# *DO NOT WRITE ON THIS SHEET!!!!!*

## CHGN121 EXAM EQUATION SHEET

### *UNITS*

**Length**

| | | |
|---|---|---|
| 1 km | = | 0.62137 mi |
| 1 mi | = | 5280 ft = 1.6093 km |
| 1 in. | = | 2.54 cm (exactly) |
| 1 Å (Angstrom) | = | $1x10^{-10}$m |

**Mass**

| | | |
|---|---|---|
| 1 kg | = | $1x10^3$ g = 2.2046 lb |
| 1 lb | = | 16 oz = 453.59 g |
| 1 amu | = | 1.66054 x $10^{-27}$ kg |

**Temperature**

| | | |
|---|---|---|
| $T_K$ | = | $T_{°C}$ + 273.15 |
| $T_{°C}$ | = | ($T_{°F}$ - 32) / 1.8 |
| $T_{°F}$ | = | (1.8$T_{°C}$) + 32 |

**Volume**

| | | |
|---|---|---|
| 1 L | = | $1x10^{-3}$ $m^3$ = 1 $dm^3$ = $1x10^3$ $cm^3$ |
| 1 gal | = | 3.7854 L = 4 qt |
| 1 $cm^3$ | = | 1 mL |
| 1 $in^3$ | = | 16.4 $cm^3$ |

**Energy**

| | | |
|---|---|---|
| 1 J | = | 1 N·m = 1 kg·$m^2$·$s^{-2}$ |
| 1 cal | = | 4.184 J |
| 1 L·atm | = | 101.325 J |

**Pressure**

| | | |
|---|---|---|
| 1 Pa | = | 1 N·$m^{-2}$ = 1 kg $m^{-1}$·$s^{-2}$ |
| 1 atm | = | 101,325 Pa = 760 torr (mm Hg) |
| 1 bar | = | $1x10^5$ Pa |
| 1 atm | = | 14.7 psi |

### *CONSTANTS*

**Avogadro's Number, 1 mole = 6.022142 × $10^{23}$ items**

**Density of liquid water (unless otherwise noted) = 1.000 g/mL**

**Gas Constant, R = 0.0820582 L·atm $mol^{-1}$ $K^{-1}$ = 8.314 J $mol^{-1}$ $K^{-1}$**

### *COMMON EQUATIONS*

**Converting empirical formula to molecular formula: multiplier = (molar mass) / (empirical formula mass)**

**Percent yield = (actual yield / theoretical yield) * 100%**

**Dilution Equation:** $C_i V_i = C_f V_f$

**Formal charge = (# of valence $e^-$) – (# of lone $e^-$) – ½ (# of shared $e^-$)**

**Coulomb's Law:** $PE = k_e \frac{q_1 q_2}{r}$ *where $k_e$ =Coulomb's constant, q = charge on ion, r = bond length*

### *GASES*

**Pressure, P = Force/Area** **STP (Standard Temperature & Pressure): T = 0 °C and P = 1 atm**

**Ideal Gas Law:** $PV = nRT$ *or* $P(MW) = dRT$ *where MW = molecular weight, d = density*

**rate of effusion:** $\frac{rate\ 1}{rate\ 2} = \sqrt{\frac{MW2}{MW\ 1}}$ **Partial Pressure:** $P_A = X_A P_{Total}$

**Combined Gas Law:** $\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$ **Standard Molar Volume, Ideal Gas at STP: $V_m$= 22.41 L/mol**

***UNITS OF CONCENTRATION***

**Mole fraction:** $X_A = \frac{n_A}{n_{Total}} = \frac{moles\ of\ component\ A}{total\ moles\ of\ particles\ or\ molecules\ in\ solution}$

$X_{Tot} = X_A + X_B + X_C + \ ... = 1$ *where the subscripts refer to chemical component A, B, C, etc.*

**Molarity (M)** $= \frac{moles\ of\ solute}{volume\ of\ solution\ (L)}$ **Mass %** $= \frac{mass\ of\ component}{total\ mass\ of\ solution} \times 100\%$

