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| **ASSIGNMENT** | |
| **Course Code** | BSC105B |
| **Course Name** |  |
| **Programme** |  |
| **Department** |  |
| **Faculty** |  |

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| **Declaration Sheet** | | | | | | | | |
| Student Name |  | | | | | | | |
| Reg. No |  | | | | | | | |
| Programme |  | | | | | Semester/Year |  | |
| Course Code |  | | | | | | | |
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| Signature of the Course Leader and date | | | | Signature of the Reviewer and date | | | | |
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|  |  |  |
| --- | --- | --- |
| **Symbol** | **Description** | **Units** |
| A | Current | Amp |
| g | Acceleration due to gravity - 9.81 | m/s2 |
| V | Voltage | Volts |
| w | Width | mm |
|  |  |  |

< Arrange in alphabetical order>

# **Question No. 1 part A**

**Solution to Question No. 1 part A:**

## A1.1 Current Status of electric-vehicles battery technology:

Overview to the question (students are expected to give a brief introduction to the context on which the Slow

## A1.2 Discussion on the given limitations of electric vehicles with respect to batteries and methods to overcome these limitations:

Students are expected to provide the solution to the question considering the points mentioned in the marking scheme of the assignment question

## A1.3 Justifications of your stance

Students are expected to discuss the solutions obtained in section 1.2 and present their views/suggestions/recommendations (not to exceed 150 words)

# **Question No. 1 part B**

**Solution to Question No. 2:**

## B1.1 Identify the types of corrosion that happen in ruptured pipelines and interpret the reasons with chemical reactions:

Overview to the question (students are expected to give a brief introduction on the context on which the question is set, applications, limitations, new developments happening and students own views on the question and the paragraph should not exceed more than 200 words and references should be cited and it should be authored by the students means to say students should not be borrowing sentences as they are from any referred literature)

## B1.2 Suggest and discuss any two important corrosion control methods that can be adopted in oil and gas pipe line systems:

Students are expected to provide the solution to the question considering the points mentioned in the marking scheme of the assignment question

# **Question No. 2 part B**

**Overview**

For given four metal strips of metals A,B,C and D, they are dipped in 1.0 M of its own metal ion solution at 298K, pair wise combination of these half cells are made and the respective Potentials are given. Due to a difference in Standard Electrode Potentials of the metals a Potential is developed between the two connected half-cells, one of them undergoes oxidation and the other should undergo reduction. By using these values the questions are to be answered.

Table 1: Potential differences of various combinations of electrodes

|  |  |  |
| --- | --- | --- |
| Anode | Cathode | E0 Cell |
| A | B | 0.20 V |
| A | C | 0.36 V |
| D | A | 0.14 V |

**Solution to Question No. 2 part B:**

## B2.1 Identification of the strongest reducing with justification:

From Table 1

Cell 2.1 and Cell 2.2 can be connected to form another cell, now as Cell 2.2 has more reduction potential, Cell 2.2 will act as cathode and Cell 2.1 will act as Anode. This could also interpreted in the following way, the one which requires the least energy to oxidize will oxidize first, hence as Cell 2.1 has less Potential relative to Cell 2.2, Cell 2.1 will act as Anode.

Now that we have 4 Equations and 4 Variables we can solve them to find the individual standard reduction potentials

Solving it using Gauss-Jordon method we get,

The System has Infinitely many solutions with where k is any real number,

Now the values are :

The one that has the strongest tendency to oxidize will make the others reduce, metal has the lowest potential hence oxidizing first and hence metal is the strongest reducing agent.

## B2.2 Identification of the strongest oxidizing agent with justification:

Using the data obtained in Equation 2.5,

The one that has the strongest tendency to reduce will make the others oxidize, metal has the highest potential hence it has highest tendency to reduce relative to other metals and hence metal is the strongest oxidizing agent.

## B2.3 Balanced equation for half-cell B and C

As the metal C has more electrode potential than B, C will act as the cathode and B as the anode

## B2.4 Calculation of the voltage produced when half-cells B and C are connected:

From Equations in 2.5

## B2.5 Calculation of the voltage produced when half-cells C and D are connected:

When half-cells C and D are connected as C has more electrode potential than D, C will act as the cathode

Using the values obtained in Equations in 2.5

**Conclusion**

It can been seen that we were given with binary combinations of metal electrodes of which cell potentials are given. Using this primary data more half cells can be created and then solved for the individual reduction potentials. It can be observed that the metal that will have that highest electrode potential acts like a cathode and the one with the lowest electrode potential acts like a anode.

