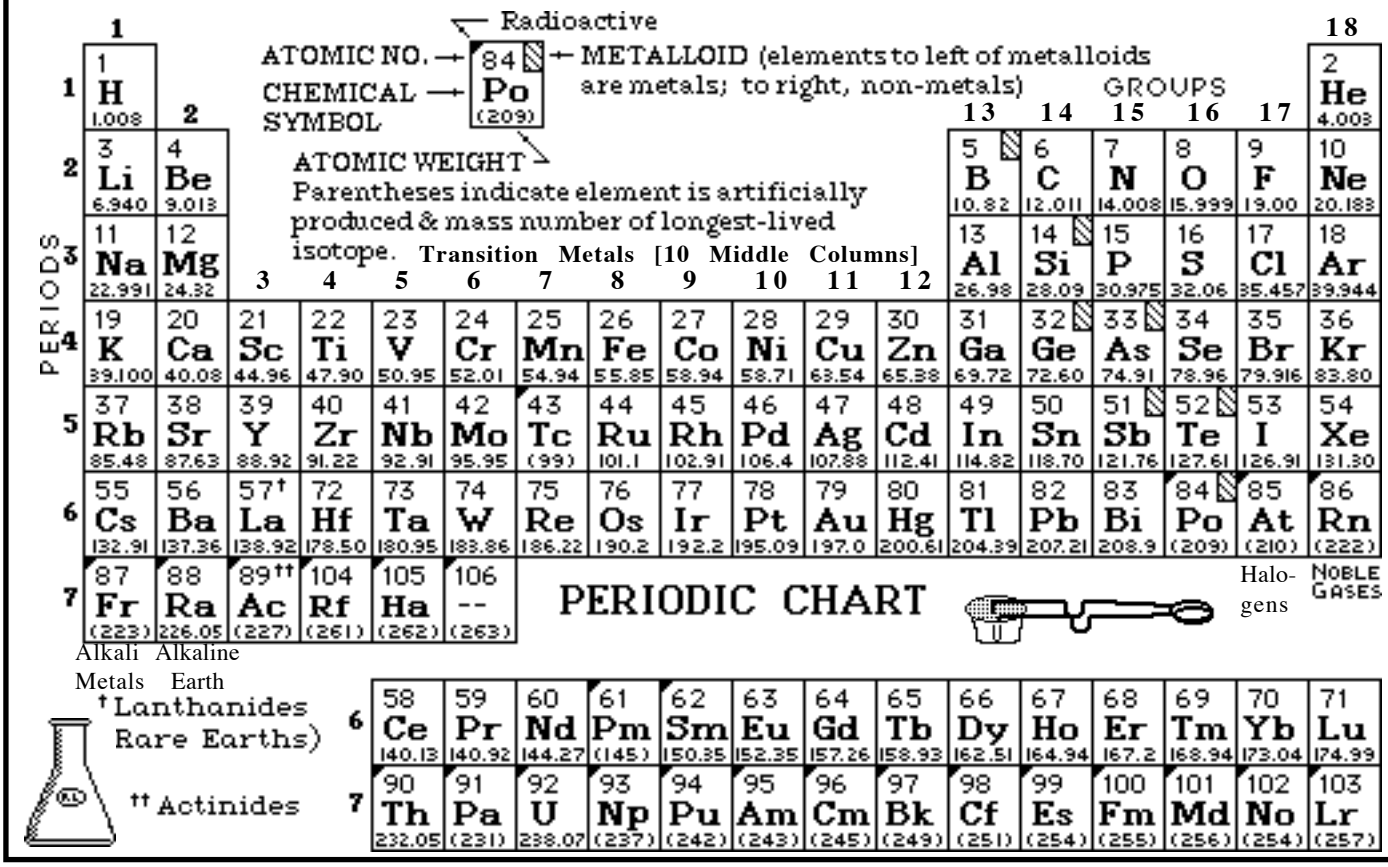
The Chemistry Cruncher Vol. 2©

PERIODIC CHART



STOICHIOMETRY FLOW CHART

Start With:	Convert to:	Multiply by:	Convert to:
Mass (g,kg,etc.) Volume (L,mL,etc.) or # of items (atoms,molec.) of a Given reactant or product	→ Moles of Given	→ Mole Ratio from the Balanced Chemical Equation	→ Mass (g,kg,etc.) Volume (L,mL,etc.) or # of items (atoms,molec.) of Unknown reactant or product

