

# STUFF I SHOULD KNOW FOR THE AP TEST BUT DO NOT KNOW YET

## 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 ( $ClO_3^-$ )
$S_2O_3^{2-}$	$\rightarrow S_4O_6^{2-}$

*Other Reducers*

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