

Chapter 12: Electrochemistry

Representing Redox Reactions

Galvanic Cells

Electrolysis

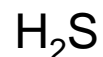
The Impact on Materials

Oxidation Number

Review from Section K.2 of your Book

1. The oxidation number (ON) of an element uncombined with another element is zero: Na(s), C(gr), H₂(g), I(s) ...
2. For monoatomic ions, the charge is the ON: Na⁺ ON = +1
3. The ONs of elements in group 1 equal 1 (ex. Lithium ON = +1) ONs of elements in group 2 equal 2 (ex. Magnesium ON = +2)
4. The ON of fluorine is always -1 in compounds.
5. The ON of the other elements in group 7 usually equals -1
6. The oxidation number of oxygen is usually -2 in compounds. Exceptions are fluorine compounds and peroxides
7. Hydrogen's ON is +1 when combine with non metals and -1 when combine with metals
8. The sum of the ONs of all the atoms in a species is equal to its total charge

Oxidation Number Examples



ON H = +1 Bonded to a non metal

ON S = -2 Total charge must equal 0 ($2(+1) - 2 = 0$)



ON O = -2 Not bonded to F or forming a peroxide

ON P = 3 Total charge must equal 0 ($4(3) - 6(2) = 0$)



ON O = -2 Not bonded to F or forming a peroxide

ON N = 5 Total charge must equal -1 ($5 - 3(2) = -1$)

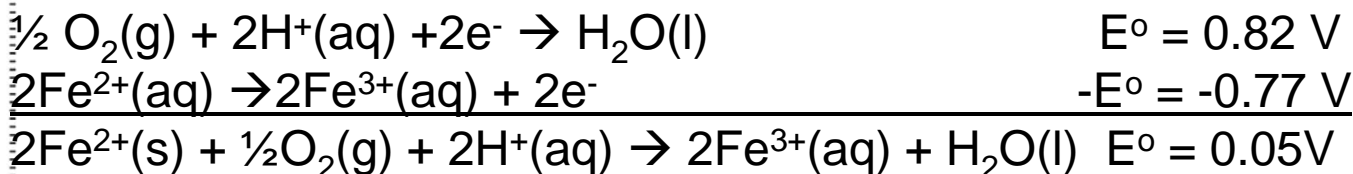
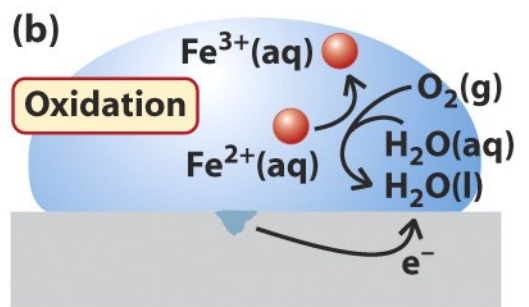
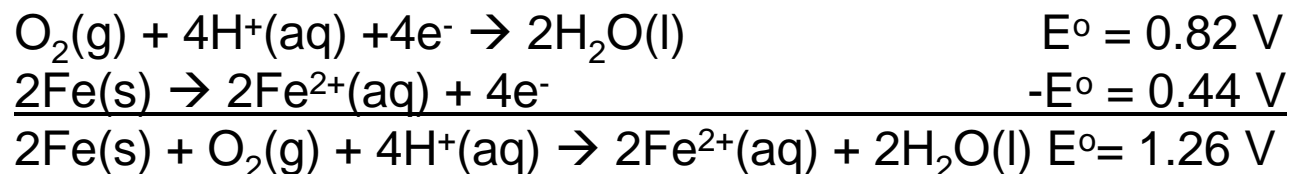
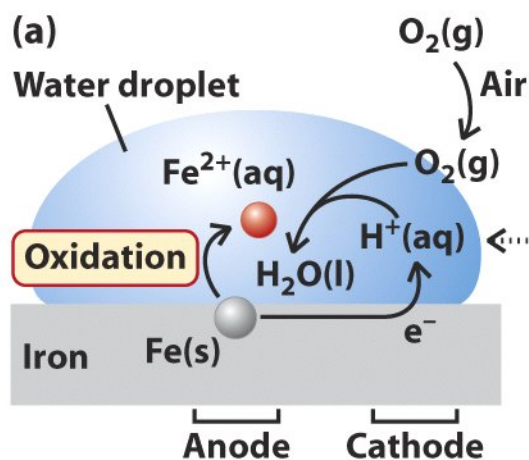
Electroplating



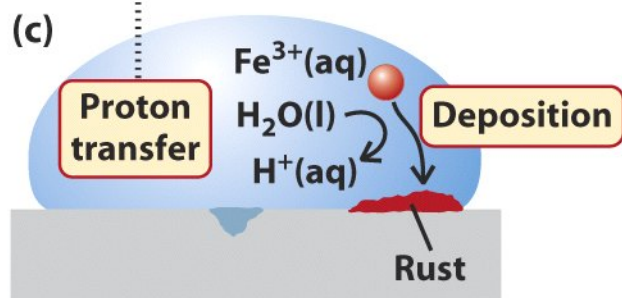
Corrosion



Corrosion



Regeneration of $\text{H}^+(\text{aq})$



Primary Cells

Galvanic cell with the reactants sealed inside at the manufacture.