Diatomic Elements
Bromine
Chlorine
Fluorine
Hydrogen
Iodine
Nitrogen
Oxygen
HOFBrINCl

1 = atomic mass in grams for an element
M = formula mass in grams for a compound
O = 6.02×10^{23} atoms of an element
L = 6.02×10^{23} formula units of a compound
E = 22.4 liters of a gas at STP

For mole problems call Avogadro's No.: 6.02×10^{23}

Colligative Properties

$\Delta T_{bp} = K_{bp} m$
$\Delta T_{fp} = K_{fp} m$ H_2O
$K_{bp} = .52°C/m$
$K_{fp} = 1.86°C/m$

$pH = -\log [H^+]$ & $pOH = -\log [OH^-]$

Diagonal Rule

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f
6s 6p 6d
7s 7p

relative/%error
$E_r = \frac{|O-A|}{A}$

Gases at STP

# of Liters	
moles	22.4

# of Particles (atoms/molec. etc.)	
6.02×10^{23}	Moles

# of Grams	
Formula Mass	Moles

Std. Temperature
0°C
273.16 K

Std. Pressure:
1 atm
760 mmHg
101.3 kPa
14.7 lb/in^2
760 Torr
1.01×10^5 N/m^2

Gas Laws

Boyles Law: $V_1P_1=V_2P_2$
Charles Law: $V_1T_2=V_2T_1$
Combined Gas Law: $V_1P_1T_2=V_2P_2T_1$
Ideal Gas Law: $PV=nRT$
$R=.0821 \frac{\text{L-atm}}{\text{mole-K}}$

Moles of Solute	
Molality	kg of solvent

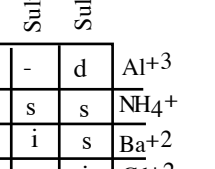
Moles	
Molarity	Liters

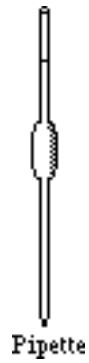
Normality	
Molarity	+ Oxidation Number

Solubility Table

s = soluble
i = insoluble
- = does not exist
s/i = partly soluble
d = decomposes

	Acetate	Bromide	Carbonate	Chlorate	Chloride	Hydroxide	Iodide	Nitrate	Oxide	Phosphate	Sulfate	Sulfide	
	$C_2H_3O_2^-$	Br^-	CO_3^{-2}	ClO_3^-	Cl^-	OH^-	I^-	NO_3^-	O^-	PO_4^{-3}	SO_4^{-2}	S^{-2}	
Aluminum	s	s	-	s	s	i	s	s	i	i	-	d	Al^{+3}
Ammonium	s	s	s	s	s	s	s	s	-	s	s	s	NH_4^+
Barium	s	s	i	s	s	s	s	s	s	i	i	s	Ba^{+2}
Cadmium	s	s	i	s	s	i	s	s	i	i	s	i	Cd^{+2}
Calcium	s	s	i	s	s	i	s	s	i	i	i	i	Ca^{+2}
Copper I (ous)	-	s/i	i	-	i	i	i	-	i	-	d	i	Cu^+
Copper II (ic)	s	s	d	s	s	i	-	s	i	i	s	i	Cu^{+2}
Hydrogen	s	s	s	s	s	HOH	s	s	s	s	s	s	H^+
Iron II (ous)	s	s	i	-	s	i	s	s	i	i	s	i	Fe^{+2}
Iron III (ic)	i	s	-	-	s	i	-	s	i	i	s/i	i	Fe^{+3}
Lead II (ous)	s	s/i	i	s	s/i	i	i	s	i	i	i	i	Pb^{+2}
Lead IV (ic)	d	-	-	-	d	-	-	-	i	-	-	-	Pb^{+4}
Magnesium	s	s	i	s	s	i	s	s	i	i	s	d	Mg^{+2}
Manganese	s	s	i	-	s	i	s	s	i	-	s	i	Mn^{+2}
Mercury I (ous)	s/i	i	i	s/i	i	-	s/i	s/d	i	i/d	i	i	Hg_2^{+2}
Mercury II (ic)	s	s/i	i	s	s	i	i	s	i	s/i	d	i	Hg^{+2}
Nickel	s	s	i	s	s	i	s	s	i	i	s	i	Ni^{+2}
Potassium	s	s	s	s	s	s	s	s	d	s	s	i	K^+
Silver	s	i	i	s	i	-	i	s	i	i	s	i	Ag^+
Sodium	s/i	s	s	s	s	s	s	s	d	s	s	s	Na^+
Tin II (ous)	-	-	-	-	s	i	s	-	i	-	s	i	Sn^{+2}
Tin IV (ic)	-	s/d	-	-	s/d	-		s	i	i	s/d	i	Sn^{+4}
Zinc	s	s	i	s	s	i		s	i	i	s	i	Zn^{+2}