***THERMODYNAMICS***

$q_p = \Delta H = \Delta E + P_{ext}\Delta V$ → *at constant ext pressure*

$q = m\ C_{sp}\ \Delta T$ *$C_{sp}$ = specific heat, m= mass*

*$H_2O$ Heat of Fusion:* $\Delta H_{fus} = 6.01\ kJ/mol$

*$H_2O$ Heat of Vaporization:* $\Delta H_{vap} = 40.7\ kJ/mol$

**Hess's Law:** $\Delta H_{rxn} = \sum n\Delta H(steps)$

$\Delta H_{rxn} \approx D_{(REACTANT\ bonds)} - D_{(PRODUCT\ bonds)}$

$\Delta H^\circ_{rxn} = \sum n\Delta H^\circ_f(products) - \sum n\Delta H^\circ_f(reactants)$

*$H_2O$ specific heat capacity*

*solid (ice) $C_{sp}$=2.09 J/g°C*

*liquid (water) $C_{sp}$= 4.184 J/g°C*

*gas (steam) $C_{sp}$= 2.01 J/g°C*

**Thermodynamic Standard State (°):** **Most stable form of substance at 1 atm pressure and 25 °C**
***OR** any specified temperature*

## SIMPLIFIED SOLUBILITY GUIDELINES

| **Compounds containing these ions are SOLUBLE** | **Exceptions (these combinations are INSOLUBLE)** |
|---|---|
| $Li^{+1}$, $Na^{+1}$, $K^{+1}$, $Rb^{+1}$, $Cs^{+1}$, $NH_4^{+1}$ | **None** |
| $NO_3^{-1}$, $C_2H_3O_2^{-1}$, $ClO_3^{-1}$, $ClO_4^{-1}$ | **None** |
| $Cl^{-1}$, $Br^{-1}$, $I^{-1}$ | **When combined with $Ag^{+1}$, $Pb^{+2}$, $Hg_2^{+2}$** |
| $SO_4^{-2}$ | **When combined with $Ag^{+1}$, $Pb^{+2}$, $Hg_2^{+2}$, $Sr^{+2}$, $Ba^{+2}$, $Ca^{+2}$** |
| **Compounds containing these ions are INSOLUBLE** | **Exceptions (these combinations are SOLUBLE)** |
| $S^{-2}$, $OH^{-1}$ | **When combined with $Li^{+1}$, $Na^{+1}$, $K^{+1}$, $Rb^{+1}$, $Cs^{+1}$, $NH_4^{+1}$, $Ba^{+2}$, $Sr^{+2}$** |
| $F^{-1}$, $CO_3^{-2}$, $PO_4^{-3}$, $SO_3^{-2}$, $CrO_4^{-2}$ | **When combined with $Li^{+1}$, $Na^{+1}$, $K^{+1}$, $Rb^{+1}$, $Cs^{+1}$, $NH_4^{+1}$** |
| **Any cation or anion NOT listed in table will form INSOLUBLE ionic compounds.** | |
| **$Ca(OH)_2$ & $Sr(OH)_2$ are borderline soluble/insoluble – we will call them INsoluble.* | |

**COMMON STRONG ACIDS**

| | | |
|---|---|---|
| **HCl** | **$HClO_4$** | **$HNO_3$** |
| **HBr** | **$HClO_3$** | **$H_2SO_4$** |
| **HI** | | |

**COMMON STRONG BASES**

**Soluble Hydroxides, Oxides & Amides**

| | | | |
|---|---|---|---|
| **LiOH** | **NaOH** | **KOH** | **RbOH** |
| **CsOH** | **$Ca(OH)_2$** | **$Sr(OH)_2$** | **$Ba(OH)_2$** |
| **$Li_2O$** | **$Na_2O$** | **$K_2O$** | |
| **$LiNH_2$** | **$NaNH_2$** | **$KNH_2$** | |

