K L University
DEPARTMENT OF CHEMISTRY
SEMESTER II, A.Y.2013-14

ENGINEERING CHEMISTRY
CONCEPT CHECK - ASSIGNMENT

Note: Answers must involve two sections a plan section and implementation section. For better understanding look at the worked example "**Electrons in Water"**.

1. **Relationship:** Draw a diagram indicating the relationship among the following terms: Oxidation, reduction, redox, anode, cathode, salt bridge, cell potential. All terms should have at least one connection.

2. **Generation of Smog:** One product in automobile exhaust is NO_2. NO_2 is responsible for the brown haze in polluted city air. At night NO_2 readily dimerizes to colorless N_2O_4. NO_2 also readily dissolves in water to produce nitric acid, HNO_3. Does either dimerization or acid production involve a redox process? Why or why not?

3. **Reactions in a Lead Storage Battery:** The lead storage battery in most automobiles consists of an anode where lead is oxidized to $PbSO_4(s)$ and a cathode where $PbO_2(s)$ is reduced to $PbSO_4(s)$. The electrolyte is H_2SO_4. What are the oxidation, reduction and net reactions for the car battery while discharging and charging? Draw and write the notation for car battery.

4. **Zinc-Air Fuel cell:** To power heart pacemakers where a compact and portable power supply is needed and controlled by the oxygen supply we can use a device called Zn-Air cell. Determine oxidation, reduction, net reactions, and suggest a design for the cell.

5. **Running Down:** The standard potential of the $Zn/Zn^{2+}//Cu^{2+}/Cu$ galvanic cell is 1.103 V. It is determined that a cell produces 0.67 V. Determine the ratio $[Zn^{2+}]/ [Cu^{2+}]$ in this cell.

6. **P^H Determination:** A glass electrode dipped in a solution of P^H equal to 4 offered an EMF of 0.2066 V with a saturated calomel electrode (SCE) at 298 K. Dipped in a solution of unknown P^H , at the same temperature in contact with SCE, recorded an EMF of 0.1076 V. Calculate the P^H of the solution, if E_{SCE} = 0.2412 V.

7. **Instant Backup:** To provide nearly instant backup electrical power in case of a power outage, the telephone company uses a device called Aluminum – Air battery. Oxidation of Al occurs at anode when the device is filled with water. Suggest the reaction for the cathode. Which ion is a good candidate for completing the circuit? How would you design this system to include the required ions?

8. **Utility poles, Nails, and Tin cans:** Left exposed to a moist atmosphere iron, an important structural material, combines with oxygen to become the familiar red rust. Yet iron, the major component of steel, is used in numerous applications, including underground pipes, utility poles, nails, and metal food cans. How is the inevitable corrosion kept at bay?

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Worked Example

Electrons in water: Water is an important participant in many redox reactions, particularly in the environment: "Water, water, everywhere . . . ." Assign oxidation numbers to H and O in water.

Plan

- Count the valence electrons.
- Oxygen is more electronegative than hydrogen, so assign eight valence electrons to oxygen. Assign the remaining electrons to hydrogen.
- The net charge is the oxidation number.

Implementation

- Valence electrons: oxygen (6) plus one for each of two hydrogen atoms totals 8
- Oxygen gets all 8. Hydrogen gets none.
- Net charge on Oxygen: gained two valence electrons, OXN is -2. Net charge on each hydrogen: lost one valence electron, OXN is +1.