Redox Reactions

* Total Ionic Equation:

$$Zn_{(s)} + Cu^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} + Cu_{(s)}$$

* Net Ionic Equation:

* $Zn_{(s)} + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$

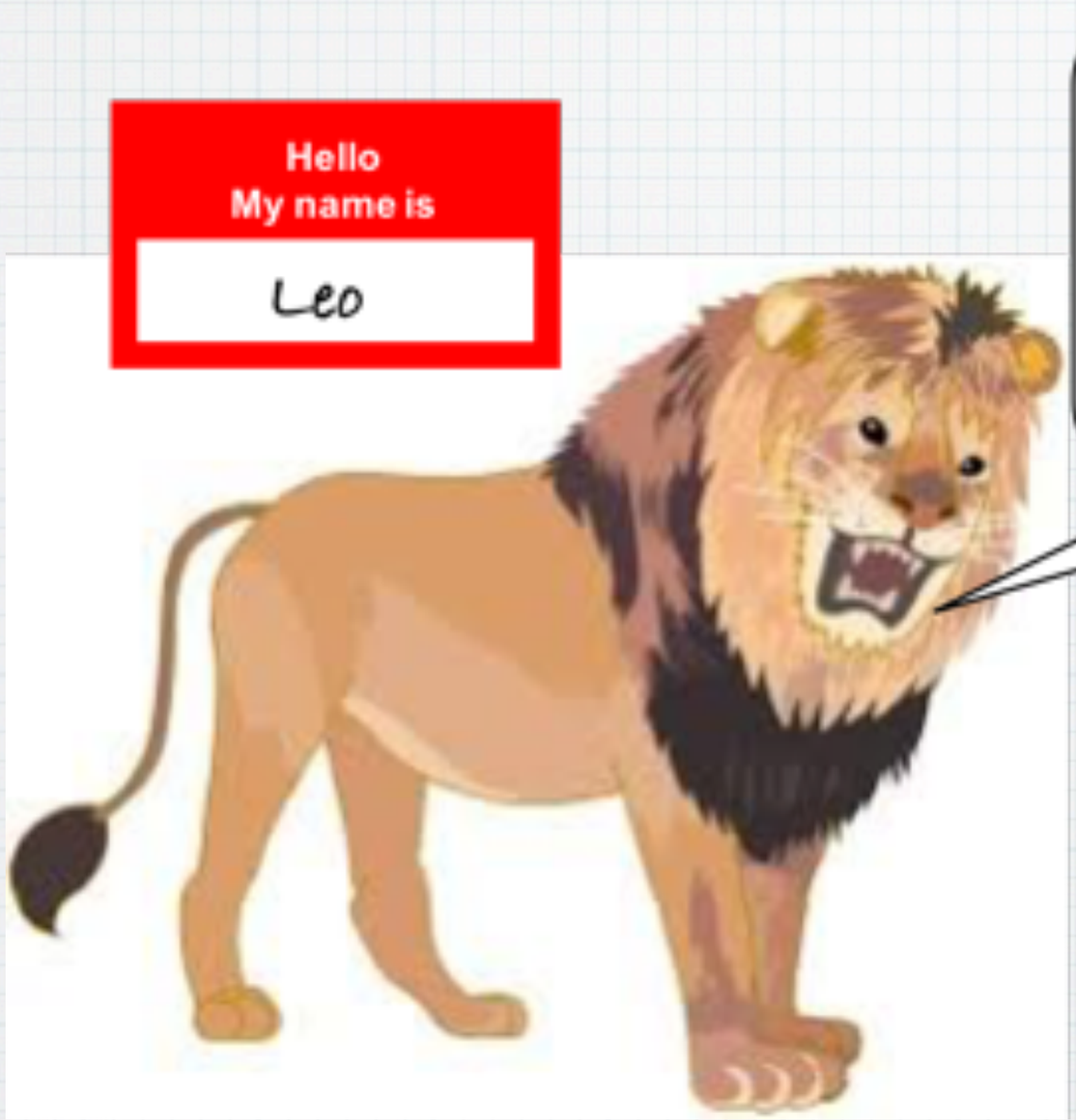
Definitions

* **Reduction:** a process in which chemical entities gain electrons.
  * In the above reaction, Cu^{2+} becomes Cu, a gain of 2 e^- (a reduction)

Definitions

* **Oxidation:** a process in which chemical entities lose electrons.
* In the above reaction, Zn becomes Zn^{2+}, a loss of 2 e^- (an oxidation)

LEO the Lion says GER



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Loss of Electrons Oxidation

Gain of Electrons Reduction

Example

* $Ca_{(s)} + Sn^{2+}_{(aq)} \rightarrow Ca^{2+}_{(aq)} + Sn_{(s)}$

Example

* $Ca_{(s)} + Sn^{2+}_{(aq)} \rightarrow Ca^{2+}_{(aq)} + Sn_{(s)}$

* $Ca_{(s)} \rightarrow Ca^{2+}_{(aq)} + 2\,e^-$ (OXIDATION)