**CaO →** ***Reacts with water to form $Ca(OH)_2$***

## STANDARD HEATS OF FORMATION at 25 °C

| Formula | $\Delta H_f^\circ$ (kJ/mol) | Formula | $\Delta H_f^\circ$ (kJ/mol) | Formula | $\Delta H_f^\circ$ (kJ/mol) |
|---|---|---|---|---|---|
| ***Bromine*** | | $C_3H_8O$(*l*, isopropanol) | −318.1 | ***Oxygen*** | |
| Br(g) | 111.9 | $C_6H_6$(*l*) | 49.1 | $O_2$(g) | 0 |
| $Br_2$(*l*) | 0 | $C_6H_{12}O_6$(s, glucose) | −1273.3 | $O_3$(g) | 142.7 |
| HBr(g) | −36.3 | $C_{12}H_{22}O_{11}$(s, sucrose) | −2226.1 | $H_2O$(g) | −241.8 |
| ***Calcium*** | | ***Chlorine*** | | $H_2O$(*l*) | −285.8 |
| Ca(s) | 0 | Cl(g) | 121.3 | ***Silver*** | |
| CaO(s) | −634.9 | $Cl_2$(g) | 0 | Ag(s) | 0 |
| $CaCO_3$(s) | −1207.6 | HCl(g) | −92.3 | AgCl(s) | −127.0 |
| ***Carbon*** | | ***Fluorine*** | | ***Sodium*** | |
| C(s, graphite) | 0 | F(g) | 79.38 | Na(s) | 0 |
| C(s, diamond) | 1.88 | $F_2$(g) | 0 | Na(g) | 107.5 |
| CO(g) | −110.5 | HF(g) | −273.3 | NaCl(s) | −411.2 |
| $CO_2$(g) | −393.5 | ***Hydrogen*** | | $Na_2CO_3$(s) | −1130.7 |
| $CH_4$(g) | −74.6 | H(g) | 218.0 | $NaHCO_3$(s) | −950.8 |
| $CH_3OH$(*l*) | −238.6 | $H_2$(g) | 0 | ***Sulfur*** | |
| $C_2H_2$(g) | 227.4 | ***Nitrogen*** | | $S_8$(s, rhombic) | 0 |
| $C_2H_4$(g) | 52.4 | $N_2$(g) | 0 | $S_8$(s, monoclinic) | 0.3 |
| $C_2H_6$(g | −84.68 | $NH_3$(g) | −45.9 | $SO_2$(g) | −296.8 |
| $C_2H_5OH$(*l*) | −277.6 | $NH_4NO_3$(s) | −365.6 | $SO_3$(g) | −395.7 |
| $C_3H_8$(g) | −103.85 | NO(g) | 91.3 | $H_2SO_4$(*l*) | −814.0 |
| $C_3H_6O$(*l*, acetone) | −248.4 | $N_2O$(g) | 81.6 | | |

