Periodic Table of the Elements

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
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 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (269)	109 **Mt** (268)	110 (271)	111 (272)	112 (277)		114 (285)		116 (289)		

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

Specific heat of $H_2O_{(s)}$ = 2.09 $\frac{J}{g\cdot°C}$ Specific heat of $H_2O_{(l)}$ = 4.184 $\frac{J}{g\cdot°C}$

Specific heat of $H_2O_{(g)}$ = 1.84 $\frac{J}{g\cdot°C}$ Heat of fusion of $H_2O_{(s)}$ = 6.01 $\frac{kJ}{mol}$

Heat of vaporization of $H_2O_{(l)}$ = 40.67 $\frac{kJ}{mol}$

$R = 0.08203 \frac{L\cdot atm}{mol\cdot K}$ or $R = 8.314 \frac{J}{mol\cdot K}$ $\Delta H = \Delta E + \Delta nRT$

q(heat flow) = mass · specific heat · ΔT

$q_{reaction} = -(q_{calorimeter} + q_{solution})$ $q_{reaction} = -(q_{calorimeter} + q_{water})$

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

Table of Standard Heats of Formation

Substance and State	ΔH_f° (kJ/mol)	Substance and State	ΔH_f° (kJ/mol)
C(*s*) (graphite)	0	HCl(*g*)	-92.3
C(*s*) (diamond)	2	HBr(*g*)	-36.4
CO(*g*)	-110.5	HI(*g*)	26.5
CO_2(*g*)	–393.5	$I_{2(g)}$	62.25
CH_4(*g*)	–75	O_2(*g*)	0
CH_3OH(*g*)	-201	O(*g*)	249
CH_3OH(*l*)	-239	O_3(*g*)	143
H_2CO(*g*)	-116		
CCl_4(*l*)	-135.4	N_2(*g*)	0
HCOOH(*g*)	-363	NH_3(*g*)	-46
HCN(*g*)	135.1	$NH_{3(aq)}$	-80
CS_2(*g*)	117.4	NH_4^+*(aq)*	-132
CS_2(*l*)	89.7	$N_2H_3CH_3$(*l*)	54
C_2H_2(*g*)	227	$N_2H_{4(l)}$	50.6
C_2H_4(*g*)	52	NO(*g*)	90.25
CH_3CHO(*g*)	-166	NO_2(*g*)	33.18
C_2H_5OH(*l*)	-278	N_2O(*g*)	82.0
$C_2H_5O_2N_{(g)}$	-533	N_2O_4(*g*)	9.16
C_2H_6(*g*)	-84.7	N_2O_4(*l*)	20
C_3H_6(*g*)	20.9	HNO_3(*aq*)	-207.36
C_3H_8(*g*)	-104	HNO_3(*l*)	-174.10
C_4H_{10}(*g*)	-126	NH_4ClO_4(*s*)	-295
CH_2 = CHCN(*l*)	152		
CH_3COOH(*l*)	-484	$S_2Cl_{2(g)}$	-18
$C_6H_{12}O_6$(*s*)	-1275	$SO_{2(g)}$	-296.83
		$H_2S_{(g)}$	-20.6
Cl_2(*g*)	0	$SOCl_{2(g)}$	-213
Cl_2(*aq*)	-23		
Cl^-(*aq*)	-167	$SiCl_{4(g)}$	-657
		$SiO_{2(s)}$	-910.94
		$SiF_{4(g)}$	-1614.9
$H_{2(g)}$	0		
H*(g)*	217	TiO_2(*s*)	-944.7
H^+(*aq*)	0	$TiCl_{4(g)}$	-763
$OH^-_{(aq)}$	-230		
$H_2O_{(l)}$	-286	ZnO(*s*)	-348
$H_2O_{(g)}$	-242	ZnS(*s*)	-206

Activity Series

Metal	Half-Reaction Reaction
Gold	$Au^{3+} + 3e^- \rightarrow Au$
Platinum	$Pt^{2+} + 2e^- \rightarrow Pt$
Mercury	$Hg^{2+} + 2e^- \rightarrow Hg$
Silver	$Ag^{+} + e^- \rightarrow Ag$
Copper	$Cu^{2+} + 2e^- \rightarrow Cu$
Hydrogen	$2H^{+} + 2e^- \rightarrow H_2$
Lead	$Pb^{2+} + 2e^- \rightarrow Pb$
Tin	$Sn^{2+} + 2e^- \rightarrow Sn$
Nickel	$Ni^{2+} + 2e^- \rightarrow Ni$
Cobalt	$Co^{2+} + 2e^- \rightarrow Co$
Iron	$Fe^{2+} + 2e^- \rightarrow Fe$
Chromium	$Cr^{3+} + 3e^- \rightarrow Cr$
Zinc	$Zn^{2+} + 2e^- \rightarrow Zn$
Manganese	$Mn^{2+} + 2e^- \rightarrow Mn$
Aluminum	$Al^{3+} + 3e^- \rightarrow Al$
Magnesium	$Mg^{2+} + 2e^- \rightarrow Mg$
Sodium	$Na^{+} + e^- \rightarrow Na$
Calcium	$Ca^{2+} + 2e^- \rightarrow Ca$
Barium	$Ba^{2+} + 2e^- \rightarrow Ba$
Potassium	$K^{+} + e^- \rightarrow K$
Lithium	$Li^{+} + e^- \rightarrow Li$

Solubility Table

Ion	Solubility	Exceptions
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