Pipette

Reaction Types

Direct Combination or Synthesis
A + B -----> AB
Decomposition or Analysis
AB -------> A + B
Single Replacement
A + BC ------> B + AC
Double Replacement
AB + CD -------> AD + CB
Combustion of Hydrocarbon
$C_xH_y + O_2$ ----> CO_2 + H_2O

Common Acids

Sulfuric	H_2SO_4
Nitric	HNO_3
Hydrochloric	HCl
Acetic	$HC_2H_3O_2$
Carbonic	H_2CO_3
Phosphoric	H_3PO_4
Perchloric	$HClO_4$
Oxalic	$H_2C_2O_4$

Prefixes

1. mono
6. hexa
2. di — 7. hepta
3. tri — 8. octa
4. tetra — 9. nona

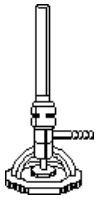
Do what you oughta add acid to watta

Polyatomic Ions

Ammonium	NH_4^{+1}
Acetate	$C_2H_3O_2^{-1}$
Arsenate	AsO_4^{-3}
Arsenite	AsO_3^{-1}
Bicarbonate	HCO_3^{-1}
Bisulfate	HSO_4^{-1}
Carbonate	CO_3^{-2}
Chlorate	ClO_3^{-1}
Chlorite	ClO_2^{-1}
Chromate	CrO_4^{-2}
Cyanide	CN^{-1}
Dichromate	$Cr_2O_7^{-2}$
Hydroxide	OH^{-1}
Iodate	IO_3^{-1}
Nitrate	NO_3^{-1}
Nitrite	NO_2^{-1}
Oxalate	$C_2O_4^{-2}$
Permanganate	MnO_4^{-1}
Perchlorate	ClO_4^{-1}
Phosphate	PO_4^{-3}
Sulfate	SO_4^{-2}
Thiocynate	SCN^{-1}
Thiosulfate	$S_2O_3^{-2}$

Common Molecular Masses (g/mole)

NaCl	58.45	$HC_2H_3O_2$	60.05	NaOH	40.00
Al_2O_3	101.96	HCl	36.46	Fe_2O_3	159.70
HNO_3	63.01	HgO	216.61	H_2SO_4	98.08
$Ca(OH)_2$	74.10	$CuSO_4$	159.6	$AgNO_3$	169.89
H_3PO_4	98.00	$KMnO_4$	158.04	$KClO_3$	122.55

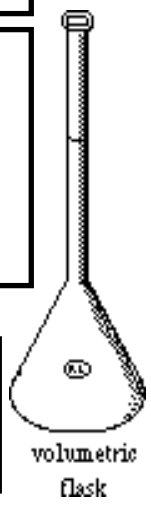


Conversions

1.0 in. = 2.54 cm
1.0 lb = 454 g
1.0 qt = 0.9463 L
1.0 km = 0.6214 mi
1 cal = 4.184 J

Common Anions & Cations

Fe	+2,+3	Pb	+2,+4	Zn	+2	Na	+1	F	-1
Cu	+1,+2	K	+1	Ag	+1	Ba	+2	Cl	-1
Al	+3	Mg	+2	Sn	+2,+4	Ca	+2	Br	-1
Cd	+2	Li	+1	Hg	+1,+2	Sr	+2	I	-1
Au	+1	Ni	+2	Co	+2,+3	H	+1	O	-2



volumetric flask

Temp. conversions:

$$°C = \frac{°F-32}{1.8}$$

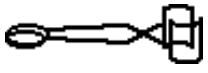
F = (1.8) (°C) + 32
K = °C + 273.16

Density = $\frac{\text{mass}}{\text{volume}}$

A = πr^2 } ○
C = πd
$V_{sphere} = 4/3\,\pi r^3$
$V_{cyl.} = \pi r^2 h$
V = l x w x h } ▭

