$\triangle H_{vap} = -\triangle H_{cond} = 40.67$ kJ/mol
$C_{water} = 4.184$ J/(g · K)
$C_{steam} = 1.865$ J/(g · K)
$C_{ice} = 2.11$ J/(g · K)
$\triangle H_{fus} = -\triangle H_{solid} = 6.01$ J/(g · K)

$P \propto V^{-1}$ and $V \propto T$

$\left[P + \frac{an^2}{V^2}\right][V - nb] = nRT$

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6\ 7s^2\ 5f^{14}\ 6d^{10}\ 7p^6$

PERIODIC TABLE OF ELEMENTS

(Ideal Gas Law) $PV = nRT$

Combined Gas) $\frac{PV}{T} = k$ (for constant amount)

(Molarity) $M = \frac{\text{moles solute}}{\text{L solution}}$

(Molality) $m = \frac{\text{moles solute}}{\text{kg solvent}}$

(Mole Fraction) $x = \frac{\text{moles component}}{\text{moles total}}$

(Graham) $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

$v_{rms} = \sqrt{\frac{3RT}{M}}$

$pH = -\log_{10}[H^+]$

$pH + pOH = 14$

$E_{photon} = hf = hc/\lambda$

$E_n = -\frac{R_H}{n^2}$

$R_H = 2.18 \times 10^{-18}$ J (Rydberg)

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

$\lambda = \frac{h}{p}$

pH_{sigfig} = past decimal

$K_{eq} = \frac{[product]}{[reactant]}$

$K_{acid}K_{base} = K_w = 1.0 \times 10^{-14}$

$i = 1$ (non-electrolyte) Van't Hoff Factor

$\triangle T_f = K_f mi$

$\triangle T_b = K_b mi$

$\Pi = iMRT$

$\triangle E = q + w = q - P\triangle V$

$\triangle H = \triangle E + P\triangle V$

$R_{Ideal\ Gas} = 62.4\frac{L \cdot mmHg}{mol \cdot K} = 0.0821\frac{L \cdot atm}{mol \cdot K} = 8.314\frac{L \cdot kPA}{mol \cdot K}, \frac{J}{mol \cdot K}$ * **

1 lb = 453.6 g

2.54 cm = 1 in

0.946 L = 1 qt

$F^\circ = \frac{9}{6}C^\circ + 32$

$C^\circ = \frac{5}{9}(F^\circ - 32)$

$h = 6.626 \times 10^{-34}$ J · s, kg · m²/s

$c = 3.00 \times 10^8$ m/s

1 mol = $6.022 \times 10^{23} = 22.4\ L_{STP}$

$\rho_{water} = 1$ g/mL

$P_{sea} = 101325$ Pa = 1 atm = 760 mmHg, torr = 14.7 psi

$K_{b_{water}} = 0.512$ $K_{f_{water}} = 1.86$

Group →

																	18
												13	14	15	16	17	He
												B 2.04	C 2.55	N 3.04	O 3.44	F 3.98	Ne
												Al 1.61	Si 1.90	P 2.19	S 2.58	Cl 3.16	Ar
4	5	6	7	8	9	10	11	12									
Ti 1.54	V 1.63	Cr 1.66	Mn 1.55	Fe 1.83	Co 1.88	Ni 1.91	Cu 1.90	Zn 1.65	Ga 1.81	Ge 2.01	As 2.18	Se 2.55	Br 2.96	Kr 3.00			
Zr 1.33	Nb 1.6	Mo 2.16	Tc 1.9	Ru 2.2	Rh 2.28	Pd 2.20	Ag 1.93	Cd 1.69	In 1.78	Sn 1.96	Sb 2.05	Te 2.1	I 2.66	Xe 2.60			
Hf 1.3	Ta 1.5	W 2.36	Re 1.9	Os 2.2	Ir 2.20	Pt 2.28	Au 2.54	Hg 2.00	Tl 1.62	Pb 1.87	Bi 2.02	Po 2.0	At 2.2	Rn 2.2			
Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og			

*	Ce 1.12	Pr 1.13	Nd 1.14	Pm 1.13	Sm 1.17	Eu 1.2	Gd 1.2	Tb 1.1	Dy 1.22	Ho 1.23	Er 1.24	Tm 1.25	Yb 1.1	Lu 1.27
**	Th 1.3	Pa 1.5	U 1.38	Np 1.36	Pu 1.28	Am 1.13	Cm 1.28	Bk 1.3	Cf 1.3	Es 1.3	Fm 1.3	Md 1.3	No 1.3	Lr 1.3