# **Question No. 3 part B**

**Overview:**

Iron is found in a combined state in nature, a majority of which is Hematite and Magnetite, and respectively, here Iron is combined in different proportions with Oxygen, to get Iron metal from this we need to use a suitable reducing agent. Coke or impure carbon is used as a fuel in the blast furnace, Coke itself and Carbon Monoxide produced from burning Coke reduce Iron (III) Oxide into Iron. Coke here also acts as a fuel for the furnace which melts the reduced metal.

Silver articles when exposed to air over a period of time forms black tarnishing layer on top of it, this layer also prevents further oxidation of Silver. Elements try to go back to the combined state where they are most stable, hence Silver tries to form back Silver Glance compound from which Silver is extracted.

**Solution to Question No. 3 part B:**

## B3.1 Identification of oxidation, reduction, oxidizing agent and reducing agent in the extraction of iron from hematite:

Reduction of the hematite ore:

At high temperatures, coke (essentially impure carbon) burns in the blast of the hot air to form carbon dioxide which is highly stable and hence this results in a highly exothermic reaction. This reaction is the main source of heat in the furnace.

Carbon Dioxide reacts with carbon to produce carbon monoxide.

Now carbon monoxide forms the main reducing agent in the furnace which reduces Ferric Oxide into Iron

Iron in the reactants is while in the products it’s the oxidation number has changed from which accounts for Reduction, as Iron gets reduced it is the Oxidizing Agent.

Carbon Monoxide on the other hand gains Oxygen and forms Carbon Monoxide, as there is a gain of oxygen it is Oxidation, and because it itself is being oxidized it will reduce the other compound, hence Carbon Monoxide is the Reducing Agent here.

In hotter parts of the blast furnace, carbon itself can act as a reducing agent forming Iron and releasing carbon monoxide, here carbon dioxide is not released as under high temperatures carbon dioxide breaks into carbon monoxide and oxygen.

## B3.2 Reasoning for blackening of Silver article, Identification of oxidation, reduction, oxidizing agent and reducing agent in the blackening of silver articles:

Silver articles over a period of time form a blackened layer on them, this is due to a very slow corrosion process of Silver. This process for silver is also knows as Silver Tarnishing.

As air contains trace amount of , Silver can react with this to form Silver Sulphide which is black in colour.



Figure B.3.1 : A silver coin tarnished due to exposure in air for elongated period of time

The reaction that follows is:

In the reaction the oxidation of changes from , this is an increase in oxidation number and hence oxidation of Silver to Silver Sulphide, as Silver is being Oxidized it act as the Reducing Agent.

The oxidation state of Hydrogen changes from this is a decrease in oxidation state, Hence Hydrogen is being Reduced to Hydrogen Gas, as Hydrogen is being Reduced, it acts as the Oxidizing Agent.

**Conclusion:**

Metals that are extracted from their ores when exposed to similar environmental condition where the ore was found in, goes back to its most stable oxidation state thereby trying to form the ore back from the extracted metal.

# **Question No. 5 Part B**

**Solution to Question No. 4 Part B:**

## B4.1 Identification of the phenomena and the chemical name of the green powdery substance present on the bronze propeller:

The phenomenon is known as corrosion in general and is called as “Bronze disease” to be specific for Bronze.

Bronze being an Alloy of Copper and Tin, Copper here forms green-blue salts when it oxidizes. Copper reacts very quickly with dissolved water to form Copper Carbonate or Basic Copper Carbonate which is green in colour.

As sea water contains dissolved halide salts, some of these halides such as Chlorine reacts with Copper to form Cuprous Chloride which again is Greenish in colour and contributes to the overall corrosion of the Bronze.

## B4.2 Illustration of chemical reactions:

The “bronze disease” is caused to the reactions that follow:

This reactions keeps on going on and on and hence eventually destroying the Bronze Structure.

The basic copper alloys react with water to create Hydrochloric Acid, this then eats away the copper alloy, leaving behind the green fuzz.

## B4.3 Any two chemical treatment to remove green fuzz

Students are expected to discuss the solutions obtained in section 1.2 and present their views/suggestions/recommendations (not to exceed 150 words)

1. As the green fuzz is due to the presence of , the structure is to be treated with 5% *Sodium sesquicarbonate* which neutralizes the remaining acid as well this converts the reactive cuprous chloride to largely inert copper oxide, hence breaking the recursive reaction chain. Once trated the specimen is kept in a dry environment and periodically inspected for reoccurrence of the *“Bronze Disease”*.
2. If the chloride ions have penetrated deep into the Bronze Structure then the structure is to be soaked in Ethanol or Acetone to remove any water content then it is soaked in *benzotriazole* (BTA) in ethanol solution, this makes the copper unreactive. Once cleaned thoroughly it is then coated in varnish, wax or raisin to prevent further corrosion.

**Bibliography**

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