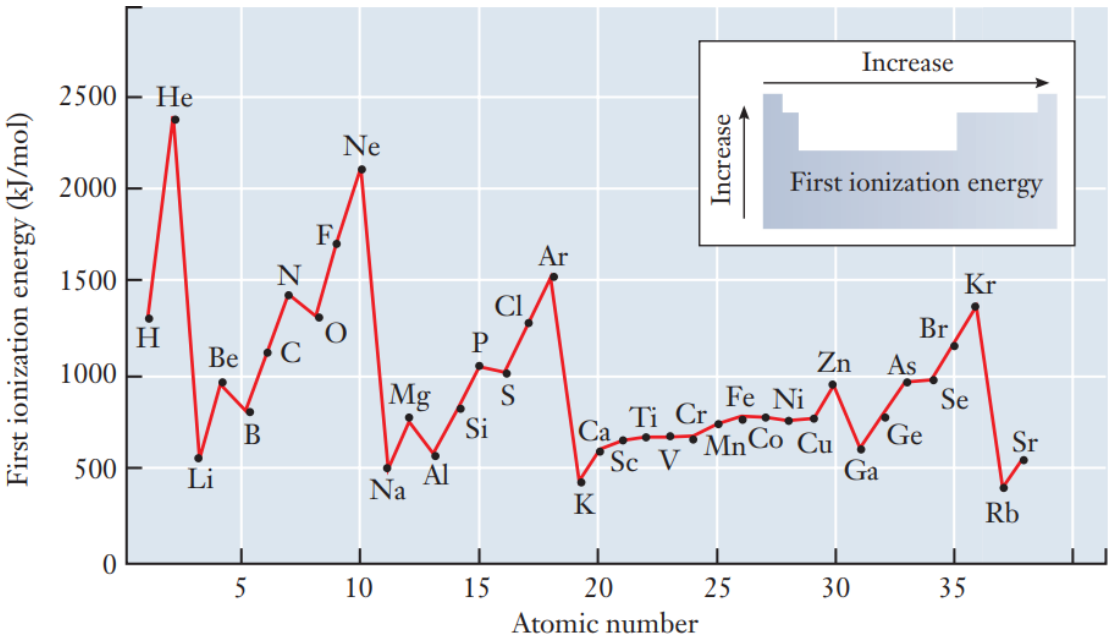
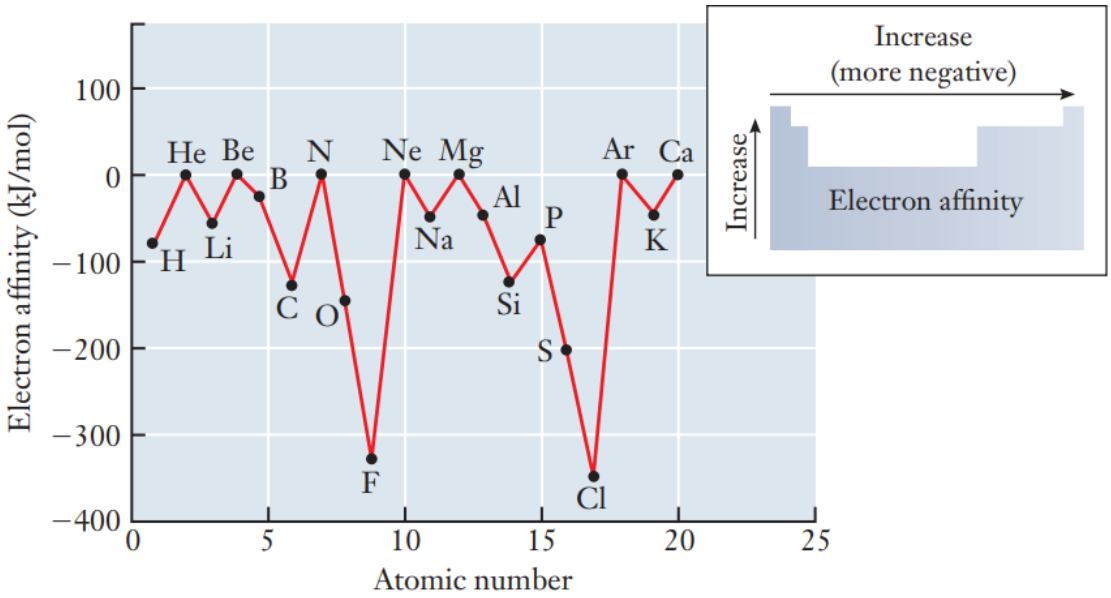



