

## Unit 4A Ionic, Covalent, and Acid Naming Test SG

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- Test structure -  $\frac{1}{3}$  multiple choice,  $\frac{1}{3}$  name  $\rightarrow$  formula,  $\frac{1}{3}$  formula  $\rightarrow$  name
- Category A and B (Ionic Compound Naming) = majority of test, covalent compound naming (category C) = small portion of test, acid naming = very small portion of test

### Ion Formation, Polyatomic Ions, & Ionic Formulas

- Valence electrons
  - **Definition:** electrons at the outermost shell of an atom (highest energy), participate in bonding and reactions
  - For a main group, there is the same # of valence electrons as the group/column number
  - Valence electrons are the **s & p electrons** in the highest principal energy level (n)
    - They cannot be d or f since d sublevels are always one behind, f sublevels are always 2 behind the principal energy level
    - All d & f sublevels will have **2 valence electrons** unless you are an exception
    - e.g. [Se]  $6s^2 4f^1$  has 2 valence electrons, only in the 6s subshell
  - Losing valence electrons helps an element be more like a noble gas
    - Helium (a noble gas) is an exception, it only has 2 valence electrons but does not form bonds (a normal noble gas has 8 valence electrons, but helium = exception)

1<sup>+</sup>

2<sup>+</sup>

3<sup>+</sup>

4<sup>+</sup>

3<sup>-</sup>

2<sup>-</sup>

1<sup>-</sup>

0

Many of the transition metals can take multiple charges. The transition metals are ignored in this trend.

Those outside the highlighted box in the 3-, 2-, and 1- columns can be assumed to have a 3- charge, 2- charge, and 1- charge respectively for this test.

1	2											3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18				
H	He											B	C	N	O	F	Ne														
Li	Be											Al	Si	P	S	Cl	Ar														
Na	Mg											Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr				
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr														
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe														
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn														
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uuq	Uup	Uuh	Uus	Uuo														
																		58	59	60	61	62	63	64	65	66	67	68	69	70	71
																		Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
																		Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

- Naming Monatomic Ions (**Cations**)
  - When naming a cation **individually and by itself**: name the element as is and add the word "ion" after it to indicate that the atom is charged.
    - E.g. Sodium  $\rightarrow$  Sodium ion
  - Some metals can form **cations** with different charges depending on the situation. Thus, **roman numerals** are needed to specify the charge of the **cation**.
    - E.g.: copper (Cu) can form multiple ions.
    - $\text{Cu}^{1+}$  would be copper (I) ion,  $\text{Cu}^{2+}$  = copper (II) ion
    - The roman numeral indicates the (+) charge
      - It can never be negative from the definition of a cation

- Roman numerals are only needed for **CATIONS**

- Naming Monatomic Ions (**Anions**)

- When naming anions, change the ending of an atom to “-ide” to indicate a **negatively** charged ion. Technically, it is more accurate to say nitride **ion**, but nitride **by itself** is also **sufficient** to describe that it is negatively charged.
  - $C^{4-}$ : carbon  $\rightarrow$  carbon  $\rightarrow$  carbide
  - $N^{3-}$ : nitride,  $H^{-}$ : hydride

- Polyatomic Ions

- An ion composed of multiple (2 or more) atoms
- **-ide/ate** on the name of the compound indicates that the compound contains a polyatomic anion
- A group of atoms that are covalently bonded to each other and collectively form a **net charge**, either positive or negative
- You cannot just distribute polyatomic ions. For example,  $(CO_3)_2$  would NOT be  $C_2O_6$ .
- Just a (-) in the exponent symbolizes a charge of 1- for the whole polyatomic ion, NOT JUST one element.
- You should **NEVER modify** or change a polyatomic ion's name, e.g. from nitrate to nitride. **Keep the name as is** since the name for the polyatomic ion has the polyatomic ion **already charged**.