Neutralization:
Acid + Base ---> Salt + Water
HCl + NaOH ---> NaCl + H_2O

H___	acids start with H
___OH	bases end with OH
___	salts do neither
HOH	water does both



System International Prefixes [SI]

Prefix	abbr.	means	multiplier*
tera	T	Trillion	10^{12}
giga	G	billion	10^{9}
mega	M	million	10^{6}
kilo	k	thousand	10^{3}
hecto	h	hunderd	10^{2}
deka	da	ten	10^{1}
-----	--	base unit	10^{0}
deci	d	1 tenth	10^{-1}
centi	c	1 hundredth	10^{-2}
milli	m	1 thousandth	10^{-3}
micro	μ	1 millionth	10^{-6}
nano	n	1 billionth	10^{-9}
pico	p	1 trillionth	10^{-12}

* replace prefix with multiplier, eg. 5.92 μg = 5.92 x 10^{-6}g

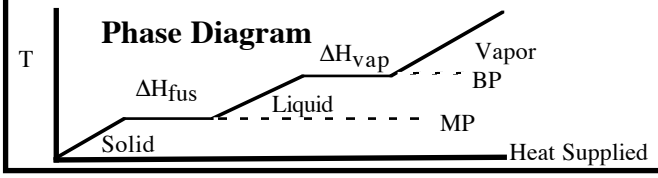
Physical Constants

Avogadro's number	N_A	= 6.0221 x 10^{23} /mole
Bohr radius	a_o	= 5.292 x 10^{-11} m
Boltzmann constant	k	= 1.381 x 10^{-23} J/K
Faraday constant	F	= 9.649 x 10^{4} C/mol e–
gas constant	R	= 8.206 x 10^{-2} L·atm/mol·K
		= 62.4 L·torr/mol·K
		= 8.314 J/mol·K
		= 8.314 L·kPa/mol·K
Planck's constant	h	= 6.626 x 10^{-34} J·s
absolute zero		= 0 K or – 273.15 °C
amu	u	= 1.6605 x 10^{-24} g
		= 1.6605 x 10^{-27} kg
gravitational const.	g	= 9.807 m/sec^2
molar volume at STP	V_m	= 22.414 L/mol
speed of light	c	= 2.998 x 10^{8} m/s
		= 2.998 x 10^{10} cm/s
electron charge	– e	= –1.602 x 10^{-19} C
electron rest mass	m_e	= 9.1096 x 10^{-28} g
		= 0.00054580 amu
proton rest mass	m_p	= 1.67265 x 10^{-24} g
		= 1.007277 amu
neutron rest mass	m_n	= 1.67495 x 10^{-24} g
		= 1.008665 amu

SI Base Units

Quantity	Unit	abbr.	Apparatus
length	meter	m	ruler
mass	kilogram	kg	balance
time	second	s	stopwatch
amount of substance	mole	mol	----------
temperature	kelvin	K	thermometer
electric current	ampere	A	ammeter
luminous intensity	candela	cd	light meter

Phase Diagram



Metric English Equivalents [length]

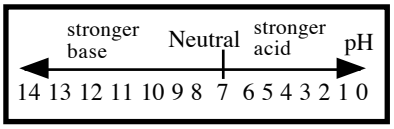
1.000 mi = 5282 ft
1.000 in = 2.540 cm
1.000 ft = 30.48 cm
1.000 yd = 0.9144 m
1.000 mi = 1.609 km
1 Å = 10^{-10} m = 0.1 nm
1.000 cm = 0.3937 in
1.000 m = 39.37 in
1.000 m = 1.094 yd
1.000 km = 0.6214 mi

Metric English Equivalents [mass]

1 lb = 16 oz
1.000 oz = 28.23 g
1.000 lb = 453.6 g
1.000 lb = 0.4536 kg
1 metric ton = 1000 kg
1.000 g = 0.03527 oz
1.000 kg = 35.27 oz
1.000 kg = 2.205 lb

Metric English Equivalents [volume]

1 ft^3 = 1728 in^3
1 yd^3 = 27 ft^3 = 46656 in^3
1.000 in^3 = 16.39 cm^3
1.000 ft^3 = 28.32 dm^3
1 m^3 = 1 000 000 cm^3
1.000 cm^3 = 0.06102 in^3
1.000 dm^3 = 61.02 in^3
1.000 m^3 = 35.31 ft^3