They can not be recharged

Type (emf)	Dry Cell (1.5 V)	Alkaline Cell (1.6 V)	Silver Cell (1.6 V)
Uses	Disposable Batteries	Longer Lasting Disposable Batteries	Medical Implants
Anode	Zinc	Zinc	Zinc
Cathode	Carbon	Carbon	Ag ₂ O
Electrolyte	MnO ₂ + Carbon Black + NH ₄ Cl	Alkaline Electrolyte	KOH
Other Information	The interior of the container is lined with paper that serves as the porous barrier. The ammonia forms the complex Zn(NH ₃) ⁴⁺ with the Zn ²⁺ ions and prevents their buildup.	The zinc only reacts with the electrolyte when the battery is being used (longer life)	The batteries are very reliable over time

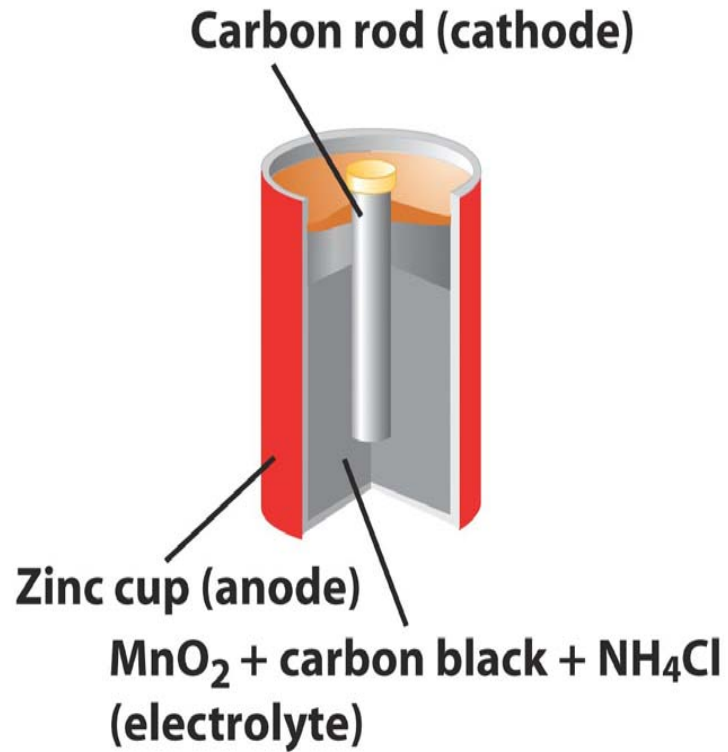
Secondary Cells

Galvanic cell that must be charged before they can be used.

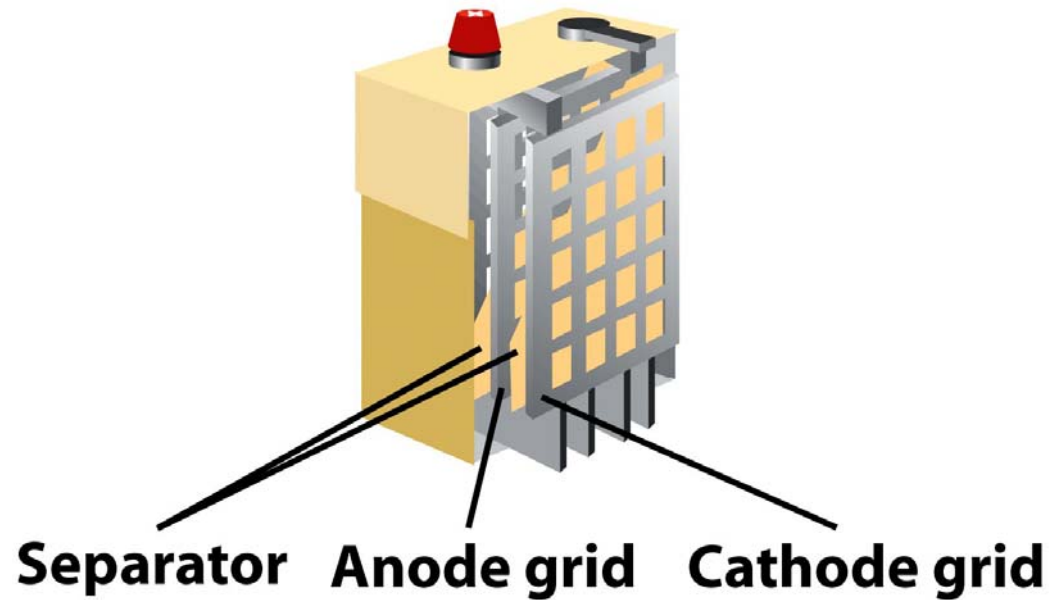
They usually can be recharged

Type (emf)	Lead-acid (12 V)	Sodium Sulfur (2.2 V)
Uses	Car Batteries	Power Electric Vehicles
Anode	Lead-antimony alloy grid with lead (II) sulfate past on it (during the first charging some of the lead (II) sulfate is reduced to lead)	Molten Na (l)
Cathode	Lead-antimony alloy grid with lead (II) sulfate past on it (during the first charge some of the lead (II) sulfate is oxidized to lead (IV) oxide)	Molten S (l)
Electrolyte	Dilute sulfuric acid	Solid porous aluminum
Other Information	The battery can generate large amounts of current for short periods, such as the time needed to start an engine.	Needs temperatures above 320°C to keep Na and S molten.

Dry Cell



Lead-Acid Cell



Grids are made of a lead-antimony alloy that are covered in lead(II) Sulfate