Polyelemental (polyatomic) ions

1+	1-	2-
Ammonium, $NH_4^+$	Hydroxide, $OH^-$	Carbonate, $CO_3^{2-}$
	Bicarbonate (hydrogen carbonate), $HCO_3^-$	Sulfate, $SO_4^{2-}$
3-	Cyanide, $CN^-$	Sulfite, $SO_3^{2-}$
	Chlorate, $ClO_3^-$	Chromate, $CrO_4^{2-}$
Phosphate, $PO_4^{3-}$	Bromate, $BrO_3^-$	Dichromate, $Cr_2O_7^{2-}$
	Nitrate, $NO_3^-$	Oxalate, $C_2O_4^{2-}$
	Nitrite, $NO_2^-$	
	Permanganate, $MnO_4^-$	
	Acetate, $C_2H_3O_2^-$ , $CH_3COO^-$	

- Highlighted polyatomic ions and their names should be **memorized** for the test.
  - <https://knowt.com/study/flashcards/b3709ff6-a623-4624-b800-af2dbb0eef93/review>
  - Test will NOT include a table of polyatomic ions
- Check Polyatomic if the subscript is on the bottom, not on the top
  - $NO_3^-$  is NOT nitrate ion ( $NO_3^-$ )

- Oxyanions

- A series of anions containing an element with different numbers of oxygen atoms
- When there are two possible combinations with oxygen...
  - The one with **more oxygen atoms** ends in “-ate”
  - The one with **less oxygen atoms** ends in “-ite”
- If there's even more or even less, you would use...
  - Hypo- prefix for even less oxygen atoms
  - Per- prefix for even more oxygen atoms

- Ionic compounds (also called salt)

- Built by electrons transferred, and made of (+) cations and (-) anions, such that the **TOTAL CHARGE** is neutral (0 charge)
    - E.g.: NaCl is an ionic compound, since Na has 1+ charge and Cl has 1- charge, and the total charge balances to 0
  - Ionic compounds form a **crystal lattice** structure, a repeating three-dimensional arrangement of ions. The lattice consists of cations and anions held together by electrostatic forces of attraction (ionic bonds).
  - Ionic compounds do **NOT** consist of discrete molecules like covalent compounds do. Instead, the entire structure is a **continuous** network of ions.
  - The formula for an ionic compound is the lowest/simplest ratio of ions needed to make a neutral compound
    - E.g. 3 Cl and 3 Na would be reduced to 1 Na and 1 Cl, even though we know that there's infinite of each (crystal lattice, repeating structure)
    - This ratio is called a **formula unit** - the smallest ratio of ions in a formula
  - Names and formulas in an ionic compound list the cation first, and the anion second (e.g. NaCl -> sodium chloride)
  - Properties of Ionic Crystals / salts
    - Hard, brittle, high melting points, poor/bad conductors of heat/electricity, unless dissolved aqueously
  - Writing Ionic Formulas - Criss Cross method
    - Determine charge on the cation and the charge on the anion
    - Write the chemical symbols of each ion - cation first, anion second
    - Cross over charge numbers as subscripts (Such that the ionic compound is overall neutral)
      - Essentially: how many cations (e.g. Pb) and anions (e.g. O) do I need to balance out the ionic compound?
    - Simplify as necessary
      - Simplest **whole number** ratio (e.g. Pb<sub>2</sub>O<sub>4</sub> -> PbO<sub>2</sub>)

$$\text{Pb}^{4+} \quad \text{O}^{2-}$$

$$\text{Pb}^{4+} \quad \text{O}^{2-}$$

$$\text{Pb}_2\text{O}_4$$

$$\text{PbO}_2$$
  - If you have multiple of a polyatomic ion like 2 of OH<sup>-</sup>: use **parentheses**: e.g. Mn<sup>2+</sup> and OH<sup>-</sup> -> Mn(OH)<sub>2</sub>
  - If you have just one polyatomic ion, it is NOT NECESSARY.
- The **first element** is **ALWAYS** the **cation** **UNLESS** it is NH<sub>4</sub> (ammonium, the only (+) polyatomic ion). Everything AFTER is the **anion**.

## Naming Ionic Compounds

- Note: The charge of an **anion** does **NOT** vary in most cases. When talking about Category A, B, C naming, we are talking about the cation, NOT the anion.
  - Anions' charge can still be expected by the regular 4-, 3-, 2-, 1- rule.
  - **Hydrogen** can be either **1+ OR 1-**, so hydrogen CAN BE an **anion**.
- You can **identify** the cation's category based on its **placement** on the **periodic table**.
- Category C does not involve ions. You identify the category by the first element listed in the chemical formula.

