

Common Polyatomic Ions	
ammonium	NH <sub>4</sub> <sup>+</sup>
acetate	CH <sub>3</sub> COO <sup>-</sup>
carbonate	CO <sub>3</sub> <sup>2-</sup>
hydrogen carbonate	HCO <sub>3</sub> <sup>-</sup>
hydroxide	OH <sup>-</sup>
nitrite	NO <sub>2</sub> <sup>-</sup>
nitrate	NO <sub>3</sub> <sup>-</sup>
chromate	CrO <sub>4</sub> <sup>2-</sup>
dichromate	Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup>
phosphate	PO <sub>4</sub> <sup>3-</sup>
hydrogen phosphate	HPO <sub>4</sub> <sup>2-</sup>
dihydrogen phosphate	H <sub>2</sub> PO <sub>4</sub> <sup>-</sup>
hypochlorite	ClO <sup>-</sup>
chlorite	ClO <sub>2</sub> <sup>-</sup>
chlorate	ClO <sub>3</sub> <sup>-</sup>
perchlorate	ClO <sub>4</sub> <sup>-</sup>
permanganate	MnO <sub>4</sub> <sup>-</sup>
sulfite	SO <sub>3</sub> <sup>2-</sup>
sulfate	SO <sub>4</sub> <sup>2-</sup>
hydrogen sulfite (bisulfite)	HSO <sub>3</sub> <sup>-</sup>
hydrogen sulfate (bisulfate)	HSO <sub>4</sub> <sup>-</sup>
cyanide	CN <sup>-</sup>
peroxide	O <sub>2</sub> <sup>2-</sup>
borate	BO <sub>3</sub> <sup>3-</sup>
iodate	IO <sub>4</sub> <sup>-</sup>

Prefix	Symbol	Multiplier
tera	T	10 <sup>12</sup>
giga	G	10 <sup>9</sup>
mega	M	10 <sup>6</sup>
kilo	k	10 <sup>3</sup>
deci	d	10 <sup>-1</sup>
centi	c	10 <sup>-2</sup>
milli	m	10 <sup>-3</sup>
micro	μ	10 <sup>-6</sup>
nano	n	10 <sup>-9</sup>
pico	p	10 <sup>-12</sup>
femto	f	10 <sup>-15</sup>

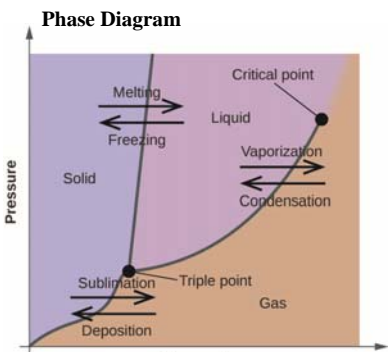
Conversions	
1 pound = 453.6 grams	
1 inch = 2.54 cm	
1 foot = 12 inches	
1 mile = 5280 feet	
1 mile = 1.609 km	
1 mL = 1 cm <sup>3</sup> = 1 cc	
1 gallon = 4 quarts	
1 liter = 1.06 quarts	
1 atm = 760 mmHg = 760 torr = 1.013 × 10 <sup>5</sup> Pa	
molar volume of gas = 22.4 L/mol at STP	

Know abbreviations and names of shaded elements.

1 H 1.008	2 He 4.003																	18 Ar 39.95
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18	
11 Na 22.99	12 Mg 24.31	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95											
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 75.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80	
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3	
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (210)	85 At (210)	86 Rn (222)	
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (263)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (266)	110 Ds (271)	111 Rg (272)	112 Cn (285)	113 Nh (284)	114 Fl (289)	115 Uup (288)	116 Lv (292)	117 Uus (293)	118 Uuo (294)	

Lanthanide series	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (147)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinide series	90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (258)	102 No (254)	103 Lr (257)

