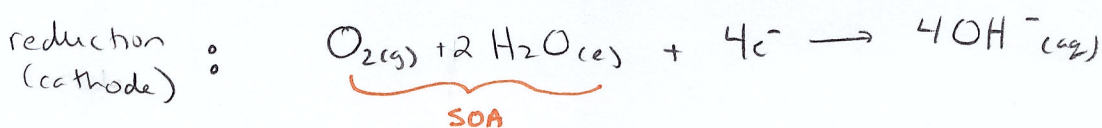
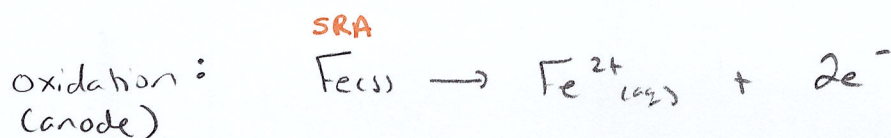
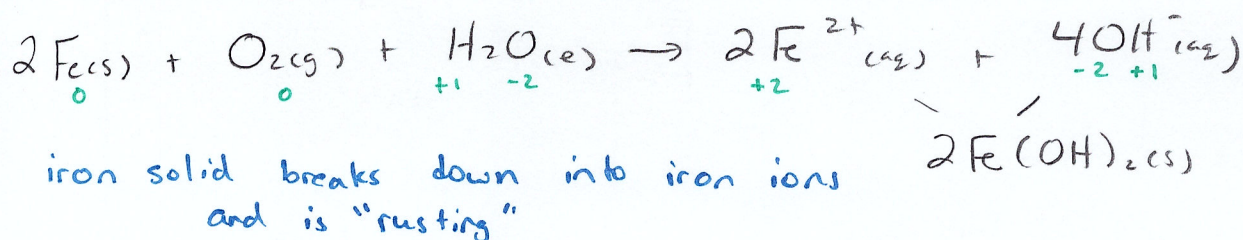


Corrosion

- Corrosion is a huge problem for society, on an industrial level and on an individual level. But how is corrosion related to electrochemistry?
- * • **Corrosion** is a spontaneous redox reaction of material with substances in their environment (usually oxygen and water).
 - * ◦ Many metals are strong reducing agents and will spontaneously react with oxygen, which is a strong oxidizing agent
- The rusting/corrosion of iron(Fe_(s)) is very common
 - As electrons leave the anode (ie. iron), the iron will break down and "rust"

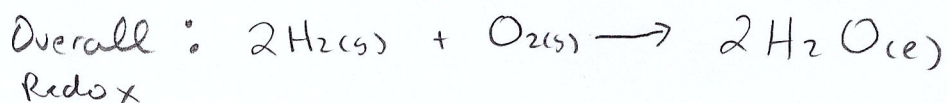
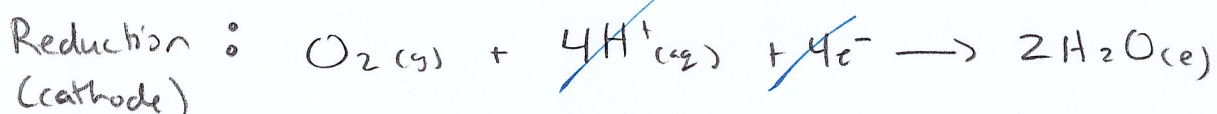
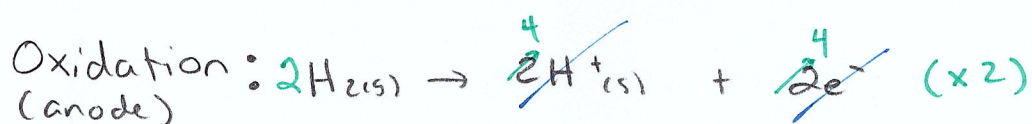
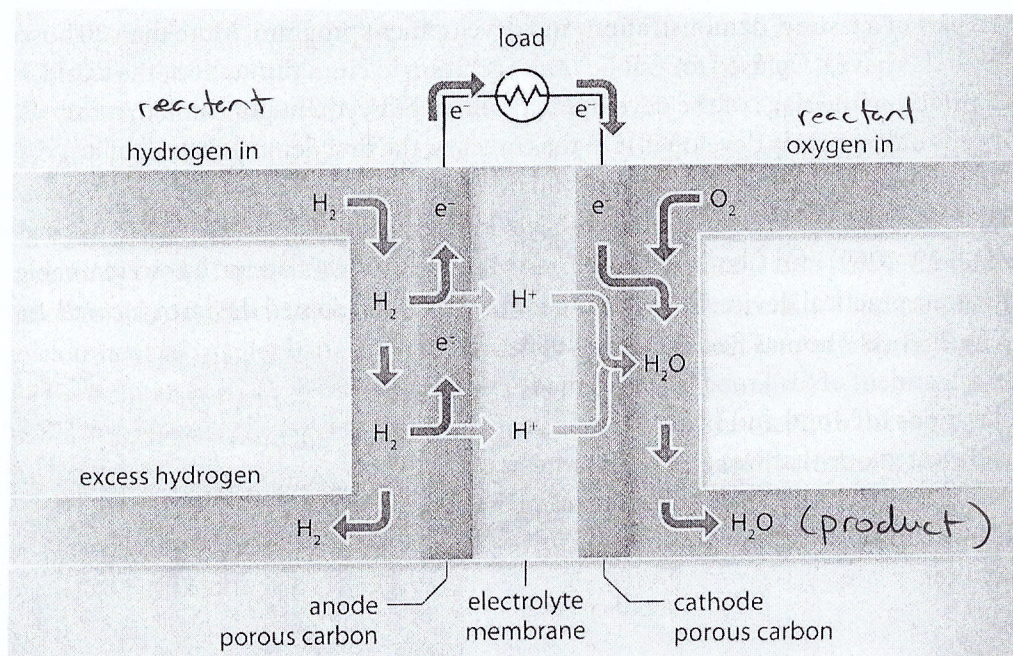


