19-2 Balancing Redox Reactions

* We have learned to write balanced molecular ionic equations & Net ionic equations.

$$ex) \ 2Ag_{(s)} + 2HCl_{(aq)} \longrightarrow 2AgCl_{(aq)} + H_{2\,(g)}$$

$$NIE = 2Ag_{(s)} + 2H^+_{(aq)} \longrightarrow 2Ag^+_{(aq)} + H_{2\,(g)}$$
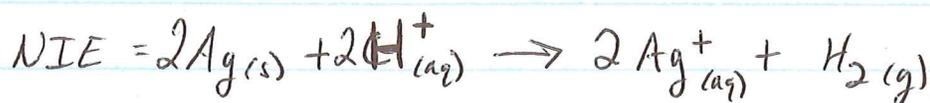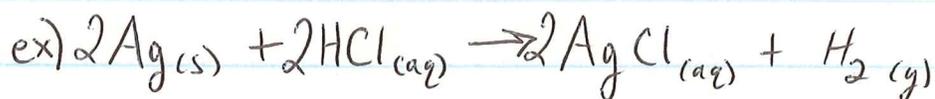
* We have also learned how to recognize <u>oxidation</u> and <u>reduction</u> reactions by observing if oxidation state goes up (LEO) or down (GER).

$$ex) \ 2Ag^0_{(s)} \longrightarrow 2Ag^+_{(aq)} = oxidation \quad (0 \rightarrow +)$$
$$2H^+_{(aq)} \longrightarrow H_{2\,(g)}^0 = reduction \quad (+ \rightarrow 0)$$
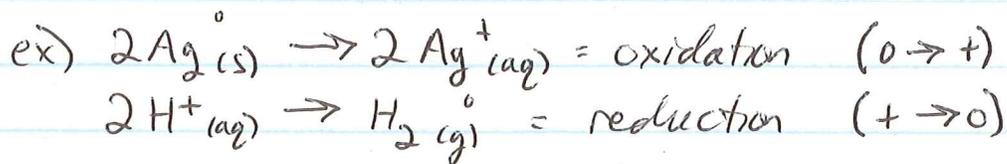
*To get a full understanding of exactly what's happening we need to include electrons into the equation by writing balanced <u>half reactions</u>

- A half reaction shows the oxidation or reduction reaction along with the total # of electrons being gained or lost in the reaction.

ex) For $Ag_{(s)}$ to become $Ag^+_{(aq)}$ it must lose 1 electron in the oxidation

so, the balanced half reaction for the oxidation
of $Ag_{(s)}$ is:

$$2Ag_{(s)} \rightarrow 2Ag^+_{(aq)} + 2e^-$$
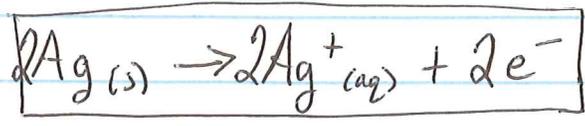
* since only 2 electrons are lost to get a 2(+) charge

- Like wise the balanced half reaction for the
reduction of $2H^+$ is:

$$2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$$
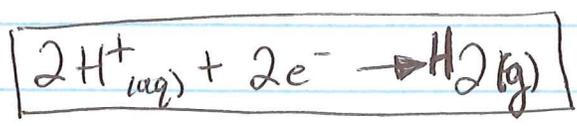
As a rule:

      Oxidations have electrons on the <u>right</u>
of the $\rightarrow$, Reductions have electrons on the
<u>left</u> of the $\rightarrow$.

ex) What are the balanced half reactions for
$2Na_{(s)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + H_{2(g)}$

TIE $2Na_{(s)} + 2H^+_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow 2Na^+_{(aq)} + SO_4^{2-}_{(aq)} + H_{2(g)}$

