

Periodic Table of the Elements

	IA																VIII A	
1	1 H 1.008																	2 He 4.00
2	3 Li 6.94	4 Be 9.01										5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18	
3	11 Na 22.99	12 Mg 24.30										13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95	
4	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 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	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
6	55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	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 (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra 226.0	89 Ac 227.0	104 (261)	105 (262)	106 (263)												

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	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
Actinides	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

Useful Information

$$PV = nRT$$

$$\ln\left(\frac{vp_2}{vp_1}\right) = -\frac{\Delta H^\circ_{\text{vap}}}{R} \left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$\text{density of H}_2\text{O} = 1.00 \frac{\text{g}}{\text{cm}^3}$$

$$\Delta H^\circ_{\text{rxn}} = \sum n(\Delta H_f^\circ(\text{products})) - \sum m(\Delta H_f^\circ(\text{reactants}))$$

$$\Delta S^\circ_{\text{rxn}} = \sum n(S^\circ(\text{products})) - \sum m(S^\circ(\text{reactants}))$$

$$\Delta G^\circ_{\text{rxn}} = \sum n(\Delta G_f^\circ(\text{products})) - \sum m(\Delta G_f^\circ(\text{reactants}))$$

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$R = 0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} = 8.314 \frac{\text{J}}{\text{mol}\cdot\text{K}}$$

$$\text{density of H}_2\text{O} = 1.00 \frac{\text{g}}{\text{cm}^3}$$

Temperature (°C)	Vapor Pressure(mmHg)	Temperature (°C)	Vapor Pressure(mmHg)
-5	3.2	50	92.5
0	4.6	55	118.0
5	6.52	60	149.4
10	9.20	65	187.5
15	12.8	70	233.7
20	17.5	75	289.1
25	23.8	80	355.1
30	31.8	85	433.6
35	42.1	90	525.8
40	55.3	95	633.9
45	71.9	100	760

Solubility Table

<u>Ion</u>	<u>Solubility</u>	<u>Exceptions</u>
NO ₃ ⁻	soluble	none
ClO ₄ ⁻	soluble	none
Cl ⁻	soluble	except Ag ⁺ , Hg ₂ ²⁺ , *Pb ²⁺
I ⁻	soluble	except Ag ⁺ , Hg ₂ ²⁺ , Pb ²⁺
SO ₄ ²⁻	soluble	except Ca ²⁺ , Ba ²⁺ , Sr ²⁺ , Hg ²⁺ , Pb ²⁺ , Ag ⁺
CO ₃ ²⁻	insoluble	except Group IA and NH ₄ ⁺
PO ₄ ³⁻	insoluble	except Group IA and NH ₄ ⁺
-OH	insoluble	except Group IA, *Ca ²⁺ , Ba ²⁺ , Sr ²⁺
S ²⁻	insoluble	except Group IA, IIA and NH ₄ ⁺
Na ⁺	soluble	none
NH ₄ ⁺	soluble	none
K ⁺	soluble	none

*slightly soluble

Thermodynamic Values (25 °C)

Substance and State	ΔH_f° $\left(\frac{\text{kJ}}{\text{mol}}\right)$	ΔG_f° $\left(\frac{\text{kJ}}{\text{mol}}\right)$	S° $\left(\frac{\text{J}}{\text{K}\cdot\text{mol}}\right)$	Substance and State	ΔH_f° $\left(\frac{\text{kJ}}{\text{mol}}\right)$	ΔG_f° $\left(\frac{\text{kJ}}{\text{mol}}\right)$	S° $\left(\frac{\text{J}}{\text{K}\cdot\text{mol}}\right)$
Carbon				Oxygen			
C(s) (graphite)	0	0	6	O ₂ (g)	0	0	205
C(s) (diamond)	2	3	2	O(g) 249	232	161	
CO(g)	-110.5	-137	198	O ₃ (g)	143	163	239
CO ₂ (g)	-393.5	-394	214	Nitrogen			
CH ₄ (g)	?	-51	186	N ₂ (g)	0	0	192
CH ₃ OH(g)	-201	-163	240	NCl ₃ (g)	230	271	-137
CH ₃ OH(l)	-239	-166	127	NF ₃ (g)	-125	-83.6	-139
CH ₃ Cl(g)	-80.8	-57.4	234	NH ₃ (g)	?	-17	193
CHCl ₃ (g)	-100.8			NH ₃ (aq)	?	-27	111
CHCl ₃ (l)	-131.8			NH ₂ CONH ₂ (aq)	?	?	174
H ₂ CO(g)	-116	-110	219	NO(g)	90	87	211
HCOOH(g)	-363	-351	249	NO ₂ (g)	32	52	240
HCN(g)	135.1	125	202	N ₂ O(g)	82	104	220
C ₂ H ₂ (g)	227	209	201	N ₂ O ₄ (g)	10	98	304
C ₂ H ₄ (g)	52	68	219	N ₂ O ₅ (g)	-42	134	178
CH ₃ CHO(g)	-166	-129	250	HNO ₃ (aq)	-207	-111	146
C ₂ H ₅ OH(l)	-278	-175	161	HNO ₃ (l)	-174	-81	156
C ₂ H ₆ (g)	-84.7	-32.9	229.5	NH ₄ Cl(s)	-314	-201	95
C ₃ H ₆ (g)	20.9	62.7	266.9	NH ₄ ClO ₄ (s)	-295	-89	186
C ₃ H ₈ (g)	-104	-24	270	Silver			
Bromine				Ag(s)	0	0	42.6
Br ₂ (l)	0	0	152.	Ag ⁺ (aq)	105.6	77.1	72.7
BrCl(g)	14.64	-0.96	240	Ag(S ₂ O ₃) ³⁻ (aq)	-1285.7	--	--
Chlorine				AgBr(s)	-100.4	-96.9	107.1
Cl ₂ (g)	0	0	223	AgCl(s)	-127.1	-109.8	96.2
Cl ₂ (aq)	-23	7	121	Sulfur			
Cl ⁻ (aq)	-167	-131	57	S(rhombic)	0	0	31.8
HCl(g)	-92	-95	187	SO ₂ (g)	-296.8	-300.2	248.8
Fluorine				SO ₃ (g)	-395.7	-371.1	256.3
F ₂ (g)	0	0	203	H ₂ S(g)	-20.17	-33.0	205.6
F ⁻ (aq)	-333	-279	-14	Titanium			
HF(g)	-271	-273	174	TiCl ₄ (g)	-763	-727	355
Hydrogen				TiO ₂ (s)	-945	-890	50
H ₂ (g)	0	0	131	Aluminum			
H(g) 217	203	115		AlCl ₃ (s)	-526	-505	184
H ⁺ (aq)	0	0	0	Barium			
OH ⁻ (aq)	-230	-157	-11	BaCl ₂ (aq)	-872	-823	123
H ₂ O(l)				Ba(OH) ₂ ·8H ₂ O(s)	-3342	-2793	427
H ₂ O(g)	-242	-229	189	Iodine			
Magnesium				I ₂ (s)	0	0	116.7
Mg(s)	0	0	33	HI(g)	25.94	1.30	206.3
Mg(aq)	-492	-456	-118				
MgO(s)	-601	-569	26.9				