## ACTIVITY SERIES

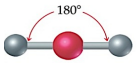
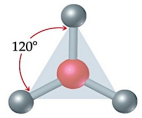
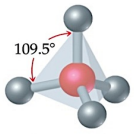
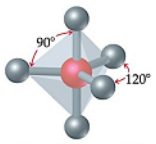
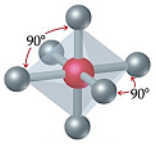
| METAL | OXIDATION RXN |
|---|---|
| Lithium | $Li_{(s)} \rightarrow Li^{+1}_{(aq)} + e^-$ |
| Potassium | $K_{(s)} \rightarrow K^{+1}_{(aq)} + e^-$ |
| Barium | $Ba_{(s)} \rightarrow Ba^{+2}_{(aq)} + 2\ e^-$ |
| Calcium | $Ca_{(s)} \rightarrow Ca^{+2}_{(aq)} + 2\ e^-$ |
| Sodium | $Na_{(s)} \rightarrow Na^{+1}_{(aq)} + e^-$ |
| Magnesium | $Mg_{(s)} \rightarrow Mg^{+2}_{(aq)} + 2\ e^-$ |
| Aluminum | $Al_{(s)} \rightarrow Al^{+3}_{(aq)} + 3\ e^-$ |
| Manganese | $Mn_{(s)} \rightarrow Mn^{+2}_{(aq)} + 2\ e^-$ |
| Zinc | $Zn_{(s)} \rightarrow Zn^{+2}_{(aq)} + 2\ e^-$ |
| Chromium | $Cr_{(s)} \rightarrow Cr^{+3}_{(aq)} + 3\ e^-$ |
| Iron | $Fe_{(s)} \rightarrow Fe^{+2}_{(aq)} + 2\ e^-$ |
| Cobalt | $Co_{(s)} \rightarrow Co^{+2}_{(aq)} + 2\ e^-$ |
| Nickel | $Ni_{(s)} \rightarrow Ni^{+2}_{(aq)} + 2\ e^-$ |
| Tin | $Sn_{(s)} \rightarrow Sn^{+2}_{(aq)} + 2\ e^-$ |
| Lead | $Pb_{(s)} \rightarrow Pb^{+2}_{(aq)} + 2\ e^-$ |
| *Hydrogen* | $H_{2(g)} \rightarrow 2H^{+1}_{(aq)} + 2\ e^-$ |
| Copper | $Cu_{(s)} \rightarrow Cu^{+2}_{(aq)} + 2\ e^-$ |
| Silver | $Ag_{(s)} \rightarrow Ag^{+1}_{(aq)} + e^-$ |
| Mercury | $Hg_{(l)} \rightarrow Hg^{+2}_{(aq)} + 2\ e^-$ |
| Platinum | $Pt_{(s)} \rightarrow Pt^{+2}_{(aq)} + 2\ e^-$ |
| Gold | $Au_{(s)} \rightarrow Au^{+3}_{(aq)} + 3\ e^-$ |

Highest Reducing Strength

Lowest Reducing Strength

## BOND DISSOCIATION ENERGY, *D*

| Bond | Bond Energy (kJ/mol) | Bond | Bond Energy (kJ/mol) | Bond | Bond Energy (kJ/mol) |
|---|---|---|---|---|---|
| H—H | 436 | N—N | 163 | Br—F | 237 |
| H—C | 414 | N=N | 418 | Br—Cl | 218 |
| H—N | 389 | N≡N | 946 | Br—Br | 193 |
| H—O | 464 | N—O | 222 | I—Cl | 208 |
| H—S | 368 | N=O | 590 | I—Br | 175 |
| H—F | 565 | N—F | 272 | I—I | 151 |
| H—Cl | 431 | N—Cl | 200 | Si—H | 323 |
| H—Br | 364 | N—Br | 243 | Si—Si | 226 |
| H—I | 297 | N—I | 159 | Si—C | 301 |
| C—C | 347 | O—O | 142 | S—O | 265 |
| C=C | 611 | O=O | 498 | Si=O | 368 |
| C≡C | 837 | O—F | 190 | S= O | 523 |
| C—N | 305 | O—Cl | 203 | Si—Cl | 464 |
| C=N | 615 | O—I | 234 | S= S | 418 |
| C≡N | 891 | F—F | 159 | S—F | 327 |
| C—O | 360 | Cl—F | 253 | S—Cl | 253 |
| C=O | 736 (799 in $CO_2$) | Cl—Cl | 243 | S—Br | 218 |
| C≡O | 1072 | | | S—S | 266 |
| C—Cl | 339 | | | | |

| e⁻ domain geometry | | | lone pairs | molecular geometry |
|---|---|---|---|---|
| 2 | linear |  | 0 | linear |
| 3 | trigonal planar |  | 0<br>1 | trigonal planar<br>bent |
| 4 | tetrahedral |  | 0<br>1<br>2 | tetrahedral<br>trigonal pyramidal<br>bent |
| 5 | trigonal bipyramidal |  | 0<br>1<br>2<br>3 | trigonal bipyramidal<br>see-saw<br>T-shaped<br>linear |
| 6 | octahedral |  | 0<br>1<br>2 | octahedral<br>square pyramidal<br>square planar |

