

1 Based on the article, "How Fuel Cells Work," explain how fuel cells work in one paragraph.

2 Determine the oxidation states for the stated element in each compound.

- Chlorine in KClO_4
- Nitrogen in $\text{Ba}(\text{NO}_3)_2$
- Phosphorus in $\text{Ca}_3(\text{PO}_4)_2$
- Manganese in LiMnO_4
- Sulfur in Na_2SO_3
- Chromium in CaCrO_4
- Sulfur in MgS_2O_3
- Nitrogen in $\text{Zn}(\text{NO}_2)_2$
- Chlorine in HClO_3
- Carbon in CaC_2O_4
- Sulfur in KHSO_4

3 Complete the worksheet, "Analyzing Oxidation-Reduction Reactions"

4 Write the half reactions for each redox reaction. Identify the oxidizing and reducing agents.

- $\text{Sn} + \text{HNO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SnO}_3 + \text{NO}$
- $\text{KMnO}_4 + \text{HCl} \rightarrow \text{KCl} + \text{MnCl}_2 + \text{H}_2\text{O} + \text{Cl}_2$
- $\text{Fe}(\text{OH})_2 + \text{H}_2\text{O}_2 \rightarrow \text{Fe}(\text{OH})_3$
- $\text{Na} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2$
- $\text{Zn} + \text{HNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{NO}_2 + \text{H}_2\text{O}$
- $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$
- $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O} + \text{S} \rightarrow \text{SO}_2 + \text{KOH} + \text{Cr}_2\text{O}_3$

5 For each, use the activity series to see if a reaction will take place. If it does, write the reaction and balance it.

Note: for metals, the format for single replacement reactions is $\text{AB} + \text{C} \rightarrow \text{CB} + \text{A}$; for nonmetals the format is $\text{AB} + \text{D} \rightarrow \text{AD} + \text{B}$

- $\text{Cu}(\text{s}) + \text{HBr}(\text{aq})$
- $\text{Cu}(\text{s}) + \text{AgCH}_3\text{COO}(\text{aq})$
- $\text{Sn}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq})$
- $\text{Mg}(\text{s}) + \text{Pb}(\text{NO}_3)_2(\text{aq})$
- $\text{Pb}(\text{s}) + \text{AuCl}(\text{aq})$
- $\text{Au}(\text{s}) + \text{LiCl}(\text{aq})$

6 In an electrochemical cell how do electrons flow?

7 At which location are in an electrochemical cell are electrons being gained? At what location are they lost?

8 Using the activity series, for each of the electrode pairs, which would be the anode in an electrochemical cell?

- | | |
|---------|----------------------|
| a Cu/Zn | g Fe/Zn |
| b Pb/Sn | h Co/Ca |
| c K/Al | i Co/Ni |
| d Ba/Li | j H ₂ /Ag |
| e Au/Pb | k Cu/Mg |
| f Mn/Zn | l Zn/Al |

9 Draw a diagram of an electrochemical cell.

10 What happens at the anode of an electrochemical cell? Is it oxidized or reduced?

11 What happens at the cathode of an electrochemical cell? Is it oxidized or reduced?

12 Aluminum is found in the mineral bauxite (Al_2O_3). To get pure aluminum, the aluminum needs to be separated from oxygen using electrolysis in an electrolytic cell.

- Bauxite forms by the following reaction: $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$. Write the half reactions.
- During the formation of bauxite from its elements, what is oxidized, and what is reduced? Does this make sense considering that aluminum is a metal? Explain.
- Write the reaction for the purification of aluminum from bauxite (it's the reverse reaction).
- Write the half reactions for the purification of aluminum. During the purification, what is oxidized, and what is reduced?

Most	Metals	Nonmetals	Most
↓	Li	F_2	↓
	Rb	Cl_2	
	K	Br_2	
	Cs	I_2	
	Ba		
	Sr		
	Ca		
	Na		
	Mg		
	Al		
	Ti		
	Mn		
	Zn		
	Cr		
	Fe		
	Co		
	Ni		
	Sn		
	Pb		
**H ₂			
Cu			
Ag			
Au			
Least		Least	

**Activity Series based on hydrogen standard
 Note: H₂ is not a metal