


ACTIVITY SERIES (use for single displacement reactions)

TABLE 4.3 A Partial Activity Series of the Elements

Oxidation Reaction		
Strongly reducing 	$\text{Li} \rightarrow \text{Li}^+ + \text{e}^-$	These elements react rapidly with aqueous H^+ ions (acid) or with liquid H_2O to release H_2 gas.
	$\text{K} \rightarrow \text{K}^+ + \text{e}^-$	
	$\text{Ba} \rightarrow \text{Ba}^{2+} + 2 \text{e}^-$	
	$\text{Ca} \rightarrow \text{Ca}^{2+} + 2 \text{e}^-$	
	$\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$	
Weakly reducing	$\text{Mg} \rightarrow \text{Mg}^{2+} + 2 \text{e}^-$	These elements react with aqueous H^+ ions or with steam to release H_2 gas.
	$\text{Al} \rightarrow \text{Al}^{3+} + 3 \text{e}^-$	
	$\text{Mn} \rightarrow \text{Mn}^{2+} + 2 \text{e}^-$	
	$\text{Zn} \rightarrow \text{Zn}^{2+} + 2 \text{e}^-$	
	$\text{Cr} \rightarrow \text{Cr}^{3+} + 3 \text{e}^-$	
	$\text{Fe} \rightarrow \text{Fe}^{2+} + 2 \text{e}^-$	
Weakly reducing	$\text{Co} \rightarrow \text{Co}^{2+} + 2 \text{e}^-$	These elements react with aqueous H^+ ions to release H_2 gas.
	$\text{Ni} \rightarrow \text{Ni}^{2+} + 2 \text{e}^-$	
	$\text{Sn} \rightarrow \text{Sn}^{2+} + 2 \text{e}^-$	
Weakly reducing	$\text{H}_2 \rightarrow 2 \text{H}^+ + 2 \text{e}^-$	These elements do not react with aqueous H^+ ions to release H_2 .
	$\text{Cu} \rightarrow \text{Cu}^{2+} + 2 \text{e}^-$	
	$\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^-$	
	$\text{Hg} \rightarrow \text{Hg}^{2+} + 2 \text{e}^-$	
	$\text{Pt} \rightarrow \text{Pt}^{2+} + 2 \text{e}^-$	
	$\text{Au} \rightarrow \text{Au}^{3+} + 3 \text{e}^-$	

Activity Series

(in decreasing activity)

Metals

Lithium (Li)	Can react with cold H_2O and acids, replacing hydrogen.
Rubidium (Rb)	
Potassium (K)	
Barium (Ba)	
Strontium (Sr)	
Calcium (Ca)	Can react with steam and acids, not liquid water replacing hydrogen.
Sodium (Na)	
Magnesium (Mg)	
Aluminum (Al)	
Manganese (Mn)	
Zinc (Zn)	
Chromium (Cr)	
Iron (Fe)	
Cadmium (Cd)	
Cobalt (Co)	
Nickel (Ni)	
Tin (Sn)	
Lead (Pb)	
Hydrogen (H)	React with oxygen forming oxides.
Antimony (Sb)	
Bismuth (Bi)	
Copper (Cu)	
Mercury (Hg)	
Silver (Ag)	Fairly unreactive. Form oxides only indirectly.
Platinum (Pt)	
Gold (Au)	

Halogens

Fluorine (F)
Chlorine (Cl)
Bromine (Br)
Iodine (I)

SOLUBILITY RULES (use for double displacement reactions)

Table 17.3 Solubilities of Ionic Compounds* aq = aqueous (dissolves in water); s = solid (does not dissolve in water)

Ions	Acetate	Bromide	Carbonate	Chlorate	Chloride	Fluoride	Hydrogen Carbonate	Hydroxide	Iodide	Nitrate	Nitrite	Phosphate	Sulfate	Sulfide	Sulfite
Aluminum	s	aq		aq	aq	s		s	—	aq		s	aq	—	
Ammonium	aq	aq	aq	aq	aq	aq	aq	—	aq	aq	aq	aq	aq	aq	aq
Barium	aq	aq	s	aq	aq	s		aq	aq	aq	aq	s	s	—	s
Calcium	aq	aq	s	aq	aq	s		s	aq	aq	aq	s	s	—	s
Cobalt(II)	aq	aq	s	aq	aq	—		s	aq	aq		s	aq	s	s
Copper(II)	aq	aq	s	aq	aq	aq		s		aq		s	aq	s	
Iron(II)	aq	aq	s		aq	s		s	aq	aq		s	aq	s	s
Iron(III)	—	aq			aq	s		s	aq	aq		s	aq	—	
Lead(II)	aq	s	s	aq	s	s		s	s	aq	aq	s	s	s	s
Lithium	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	s	aq	aq	aq
Magnesium	aq	aq	s	aq	aq	s		s	aq	aq	aq	s	aq	—	aq
Nickel	aq	aq	s	aq	aq	aq		s	aq	aq		s	aq	s	s
Potassium	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq
Silver	s	s	s	aq	s	aq		—	s	aq	s	s	s	s	s
Sodium	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq
Zinc	aq	aq	s	aq	aq	aq		s	aq	aq		s	aq	s	s

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	RULE	EXCEPTION
ALWAYS DISOLVE	NO_3^- , NH_4^+ , ClO_4^- , ClO_3^-	None
	Cl^- , Br^- , I^-	Ag^+ , Hg_2^{2+} , Cu^+ , Pb^{2+}
	SO_4^{2-}	Ca^{2+} , Sr^{2+} , Ba^{2+} , Hg_2^{2+} , Ag^+
NEVER DISSOLVE	S^{2-}	Ions of group IA, IIA
	CO_3^{2-} , PO_4^{3-} , SO_3^{2-} , CrO_4^{2-}	Ions of group IA
	OH^-	Ba^{2+} , Ca^{2+} , Sr^{2+} , ions of group IA