H 2.20	2																
Li 0.98	Be 1.57																
Na 0.93	Mg 1.31	3	4	5	6	7	8	9	10	11	12						
K 0.82	Ca 1.00	Sc 1.36	Ti 1.54	V 1.63	Cr 1.66	Mn 1.55	Fe 1.83	Co 1.88	Ni 1.91	Cu 1.90	Zn 1.65	Ga 1.81	Ge 2.01	As 2.18	Se 2.55	Br 2.96	Kr 3.00
Rb 0.82	Sr 0.95	Y 1.22	Zr 1.33	Nb 1.6	Mo 2.16	Tc 1.9	Ru 2.2	Rh 2.28	Pd 2.20	Ag 1.93	Cd 1.69	In 1.78	Sn 1.96	Sb 2.05	Te 2.1	I 2.66	Xe 2.60
Cs 0.79	Ba 0.89	La 1.1	Hf 1.3	Ta 1.5	W 2.36	Re 1.9	Os 2.2	Ir 2.20	Pt 2.28	Au 2.54	Hg 2.00	Tl 1.62	Pb 1.87	Bi 2.02	Po 2.0	At 2.2	Rn 2.2
Fr 0.7	Ra 0.9	Ac 1.1	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og

IA	IIA		IIIB	IVB	VB	VIB	VIIB	VIIIB	VIIIB	VIIIB	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1																		2
H_2																		He
Hydrogen																		Helium
1.008																		4.0026
3	4												5	6	7	8	9	10
Li	Be												B	C	N_2	O_2	F_2	Ne
Lithium	Beryllium												Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon
6.94	9.0122												10.81	12.011	14.007	15.999	18.998	20.180
11	12		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Na	Mg		Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn^{2+}	Al	Si	P	S	Cl_2	Ar
Sodium	Magnesium		Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Aluminium	Silicon	Phosphorus	Sulfur	Chlorine	Argon
22.990	24.305		44.956	47.867	50.942	51.996	54.938	55.845	58.933	58.693	63.546	65.38	26.982	28.085	30.974	32.06	35.45	39.948
19	20		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca		Sc	Ti	V	Cr ★	Mn	Fe	Co	Ni	Cu ★	Zn	Ga	Ge	As	Se	Br_2	Kr
Potassium	Calcium		Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton
39.098	40.078		44.956	47.867	50.942	51.996	54.938	55.845	58.933	58.693	63.546	65.38	69.723	72.630	74.922	78.971	79.904	83.798
37	38		39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr		Y	Zr	Nb ★	Mo ★	Tc	Ru ★	Rh ★	Pd ★	Ag^{1+} ★	Cd	In	Sn ★	Sb	Te	I	Xe
Rubidium	Strontium		Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium	Indium	Tin Needs Numerals	Antimony	Tellurium	Iodine	Xenon
85.468	87.62		88.906	91.224	92.906	95.95	(98)	101.07	102.91	106.42	107.87	112.41	114.82	118.71	121.76	127.60	126.90	131.29
55	56		57–71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba			Hf	Ta	W	Re	Os	Ir	Pt	Au ★	Hg	Tl	Pb	Bi	Po	At	Rn
Caesium	Barium			Hafnium	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury	Thallium	Lead	Bismuth	Polonium	Astatine	Radon
132.91	137.33			178.49	180.95	183.84	186.21	190.23	192.22	195.08	196.97	200.59	204.38	207.2	208.98	(209)	(210)	(222)
87	88		89–103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
Fr	Ra			Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og
Francium	Radium			Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Meitnerium	Darmstadtium	Roentgenium	Copernicium	Nihonium	Flerovium	Moscovium	Livermorium	Tennessine	Oganesson
(223)	(226)			(267)	(268)	(269)	(270)	(277)	(278)	(281)	(282)	(285)	(286)	(289)	(290)	(293)	(294)	(294)

Ionization Energy
Electronegativity
Electron Affinity
Effective Nuclear Charge

Radius
Metalic Character

Radius
Metalic Character

Electronegativity Z_{eff}
Ionization Energy
Electron Affinity

dz² dxy dxz dyz dx²-dy²

p_x p_y p_z

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Lanthanum	Cerium	Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium	Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium	Lutetium
138.91	140.12	140.91	144.24	(145)	150.36	151.96	157.25	158.93	162.50	164.93	167.26	168.93	173.05	174.97
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
Actinium	Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium	Lawrencium
(227)	232.04	231.04	238.03	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(266)