Soluble compounds contain	Except when paired with
Group I metal cations or NH <sub>4</sub> <sup>+</sup>	None
CH <sub>3</sub> COO <sup>-</sup> , HCO <sub>3</sub> <sup>-</sup> , NO <sub>3</sub> <sup>-</sup> , or ClO <sub>3</sub> <sup>-</sup>	None
Cl <sup>-</sup> , Br <sup>-</sup> , or I <sup>-</sup>	Ag <sup>+</sup> , Hg <sub>2</sub> <sup>2+</sup> , Pb <sup>2+</sup>
SO <sub>4</sub> <sup>2-</sup>	Ag <sup>+</sup> , Hg <sub>2</sub> <sup>2+</sup> , Pb <sup>2+</sup> , Ca <sup>2+</sup> , Sr <sup>2+</sup> , Ba <sup>2+</sup>
Insoluble compounds contain	Except when paired with
CO <sub>3</sub> <sup>2-</sup> , CrO <sub>4</sub> <sup>2-</sup> , or PO <sub>4</sub> <sup>3-</sup>	Group I cations or NH <sub>4</sub> <sup>+</sup>
OH <sup>-</sup> or S <sup>2-</sup>	Group I cations or NH <sub>4</sub> <sup>+</sup> , Ca <sup>2+</sup> , Sr <sup>2+</sup> , Ba <sup>2+</sup>

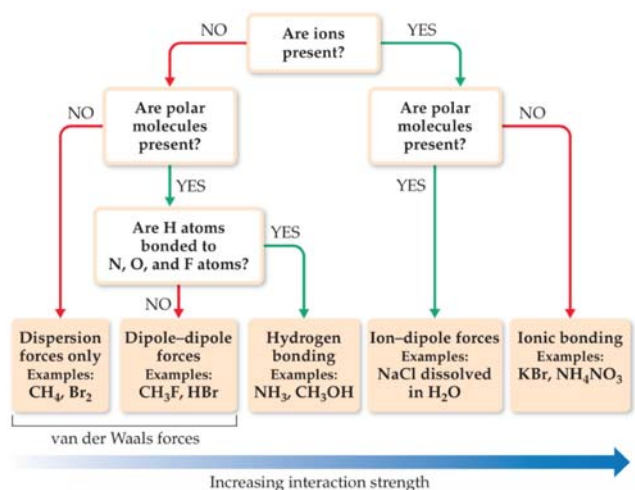


**105, 109, 110**

Electron geometry	Hybridization
linear	sp
trigonal planar	sp <sup>2</sup>
tetrahedral	sp <sup>3</sup>

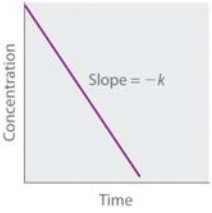

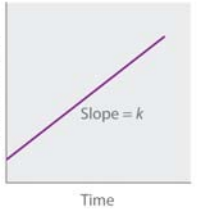
Strong Acids	Strong Bases
HCl, HBr, HI, HNO <sub>3</sub> , HClO <sub>4</sub> , H <sub>2</sub> SO <sub>4</sub>	Group I & II metal hydroxides

**Intermolecular Forces**

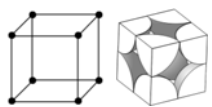
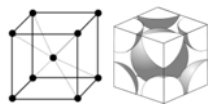
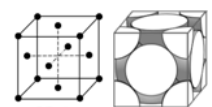


Number of electron pairs	Electron pair geometries: 0 lone pair	1 lone pair	2 lone pairs	3 lone pairs	4 lone pairs
2	Linear 180° X—A—X				
3	Trigonal planar 120° X—A—X	Bent or angular <120° X—A—X			
4	Tetrahedral 109° X—A—X	Trigonal pyramid <109° X—A—X	Bent or angular <<109° X—A—X		
5	Trigonal bipyramid 120°/90° X—A—X	Sawhorse or seesaw <120°/90° X—A—X	T-shape <90° X—A—X	Linear 180° X—A—X	
6	Octahedral 90° X—A—X	Square pyramid <90° X—A—X	Square planar 90° X—A—X	T-shape X—A—X	Linear 180° X—A—X

Concentration Unit	Definition
molarity (M)	$\frac{\text{mol solute}}{\text{L solution}}$
molality (m) (used in 107)	$\frac{\text{mol solute}}{\text{kg solvent}}$
mole fraction (c)	$\frac{\text{moles of solute}}{\text{moles of solute} + \text{solvent}}$
percent by mass (%)	$\frac{\text{mass of solute}}{\text{mass of solution}} \times 100$
parts per million (ppm)	$\frac{\text{mass of solute}}{\text{mass of solution}} \times 10^6$
parts per billion (ppb)	$\frac{\text{mass of solute}}{\text{mass of solution}} \times 10^9$

