

Topic 3 - Predicting Redox Reaction in Solution

- In solutions, molecules and ions behave independently of each other.
- A first step in predicting redox reactions is to list all entities that are present

Example:

Copper is placed into an acidic potassium permanganate solution

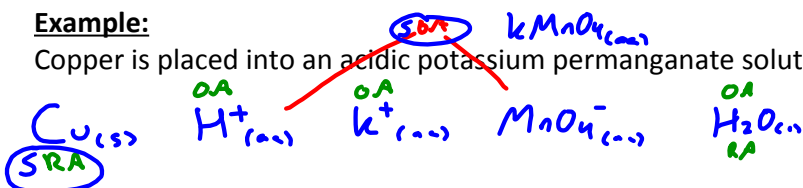


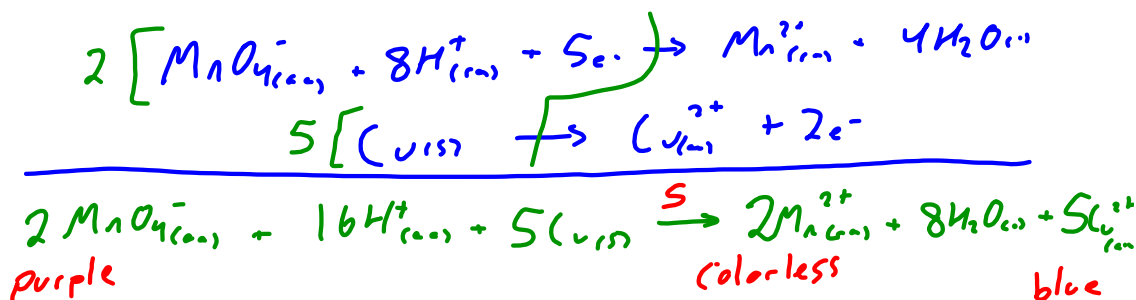
Table 6 Hints for Listing and Labelling Entities

- Aqueous solutions contain $\text{H}_2\text{O}(l)$ molecules.
- Acidic solutions contain $\text{H}^+(aq)$ ions.
- Basic solutions contain $\text{OH}^-(aq)$ ions.
- Some oxidizing and reducing agents are combinations, for example, $\text{MnO}_4^-(aq)$ and $\text{H}^+(aq)$.
- $\text{H}_2\text{O}(l)$, $\text{Fe}^{3+}(aq)$, $\text{Cu}^+(aq)$, $\text{Si}^{4+}(aq)$, and $\text{Cr}^{3+}(aq)$ may act as either oxidizing or reducing agents. Label both possibilities in your list.

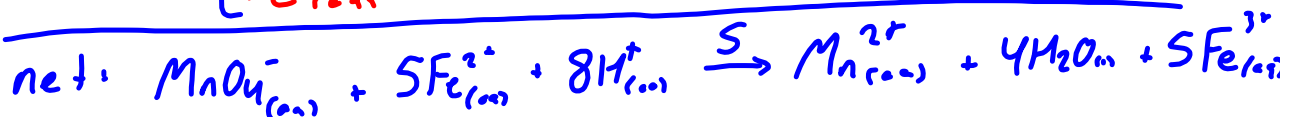
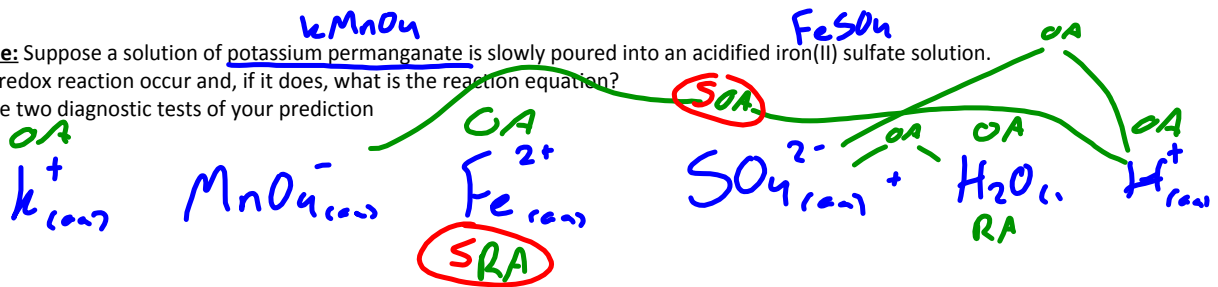
Then the following instructions allow you to finish predicting the redox reaction that will occur

- Choose the strongest oxidizing agent present in your mixture by starting at the top left corner of a redox table and going down the list until you find the oxidizing agent that is in your mixture.
- Choose the strongest reducing agent in your mixture by starting at the bottom right corner of the table and going up the list until you find the reducing agent that is in your mixture.
- Read reduction half-reaction equations from left to right (following the forward arrow).
- Read oxidation half-reaction equations from right to left (following the reverse arrow).
- Assume that any substances not present in the table are spectator ions. You do not need to label or consider these substances. NS