**Table 6.2** Allowed combinations of quantum numbers

Relationships among values of the different quantum numbers are illustrated. This table allows us to make another observation about quantum numbers. If we count the total number of orbitals in each shell, it is equal to the square of the principal quantum number, $n^2$.

| Value of $n$ | Values for $\ell$ (letter designation) | Values for $m_\ell$ | Number of Orbitals |
|---|---|---|---|
| 1 | 0 ($s$) | 0 | 1 |
| 2 | 0 ($s$) | 0 | 1 |
| | 1 ($p$) | −1, 0, 1 | 3 |
| 3 | 0 ($s$) | 0 | 1 |
| | 1 ($p$) | −1, 0, 1 | 3 |
| | 2 ($d$) | −2, −1, 0, 1, 2 | 5 |
| 4 | 0 ($s$) | 0 | 1 |
| | 1 ($p$) | −1, 0, 1 | 3 |
| | 2 ($d$) | −2, −1, 0, 1, 2 | 5 |
| | 3 ($f$) | −3, −2, −1, 0, 1, 2, 3 | 7 |


First ionization energy (kJ/mol)
2500
2000
1500
1000
500
0
5
10
15
20
25
30
35
Atomic number
He
H
Li
Be
B
C
N
O
F
Ne
Na
Mg
Al
Si
P
S
Cl
Ar
K
Ca
Sc
Ti
V
Cr
Mn
Fe
Co
Ni
Cu
Zn
Ga
Ge
As
Se
Br
Kr
Rb
Sr
Increase
Increase
First ionization energy


Electron affinity (kJ/mol)
100
0
−100
−200
−300
−400
0
5
10
15
20
25
Atomic number
H
He
Li
Be
B
C
N
O
F
Ne
Na
Mg
Al
Si
P
S
Cl
Ar
K
Ca
Increase
(more negative)
Increase
Electron affinity

## CHAPTER 7 Chemical Bonding and Molecular Structure 化学键和分子结构

### 1. 术语

Biocompatibility 生物相容性 – the ability of materials to interact with the natural biological materials without triggering a response form the immune system

Bond energy

Bond length

Octet rule 八隅体规则 – an atom will form covalent bonds to achieve a complement of eight valence electrons

Lewis dot symbol

Lewis structure 路易斯结构式

Bonding pair 共用电子对

Lone pair 孤对电子

Double bond

Triple bond

Electronegativity 电负性

Dipole 偶极

Polar bond 极性键

Resonance hybrid 共振杂化

Resonance structure 共振结构

Valence bond model 价键模型

Orbital overlap 轨道重叠

Sigma bond σ 键

Pi bond π 键

Hybridization 杂化

Hybrid orbital 杂化轨道

Molecular shape

Valence shell electron pair repulsion (VSEPR) theory 价层电子对互斥理论 – molecules assume a shape that allows them to minimize the repulsions between electron pairs in the valence shell of the central atom

Molecular shapes based on VSEPR theory:

Linear 直线 ($AX_2$)

Trigonal planar 平面三角 ($AX_3$) → V-shaped V 形 ($AX_2E$) (/bent 折线)

Tetrahedral 四面体 ($AX_4$) → trigonal pyramidal 三角锥 ($AX_3E$) → V-shaped ($AX_2E_2$)

Trigonal bipyramidal 三角双锥 ($AX_5$) → seesaw 变形四面体 ($AX_4E$) → T-shaped T 形 ($AX_3E_2$) → linear ($AX_2E_3$)

Octahedral 八面体 ($AX_6$) → square pyramidal 四角锥 ($AX_5E$) → square planar 平面立方 ($AX_4E_2$)