Super 7 Strong Acids

CO_2
CO
CH_4
C_2H_6
C_3H_8
C_4H_{10}
NO
NO_2
N_2O
NH_3
SO_3
SO_2
H_2S
HCl

HI
HBr
HCl
HNO_3
H_2SO_4
$HClO_3$
$HClO_4$

Polyatomic Ions

1+	
$(NH_4)^{+1}$	ammonium

1-	
$(NO_3)^{-1}$	nitrate
$(NO_2)^{-1}$	nitrite
$(OH)^{-1}$	hydroxide
$(HCO_3)^{-1}$	bicarbonate or hydrogen carbonate
$(C_2H_3O_2)^{-1}$	acetate
$(ClO_4)^{-1}$	perchlorate
$(ClO_3)^{-1}$	chlorate
$(ClO_2)^{-1}$	chlorite
$(ClO)^{-1}$	hypochlorite
$(CN)^{-1}$	cyanide
$(SCN)^{-1}$	thiocyanate
$(HSO_4)^{-1}$	bisulfate or hydrogen sulfate
$(MnO_4)^{-1}$	permanganate
$(H_2PO_4)^{-1}$	dihydrogen phosphate
$(IO_4)^{-1}$	periodate
$(IO_3)^{-1}$	iodate
$(IO)^{-1}$	hypoiodite
$(NH_2)^{-1}$	amide
$(CHO_2)^{-1}$	formate

2-	
$(CrO_4)^{-2}$	chromate
$(Cr_2O_7)^{-2}$	dichromate
$(CO_3)^{-2}$	carbonate
$(HPO_4)^{-2}$	dibasic phosphate or hydrogen phosphate
$(MnO_4)^{-2}$	manganate
$(O_2)^{-2}$	peroxide
$(S_2O_3)^{-2}$	thiosulfate
$(SO_4)^{-2}$	sulfate
$(SO_3)^{-2}$	sulfite
$(C_2O_4)^{-2}$	oxalate

3-	
$(AsO_4)^{-3}$	arsenate
$(AsO_3)^{-3}$	arsenite
$(BO_3)^{-3}$	borate
$(C_6H_5O_7)^{-3}$	citrate
$(PO_4)^{-3}$	phosphate or tribasic phosphate
$(PO_3)^{-3}$	phosphite

4-	
$(SiO_4)^{-4}$	silicate (ortho)

Atomic Ions

+1	
Li^{+1}	Lithium
Na^{+1}	Sodium
K^{+1}	Potassium
Ag^{+1}	Silver
Cu^{+1}	Copper (I) or Cuprous
Cs^{+1}	Cesium
H^{+1}	Hydrogen

-1	
F^{-1}	Fluoride
Br^{-1}	Bromide
Cl^{-1}	Chloride
I^{-1}	iodide
H^{-1}	hydride

+2	
Mg^{+2}	Magnesium
Ca^{+2}	Calcium
Ba^{+2}	Barium
Zn^{+2}	Zinc
Cd^{+2}	Cadmium (II)
Cr^{+2}	Chromium (II) or Chromous
Co^{+2}	Cobalt (II) or Cobaltous
Hg^{+2}	Mercury (II) or Mercuric
Hg_2^{+2}	Mercury (I) or Mercurous
Mn^{+2}	Manganese (II) or manganous

-2	
O^{-2}	Oxide
O_2^{-2}	Peroxide
S^{-2}	Sulfide

+2 (cont)	
Cu^{+2}	Copper (II) or Cupric
Pb^{+2}	Lead (II) or Plumbous
Fe^{+2}	Iron (II) or Ferrous
Ni^{+2}	Nickel (II)
Sn^{+2}	Tin (II) or Stannous
Sr^{+2}	Strontium

+3	
Al^{+3}	Aluminum
Fe^{+3}	Iron (III) or Ferric
Ni^{+3}	Nickel (III)
Cr+3	Chromium (III) or Chromic

+4	
Pb^{+4}	Lead (IV)
Si^{+4}	Silicon (IV)
Sn^{+4}	Tin (IV) or Stannic
Mn^{+4}	Manganese (IV)