# ELECTRONEGATIVITY

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H 2.1 | | | | | | | | | | | | | | | | He |
| Li 1.0 | Be 1.5 | | | | | | | | | | | B 2.0 | C 2.5 | N 3.0 | O 3.5 | F 4.0 | Ne |
| Na 0.9 | Mg 1.2 | | | | | | | | | | | Al 1.5 | Si 1.8 | P 2.1 | S 2.5 | Cl 3.0 | Ar |
| K 0.8 | Ca 1.0 | Sc 1.3 | Ti 1.5 | V 1.6 | Cr 1.6 | Mn 1.5 | Fe 1.8 | Co 1.9 | Ni 1.9 | Cu 1.9 | Zn 1.6 | Ga 1.6 | Ge 1.8 | As 2.0 | Se 2.4 | Br 2.8 | Kr |
| Rb 0.8 | Sr 1.0 | Y 1.2 | Zr 1.4 | Nb 1.6 | Mo 1.8 | Tc 1.9 | Ru 2.2 | Rh 2.2 | Pd 2.2 | Ag 1.9 | Cd 1.7 | In 1.7 | Sn 1.8 | Sb 1.9 | Te 2.1 | I 2.5 | Xe |
| Cs 0.7 | Ba 0.9 | Lu 1.1 | Hf 1.3 | Ta 1.5 | W 1.7 | Re 1.9 | Os 2.2 | Ir 2.2 | Pt 2.2 | Au 2.4 | Hg 1.9 | Tl 1.8 | Pb 1.9 | Bi 1.9 | Po 2.0 | At 2.1 | Rn |

**RULES for Assigning Oxidation Number:**

1. **For atom in elemental form, oxidation number always zero.**

2. **For monatomic ion, oxidation number is charge on the ion.**

3. **For nonmetals in covalent compound or polyatomic ion, oxidation number usually negative and**
   a) **Hydrogen +1 when bonded to nonmetals and -1 when bonded to metals.**
   b) **Oxygen usually -2 except when in peroxide compound where is -1.**
   c) **Fluorine always -1.**