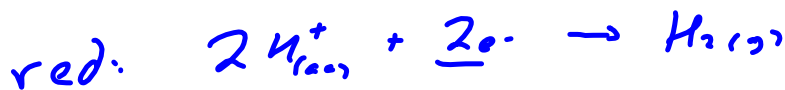
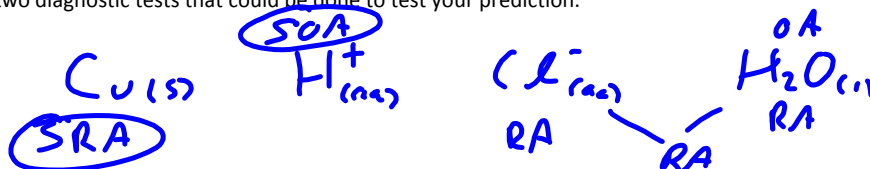
Continue example from above



Example: Suppose a solution of potassium permanganate is slowly poured into an acidified iron(II) sulfate solution. Does a redox reaction occur and, if it does, what is the reaction equation? Describe two diagnostic tests of your prediction

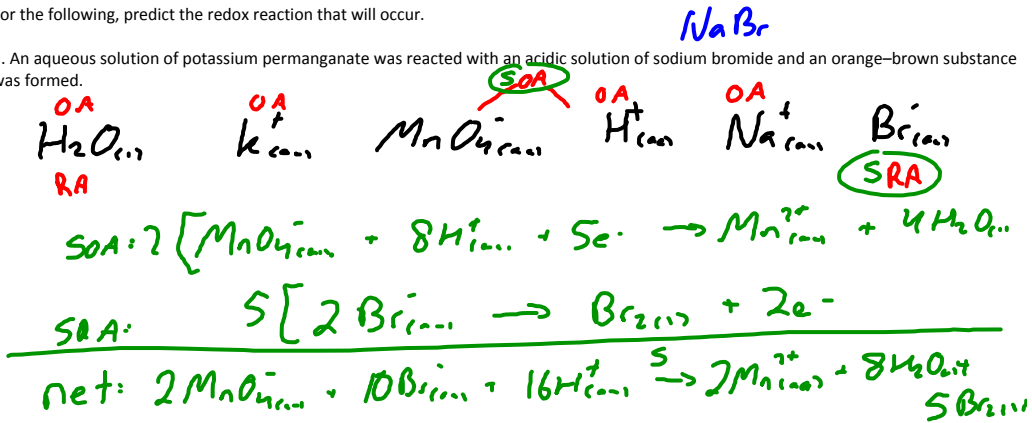


Example: In a chemical industry, could copper pipe be used to transport a hydrochloric acid solution? To answer this question, (a) predict the redox reaction and its spontaneity, and (b) describe two diagnostic tests that could be done to test your prediction.

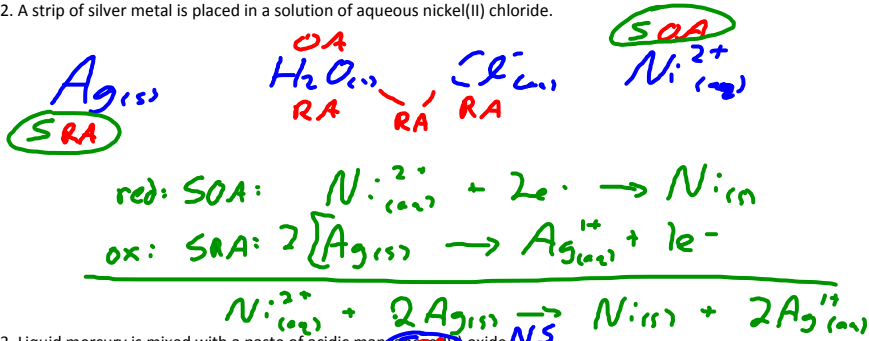


For the following, predict the redox reaction that will occur.

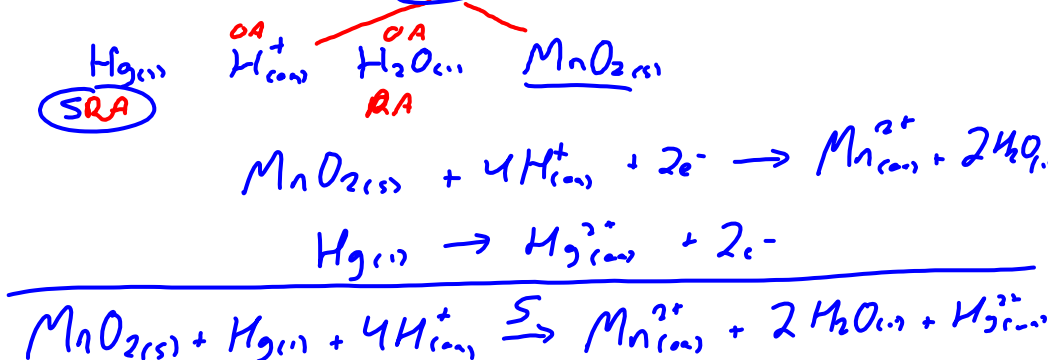
1. An aqueous solution of potassium permanganate was reacted with an acidic solution of sodium bromide and an orange-brown substance was formed.



