



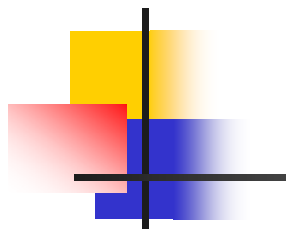
Reactivity of Metals



The Reactivity Series:

- By doing experiments scientists have ranked the reactivity of many metals and their ions.
- The more reactive a metal is, the less reactive its ion is.

*Activity Series for 1.0 mol/L Solution
at 25 °C and 101.325 kPa*



Very
reactive ion

Reduction Half-Reaction			
<u>Au³⁺(aq)</u>	+	3e ⁻	→ <u>Au(s)</u>
H ₂ O ²⁺ (aq)	+	2e ⁻	→ H ₂ (l)

Very stable
atom

So any reaction with Au³⁺ will most likely go \Rightarrow

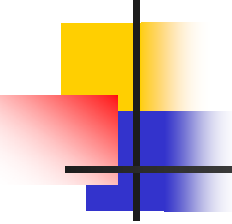
Decreasing strength of reactant as an oxidizing agent	2H ⁺ (aq)	+	2e ⁻	→	H ₂ (g)	Increasing strength of reactant as a reducing agent
	Pb ²⁺ (aq)	+	2e ⁻	→	Pb(s)	
	Sn ²⁺ (aq)	+	2e ⁻	→	Sn(s)	
	Ni ²⁺ (aq)	+	2e ⁻	→	Ni(s)	
	Cd ²⁺ (aq)	+	2e ⁻	→	Cd(s)	
	Fe ²⁺ (aq)	+	2e ⁻	→	Fe(s)	
	Zn ²⁺ (aq)	+	2e ⁻	→	Zn(s)	
	Cr ²⁺ (aq)	+	2e ⁻	→	Cr(s)	
	Al ³⁺ (aq)	+	3e ⁻	→	Al(s)	
	Mn ²⁺ (aq)	+	2e ⁻	→	Mn(s)	

So a reaction involving Li will most likely go

Very stable
ion

Ca ²⁺ (aq)	+	2e ⁻	→	Ca(s)
<u>Li⁺(aq)</u>	+	e ⁻	→	<u>Li(s)</u>

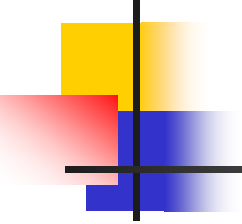
Very reactive
atom

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- Au^{3+} is on the top left of the table which means it is very reactive
 - Au^{3+} is easily reduced to Au metal
 - Au^{3+} is a very strong oxidizing agent
 - Au metal is not easily oxidized to the ion (gold doesn't react with many substances)

- When you read the table from left to right, it is a reduction reaction
- From right to left, it is an oxidation reaction

Reduction Half-Reaction			
$\text{Au}^{3+}(\text{aq})$	+	3e^{-}	$\rightarrow \text{Au}(\text{s})$
$\text{Hg}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Hg}(\text{l})$
$\text{Ag}^{+}(\text{aq})$	+	e^{-}	$\rightarrow \text{Ag}(\text{s})$
$\text{Cu}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Cu}(\text{s})$
$2\text{H}^{+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{H}_2(\text{g})$
$\text{Pb}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Pb}(\text{s})$
$\text{Sn}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Sn}(\text{s})$
$\text{Ni}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Ni}(\text{s})$
$\text{Cd}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Cd}(\text{s})$
$\text{Fe}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Fe}(\text{s})$
$\text{Zn}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Zn}(\text{s})$
$\text{Cr}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Cr}(\text{s})$
$\text{Al}^{3+}(\text{aq})$	+	3e^{-}	$\rightarrow \text{Al}(\text{s})$
$\text{Mg}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Mg}(\text{s})$
$\text{Na}^{+}(\text{aq})$	+	e^{-}	$\rightarrow \text{Na}(\text{s})$
$\text{Ca}^{2+}(\text{aq})$	+	2e^{-}	$\rightarrow \text{Ca}(\text{s})$
$\text{Li}^{+}(\text{aq})$	+	e^{-}	$\rightarrow \text{Li}(\text{s})$

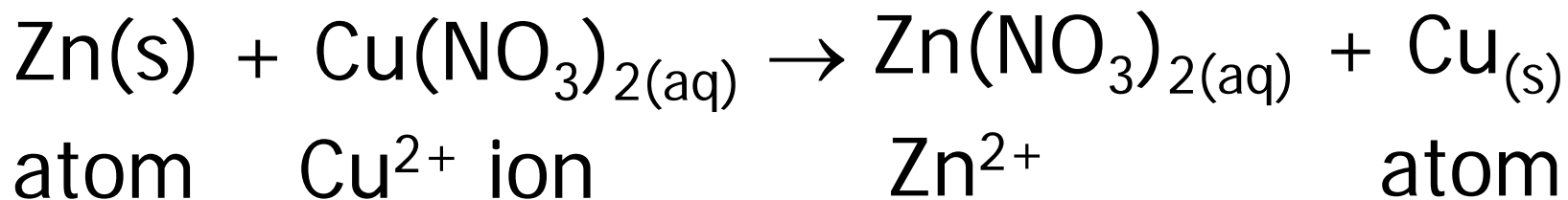
↑
Increasing strength of reactant as an oxidizing agent
↓
Increasing strength of reactant as a reducing agent

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- You can use the Activity Series to predict if whether or not a spontaneous reaction will occur. (i.e. a reaction that occurs on its own with no extra energy added.)



Example

A piece of zinc is added to a solution of copper(II) nitrate. Will a reaction occur?

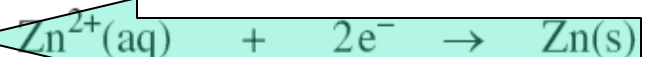
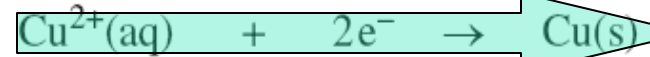
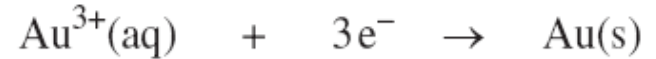


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- Write the possible reduction $\frac{1}{2}$ reactions

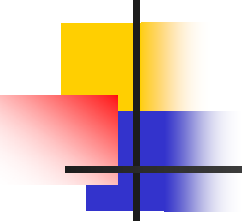




Reduction Half-Reaction



- Cu^{2+} is near the top left which means Cu^{2+} is very reactive and Cu atoms are stable
- Zn(s) atoms are near bottom right which means that Zn atoms are reactive and Zn^{2+} ions are stable

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- Whenever the reduction $\frac{1}{2}$ reaction is above the oxidizing $\frac{1}{2}$ reaction, the reaction is spontaneous



Homework

- P 82: #28, 29

- P83: #31, 32