

Student Packet: 8.4: Redox Half-Reactions: Student Handout AP® Chemistry

To understand oxidation numbers to the point where they are second nature, you also have to be very good at balancing redox reactions. When you are given a reaction, you balance it, assign every atom an oxidation number and determine who is oxidized (loses electrons which are negatively charged so the oxidation number increases) and who is reduced (gains electrons so the oxidation number decreases).

Here's a pretty good (quick and painless) Redox balancing technique

Step 1. Identify who is oxidized and who is reduced and break the reaction into two half-reactions.

- One for the oxidation $\longrightarrow$ The oxidation half-reaction
- One for the reduction $\longrightarrow$ The reduction half-reaction

Step 2. Do all the rest of these steps

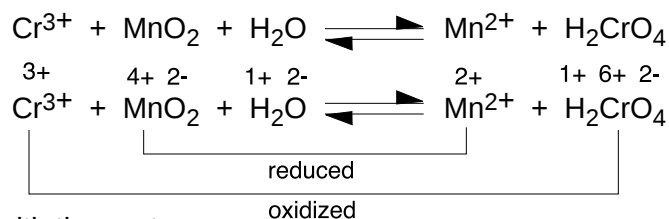
In acid solution

1. Balance all atoms other than H and O
2. Balance O with H_2O
3. Balance H with H^+
4. Balance charge (both sides have to have the same net charge) by adding electrons, e^-
5. Add the two half-reactions so that the e^- 's cancel algebraically
6. Cancel other species that appear on both sides of the equation
7. Check and make sure everybody's balanced

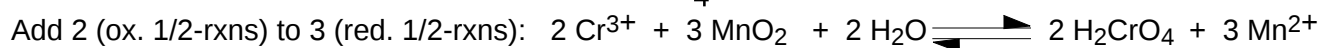
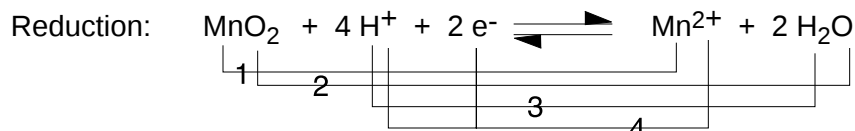
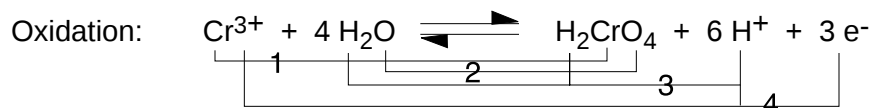
In basic solution

1. Do everything exactly the same as in acid solution (steps 1 to 5)
2. For each H^+ that's left, add an OH^- to both sides of the equation
3. On the side with H^+ , add the H^+ and the OH^- together to get H_2O
4. These should algebraically cancel with the H_2O that was already on the other side
5. Check and make sure everything's balanced

For example: Balance this reaction



2. It's in acid solution (H_2CrO_4) so proceed with those steps.



Student Packet: 8.4: Redox Half-Reactions: AssessMe questions

- 1) Given the standard electrode potentials:



A voltaic cell constructed using this redox pair would have a net EMF of approximately:

- A) 0.00 V B) 0.72 V C) 1.997 V D) 5.70 V E) I'm clueless

- 2) Given the standard electrode potentials:



Which pair of substances will react spontaneously?

- A) Ni^{2+} with Cr^{3+} B) Ni with Cr^{3+}
 C) Ni^{2+} with Cr D) Ni with Cr E) I'm clueless

- 3) What is the pH of water at 35°C (
- $K_w = 2.09 \times 10^{-14}$
-)?

- A) 7.0 B) 6.8 C) 6.0 D) 7.2 E) I'm clueless

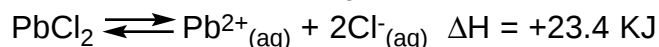
- 4) What is the pH of a
- 2×10^{-6}
- M solution of nitric acid (
- HNO_3
-)?

- A) -5.7 B) 6 C) 7 D) 5.7 E) I'm clueless

- 5) At room temperature the concentrations of protons and hydroxide in pure water are equal. How does this change as the temperature is increased?