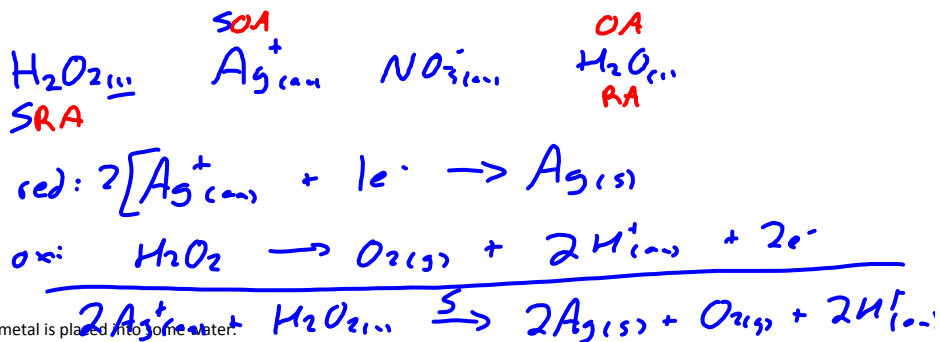
2. A strip of silver metal is placed in a solution of aqueous nickel(II) chloride.



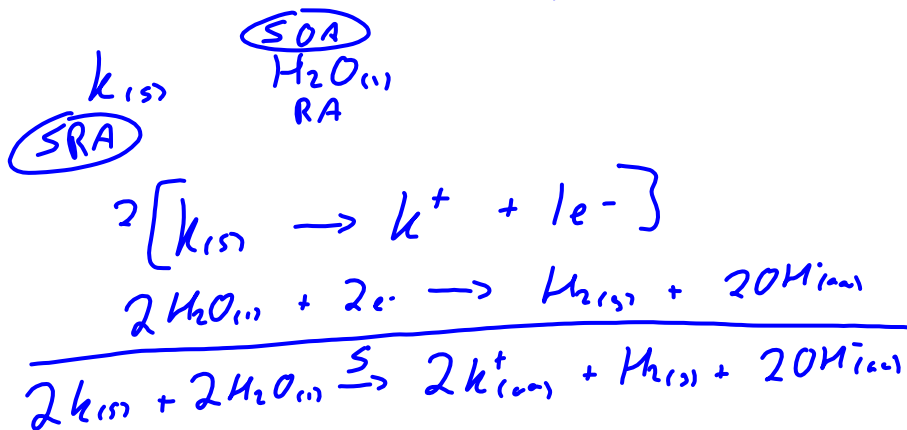
3. Liquid mercury is mixed with a paste of acidic manganese dioxide.



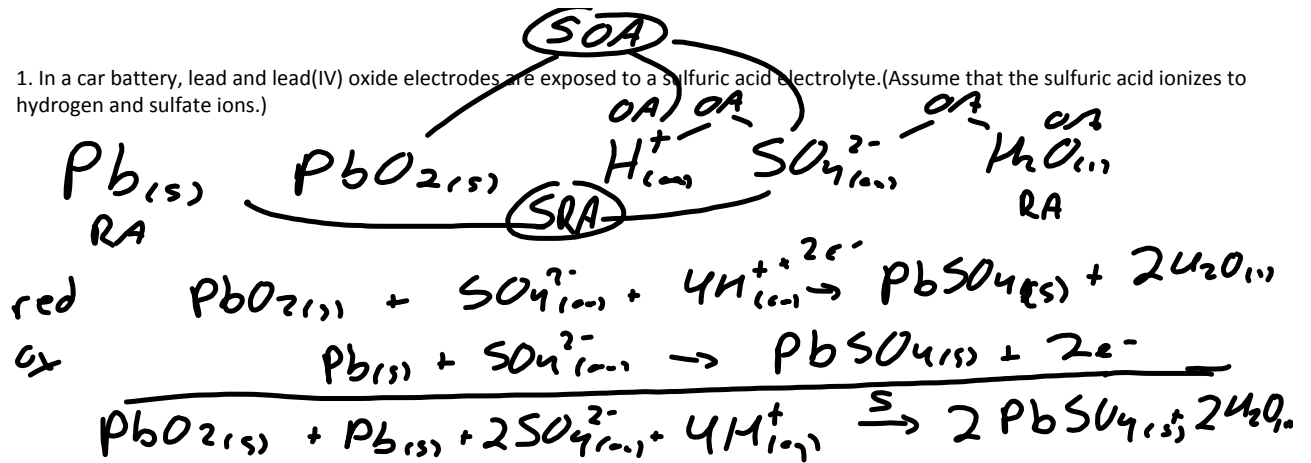
4. Hydrogen peroxide and silver nitrate are mixed.



5. Potassium metal is placed into some water.



1. In a car battery, lead and lead(IV) oxide electrodes are exposed to a sulfuric acid electrolyte. (Assume that the sulfuric acid ionizes to hydrogen and sulfate ions.)



2. A gold ring accidentally falls into a hydrochloric acid solution.

3. Nitric acid is painted onto a copper sheet to etch a design