* $Sn^{2+}_{(aq)} + 2\,e^- \rightarrow Sn_{(s)}$ (REDUCTION)

Example

* $4\ Al_{(s)} + 3\ O_{2(g)} \rightarrow 2\ Al_2O_{3(s)}$

Example

* $4\,Al \rightarrow 4\,Al^{3+} + 12\,e^-$ (OXIDATION)

  $Al \rightarrow Al^{3+} + 3\,e^-$

* $3\,O_2 + 12\,e^- \rightarrow 6\,O^{2-}$ (REDUCTION)

* $O_2 + 4\,e^- \rightarrow 2\,O^{2-}$

Covalent Compounds

* $CH_{4(g)} + 2\,O_{2(g)} \rightarrow CO_{2(g)} + 2\,H_2O_{(l)}$
* To identify where electrons are being transferred, oxidation numbers are assigned to each atom and ion in a reaction.
* You can think of these like "apparent" charges

Rules for Assigning Oxidation Numbers

* 1) The OX# of an atoms in an uncombined element is always 0.
  * Ex. P in P_4 has an OX# of 0
* 2) The OX# of a simple ion is the charge of the ion.
  * Ex. Ca^{2+} has an OX# of +2

Rules for Assigning Oxidation Numbers

* 3) The OX# of hydrogen is +1 (except in metal hydrides).
  * Ex. NaH - Na has OX# of +1, H has OX# of -1
* 4) The OX# of oxygen is -2 (except in peroxides).
  * Ex. H_2O_2 - H has OX# of +1, O has OX# of -1

Rules for Assigning Oxidation Numbers

* 5) The OX# of Group I element ions is +1. The OX# of Group II element ions is +2.
* 6) The sum of OX#s in a compound must equal 0.
* 7) The sum of OX#s in a polyatomic ion must equal the charge of the ion.

Example

* NH_3 ON of N =
* $CaCl_2$ ON of Ca =
* MoS_2 ON of Mo =
* $Na_2S_2O_3$ ON of S =
* ClO^- ON of Cl =
* H_3PO_4 ON of P =
* MnO_4^{1-} ON of Mn =

Example

* NH_3 ON of N = -3
* $CaCl_2$ ON of Ca = +2
* MoS_2 ON of Mo = +4
* $Na_2S_2O_3$ ON of S = +2
* H_3PO_4 ON of P = +5
* MnO_4^{1-} ON of Mn = +7

Examples

* $Cr_2O_7^{2-}$ ON of Cr =
* C_3H_8 ON of C =
* C_3H_6O ON of C =
* $Cr(NO_3)_3$ ON of Cr =
* H_2O_2 ON of O =
* $(NH_4)_2CO_3$ ON of C =

Examples

* $Cr_2O_7^{2-}$ ON of Cr = +6
* C_3H_8 ON of C = -8/3
* C_3H_6O ON of C = -4/3
* $Cr(NO_3)_3$ ON of Cr = +3
* H_2O_2 ON of O = -1
* $(NH_4)_2CO_3$ ON of C = +4

Is this a redox reaction?

* $2KI + Pb(NO_3)_2 \rightarrow PbI_2 + 2KNO_3$

Is this a redox reaction?

* $\underset{+1\ -1}{2KI} + \underset{+2\ +5\ -2}{Pb(NO_3)_2} \rightarrow \underset{+2\ -1}{PbI_2} + \underset{+1\ +5\ -2}{2KNO_3}$

Is this a redox reaction?

* $\overset{+1\ -1}{2KI} + \overset{+2\ +5\ -2}{Pb(NO_3)_2} \rightarrow \overset{+2\ -1}{PbI_2} + \overset{+1\ +5\ -2}{2KNO_3}$

No change in oxidation numbers, therefore not a redox reaction.

Is this a redox reaction?

* $4NH_3 + 7O_2 \rightarrow 4NO_2 + 6H_2O$

Is this a redox reaction?

* $\underset{-3\ +1}{4NH_3} + \underset{0}{7O_2} \rightarrow \underset{+4\ -2}{4NO_2} + \underset{+1\ -2}{6H_2O}$

Is this a redox reaction?

* $\underset{-3\ +1}{4NH_3} + \underset{0}{7O_2} \rightarrow \underset{+4\ -2}{4NO_2} + \underset{+1\ -2}{6H_2O}$

N is being oxidized (-3 to +4) and O is being reduced (0 to -2), therefore this IS REDOX

Homework

* p. 586 #4-6
* p. 588 #7,8
* p. 589 #1,3,5,6,8