	Zeroth Order	First Order	Second Order
<b>Differential rate law</b>	Rate = $-\frac{\Delta[A]}{\Delta t} = k$	Rate = $-\frac{\Delta[A]}{\Delta t} = k[A]$	Rate = $-\frac{\Delta[A]}{\Delta t} = k[A]^2$
<b>Integrated rate law</b>	$[A] = [A]_0 - kt$	$[A] = [A]_0 e^{-kt}$ or $\ln[A] = \ln[A]_0 - kt$	$\frac{1}{[A]} = \frac{1}{[A]_0} + kt$
<b>Straight-line plot to determine rate constant</b>			
<b>Half-life</b>	$t_{1/2} = \frac{[A]_0}{2k}$	$t_{1/2} = \frac{0.693}{k}$	$t_{1/2} = \frac{1}{k[A]_0}$
<b>Units of k, rate constant</b>	M/s	1/s	$M^{-1} \cdot s^{-1}$

### Simple Cubic Unit Cells

Name	Atoms per cell	Structure	Sharing of atoms	Coordination number	Packing efficiency
Simple cubic	1		8 corner atoms	6	low
Body-centered cubic	2		8 corner atoms, 1 body atom	8	medium
Face-centered cubic	4		8 corner atoms, 6 face atoms	12	high

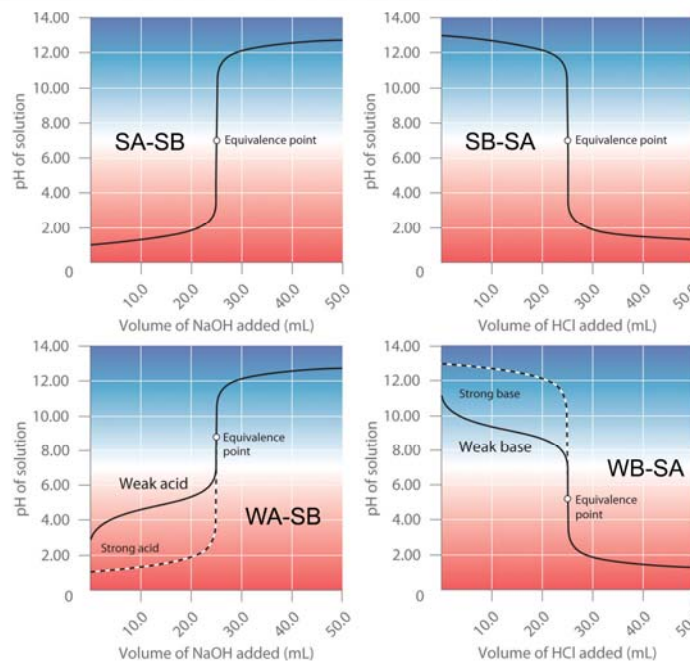
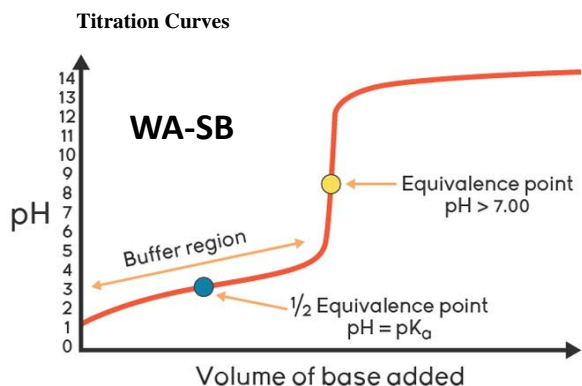
### Unit cell fractions

Atom Location	Fraction in unit cell
Body	1
Face	1/2
Edge	1/4
Corner	1/8

### Ligands

Name (abbreviation)	Coordination number
H <sub>2</sub> O	1
NH <sub>3</sub>	1
halides	1
CO	1
CN <sup>-</sup>	1
SCN <sup>-</sup>	1
oxalate (ox)	2
ethylenediamine (en)	2
EDTA	4-6

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### Nuclear Decay Reactions

Type of radiation	Symbol	Mass number	charge
Alpha particle	$\alpha$ or ${}^4_2\text{He}$	4	2+
Beta particle	$\beta$ or ${}^0_{-1}e$	0	1-
Gamma ray	$\gamma$ or ${}^0_0\gamma$	0	0
Neutron	${}^1_0n$	1	0
Positron	$\beta^+$ or ${}^0_1e$	0	1+

### Electrochemical Cell