### 2. 表格

| Atoms bonded to central atom | Lone pairs | Electron domains (Steric number) | Shape | Ideal bond angle (example's bond angle) | Example | Image |
|---|---|---|---|---|---|---|
| 2 | 0 | 2 | linear | 180° | $CO_2$ |  |
| 3 | 0 | 3 | trigonal planar | 120° | $BF_3$ |  |
| 2 | 1 | 3 | bent | 120° (119°) | $SO_2$ |  |
| 4 | 0 | 4 | tetrahedral | 109.5° | $CH_4$ |  |
| 3 | 1 | 4 | trigonal pyramidal | 109.5° (106.8°)[10] | $NH_3$ |  |
| 2 | 2 | 4 | bent | 109.5° (104.48°)[11][12] | $H_2O$ |  |
| 5 | 0 | 5 | trigonal bipyramidal | 90°, 120° | $PCl_5$ |  |
| 4 | 1 | 5 | seesaw | ax–ax 180° (173.1°), eq–eq 120° (101.6°), ax–eq 90° | $SF_4$ |  |
| 3 | 2 | 5 | T-shaped | 90° (87.5°), 180° (175°) | $ClF_3$ |  |
| 2 | 3 | 5 | linear | 180° | $XeF_2$ |  |
| 6 | 0 | 6 | octahedral | 90°, 180° | $SF_6$ |  |
| 5 | 1 | 6 | square pyramidal | 90° (84.8°) | $BrF_5$ |  |
| 4 | 2 | 6 | square planar | 90°, 180° | $XeF_4$ |  |
| 7 | 0 | 7 | pentagonal bipyramidal | 90°, 72°, 180° | $IF_7$ |  |
| 6 | 1 | 7 | pentagonal pyramidal | 72°, 90°, 144° | $XeOF_5^-$ |  |
| 5 | 2 | 7 | pentagonal planar | 72°, 144° | $XeF_5^-$ |  |
| 8 | 0 | 8 | square antiprismatic | | $XeF_8^{2-}$ |  |
| 9 | 0 | 9 | tricapped trigonal prismatic | | $ReH_9^{2-}$ |  |

## 3. 公式

Potential energy 势能 $V = k\frac{q_1 q_2}{r}$

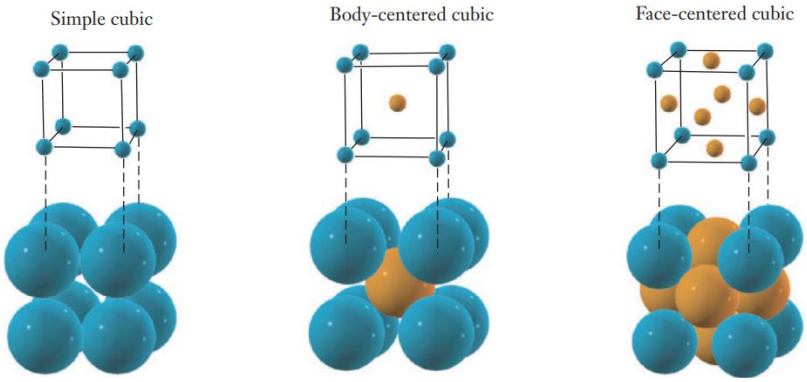
## CHAPTER 8 Molecules and Materials 分子与材料

### 1. 术语

Phase diagram 相图 – a map showing which state of the element will be most stable at a given combination of temperature and pressure
Nanotube 纳米管
Crystalline solid – substances assume regular, repeating geometric arrangements
Amorphous solid 无定形体 – substances solidify into random arrangements
Packing efficiency 空间利用率
Hexagonal close-packing (hcp) 六方密堆积
Cubic close-packing (ccp) 立方密堆积
Face-centered cubic (fcc) 面心立方
Body-centered cubic (bcc) 体心立方
Simple cubic (sc) 简单立方
Unit cell 晶胞
Coordination number 配位数 – the number of atoms immediately adjacent to any given atom
Malleable 可塑的
Ductile 易延展的
Sea of electrons model
Band theory
Bonding molecular orbital 成键轨道
Antibonding molecular orbital 反键轨道
Valence band 价带
Conduction band 导带
Insulator 绝缘体
Band gap 能隙
Doping 掺杂
Donor level 施主能级
Acceptor level 受主能级
N-type semiconductor N 型半导体
P-type semiconductor P 型半导体
P-N junction PN 结
Intermolecular forces 分子间作用力
Dispersion forces (/London forces) (/instantaneous dipole-induced dipole forces) 色散力
Polarizability 极化性
Dipole-dipole force 偶极-偶极力
Hydrogen bonding 氢键
Vapor pressure 蒸汽压
Volatile – liquids that can be readily vaporized
Dynamic equilibrium 动态平衡
Normal boiling point 标准沸点 – the temperature at which its vapor pressure is equal to 1 atm
Surface tension 表面张力
Cohesion 内聚力 – the liquid-liquid interactions