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- * • One method used to prevent corrosion is to apply a protective coating to the metal, such as paint, enamel, grease/oil, and plastic.
 - This protective coating prevents air and water from actually reaching the surface of the metal; therefore preventing corrosion from actually taking place.
 - A protective coating is only effective if the entire metal surface is covered.
- * • Another method used to prevent corrosion is cathode protection. ← SRA
 - **Cathode protection** involves attaching a more reactive metal to the iron object you are trying to protect. The more reactive metal will act as the anode and will slowly corrode and break down due to the oxidation reaction.
 - This more reactive metal is called the **sacrificial anode** because it is being destroyed to protect the iron.
 - Unlike a protective coating, the metal in cathodic protection does not need to cover the entire surface; the sacrificial anode will just need to be replaced periodically.

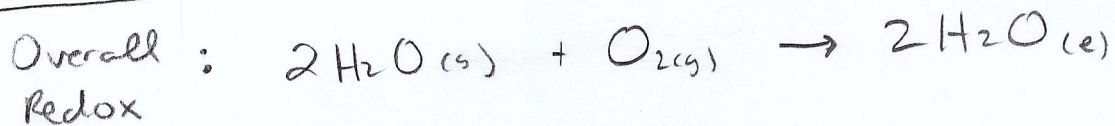
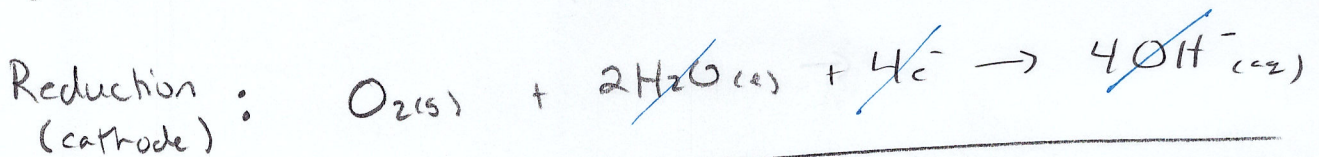
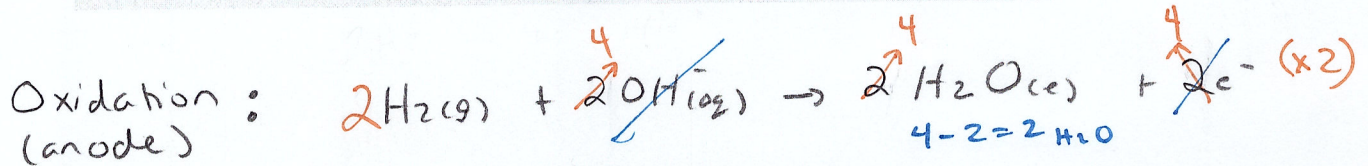
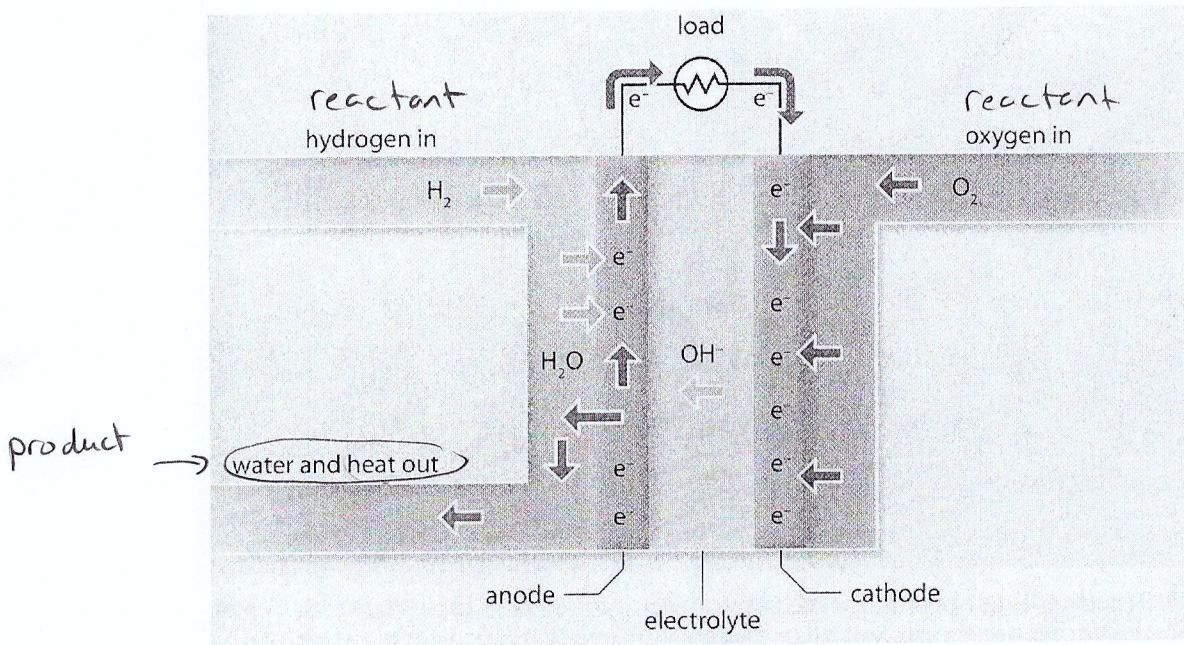
Fuel Cells