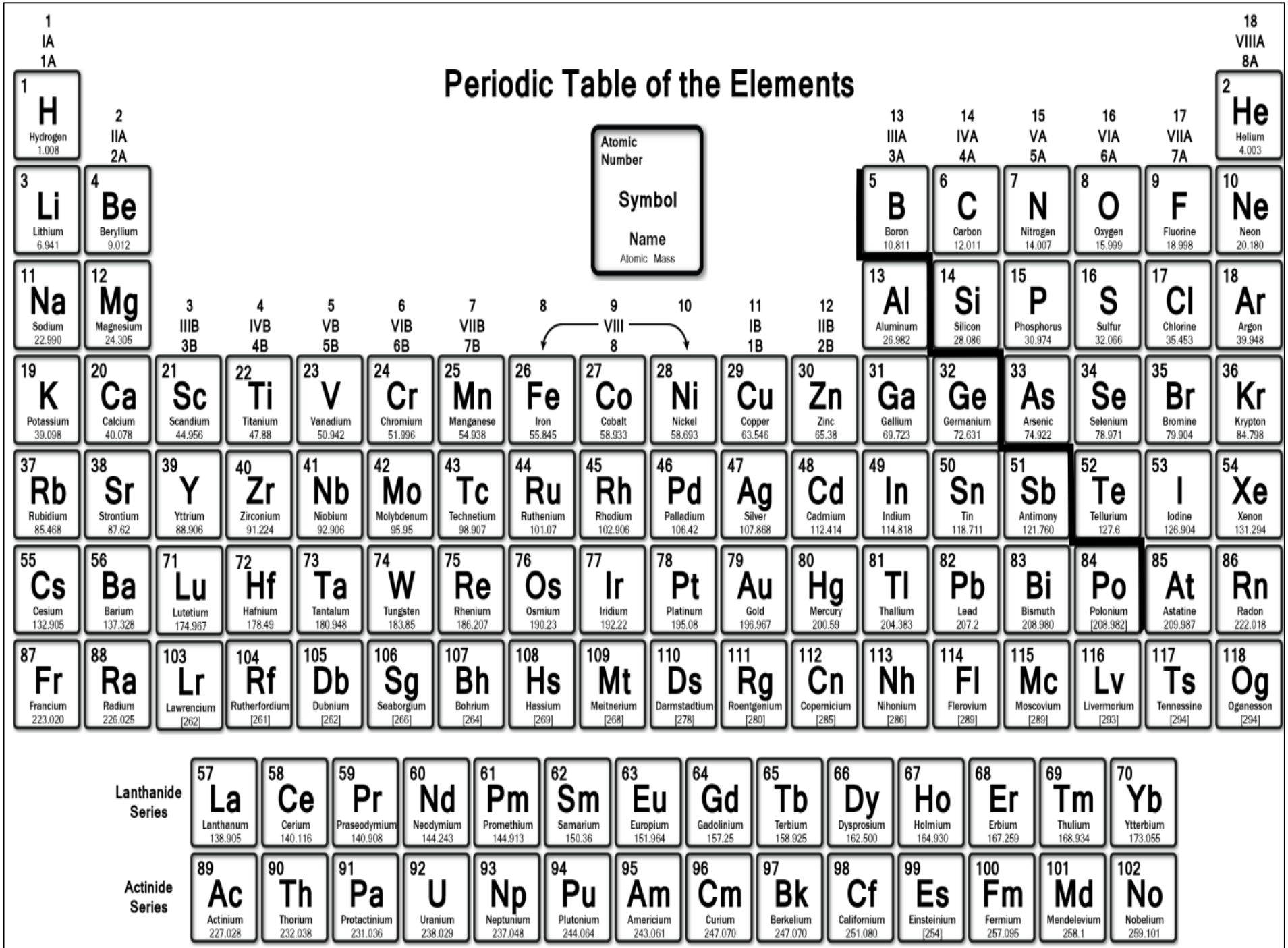
   **Other halogens usually -1 except when in a polyatomic ion with oxygen then are positive and valued to balance the ion.**

4. **For metals/nonmetals in ionic compounds, oxidation number is charge on the ion.**

5. **Sum of oxidation numbers of all atoms in neutral compound must equal zero.**
   **Sum of oxidation numbers of all atoms in polyatomic ion must equal charge on the ion.**

| | | |
|---|---|---|
| Ac | Actinium | 89 |
| Ag | Silver | 47 |
| Al | Aluminum | 13 |
| Am | Americium | 95 |
| Ar | Argon | 18 |
| As | Arsenic | 33 |
| At | Astatine | 85 |
| Au | Gold | 79 |
| B | Boron | 5 |
| Ba | Barium | 56 |
| Be | Beryllium | 4 |
| Bh | Bohrium | 107 |
| Bi | Bismuth | 83 |
| Bk | Berkelium | 97 |
| Br | Bromine | 35 |
| C | Carbon | 6 |
| Ca | Calcium | 20 |
| Cd | Cadmium | 48 |
| Ce | Cerium | 58 |
| Cf | Californium | 98 |
| Cl | Chlorine | 17 |
| Cm | Curium | 96 |
| Co | Cobalt | 27 |
| Cr | Chromium | 24 |
| Cs | Cesium | 55 |
| Cu | Copper | 29 |
| Db | Dubnium | 105 |
| Ds | Darmstadtium | 110 |
| Dy | Dysprosium | 66 |
| Er | Erbium | 68 |
| Es | Einsteinium | 99 |
| Eu | Europium | 63 |
| F | Fluorine | 9 |
| Fe | Iron | 26 |
| Fm | Fermium | 100 |
| Fr | Francium | 87 |
| Ga | Gallium | 31 |
| Gd | Gadolinium | 64 |
| Ge | Germanium | 32 |
| H | Hydrogen | 1 |
| He | Helium | 2 |
| Hf | Hafnium | 72 |
| Hg | Mercury | 80 |
| Ho | Holmium | 67 |
| Hs | Hassium | 108 |
| I | Iodine | 53 |
| In | Indium | 49 |
| Ir | Iridium | 77 |
| K | Potassium | 19 |
| Kr | Krypton | 36 |
| La | Lanthanum | 57 |
| Li | Lithium | 3 |
| Lr | Lawrencium | 103 |
| Lu | Lutetium | 71 |
| Md | Mendelevium | 101 |
| Mg | Magnesium | 12 |
| Mn | Manganese | 25 |
| Mo | Molybdenum | 42 |
| Mt | Meitnerium | 109 |
| N | Nitrogen | 7 |

