Study Card to Accompany Zumdahl's *Introductory Chemistry* Series

Measurements and Calculations

Table 2.2 The Commonly Used Prefixes in the Metric System p.19

Prefix	Symbol	Meaning	Power of 10 for Scientific Notation
mega	M	1,000,000	10^6
kilo	k	1000	10^3
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	μ	0.000001	10^{-6}
nano	n	0.000000001	10^{-9}

Table 2.6 Some Examples of Commonly Used Units p.22

length	A dime is 1 mm thick. A quarter is 2.5 cm in diameter. The average height of an adult man is 1.8 m.
mass	A nickel has a mass of about 5 g. A 120-lb woman has a mass of about 55 kg.
volume	A 12-oz can of soda has a volume of about 360 mL. A half gallon of milk is equal to about 2 L of milk.

$1 cm^3 = 1 mL$

density = mass / volume

density of $H_2O(l) = 1.0$ g/mL

Avogadro's number = 6.022×10^{23}

Energy

Heat Required = Q = specific heat capacity × mass × ΔT

Specific heat capacity of $H_2O(l)$ = 4.184 J/g °C

Kinetic energy = $mv^2/2$

Exothermic reactions produce heat

Endothermic reactions absorb heat

Kinds of Chemical Reactions

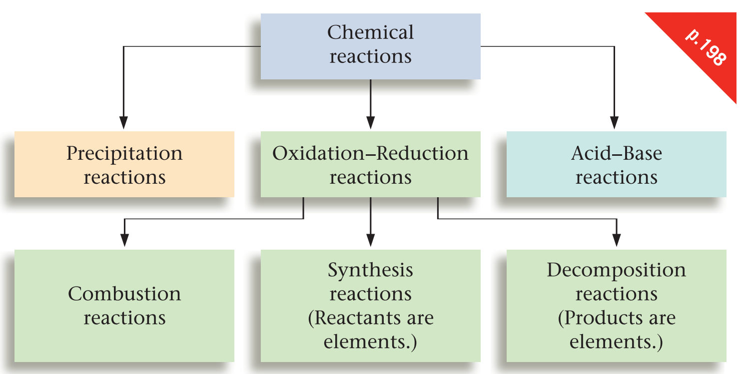

Figure 7.12 Summary of classes of reactions.

Atomic Structure

$^{23}_{11}Na$

- Mass number (A) (number of protons and neutrons)
- Element symbol
- Atomic number (Z) (number of protons)

$A - Z = \#n^0$

$\#p^+ - \#e^- = \text{charge}$

Gases

STP: 0°C, 1 atm

Volume of 1 mole of ideal gas at STP = 22.4 L

$PV = nRT$ (Ideal Gas Law)

$R = 0.08206$ L atm/K mol

Process at constant n and T: $P_1V_1 = P_2V_2$ (Boyle's Law)

Process at constant n and P: $V_1/T_1 = V_2/T_2$ (Charles's Law)

Process at constant T and P: $V_1/n_1 = V_2/n_2$ (Avogadro's Law)

Types of Crystaline Solids

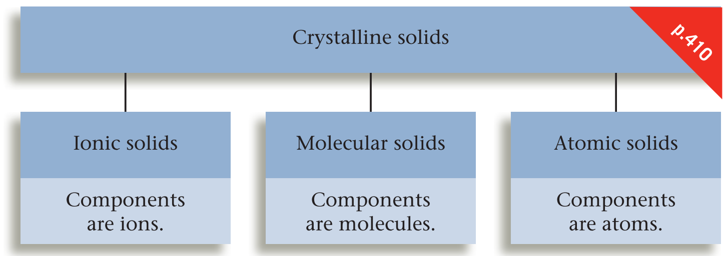

Figure 13.13 The classes of crystalline solids.

