

Memorize this page this summer!

IONS LIST

acetate	$C_2H_3O_2^-$	ferric	Fe^{3+} (yellow)	oxalate	$C_2O_4^{2-}$
aluminum	Al^{3+}	ferrous	Fe^{2+} (green)	oxide	O^{2-}
ammonium	NH_4^+	fluoride	F^-	perbromate	BrO_4^-
barium	Ba^{2+}	hydrogen	H^+	perchlorate	ClO_4^-
bicarbonate	HCO_3^-	hydronium	H_3O^+	periodate	IO_4^-
bisulfate	HSO_4^-	hydroxide	OH^-	permanganate	MnO_4^- (purple)
bisulfide	HS^-	hypobromite	BrO^-	peroxide	O_2^{2-}
bisulfite	HSO_3^-	hypochlorite	ClO^-	phosphate	PO_4^{3-}
bromate	BrO_3^-	hypoiodite	IO^-	phosphide	P^{3-}
bromide	Br^-	iodate	IO_3^-	phosphite	PO_3^{3-}
bromite	BrO_2^-	iodide	I^-	potassium	K^+
calcium	Ca^{2+}	iodite	IO_2^-	silver	Ag^+
carbonate	CO_3^{2-}	lead	Pb^{2+}	sodium	Na^+
chlorate	ClO_3^-	lithium	Li^+	stannic	Sn^{4+}
chloride	Cl^-	magnesium	Mg^{2+}	stannous	Sn^{2+}
chlorite	ClO_2^-	manganese	Mn^{2+}	strontium	Sr^{2+}
chromate	CrO_4^{2-} (yellow)	mercuric	Hg^{2+}	sulfate	SO_4^{2-}
chromium	Cr^{3+}	mercurous	Hg_2^{2+}	sulfide	S^{2-}
cupric	Cu^{2+} (blue)	nickel	Ni^{2+} (green)	sulfite	SO_3^{2-}
cuprous	Cu^+ (green)	nitrate	NO_3^-	thiocyanate	SCN^-
cyanide	CN^-	nitride	N^{3-}	thiosulfate	$S_2O_3^{2-}$
dichromate	$Cr_2O_7^{2-}$ (orange)	nitrite	NO_2^-	zinc	Zn^{2+}

SOLUBILITY RULES

Always soluble:

alkali metal ions (Li^+ , Na^+ , K^+ , Rb^+ , Cs^+), NH_4^+ ,
 NO_3^- , ClO_3^- , ClO_4^- , $C_2H_3O_2^-$, HCO_3^-

Generally soluble: (mnemonics)

Cl^- , Br^- , I^- Soluble except Ag^+ , Pb^{2+} , Hg_2^{2+} (AP/H)
 F^- Soluble except Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+} , Mg^{2+}

(CBS-PM)
 SO_4^{2-} Soluble except Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+} (CBS/PBS)

Generally insoluble:

O^{2-} , OH^- Insoluble except alkali metal ions and NH_4^+
 Ca^{2+} , Sr^{2+} , Ba^{2+} (CBS) somewhat soluble

CO_3^{2-} , PO_4^{3-} , S^{2-} , SO_3^{2-} , $C_2O_4^{2-}$, CrO_4^{2-}
 Insoluble except alkali metals and NH_4^+

GASES THAT FORM

$\rightarrow H_2CO_3 \rightarrow CO_2 + H_2O$ $\rightarrow NH_4OH \rightarrow NH_3 + H_2O$
 $\rightarrow H_2SO_3 \rightarrow SO_2 + H_2O$ $\rightarrow H_2S$
 $\rightarrow 2HNO_2 \rightarrow NO + NO_2 + H_2O$ $\rightarrow HCN$

WEAK ELECTROLYTES

Weak Acids (esp. $HC_2H_3O_2$ and HF)

(Memorize the 8 strong acids... all others are weak)

HCl	hydrochloric acid	HNO_3	nitric acid
HBr	hydrobromic acid	HIO_4	periodic acid
HI	hydroiodic acid	H_2SO_4	sulfuric acid
$HClO_4$	perchloric acid	$HClO_3$	chloric acid

Ammonium Hydroxide ($NH_4OH \approx NH_3(aq)$) Water (H_2O)

DRIVING FORCES — Double Replacement

- Insoluble Solid (Precipitate)
- Weak Electrolyte (H_2O or Weak Acid)
- Gas Formation

STRONG OXIDIZERS (Oxidizing Agents)

MnO_4^- in acid solution $\rightarrow Mn^{2+} + H_2O$
 MnO_2 in acid solution $\rightarrow Mn^{2+} + H_2O$
 MnO_4^- in neutral or basic sol'n $\rightarrow MnO_2$
 $Cr_2O_7^{2-}$ in acid solution $\rightarrow Cr^{3+} + H_2O$
 $Cr_2O_7^{2-}$ with a base $\rightarrow CrO_4^{2-} + H_2O$
 CrO_4^{2-} in basic solution $\rightarrow CrO_2^- + H_2O$
 HNO_3 , concentrated $\rightarrow NO_2 + H_2O$
 HNO_3 , dilute (e.g. 6 M) $\rightarrow NO + H_2O$
 H_2SO_4 , hot, concentrated $\rightarrow SO_2 + H_2O$
 Free halogens (e.g. Cl_2) \rightarrow halide ions (Cl^-)
 H_2O_2 in acid solution $\rightarrow H_2O$
 Note: H_2O_2 decomposes $\rightarrow H_2O + O_2$
 Na_2O_2 $\rightarrow NaOH$
 $HClO_4$ $\rightarrow Cl^- + H_2O$

Other Oxidizers

Metal-"ic" ions (e.g. Sn^{4+} , Fe^{3+}) \rightarrow "-ous" ions (Sn^{2+} , Fe^{2+})
 H_2O $\rightarrow H_2 + OH^-$

STRONG REDUCERS (Reducing Agents)

Halide ions (e.g. Cl^-) \rightarrow Free halogen (Cl_2)
 Free metals \rightarrow metal ions
 "ites" SO_3^{2-} or SO_2 , NO_2^- \rightarrow "ates" SO_4^{2-} , NO_3^-
 Free halogens, dil. basic sol'n \rightarrow hypohalite ions (ClO^-)
 Free halogens, conc. basic sol'n \rightarrow halate ions (ClO_3^-)
 $S_2O_3^{2-}$ $\rightarrow S^{4+} + O_2^{2-}$

Other Reducers

Metal-"ous" ions (e.g. Sn^{2+}) \rightarrow "-ic" ions (Sn^{4+})
 H_2O $\rightarrow O_2 + H^+$