Electroneg. Differfence	Type of Bond
0.0-0.4	Covalent [NP]
0.4-1.0	Covalent [MP]
1.0-2.0	Covalent [VP]
≥ 2.0	Ionic

H	Li	Be	B	C	N	O	F	Na	Mg	Al	Si	P	S	Cl
2.1	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0.9	1.2	1.5	1.8	2.1	2.5	3.0
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As
0.8	1.0	1.3	1.5	1.6	1.6	1.5	1.8	1.8	1.8	1.9	1.6	1.6	1.8	2.0
Se	Br	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In
2.4	2.8	0.8	1.0	1.2	1.4	1.6	1.8	1.9	2.2	2.2	1.9	1.9	1.7	1.7
Sn	Sb	Te	I	Cs	Ba	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg
1.8	1.9	2.1	2.5	0.7	0.9	1.3	1.5	1.7	1.9	2.2	2.2	2.4	2.4	1.9
Tl	Pb	Bi	Po	At	Fr	Ra								
1.8	1.8	1.9	2.0	2.2	0.7	0.9								

Table of Electronegativities

The Element List

Actinium		Mercury	Hg
Ac		Molybdenum	Mo
Aluminum	Al	Neilsbohrium	Ns
Americium	Am	Neodyium	Nd
Antimony	Sb	Neon	Ne
Argon	Ar	Neptunium	Np
Arsenic	As	Nickel	Ni
Astatine	At	Niobium	
Barium	Ba	Nb	
Berkelium	Bk	Nitrogen	
Beryllium	Be	N	
Bismuth	Bi	Nobelium	No
Boron	B	Osmium	Os
Bromine		Oxygen	O
Br		Palladium	Pd
Cadmium		Phosphorus	P
Cd		Platinum	
Calcium	Ca	Pt	
Californium	Cf	Plutonium	Pu
Carbon	C	Polonium	Po
Cerium	Ce	Potassium	K
Cesium	Cs	Praeseodymium	Pr
Chlorine		Promethium	Pm
Cl		Protactinium	Pa
Chromium	Cr	Radium	Ra
Cobalt	Co	Radon	Rn
Copper	Cu	Rhenium	
Curium	Cm	Re	
Dysprosium	Dy	Rhodium	
Einsteinium	Es	Rh	
Erbium	Er	Rubidium	Rb
Europium	Eu	Ruthenium	Ru
Fermium		Rutherfordium	Rf
Fm		Samarium	Sm
Fluorine	F	Scandium	Sc
Francium		Selenium	
Fr		Se	
Gadolinium	Gd	Silicon	Si
Gallium	Ga	Silver	Ag
Germanium	Ge	Sodium	Na
Gold	Au	Strontium	Sr
Hafnium	Hf	Sulfur	S
Hahnium		Tantalum	
Ha		Ta	
Hassium	Hs	Technetium	Tc
Helium	He	Tellurium	Te
Holmium		Terbium	Tb
Ho		Thallium	
Hydrogen	H	Tl	
Indium	In	Thorium	Th
Iodine	I	Thullium	
Iridium	Ir	Tm	
Iron	Fe	Tin	Sn
Krypton	Kr	Titanium	
Lanthanum	La	Ti	
Lawrencium	Lr		

Heat Equations

$Q = mH_V$ $Q = mc\Delta T$ $Q = mH_f$

$\Delta H = \Delta H_f(\text{products}) - \Delta H_f(\text{reactants})$

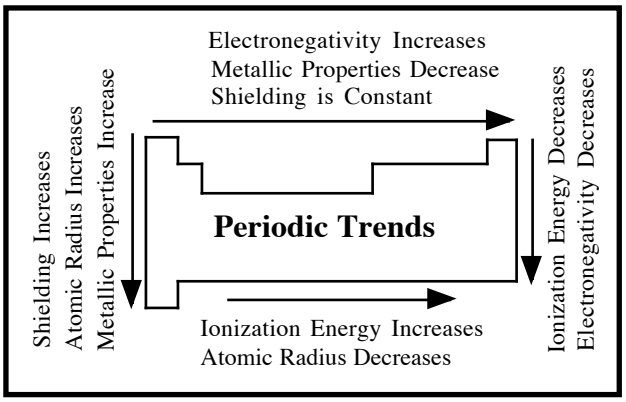
Activity Series (Metals)

Li
K
Ba
Ca
Na
Mg
Al
Mn
Zn
Cr
Fe
Cd
Co
Ni
Sn
Pb
H
Sb
Bi
As
Cu
Hg
Ag
Pt
Au

Buret

Wear Goggles

Wear Apron



Rules for Significant Figures

Significant figures are the digits in any measurement that are known with certainty plus one digit that is uncertain.