Periodic Table of the Elements																		18															
1																	18																
IA																	IVA																
1	2															16	17	18															
H	He															Ne	Ar	Kr	Xe	Rn													
3	4															5	6	7	8	9	10	11	12	13	14	15	16	17	18				
Li	Be															B	C	N	O	F	Ne	Na	Mg	Al	Si	P	S	Cl	Ar				
11	12															19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Na	Mg															K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68				
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd				
87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116				
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	Cs	Ba	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl				
85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115			
Cs	Ba	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	Fr	Ra	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm			
85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116		
Fr	Ra	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118		
119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150		
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182		
183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	
183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	
217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	
257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	
297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	
337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	
377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	
427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	
467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	
507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	
547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	
587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	
627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	
667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	
707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	
747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	
787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	
827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	
867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	
907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	
947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	
967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	
1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	
1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	
1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	
1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	
1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	
1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	
1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	
1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	
1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	
1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	
1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	
1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	12			

Category A	Category B	Category C
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- Category A, B, C elements must be memorized (which elements are in what category). Periodic table will be provided on the test
- Note: at times it is easy to mess up similar names. Sulfate and sulfite are polyatomics and not the same. Sulfide is just a regular sulfur ion with charge 2-, not a polyatomic ion.
- **Category A** cations
  - Metals (cations) that form **one kind** of ion (e.g. Na is a category A cation since it can only form a  $\text{Na}^+$  ion).
  - Category A also includes **polyatomic ions** since they always have the same charge
    - Put even more simply,  $\text{NH}_4^+$  is the only polyatomic cation, so it is the only category A polyatomic ion.
  - Cation is listed first, then the anion
  - Monatomic cation = name of element as is
  - Monatomic **anion** = root + **ide**
    - If **anion** is **polyatomic**, do **NOT** change its name

# Category A:

## Metals that form one ion

These metals only form one ion and therefore you do not need to put the charge in the name since the charge will always be the same.

+1										+2										+3										-3	-2	-1	He																																																																																																																																	
1	H									Li									Be									B									C									N									O									F									Ne																																																																																									
11	Na									Mg									Al									Si									P									S									Cl									Ar																																																																																																		
19	K									Ca									Sc									Ti									V									Cr									Mn									Fe									Co									Ni									Cu									Zn									Ga									Ge									As									Se									Br									Kr								
37	Rb									Sr									Y									Zr									Nb									Mo									Tc									Ru									Rh									Pd									Ag									Cd									In									Sn									Sb									Te									I									Xe								
55	Cs									Ba									La									Hf									Ta									W									Re									Os									Ir									Pt									Au									Hg									Tl									Pb									Bi									Po									At									Rn								
87	Fr									Ra									+Ac									Rf									Ha									Sg									Ns									Hs									Mt									110									111									112									113																																																					

Also included is the one polyatomic anion:  $\text{NH}_4^+$  (ammonium)



- **Ternary** compound - made of three or more different elements (because the compound has one or more polyatomic ions)
  - E.g.  $\text{NH}_4\text{F}$  - ammonium fluoride,  $\text{Ca}(\text{NO}_3)_2$  - calcium nitrate,  $\text{FeSO}_3$  -> iron (II) sulfite
- Net charge **still has to be 0**, since they are still ionic compounds

## Naming Covalent Compounds

- Recall: Ionic Bond = cations + anions **OR EQUIVALENTLY** metals + nonmetals
  - Most cations = metals, most anions = nonmetals
- Covalent Bond = metalloid + nonmetal **OR** nonmetal + nonmetal
  - No "ions" that are combined; rather, atoms share electrons to achieve stable electron configurations
  - DO NOT simplify formulas for category C because they represent actual **molecular** ratios (Category C cations form molecules), not just the ratio of atoms.
- Covalent Nomenclature/Naming (**Category C**)
  - Name the first element
    - Use the full name of the first element.
    - Add a **prefix** if there is **more than one atom** of the element (do **NOT** use "mono-" for the first element if there is only one atom).
  - Name the second element
    - Change the ending of the second element to **"-ide"**.
    - Always use a **prefix** to indicate the number of atoms, **EVEN IF** there is only one atom of the second element.
  - Mono prefix: only used on second element
  - Examples
    - $\text{NO}$  - nitrogen monoxide
    - $\text{NO}_2$  - nitrogen dioxide
    - $\text{N}_2\text{O}$  - dinitrogen monoxide
    - $\text{N}_2\text{O}_3$  - dinitrogen trioxide
    - $\text{SF}_6$  - sulfur hexafluoride (**NOT** monosulfur hexafluoride)
  - Prefixes (memorize!):