- As a society so dependent on electrical energy, we are continually looking for new methods of providing clean electric energy for transportation, industries and homes
- A **fuel cell** is fundamentally a battery/voltaic cell that can be refueled as the reactants flow in and the products flow out
- Even though fuel cells are much cleaner and efficient than a combustion engine, fuel cells are very costly
- Several types of fuel cells have been designed, but all cells are based on the same principles of a voltaic cell
- A proton exchange membrane (PEM) fuel cell



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- An alkaline fuel cell



- Another problem with fuel cells is not only the storage of hydrogen but the extraction/production of pure hydrogen
 - There is only trace amounts of hydrogen found in our atmosphere
 - To produce hydrogen from other compounds requires energy itself

Now try pg. pg. 500 #14, 16 & pg. 501 #14, 15

Student Textbook page 500

- Q14.** Aluminium provides cathodic protection on an iron object because it is a better reducing agent than iron. This means that the aluminium reacts first, saving the iron from rusting.
- Q15.** The corrosion problems most likely showed up in the Atlantic provinces due to high volumes of precipitation throughout the year (both rain and snow), coupled with the use of salt on winter roads. Taken together, these factors encourage corrosion.
- Q16. (a)** Given the cell potential of the following half-reaction
- $$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}(\text{l})$$
- $$E^\circ = 1.23 \text{ V}$$
- Elemental oxygen is a much better oxidizing agent under acidic conditions.
- (b)** Acid rain greatly increases oxygen's ability to act as an oxidizing agent and contributes to rusting.

Section 13.2 Review Answers

Student Textbook page 501

- 12.** The use of salt lowers the melting point of snow, causing more water to be mobile and reactive. Furthermore, the salt also provides electrolytes required for the salt bridge.
- 13.** When the steel cans corrode, they produce aqueous ions. However, the aluminum cans produce solid aluminium oxide, which slows down the corrosion process.
- 14.** Zinc is a more reactive metal than iron, as noted by its cell potential, so it will react before iron does.
- 15. (a)** Two metals that do not react in the presence of oxygen and water are silver and gold, as noted by their cell potentials being higher than that of the oxygen and water half-reaction.
- (b)** Since these metals are quite resistant to corrosion they are useful for industrial processes that take place under extremely adverse conditions that promote corrosion, such as high temperatures or acidic environments, like the aerospace or petroleum industry.