Rule 1: In numbers that do not contain zeros, all the digits are significant.

3.1428	[5]	3.14	[3]
469	[3]		

Rule 2: All zeros between significant digits are significant

7.053	[4]	7053	[4]
302	[3]		

Rule 3: Zeros to the left of the first nonzero digit serve only to fix the position of the decimal point and are not significant

0.0056	[2]	0.0789	[3]
0.000001	[1]		

Rule 4: In a number with digits to the right of a decimal point, zeros to the right of the last nonzero digit are significant

43	[2]	43.0	[3]
43.00	[4]	0.00200	[3]
0.40050	[5]		

Rule 5: In a number that has no decimal point, and that ends in zeros (such as 3600), the zeros at the end may or may not be significant (it is ambiguous). To avoid ambiguity express the number in scientific notation showing in the

Selected Constants for H_2O

molar mass.....18.0153 g/mol
normal freezing point.....0.00 °C
normal boiling point.....100.00°C
average specific heat, C_p.....2.06 J/g·°C, solid
4.18 J/g·°C, liquid
2.02 J/g·°C, gas
heat of fusion, ΔH_f.....334 J/g
heat of vaporization, ΔH_V...2260 J/g
molal fp depression, K_f.....1.853 kg·°C/mol
molal bp elevation, K_b.....0.515 kg·°C/mol

Rounding Rules

XY--------> X

When Y > 5, increase X by 1
When Y < 5, don't change X
When Y = 5,
if X is odd, increase X by 1
if X is even, don't change X

Oxidation	Reduction
Loss of e^-	Gain of e^-
gain of O	loss of O

Chemical Naming Cruncher

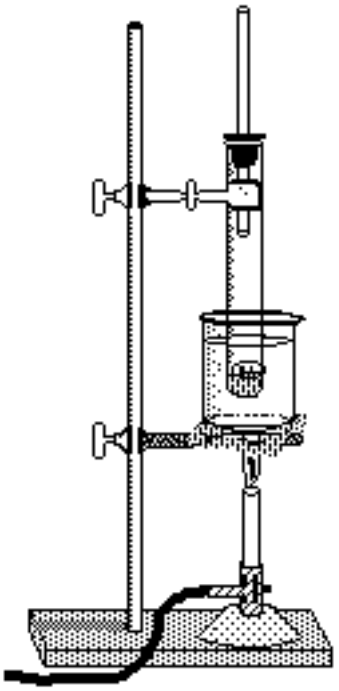
formula has a charge → **yes** → **ION**

no

Wear Goggles

- cations with only one oxidation state are named as the element (Na^{1+} = sodium ion);
- monoatomic anions have an -ide ending (O^{2-} = oxide)

polyatomic and multivalent cations	polyatomic anions
NH_4^{1+}...ammonium	$C_2H_2O_2^{1-}$....acetate
Cu^{1+}.....copper (I), cuprous	CO_3^{2-}.....carbonate
Cu^{2+}.....copper (II), cupric	ClO_3^{1-}..... chlorate
Fe^{2+}.....Iron (II), ferrous	CrO_4^{2-}.....chromate
Fe^{3+}.....Iron (III), ferric	CN^{1-}.....cyanide
Pb^{2+}.....Lead (II), plumbous	HCO_3^{1-}.....bicarbonate
Pb^{4+}.....Lead (IV), plumbic	HSO_4^{1-}.....bisulfate
Sn^{2+}.....tin (II), stannous	MnO_4^{1-}.....permanganate
Sn^{4+}.....tin (IV), stannic	PO_4^{3-}.....phosphate



formula contains only one element → **yes** → **ELEMENT**

no

Some elements exist as molecules

- diatomic HOFBrINCl (say it: hofbrincl!)
- more than two atoms: P_4, S_8

exception: O_3 is ozone

formula contains both carbon and hydrogen (may contain others) → **yes** → **ORGANIC COMPOUND**

no

Organic nomenclature is based on number of carbon atoms in the longest chain.

