

(m)L	(milli)Liter(s)	mmHg	mm of Mercury
g	Gram(s)	(k)J	(kilo)Joule(s)
nm	Nanometer(s)	V	Volt(s)
atm	Atmosphere(s)	mol	Mole(s)

Avogadro's Number	$N_A = 6.02214 \times 10^{23} \text{ mol}^{-1}$
Faraday Constant	$F = 96485.33 \text{ C mol}^{-1}$
Atomic Mass Constant	$1 \text{ amu} = 1.660538 \times 10^{-27} \text{ kg}$
Molar Gas Constant	$R = 8.3144 \text{ J mol}^{-1} \text{ K}^{-1}$
$R = 62.36 \text{ L atm (mol K)}^{-1}$	$= 0.08205746 \text{ L atm K}^{-1} \text{ mol}^{-1}$
Coulomb's Constant	$k_e = 8.987551 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$
Speed of Light (Vacuum)	$c = 2.998 \times 10^8 \text{ m s}^{-1}$
Boltzmann Constant	$k_b = 1.3807 \times 10^{-23} \text{ J K}^{-1}$
Charge on a Proton/Electron	$e = 1.602 \times 10^{-19} \text{ C}$
Planck's Constant	$h = 6.626 \times 10^{-34} \text{ Js}$
Specific heat cap. of $\text{H}_2\text{O(l)}$	$c = 4.18 \text{ kJ kg}^{-1} \text{ } ^\circ\text{C}^{-1}$

Kinetics	
$[A]_t - [A]_0 = -kt$ (first order)	
$\ln[A]_t - \ln[A]_0 = -k$ (second order)	
$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$ (third order)	
$t_{1/2} = \frac{0.693}{k}$ (first order)	
B \rightleftharpoons cC + dD.	
Gasses/Solutions	Thermo/Electrochem
$PV = nRT$	$q = mc\Delta T$
$P_A = P_{\text{total}} X_A$, where $X_A = \frac{\text{moles } A}{\text{total moles}}$	$\Delta S^\circ = \sum_{\text{products}} S^\circ - \sum_{\text{reactants}} S^\circ$
$P_{\text{total}} = P_A + P_B + P_C + \dots$	Same for ΔH° and ΔG°
$K = {}^\circ\text{C} + 273.15$	$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$
$M = \frac{\text{moles solute}}{\text{Liters solution}}$, $m = \frac{\text{moles solute}}{\text{kg solvent}}$	$= -RT \ln K = -nFE^\circ$
1 atm = 760 mmHg = 760 torr	$I = \frac{q}{t}$
STP = 273.15 K and 1.0 atm	$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{RT}{nF} \ln Q.$
At STP, ideal gas 22.4L mol ⁻¹ .	
Standard conditions are 25° C and 1 atm.	

Equilibrium

$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}, \text{ where } aA + bB \rightleftharpoons cC + dD.$$

$$K_p = \frac{(P_C)^c (P_D)^d}{(P_A)^a (P_B)^b}$$

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$K_b = \frac{[OH^-][HB^+]}{[B]}$$

$$K_w = K_a K_b = [H^+][OH^-] = 1.0 \times 10^{-14} \quad (25^\circ \text{C})$$

$$\text{pH} = -\log[H^+], \text{pOH} = -\log[OH^-]$$

$$\text{pH} + \text{pOH} = 14.$$

$$\text{pH} = \text{p}K_a + \log \frac{[A^-]}{[HA]}$$

$$\text{p}K_a = -\log K_a, \text{p}K_b = -\log K_b.$$

Gases:

$$PV = nRT$$

$$P_A = \frac{n_A}{n} P_{\text{total}}$$

$$P_{\text{total}} = P_A + P_B + \dots$$

$$K = \frac{P_C^c P_D^d}{P_A^a P_B^b}$$

$$M = \frac{m}{n}$$

$$1 \text{ atm} = 101.3 \text{ kPa}$$

$$\text{STP} = 0^\circ \text{C}, 1 \text{ atm}$$

$$\text{At STP, } 1 \text{ mol of gas occupies } 22.7 \text{ L}$$

Standard States

Gasses/Solutions

$$PV = nRT$$
$$P_A = P_{\text{total}} X_A, \text{ where } X_A =$$
$$P_{\text{total}} = P_A + P_B + P_C + \dots$$
$$M = \frac{\text{moles solute}}{\text{moles solvent}}$$
$$M = \frac{\text{g solute}}{\text{Liters solution}}, m = \frac{\text{kg solute}}{\text{kg solvent}}$$

STP = 273.15 K and 1.0 atm

At STP, ideal gas 22.4L mol^{-1}

Standard conditions are 25° C

Thermo/Electrochem

$$q = mc\Delta T$$
$$\Delta S^\circ = \sum_{\text{products}} S^\circ - \sum_{\text{reactants}} S^\circ$$

Same for ΔH° and ΔC_p

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$
$$= -kT \ln K = -nF E$$
$$E_{\text{cell}} = E^{\circ} - \frac{RT}{n} \ln Q$$
$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{RT}{nF} \ln Q.$$

atm.