Adhesion 粘附力 – the liquid-solid interactions
Addition polymerization 加聚反应
Degree of polymerization 聚合度 – the average number of repeating units in the polymer
Methyl 甲基：$-CH_3$
Isotactic polymer – all of the pendant groups are located on the same side of the hydrocarbon backbone chain 单体分子方向相同
Syndiotactic polymer – the pendant groups have a regular, alternating pattern along the hydrocarbon backbone chain 单体分子方向交替
Atactic polymer – 单体分子无序排列
Condensation polymer 缩聚物
Copolymer 共聚物
Alternating copolymer – 两种单体分子轮流聚合而成
Block copolymer – 两种或多种单体分子在长链中呈块状排列而成
Graft copolymer – 由一个单体分子和另一个单体分子的侧链组成，一个单体分子会与另一种单体分子结合，形成一条或多条侧链
Thermoplastic polymer 热塑性聚合物 – 可以反复加热和冷却而不发生化学变化，在加热时变软或熔化，并且可以通过成型或挤出加工成为各种形状
Thermosetting polymer 热固性聚合物 – 在加热时发生化学变化而形成三维网络结构，在加热时不会熔化，而是因其分子已经固定会变硬和变脆
Micro-electro-mechanical systems (MEMS) 微机电系统
Etching 蚀刻

**2. 表格**



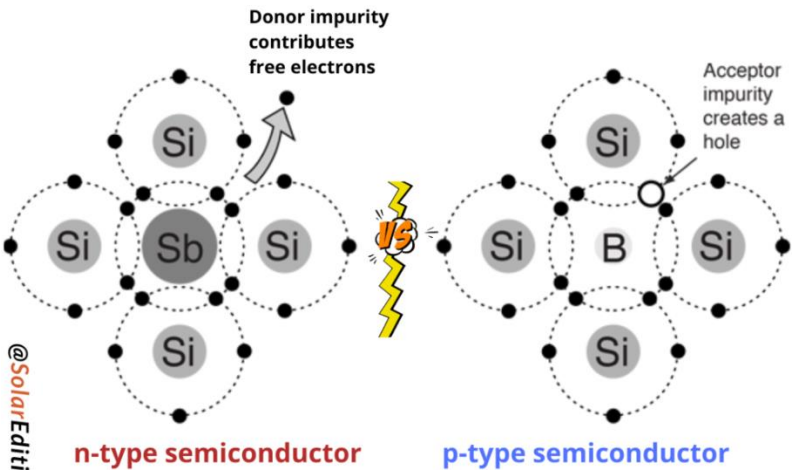



**Table 8.1** Some vapor pressures and boiling points

Vapor pressures at 22°C and normal boiling points of a variety of substances

| Substance | Vapor Pressure (torr) | Normal Boiling Point (°C) |
|---|---|---|
| Acetone | 202 | 56.2 |
| $Br_2$ | 185 | 58.8 |
| $CClF_3$ | 24,940 | –81.1 |
| $CCl_2F_2$ | 4448 | –29.8 |
| $CCl_3F$ | 717 | 23.8 |
| $CCl_4$ | 99.0 | 76.54 |
| HCN | 657 | 26 |
| Formaldehyde | 3525 | –21 |
| Methanol | 108 | 64.96 |
| *n*-Pentane | 455 | 36.07 |
| Neopentane | 1163 | 9.5 |
| Isobutane | 2393 | –11 |
| *n*-Butane | 1658 | –0.5 |
| Propane | 6586 | –42.07 |
| Ethane | 29,380 | –88.63 |
| Water | 19.8 | 100 |