the alkanes	functional groups
CH_4.....methane	R-OH.....alcohol
C_2H_6....ethane	R-NH_2.....amine
C_3H_8....propane	R-COOH...carboxylic acid
C_4H_{10}..butane	R-O-R.....ether
C_5H_{12}..pentane	R-CO-H.....aldehyde
C_6H_{14}..hexane	R-CO-R.....ketone

substitutions and functional groups use numbers to indicate their position in the carbon chain; prefixes are used for more than one group (example: 2,2,4-trimethylpentane

Wear Apron

first element listed in formula is hydrogen → **yes** → **ACID**

no

Acid names are based on the anion in the acid

if the anion is....	the name of the acid is....	example
root-ide	hydro-root-ic acid	chloride, Cl^{1-} makes hydrochloric acid, $HCl_{(aq)}$
root-ate	root-ic-acid	carbonate, CO_3^{2-} makes carbonic acid, H_2CO_3 (aq)
root-ite	root-ous acid	nitrite, NO_2^{1-}, makes nitrous acid, $HNO_{2(aq)}$

Some molecular compounds dissolve in water to form acids. HCl is a gas unless specified $HCl_{(aq)}$

formula contains only nonmetals and/or hydrogen → **yes** → **BINARY MOLECULAR COMPOUND**

no

Binary molecular compounds use prefixes to indicate the number of atoms in a formula; the name always ends in -ide; mono-is not used except for the second element named.

- the less electronegative element is written and named first
- the more electronegative element is named second with an -ide ending

Greek prefixes

one....mono	three...tri	five.....penta	seven....hepta	nine....nona
two....di	four.....tetra	six.....hexa	eight.....octa	ten.....deca

formula contains anion + cation (metal/nonmetal), may contain polyatomic ions → **yes** → **SALT**

Salts are named as cation + anion

Cation--the name of the element or polyatomic ion; if the cation is multivalent, the oxidation number is indicated by one of the methods below:

- Stock system: include oxidation number in Roman numerals (Cu^{2+} = copper (II))
- traditional: lower oxidation number has -ous ending, higher has -ic ending Cu^{2+} = cupric)

Anion--binary compounds all end in -ide; polyatomic ions have their own names

derivatives of the oxygen-containing anions (end in -ate);

add one oxygen atom	per-root-ate	SO_4^{2-}, sulfate to SO_5^{2-}, persulfate
subtract one oxygen atom	root-ite	NO_3^{1-},nitrate to NO_2^{1-}, nitrite
subtract two oxygen atoms	hypo-root-ite	ClO_3^{1-}, chlorate to ClO^{1-}, hypochlorite

Pipette

indicator

Periodic Table

	1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H 1.0001																		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 15.99	9 F 18.99	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31												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 39.1	20 Ca 40.08		21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 51.99	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.5	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 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.91	54 Xe 131.29
6	55 Cs 132.9	56 Ba 137.33	57-70 *	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po 209	85 At 210	86 Rn 222
7	87 Fr 223	88 Ra 226.03	89-102 **	103 Lr 260	104 Rf 261.1	105 Db 262.1	106 Sg 263.1	107 Bh 264.1	108 Hs 265.1	109 Mt [268]	110 Uun [269]	111 Uuu [272]	112 Uub [277]		114 Uuq [289]		116 Uuh [289]		118 Uuo [293]

*lanthanides	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 145	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.92	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
**actinides	89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	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

1	Hydrogen	H
2	Helium	He
3	Lithium	Li
4	Beryllium	Be
5	Boron	B
6	Carbon	C
7	Nitrogen	N
8	Oxygen	O
9	Fluorine	F
10	Neon	Ne
11	Sodium	Na
12	Magnesium	Mg
13	Aluminum	Al
14	Silicon	Si
15	Phosphorus	P
16	Sulfur	S
17	Chlorine	Cl
18	Argon	Ar
19	Potassium	K
20	Calcium	Ca
21	Scandium	Sc
22	Titanium	Ti
23	Vanadium	V
24	Chromium	Cr
25	Manganese	Mn
26	Iron	Fe
27	Cobalt	Co
28	Nickel	Ni
29	Copper	Cu
30	Zinc	Zn