	1 IA	
1	<div>12.20</div> <div>H₂</div> <div>Hydrogen</div> <div>1.01</div>	2 IIA
2	<div>30.98</div> <div>Li</div> <div>Lithium</div> <div>6.94</div>	<div>49.01</div> <div>Be</div> <div>Beryllium</div> <div>9.01</div>
3	<div>110.93</div> <div>Na</div> <div>Sodium</div> <div>22.99</div>	<div>121.31</div> <div>Mg</div> <div>Magnesium</div> <div>24.31</div>
4	<div>190.82</div> <div>K</div> <div>Potassium</div> <div>39.10</div>	<div>201.00</div> <div>Ca</div> <div>Calcium</div> <div>40.08</div>
5	<div>370.82</div> <div>Rb</div> <div>Rubidium</div> <div>85.47</div>	<div>380.95</div> <div>Sr</div> <div>Strontium</div> <div>87.62</div>
6	<div>550.79</div> <div>Cs</div> <div>Caesium</div> <div>132.91</div>	<div>560.89</div> <div>Ba</div> <div>Barium</div> <div>137.33</div>
7	<div>870.7</div> <div>Fr</div> <div>Francium</div> <div>(223)</div>	<div>880.9</div> <div>Ra</div> <div>Radium</div> <div>(226)</div>

3 IIIA	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	26.98	28.09	30.97	32.06	35.45	39.95
21 1.36 Sc Scandium 44.96	22 1.54 Ti Titanium 47.87	23 1.63 V Vanadium 50.94	24 1.66 Cr ★ Chromium 52.00	25 1.55 Mn Manganese 54.94	26 1.83 Fe Iron 55.85	27 1.88 Co Cobalt 58.93	28 1.91 Ni Nickel 58.69	29 1.90 Cu ★ Copper 63.55	30 1.65 Zn Zinc ⁽²⁺⁾ 65.38	31 1.81 Ga Gallium 69.72	32 2.01 Ge Germanium 72.63	33 2.18 As Arsenic 74.92	34 2.55 Se Selenium 78.97	35 2.96 Br ₂ Bromine 79.90	36 3.00 Kr Krypton 83.80
39 1.22 Y Yttrium 88.91	40 1.33 Zr Zirconium 91.22	41 1.6 Nb ★ Niobium 92.91	42 2.16 Mo ★ Molybdenum 95.95	43 1.9 Tc Technetium (98)	44 2.2 Ru ★ Ruthenium 101.07	45 2.28 Rh ★ Rhodium 102.91	46 2.20 Pd ★★ Palladium 106.42	47 1.93 Ag ★ Silver ⁽¹⁺⁾ 107.87	48 1.69 Cd Cadmium 112.41	49 1.78 In Indium 114.82	50 1.96 Sn Tin 118.71	51 2.05 Sb Antimony 121.76	52 2.1 Te Tellurium 127.60	53 2.86 I ₂ Iodine 126.90	54 2.60 Xe Xenon 131.29
57-71 La-Lu Lanthanide	72 1.3 Hf Hafnium 178.49	73 1.5 Ta Tantalum 180.95	74 2.36 W Tungsten 183.84	75 1.9 Re Rhenium 186.21	76 2.2 Os Osmium 190.23	77 2.20 Ir Iridium 192.22	78 2.28 Pt ★ Platinum 195.08	79 2.54 Au ★ Gold 196.97	80 2.00 Hg Mercury 200.59	81 1.62 Tl Thallium 204.38	82 1.87 Pb Lead 207.2	83 2.02 Bi Bismuth 208.98	84 2.0 Po Polonium (209)	85 2.2 At Astatine (210)	86 2.2 Rn Radon (222)
89-103 Ac-Lr Actinide	104 Rf Rutherfordium (267)	105 Db Dubnium (268)	106 Sg Seaborgium (269)	107 Bh Bohrium (270)	108 Hs Hassium (277)	109 Mt Meitnerium (278)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (282)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (290)	116 Lv Livermorium (293)	117 Ts Tennessine (294)	118 Og Ogannesson (294)

Gas	Super ⁷		
NO	HI	Alkali Metal	Z
NO ₂	HBr	Alkaline-Earth	
CO	HCl	Metal	
CO ₂	HNO ₃	Metalloid	
CH ₄	H ₂ SO ₄	Non-metal	
C ₂ H ₆	HClO ₃	Halogen	
C ₃ H ₈	HClO ₄	Noble Gas	
C ₄ H ₁₀		Lanthanide/Actinide	
N ₂ O	NH ₃	Synthetic	
SO ₃	SO ₂	★Aufbau Exception	
H ₂ S	HCl	EN, IE, EA, & Z_{eff} i	
		Radius & Metallic d	

Z E.N.
Sym
Name
mass

Synthetic

★ Aufbau Exception

EN, IE, EA, & \mathbb{Z}_{eff} increase $\rightarrow \uparrow$
Radius & Metallic decrease $\rightarrow \uparrow$