| | | |
|---|---|---|
| Na | Sodium | 11 |
| Nb | Niobium | 41 |
| Nd | Neodymium | 60 |
| Ne | Neon | 10 |
| Ni | Nickel | 28 |
| No | Nobelium | 102 |
| Np | Neptunium | 93 |
| O | Oxygen | 8 |
| Os | Osmium | 76 |
| P | Phosphorus | 15 |
| Pa | Protactinium | 91 |
| Pb | Lead | 82 |
| Pd | Palladium | 46 |
| Pm | Promethium | 61 |
| Po | Polonium | 84 |
| Pr | Praseodymium | 59 |
| Pt | Platinum | 78 |
| Pu | Plutonium | 94 |
| Ra | Radium | 88 |
| Rb | Rubidium | 37 |
| Re | Rhenium | 75 |
| Rf | Rutherfordium | 104 |
| Rh | Rhodium | 45 |
| Rn | Radon | 86 |
| Ru | Ruthenium | 44 |
| S | Sulfur | 16 |
| Sb | Antimony | 51 |
| Sc | Scandium | 21 |
| Se | Selenium | 34 |
| Sg | Seaborgium | 106 |
| Si | Silicon | 14 |
| Sm | Samarium | 62 |
| Sn | Tin | 50 |
| Sr | Strontium | 38 |
| Ta | Tantalum | 73 |
| Tb | Terbium | 65 |
| Tc | Technetium | 43 |
| Te | Tellurium | 52 |
| Th | Thorium | 90 |
| Ti | Titanium | 22 |
| Tl | Thallium | 81 |
| Tm | Thulium | 69 |
| U | Uranium | 92 |
| Uub | Ununbium | 112 |
| Uuh | Ununhexium | 116 |
| Uuo | Ununoctium | 118 |
| Uup | Ununpentium | 115 |
| Uuq | Ununquadium | 114 |
| Uus | Ununseptium | 117 |
| Uut | Ununtrium | 113 |
| Uuu | Ununium | 111 |
| V | Vanadium | 23 |
| W | Tungsten | 74 |
| Xe | Xenon | 54 |
| Y | Yttrium | 39 |
| Yb | Ytterbium | 70 |
| Zn | Zinc | 30 |
| Zr | Zirconium | 40 |