31	Gallium	Ga
32	Germanium	Ge
33	Arsenic	As
34	Selenium	Se
35	Bromine	Br
36	Krypton	Kr
37	Rubidium	Rb
38	Strontium	Sr
39	Yttrium	Y
40	Zirconium	Zr
41	Niobium	Nb
42	Molybdenum	Mo
43	Technetium	Tc
44	Ruthenium	Ru
45	Rhodium	Rh
46	Palladium	Pd
47	Silver	Ag
48	Cadmium	Cd
49	Indium	In
50	Tin	Sn
51	Antimony	Sb
52	Tellurium	Te
53	Iodine	I
54	Xenon	Xe
55	Caesium	Cs
56	Barium	Ba
57	Lanthanum	La
58	Cerium	Ce
59	Praseodymium	Pr
60	Neodymium	Nd

61	Promethium	Pm
62	Samarium	Sm
63	Europium	Eu
64	Gadolinium	Gd
65	Terbium	Tb
66	Dysprosium	Dy
67	Holmium	Ho
68	Erbium	Er
69	Thulium	Tm
70	Ytterbium	Yb
71	Lutetium	Lu
72	Hafnium	Hf
73	Tantalum	Ta
74	Tungsten	W
75	Rhenium	Re
76	Osmium	Os
77	Iridium	Ir
78	Platinum	Pt
79	Gold	Au
80	Mercury	Hg
81	Thallium	Tl
82	Lead	Pb
83	Bismuth	Bi
84	Polonium	Po
85	Astatine	At
86	Radon	Rn
87	Francium	Fr
88	Radium	Ra
89	Actinium	Ac
90	Thorium	Th

91	Protactinium	Pa
92	Uranium	U
93	Neptunium	Np
94	Plutonium	Pu
95	Americium	Am
96	Curium	Cm
97	Berkelium	Bk
98	Californium	Cf
99	Einsteinium	Es
100	Fermium	Fm
101	Mendelevium	Md
102	Nobelium	No
103	Lawrencium	Lr
104	Rutherfordium	Rf
105	Dubnium	Db
106	Seaborgium	Sg
107	Bohrium	Bh
108	Hassium	Hs
109	Meitnerium	Mt
110	Ununnillium	Uun
111	Unununium	Uuu
112	Ununbium	Uub
113	********	
114	Ununquadium	Uuq
115	********	
116	Ununhexium	Uuh
117	********	
118	Ununoctium	Uuo
119	********	
120	********	

Dmitri Mendeleyev-developed first periodic table
Periodic Law - The properties of elements are a periodic function of their atomic numbers.
Moseley-Discovered atomic numbers by bombarding atoms with x-rays.
Atomic No.-The number of protons in the nucleus.
Atomic Weight-The average weight(mass) of an atom of an element as determined from naturally occuring mixture of the elements
Carbon-12 - The isotope of carbon used as a standard for atomic weights. One atom of carbon-12 has a mass of exactly 12.0000000 amu's.
AMU- Atomic Mass Unit

Ionization Energy- Energy needed to remove the most loosely bound electron from an atom.

$$X + I.E. \text{ ------> } X^{+1} + 1e^{-}$$

Electron Affinity- Energy released when an atom accepts an electron into its valence shell.

$$X + 1e^{-} \text{ ------> } X^{-1} + EA$$

Electronegativity- The ability of an atom to attract electrons in a bond.
Shielding (Screening)- The ability of the kernel electrons to reduce the attraction of the nucleus for the valence electrons.
Covalent Atomic Radius- Half the distance between two identical nuclei in a covalent bond.
VAN der Walls Radius- Half the distance between two adjacent nuclei in a crystal in which they are not sharing electrons.

Trends of the Periodic Table (based on increasing At. No.)

	Row	Group
Ionization energy	Increases	Decreases
Electronegativity	Increases	Decreases
Metallic Properties	Decreases	
Increases		
Nonmetallic Prop.	Increases	Decreases
Atomic Radius	Decreases	
Increases		

Group Names & Characteristics
Group 1- Alkali Metals -Very Reactive
Group 2 -Alkaline Earth Metals - Reactive
Group 17- Halogens - Contains solids, liq. & gases Active
Group 18- Noble Gases-All monatomic. Unreactive
Groups 3 to11-Transition Metals - Incomplete d sublevels, colored compounds, variable ox. nos.

Metals- Left of stairs, Solids except Hg, malleable,ductile,good conductors.
Nonmetals- Right of stairs, Tend to be molecular, covalent bonding, gases or soft liguids, some are diatomic (HOFBrINCl)
Metalloids-have both metllic and nonmetallic properties, Si,Ge,As,and Sb are used extensively in the electronics industry to make semiconductors.