Solutions

$$\text{Mass percent} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$$ (p.428)

$$M = \text{molarity} = \frac{\text{moles of solute}}{\text{liters of solution}} = \frac{\text{mol}}{\text{L}}$$ (p.430)

Mass of solute = (molar mass of solute) × (L of solution) × (Molarity)

$$\text{Normality} = N = \frac{\text{number of equivalents}}{\text{1 liter of solution}} = \frac{\text{equivalents}}{\text{liter}} = \frac{\text{equiv}}{\text{L}}$$ (p.443)

Acids and Bases

Common Strong Acids: HCl, HNO_3, H_2SO_4, $HClO_4$, HI

Common Weak Acids: HSO_4^-, CH_3COOH (often written $HC_2H_3O_2$), HF

Common Strong Bases: $NaOH$, KOH

Common Weak Bases: NH_3

$K_W = 10^{-14} = [H^+][OH^-]$ (ion-product constant for water) (p.466)

$pH = -\log[H^+]$ (p.468)

$pOH = -\log[OH^-]$ (p.469)

$pH + pOH = 14.00$ (p.471)

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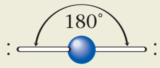
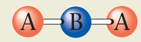
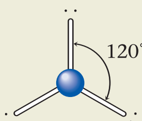
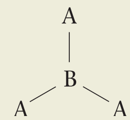
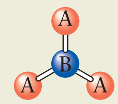
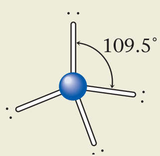
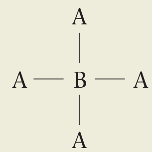
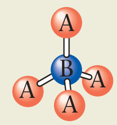
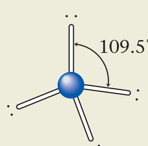
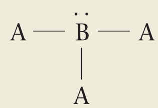
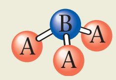
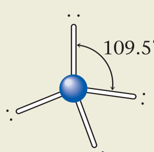
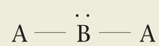
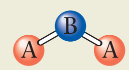
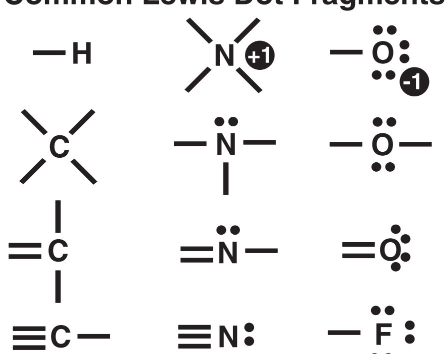
Chemical Bonding

Table 11.4 Arrangements of Electron Pairs and the Resulting Molecular Structures for Two, Three, and Four Electron Pairs p.345

Case	Number of Electron Pairs	Bonds	Electron Pair Arrangement	Ball-and-Stick Model	Angle Between Pairs	Partial Molecular Structure	Lewis Structure	Ball-and-Stick Model	Example
1	2	2	Linear		180°	Linear	A—B—A		BeF_2
2	3	3	Trigonal planar (triangular)		120°	Trigonal planar (triangular)			
3	4	4	Tetrahedral		109.5°	Tetrahedral			CH_4
4	4	3	Tetrahedral		109.5°	Trigonal pyramid			NH_3
5	4	2	Tetrahedral		109.5°	Bent or V-shaped			H_2O

Common Lewis Dot Fragments



Oxidation–Reduction Reactions

Oxidation is loss of electrons (OIL)
Reduction is gain of electrons (RIG)

Rules for Assigning Oxidation States p.524

1. The oxidation state of an atom in an uncombined element is 0.
2. The oxidation state of a monoatomic ion is the same as its charge.
3. Oxygen is assigned an oxidation state of −2 in most of its covalent compounds. Important exception: peroxides (compounds containing the O_2^{2-} group), in which each oxygen is assigned an oxidation state of −1.
4. In its covalent compounds with nonmetals, hydrogen is assigned an oxidation state of +1.
5. In binary compounds, the element with the greater electronegativity is assigned a negative oxidation state equal to its charge as an anion in its ionic compounds.
6. For an electrically neutral compound, the sum of the oxidation states must be zero.
7. For an ionic species, the sum of the oxidation states must equal the overall charge.

Equilibrium Constants

$aA + bB \rightleftharpoons cC + dD,\ K = [C]^c[D]^d/[A]^a[B]^b$ (pp.490-491)

$A_2B_3(s) \rightleftharpoons 2A^{3+}(aq) + 3B^{2-}(aq),\ K_{sp} = [A^{3+}]^2[B^{2-}]^3$

[X] = Molarity of X