5. REDOX REACTIONS

UNIT 1 REACTIONS IN AQUEOUS SOLUTIONS

CH40S

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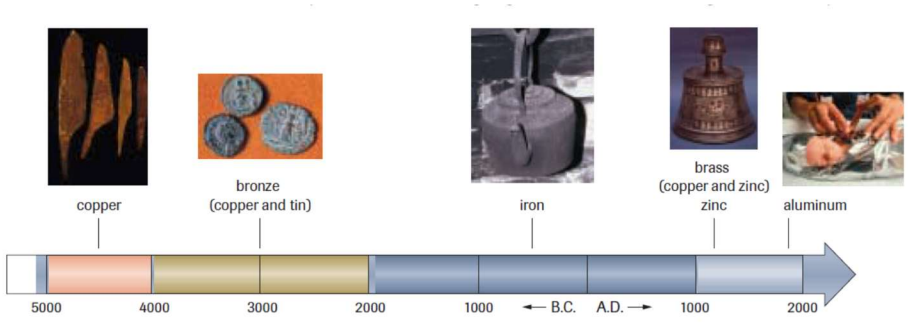
REDOX = REDUCTION + OXIDATION

The historic definitions:

REDUCTION: reducing the volume of a naturally occuring metal ore (ie. $CuO_{(s)}$) into its components and extracting the metal (ie. $Cu_{(s)}$)



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REDOX = REDUCTION + OXIDATION

The historic definitions:

OXIDATION: The reaction of a metal with oxygen in the air, resulting in corrosion.

These definitions are still somewhat true, but not nearly detailed enough for us!

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OBSERVE…

A piece of copper wire, Cu(s), is placed in an aqueous solution of silver nitrate, $AgNO_3(aq)$.

Observations:

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WHAT'S GOING ON?

Write the balanced chemical equation for this reaction:

Write the complete ionic equation for this reaction:

Write the net ionic equation for this reaction:

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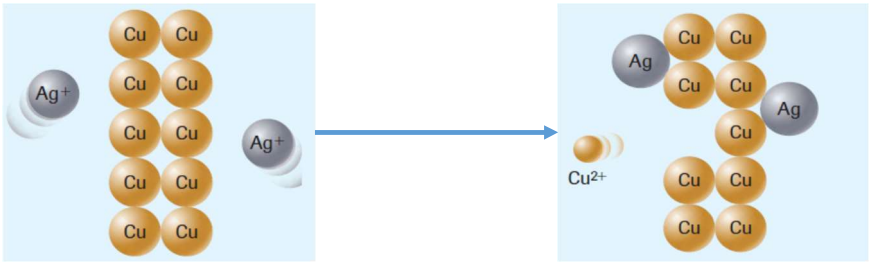
WHAT'S GOING ON?



Losing electrons = oxidation

$$2Ag^{+} + Cu \rightarrow 2Ag + Cu^{2+}$$

Gaining electrons = reduction

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REDOX…

Losing **E**lectrons **O**xidation

Oxidation **I**s **L**osing

Gaining **E**lectrons **R**eduction

Reduction **I**s **G**aining

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PREDICTING REDOX REACTIONS

- An element can only steal electrons from another element if it is "strong" enough.
- The ranking of a chemicals ability to steal electrons is called an Activity Series.
- The lower the element, the better it is at stealing electrons. The higher the element, the better it is at losing electrons.

Metal	Oxidation Reaction
Lithium	$Li(s) \longrightarrow Li^+(aq) + e^-$
Potassium	$K(s) \longrightarrow K^+(aq) + e^-$
Barium	$Ba(s) \longrightarrow Ba^{2+}(aq) + 2e^-$
Calcium	$Ca(s) \longrightarrow Ca^{2+}(aq) + 2e^-$
Sodium	$Na(s) \longrightarrow Na^+(aq) + e^-$
Magnesium	$Mg(s) \longrightarrow Mg^{2+}(aq) + 2e^-$
Aluminum	$Al(s) \longrightarrow Al^{3+}(aq) + 3e^-$
Manganese	$Mn(s) \longrightarrow Mn^{2+}(aq) + 2e^-$
Zinc	$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$
Chromium	$Cr(s) \longrightarrow Cr^{3+}(aq) + 3e^-$
Iron	$Fe(s) \longrightarrow Fe^{2+}(aq) + 2e^-$
Cobalt	$Co(s) \longrightarrow Co^{2+}(aq) + 2e^-$
Nickel	$Ni(s) \longrightarrow Ni^{2+}(aq) + 2e^-$
Tin	$Sn(s) \longrightarrow Sn^{2+}(aq) + 2e^-$
Lead	$Pb(s) \longrightarrow Pb^{2+}(aq) + 2e^-$
Hydrogen	$H_2(g) \longrightarrow 2\,H^+(aq) + 2e^-$
Copper	$Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$
Silver	$Ag(s) \longrightarrow Ag^+(aq) + e^-$
Mercury	$Hg(l) \longrightarrow Hg^{2+}(aq) + 2e^-$
Platinum	$Pt(s) \longrightarrow Pt^{2+}(aq) + 2e^-$
Gold	$Au(s) \longrightarrow Au^{3+}(aq) + 3e^-$

Ease of oxidation increases

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PREDICT A REDOX REACTION

Use the Activity Series to predict the spontaneity of the following reaction.

$$\_\_Al_{(s)} + \_\_Fe_2O_{3(aq)}$$

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Ease of oxidation increases

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PREDICT A REDOX REACTION

Write the balanced chemical equation, the complete ionic equation, and the net ionic equation for the reaction:

$$\_\_Al_{(s)} + \_\_Fe_2O_{3(aq)} \rightarrow$$

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THE THERMITE REACTION

CAUTION: This reaction will reach a temperature of about 3000°C!

$2\ Al + Fe_2O_3 \rightarrow$

Identify the substance being reduced. Prove it!

Identify the substance being oxidized. Prove it!

Thermite Rail Welding

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