Periodic Table of the Elements
Atomic Number
Symbol
Name
Atomic Mass
1 IA 1A
2 IIA 2A
3 IIIB 3B
4 IVB 4B
5 VB 5B
6 VIB 6B
7 VIIB 7B
8 9 VIII 10 8
11 IB 1B
12 IIB 2B
13 IIIA 3A
14 IVA 4A
15 VA 5A
16 VIA 6A
17 VIIA 7A
18 VIIIA 8A
1 H Hydrogen 1.008
2 He Helium 4.003
3 Li Lithium 6.941
4 Be Beryllium 9.012
5 B Boron 10.811
6 C Carbon 12.011
7 N Nitrogen 14.007
8 O Oxygen 15.999
9 F Fluorine 18.998
10 Ne Neon 20.180
11 Na Sodium 22.990
12 Mg Magnesium 24.305
13 Al Aluminum 26.982
14 Si Silicon 28.086
15 P Phosphorus 30.974
16 S Sulfur 32.066
17 Cl Chlorine 35.453
18 Ar Argon 39.948
19 K Potassium 39.098
20 Ca Calcium 40.078
21 Sc Scandium 44.956
22 Ti Titanium 47.88
23 V Vanadium 50.942
24 Cr Chromium 51.996
25 Mn Manganese 54.938
26 Fe Iron 55.845
27 Co Cobalt 58.933
28 Ni Nickel 58.693
29 Cu Copper 63.546
30 Zn Zinc 65.38
31 Ga Gallium 69.723
32 Ge Germanium 72.631
33 As Arsenic 74.922
34 Se Selenium 78.971
35 Br Bromine 79.904
36 Kr Krypton 84.798
37 Rb Rubidium 85.468
38 Sr Strontium 87.62
39 Y Yttrium 88.906
40 Zr Zirconium 91.224
41 Nb Niobium 92.906
42 Mo Molybdenum 95.95
43 Tc Technetium 98.907
44 Ru Ruthenium 101.07
45 Rh Rhodium 102.906
46 Pd Palladium 106.42
47 Ag Silver 107.868
48 Cd Cadmium 112.414
49 In Indium 114.818
50 Sn Tin 118.711
51 Sb Antimony 121.760
52 Te Tellurium 127.6
53 I Iodine 126.904
54 Xe Xenon 131.294
55 Cs Cesium 132.905
56 Ba Barium 137.328
71 Lu Lutetium 174.967
72 Hf Hafnium 178.49
73 Ta Tantalum 180.948
74 W Tungsten 183.85
75 Re Rhenium 186.207
76 Os Osmium 190.23
77 Ir Iridium 192.22
78 Pt Platinum 195.08
79 Au Gold 196.967
80 Hg Mercury 200.59
81 Tl Thallium 204.383
82 Pb Lead 207.2
83 Bi Bismuth 208.980
84 Po Polonium [208.982]
85 At Astatine 209.987
86 Rn Radon 222.018
87 Fr Francium 223.020
88 Ra Radium 226.025
103 Lr Lawrencium [262]
104 Rf Rutherfordium [261]
105 Db Dubnium [262]
106 Sg Seaborgium [266]
107 Bh Bohrium [264]
108 Hs Hassium [269]
109 Mt Meitnerium [268]
110 Ds Darmstadtium [278]
111 Rg Roentgenium [280]
112 Cn Copernicium [285]
113 Nh Nihonium [286]
114 Fl Flerovium [289]
115 Mc Moscovium [289]
116 Lv Livermorium [293]
117 Ts Tennessine [294]
118 Og Oganesson [294]
Lanthanide Series
57 La Lanthanum 138.905
58 Ce Cerium 140.116
59 Pr Praseodymium 140.908
60 Nd Neodymium 144.243
61 Pm Promethium 144.913
62 Sm Samarium 150.36
63 Eu Europium 151.964
64 Gd Gadolinium 157.25
65 Tb Terbium 158.925
66 Dy Dysprosium 162.500
67 Ho Holmium 164.930
68 Er Erbium 167.259
69 Tm Thulium 168.934
70 Yb Ytterbium 173.055
Actinide Series
89 Ac Actinium 227.028
90 Th Thorium 232.038
91 Pa Protactinium 231.036
92 U Uranium 238.029
93 Np Neptunium 237.048
94 Pu Plutonium 244.064
95 Am Americium 243.061
96 Cm Curium 247.070
97 Bk Berkelium 247.070
98 Cf Californium 251.080
99 Es Einsteinium [254]
100 Fm Fermium 257.095
101 Md Mendelevium 258.1
102 No Nobelium 259.101