

Formulas

$$c = \lambda \cdot \nu$$

$$E = h \cdot \nu$$

$$E_{ke} = \frac{1}{2} \cdot m \cdot v^2 = h(\nu - \nu_0)$$

$$E = m \cdot c^2$$

$$\frac{1}{\lambda} = R_{\infty} \left(\frac{1}{n_{in}^2} - \frac{1}{n_{out}^2} \right)$$

$$\Delta E = R_H \left(\frac{1}{n_i^2} - \frac{1}{n_f^2} \right)$$

$$\%A.E. = \left(\frac{\sum \text{molar mass}_{\text{atoms in desired product}}}{\sum \text{molar mass}_{\text{reactants}}} \right) \cdot 100$$

$$i\hbar \frac{\partial}{\partial t} \Psi(x, t) = \left[-\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} + V(x, t) \right] \Psi(x, t)$$

$$\%yield = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$\%error = \frac{|\text{exp} - \text{theo}|}{\text{theo}} \times 100$$

$$Z_{eff} = \text{Atomic \#} - \text{inner } e^-$$

$$FC = \text{Group \#} - (\#bonds) - (\#nonbonding e^-)$$

$$\Delta H_{rxn}^{\circ} = \sum (n \cdot \Delta H_f^{\circ}(p)) - \sum (n \cdot \Delta H_f^{\circ}(r))$$

$$\Delta H_{rxn} = \sum (n \cdot D(r \text{ bonds})) - \sum (n \cdot D(p \text{ bonds}))$$

Soluble Salts

- Most nitrate (NO_3^-), acetate ($\text{C}_2\text{H}_3\text{O}_2^-$), chlorate (ClO_3^-) and perchlorate (ClO_4^-) salts.
- Most salts containing the alkali metal ions (Li^+ , Na^+ , K^+ , Cs^+ , Rb^+) and the ammonium ion (NH_4^+).
- Most chloride, bromide and iodide salts are soluble.
Notable exceptions: Salts containing the ions Ag^+ , Pb^{2+} , Cu^+ and Hg_2^{2+} .
- Most sulfate salts (SO_4^{2-}) are soluble.
Notable exceptions: Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+} , and Hg_2^{2+} .

Insoluble Salts

- All common metal hydroxides (OH^-) are insoluble.
Notable exceptions: Hydroxides of Group IA metals, NH_4^+ and the larger members of Group IIA metals (starting with Ca^{2+}) are all soluble
- All common carbonates (CO_3^{2-}), phosphates (PO_4^{3-}) and chromates (CrO_4^{2-}) are insoluble.
Notable exceptions: Group IA metals and NH_4^+
- All common sulphides (S^{2-}) are insoluble.
Notable exceptions: Group IA metals, Group IIA metals and NH_4^+

Soluble Salts (aq)	Common Exceptions (s)	Insoluble Salts (s)	Common Exceptions (aq)
Group 1A cations: Li^+ , Na^+ , K^+ , Rb^+ , Cs^+	<i>None</i>	CO_3^{2-} (carbonates)	Carbonates, phosphates, chromates of group 1A cations and NH_4^+
Ammonium ion: NH_4^+	<i>None</i>	PO_4^{3-} (phosphates)	
Halides: Cl^- , Br^- , I^-	Halides of Ag^+ , Pb^{2+} , Cu^+ , Hg_2^{2+}	CrO_4^{2-} (chromates)	
NO_3^- (nitrate)	<i>None</i>	S^{2-} (sulfide)	Sulfides of group 1A cations, 2A cations, NH_4^+
ClO_3^- (chlorate) and ClO_4^- (perchlorate)	<i>None</i>	OH^- (hydroxide)	Hydroxides of group 1A cations, Ca^{2+} , Sr^{2+} , Ba^{2+} , NH_4^+
$\text{C}_2\text{H}_3\text{O}_2^-$ (acetate)	<i>None</i>		
SO_4^{2-} (sulfate)	Sulfates of Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+} , Hg_2^{2+}		

