

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

## IONS LIST

acetate	$C_2H_3O_2^-$	ferric	$Fe^{3+}$	oxalate	$C_2O_4^{2-}$
aluminum	$Al^{3+}$	ferrous	$Fe^{2+}$	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	$Cu^+$ (blue)	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 ( $Li^+$ ,  $Na^+$ ,  $K^+$ ,  $Rb^+$ ,  $Cs^+$ ),  $NH_4^+$ ,  
 $NO_3^-$ ,  $ClO_3^-$ ,  $ClO_4^-$ ,  $C_2H_3O_2^-$

*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 and alkali metals, 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

$\rightarrow H_2CO_3 \rightarrow CO_2 + H_2O$        $\rightarrow NH_4OH \rightarrow NH_3 + H_2O$

$\rightarrow H_2SO_3 \rightarrow SO_2 + H_2O$        $\rightarrow H_2S$

$\rightarrow HNO_2 \rightarrow NO + NO_2 + H_2O$        $\rightarrow HCN$

## 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 ( $Sn^{4+}$ )

$H_2O$        $\rightarrow O_2 + H^+$