# of atoms	Prefix		# of atoms	Prefix
1	mono-		6	hexa-
2	di-		7	hepta-
3	tri-		8	octa-
4	tetra-		9	nona-
5	penta-		10	deca-

- Double Vowels
  - When **ao** or **oo** occur together, drop the **first vowel**
  - Mg\_10 O\_10: dec**a**oxide → dec**o**xide
  - Only valid for **ao** and **oo**, if it is **io** or **ia**, you keep both
- Category C: covalent naming
  - Element listed first determines if it's in category C or not
  - Mostly nonmetals/semimetals
  - No polyatomic ions to worry about

## Naming Acids

- Acid formulas will start with a **Hydrogen atom** (HCl, HNO<sub>3</sub>, HNO<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>) as the cation
- Acids belong to Category C (covalent compounds) because their chemical bonds are primarily **covalent** but when they dissociate in water, they form ions.
- When the anion does **NOT** contain **Oxygen**: (usually just 2 elements)
  - Use the prefix **hydro** + root of the anion's name – **ic** + “acid”
  - Example: HCl = hydrochlor**ic** acid; HBr- hydrobrom**ic** acid
- When the anion **DOES** contain **Oxygen** (3 or more elements)
  - The name will depend on the name of the polyatomic anion.
  - Do **NOT** use the prefix hydro!!!
  - If the anion ends in ATE → change the name to end in **IC + acid**
  - If the anion ends in ITE → change the name to end in **OUS + acid**
  - ATE → IC
  - ITE → OUS
  - Examples
    - H<sub>2</sub> SO<sub>4</sub>: SO<sub>4</sub> has an overall charge of 2-, so you need 2 hydrogen atoms (since hydrogen has a 1+ charge)
      - Anion is sulf**ate**, so the name of the acid ends in **ic** → sulfur**ic** acid
    - H<sub>2</sub> SO<sub>3</sub>: anion is sulf**ite**, so the name of the acid ends in **ous** → sulfur**ous** acid
  - Acids must be **neutral** overall. The number of H<sup>+</sup> ions needed equals the absolute value of the anion's charge. Each Hydrogen ion contributes a 1+ charge. Add enough H<sup>+</sup> ions to balance the charge of the anion. Write the formula with the hydrogen atoms first, followed by the anion
    - H<sub>2</sub> SO<sub>4</sub>: SO<sub>4</sub> has an overall charge of 2-, so you need 2 hydrogen atoms (since hydrogen has a 1+ charge)

## Helpful References and Tables

Periodic Table of the Elements

Category A	Category B	Category C
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### Polyelemental (polyatomic) ions

1+	1-	2-
Ammonium, $\text{NH}_4^+$	Hydroxide, $\text{OH}^-$ Bicarbonate (hydrogen carbonate), $\text{HCO}_3^-$ Cyanide, $\text{CN}^-$ Chlorate, $\text{ClO}_3^-$ Bromate, $\text{BrO}_3^-$ Nitrate, $\text{NO}_3^-$ Nitrite, $\text{NO}_2^-$ Permanganate, $\text{MnO}_4^-$ Acetate, $\text{C}_2\text{H}_3\text{O}_2^-$ , $\text{CH}_3\text{COO}^-$	Carbonate, $\text{CO}_3^{2-}$ Sulfate, $\text{SO}_4^{2-}$ Sulfite, $\text{SO}_3^{2-}$ Chromate, $\text{CrO}_4^{2-}$ Dichromate, $\text{Cr}_2\text{O}_7^{2-}$ Oxalate, $\text{C}_2\text{O}_4^{2-}$

Many of the transition metals can take multiple charges. The transition metals are ignored in this trend.

Those outside the highlighted box in the 3-, 2-, and 1- columns can be assumed to have a 3- charge, 2- charge, and 1- charge respectively for this test.

Trends for Ionic Charge