Periodic Table of the Elements

1 1A H Hydrogen 1.008	2 2A He Helium 4.003	3 3A B Boron 10.811	4 4A C Carbon 12.011	5 5A N Nitrogen 14.007	6 6A O Oxygen 15.999	7 7A F Fluorine 18.998	8 8A Ne Neon 20.180	9 9A Li Lithium 6.941	10 10A Be Beryllium 9.012	11 11A Na Sodium 22.990	12 12A Mg Magnesium 24.305	13 13A Al Aluminum 26.982	14 14A Si Silicon 28.086	15 15A P Phosphorus 30.974	16 16A S Sulfur 32.066	17 17A Cl Chlorine 35.453	18 18A Ar Argon 39.948	19 19A K Potassium 39.098	20 20A Ca Calcium 40.078	21 3B Sc Scandium 44.956	22 4B Ti Titanium 47.867	23 5B V Vanadium 50.942	24 6B Cr Chromium 51.996	25 7B Mn Manganese 54.938	26 8B Fe Iron 55.845	27 8B Co Cobalt 58.933	28 8B Ni Nickel 58.693	29 8B Cu Copper 63.546	30 8B Zn Zinc 65.38	31 9B Ga Gallium 69.723	32 9B Ge Germanium 72.631	33 9B As Arsenic 74.922	34 9B Se Selenium 78.971	35 9B Br Bromine 79.904	36 9B Kr Krypton 83.798	37 1B Rb Rubidium 85.468	38 2B Sr Strontium 87.62	39 3B Y Yttrium 88.906	40 4B Zr Zirconium 91.224	41 5B Nb Niobium 92.906	42 6B Mo Molybdenum 95.95	43 7B Tc Technetium 98.907	44 8B Ru Ruthenium 101.07	45 8B Rh Rhodium 102.906	46 8B Pd Palladium 106.42	47 9B Ag Silver 107.868	48 9B Cd Cadmium 112.414	49 9B In Indium 114.818	50 9B Sn Tin 118.711	51 9B Sb Antimony 121.760	52 9B Te Tellurium 127.6	53 9B I Iodine 126.904	54 9B Xe Xenon 131.294	55 1B Cs Cesium 132.905	56 2B Ba Barium 137.328	57-71 Lanthanide Series La Lanthanum 138.905 Ce Cerium 140.116 Pr Praseodymium 140.908 Nd Neodymium 144.243 Pm Promethium 144.913 Sm Samarium 150.36 Eu Europium 151.964 Gd Gadolinium 157.25 Tb Terbium 158.925 Dy Dysprosium 162.500 Ho Holmium 164.930 Er Erbium 167.259 Tm Thulium 168.934 Yb Ytterbium 173.055 Lu Lutetium 174.967	72 6B Hf Hafnium 178.49	73 7B Ta Tantalum 180.948	74 8B W Tungsten 183.84	75 8B Re Rhenium 186.207	76 8B Os Osmium 190.23	77 8B Ir Iridium 192.217	78 8B Pt Platinum 195.085	79 9B Au Gold 196.967	80 9B Hg Mercury 200.592	81 9B Tl Thallium 204.383	82 9B Pb Lead 207.2	83 9B Bi Bismuth 208.980	84 9B Po Polonium [208.982]	85 9B At Astatine 209.967	86 9B Rn Radon 222.018	87 1B Fr Francium 223.020	88 2B Ra Radium 226.025	89-103 Actinide Series Ac Actinium 227.028 Th Thorium 232.038 Pa Protactinium 231.036 U Uranium 238.029 Np Neptunium 237.046 Pu Plutonium 244.064 Am Americium 243.061 Cm Curium 247.070 Bk Berkelium 247.070 Cf Californium 251.080 Es Einsteinium [254] Fm Fermium 257.085 Md Mendelevium 258.1 No Nobelium 259.101 Lr Lawrencium [262]	104 10B Rf Rutherfordium [261]	105 10B Db Dubnium [262]	106 10B Sg Seaborgium [266]	107 10B Bh Bohrium [264]	108 10B Hs Hassium [269]	109 10B Mt Meitnerium [278]	110 10B Ds Darmstadtium [281]	111 10B Rg Roentgenium [280]	112 10B Cn Copernicium [285]	113 9B Nh Nihonium [286]	114 9B Fl Flerovium [289]	115 9B Mc Moscovium [289]	116 9B Lv Livermorium [293]	117 9B Ts Tennessine [294]	118 9B Og Oganesson [294]
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$$\text{Rydberg Constant } (R_{\infty}) = 1.0974 \times 10^7 \text{ m}^{-1}$$

$$\text{Rydberg Constant } (R_H) = 2.178 \times 10^{-18} \text{ J}$$

$$\text{Planck's Constant } (h) = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$$

$$\text{Speed of light } (c) = 2.998 \times 10^8 \text{ m} \cdot \text{s}^{-1}$$

$$\text{Avogadro's number} = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$\text{Universal Gas Constant} = 0.08206 \text{ L} \cdot \text{atm} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

$$K^{-1} = 8.314 \text{ L} \cdot \text{kPa} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

$$1 \text{ atm} = 101.3 \text{ kPa} = 760 \text{ mm Hg} = 760 \text{ torr}$$

$$T(K) = T(^{\circ}\text{C}) + 273.15$$