- A) $[\text{H}_3\text{O}]^{+} > [\text{OH}^{-}]$
 B) $[\text{H}_3\text{O}]^{+} < [\text{OH}^{-}]$
 C) It doesn't.
 D) This can't be determined from the data provided.
 E) I'm clueless

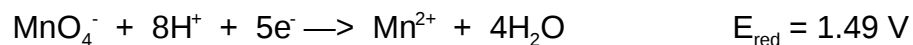
- 6) Predict what effect the addition of
- $\text{Pb}(\text{NO}_3)_2$
- has on the position of the equilibrium.



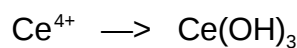
- A) shift toward products
 B) shift toward reactants
 C) no effect
 D) can't be determined
 E) I'm clueless

Student Packet: 8.4: Redox Half-Reactions: ShowMe questions

1) Order the following oxidizing agents by increasing strength under standard conditions:



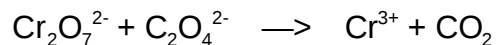
2) Balance this half-reaction (basic solution):



3) Balance the following reaction:
(acidic, aqueous)

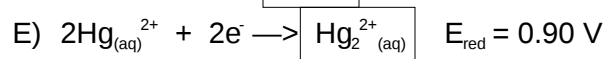
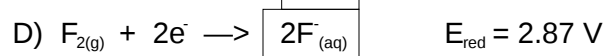
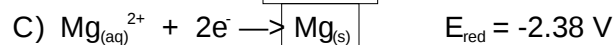
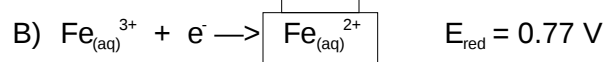
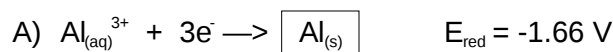


4) Balance the following oxidation reduction equation:
(acidic, aqueous)

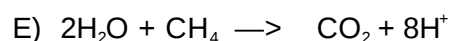
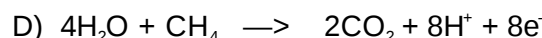
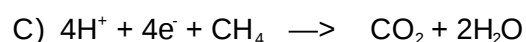
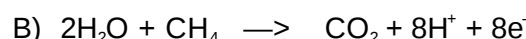
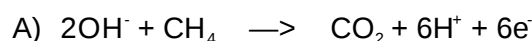
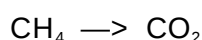


Student Packet: 8.4: Redox Half-Reactions: TestMe questions

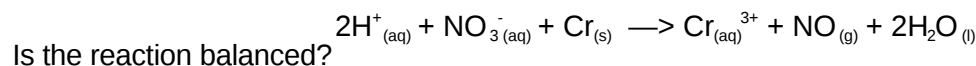
- 1) Which of the following is the strongest reducing agent?
(agent is boxed)



- 2) Balance the following half-reaction:



- 3) Which species is oxidized in the following reaction:



A) H^+ is oxidized, equation is balanced.

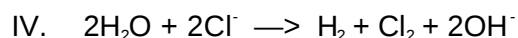
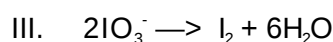
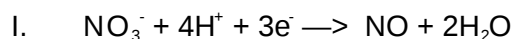
B) NO_3^- is oxidized, equation is not balanced.

C) Cr is oxidized, equation is balanced.

D) NO is oxidized, equation is not balanced.

E) Cr is oxidized, equation is not balanced.

- 4) Which of the following are balanced reactions?



- A) I only B) II only C) IV only D) I and IV E) I and III

- 5) A voltage of 0.435 V is measured for:



What is the K_{sp} of AgI?
($\text{Ag}^+ + \text{e}^- \longrightarrow \text{Ag}$ $E_{\text{red}} = +0.8 \text{ V}$)

- A) 4.2×10^{-5} B) 9.1×10^{-9} C) 6.5×10^{-13} D) 8.3×10^{-17} E) 7.2×10^{-25}