-3	
N^{-3}	Nitride
P^{-3}	Phosphide

Name: _____ Date: _____ Period: _____

Metal Activity Series / Redox Table

Super 7 Strong Acids

HI
HBr
HCl
HNO_3
H_2SO_4
$HClO_3$
$HClO_4$

Strong Base Is
Group I/II
Hydroxides (OH)-

Element	Metal Ion(s) Found in nature	Metal Obtained
Lithium	Li^+	Li (s)
Potassium	K^+	K (s)
Barium	Ba^{2+}	Ba(s)
Calcium	Ca^{2+}	Ca (s)
Sodium	Na^+	Na (s)
Magnesium	Mg^{2+}	Mg (s)
Aluminum	Al^{3+}	Al (s)
Manganese	Mn^{2+}	Mn (s)
Zinc	Zn^{2+}	Zn (s)
Chromium	Cr^{3+}, Cr^{2+}	Cr (s)
Iron	Fe^{3+}, Fe^{2+}	Fe (s)
Cobalt	Co^{2+}	Co (s)
Nickel	Ni^+	Ni (s)
Tin	Sn^{2+}	Sn(s)
Lead	Pb^{2+}	Pb (s)
Hydrogen	$2H^+$	H_2 (g)
Copper	Cu^{2+}, Cu^+	Cu (s)
Silver	Ag^+	Ag (s)
Mercury	Hg^{2+}	Hg (l)
Platinum	Pt^{2+}	Pt (s)
Gold	Au^{3+}, Au^+	Au (s)

CO_2
CO
CH_4
C_2H_6
C_3H_8
C_4H_{10}
NO
NO_2
N_2O
NH_3
SO_3
SO_2
H_2S
HCl

Table 20-1 Processes Leading to Oxidation and Reduction

Oxidation	Reduction
Complete loss of electrons (ionic reactions)	Complete gain of electrons (ionic reactions)
Shift of electrons away from an atom in a covalent bond	Shift of electrons toward an atom in a covalent bond
Gain of oxygen	Loss of oxygen
Loss of hydrogen by a covalent compound	Gain of hydrogen by a covalent compound
An increase in oxidation number	A decrease in oxidation number

Solubility Chart

$MO+H_2O$ -> M(OH) base
N.M.O+H_2O--> Acid
MO+NMO-->Salt
MCO_3->$MO+CO_2$
M(OH)-->$MO+H_2O$
$MClO_3$-->$MCl+O_2$
Acid-->$NMO+H_2O$
Combustion-->CO_2+H_2O+E

Cations	Soluble with ___ (aq)	Forms Precipitates with ___ (s)
Na^+, K^+, and NH_4^+	Most Anions	$(NH_4)_2C_2O_4$ forms a precipitate
Bi^{3+}	Nothing	Most anions
As^{3+}	I^{1-}	Most anions
Sb^{3+}	Cl^{1-}	Most anions

Anions	Soluble with ___ (aq)	Forms Precipitates with ___ (s)
NO_3^{1-} nitrate	Most cations	No common cations
ClO_4^{1-} perchlorate	Most cations	No common cations
ClO_3^{1-} chlorate	Most cations	No common cations
$C_2H_3O_2^{1-}$ acetate	Most cations	Ag^{1+}, Hg_2^{2+}
F^{1-} fluoride	Most cations	Cr^{3+}
Cl^{1-} chloride	Most cations	Ag^+,$Pb^{2+,4+}$,Hg_2^{2+},Tl^{1+}
Br^{1-} bromide	Most cations	Ag^+,$Pb^{2+,4+}$,Hg_2^{2+},Tl^{1+}
I^{1-} iodide	Most cations	Ag^+,$Pb^{2+,4+}$,Hg_2^{2+},Tl^{1+}
SO_4^{2-} sulfate	Most cations	Ag^+,Ba^{2+},Sr^{2+},$Pb^{2+,4+}$,Ca^{2+},Hg_2^{2+}
CrO_4^{2-} chromate	Most cations	Ba^{2+},Sr^{2+},$Pb^{2+,4+}$,Ca^{2+},Hg_2^{2+}
S^{2-} sulfide	Na^+, K^+,NH_4^+,Li^+,Sr^{2+}	Most other cations
OH^{1-} hydroxide	Na^+, K^+,NH_4^+,Li^+,Sr^{2+},Ba^{2+},Ca^{2+}	Most other cations
CO_3^{2-} carbonate	Na^+, K^+,NH_4^+,Li^+	Most other cations
PO_4^{3-} phosphate	Na^+, K^+,NH_4^+	Most other cations
O^{2-} oxide	No common cations	Most cations