$2Na_{(s)} + 2H^+_{(aq)} \rightarrow 2Na^+_{(aq)} + H_{2(g)}$

ox = $\boxed{2Na_{(s)} \rightarrow 2Na^+ + 2e^-}$ red = $\boxed{2H^+ + 2e^- \rightarrow H_{2(g)}}$
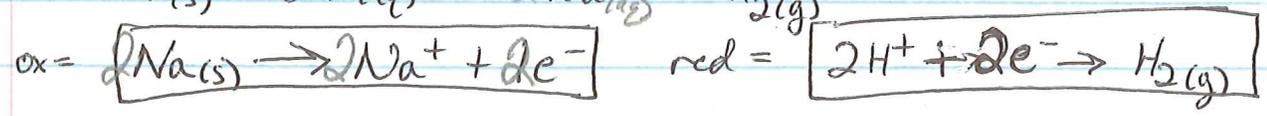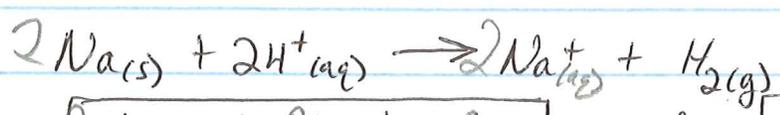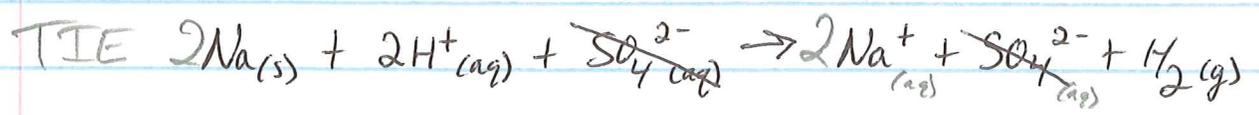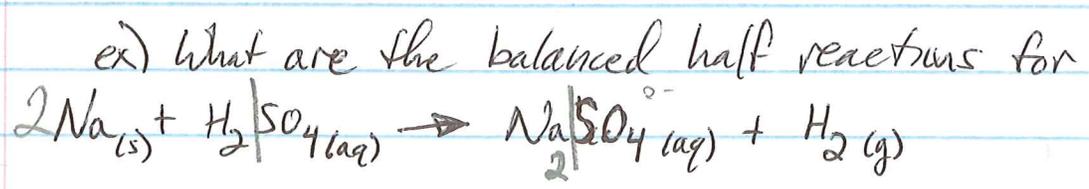
ex) What are the balanced half reactions for the following eqn:

$$Cu_{(s)} + 2HBr_{(aq)} \longrightarrow CuBr_{2\ (aq)} + H_{2\ (g)}$$

TIE $= Cu_{(s)} + 2H^+_{(aq)} + \cancel{2Br^-_{(aq)}} \longrightarrow Cu^{2+}_{(aq)} + \cancel{2Br^-_{(aq)}} + H_{2\ (g)}$

NIE $= Cu_{(s)} + 2H^+_{(aq)} \longrightarrow Cu^{2+}_{(aq)} + H_{2}^{\circ}{}_{(g)}$

(red bracket over right portion, ox bracket under left portion)

Half rxns $=$ ox $= \boxed{Cu_{(s)} \longrightarrow Cu^{2+}_{(aq)} + 2e^-}$ red $= \boxed{2H^+ + 2e^- \longrightarrow H_{2\ (g)}}$

ex) $2Fe_{(s)} + 3H_2SO_{4\ (aq)} \longrightarrow Fe_2(SO_4)_{3\ (aq)} + 3H_{2\ (g)}$

TIE $= 2Fe_{(s)} + 6H^+_{(aq)} + \cancel{3SO_4^{2-}{}_{(aq)}} \longrightarrow 2Fe^{3+}_{(aq)} + \cancel{3SO_4^{2-}{}_{(aq)}} + 3H_{2\ (g)}$

NIE $= 2Fe_{(s)} + 6H^+_{(aq)} \longrightarrow 2Fe^{3+}_{(aq)} + 3H_{2\ (g)}$

(red bracket over right portion, ox bracket under left portion)

half rxns $= \boxed{2Fe_{(s)} \longrightarrow 2Fe^{3+} + 6e^-} =$ Oxidation

$\boxed{6H^+ + 6e^- \longrightarrow 3H_{2\ (g)}} =$ reduction