**RATU NAVULA COLLEGE**

**HOME-BASED LEARNING-2021**

**YEAR 12B: CHEMISTRY**

**LESSON 34**

**STRAND:3. REACTION**

**SUB-STRAND:3.2 OXIDATION-REDUCTION**

**LEARNING OUTCOME:**

* **Distinguishing between oxidation and reduction reactions**
* **Calculating oxidation number(oxidation state)**

**Oxidation-Reduction**

* **Oxidation** is the **gain of oxygen**. For example, combustion and corrosion reaction
* **Reduction** is the **loss of oxygen**. Oxidation and reduction reactions occur simultaneously.
* As a substance is reduced, the other reactant will be oxidised.

**NOTE:**

* **oxidation is the loss of hydrogen or electrons**
* **Reduction is the gain of hydrogen or electrons**

**REDOX REACTIONS-** are reactions where electrons are transferred from one species to another.

-It is also known as electron transfer reactions.

**DEFINITION OF OXIDATION AND REDUCTION :**

|  |  |  |  |
| --- | --- | --- | --- |
| **OXIDATION** |  | **REDUCTION** |  |
| * **Addition of oxygen** | √ | * **Removal of oxygen** | X |
| * **Removal of hydrogen** | X | * **Addition of hydrogen** | **√** |
| * **Removal electrons**   **(gain of electrons on the product side)** | X | * **Addition of electrons**   **(gain of the electrons on the reactant side)** | **√** |
| * **Increase in the oxidation state** | | * **Decrease in the oxidation state** | |

**OXIDATION NUMBER (ON)**

* Is the change an atom would carry if the molecule were completely ionic.
* It is also known as **OXIDATION STATE.**

Example: CaCl2 -  , Ca2+, Cl- ( oxidation number of Ca is +2 and Cl is -1)

**RULES FOR ASSIGNING OXIDATION NUMBERS**

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| --- | --- |
| **RULES** | **EXAMPLES** |
| 1. **ATOMS EXISTS AS ELEMENTS:**  * they **have an oxidation number(ON) of ZERO** | **Na = 0 ; Cl2= 0**  **02= 0 ; Mg = 0** |
| 1. **MONOATOMIC (one atom)**  * **Ion is the same as the charge on the ion.** | **Ca2+= +2**  **Cl- = -1** |
| 1. **HYDROGEN IN COMPOUNDS**  * **Oxidation number +1, except in metal hydrides where it is -1.** | **(ON) of H in H2O= +1**  **(ON) of H in NaH= -1** |
| 1. **OXYGEN IN COMPOUNDS**  * **Oxidation number (ON) of -2, except in H2O2, where its oxidation number is -1;(OF2) is +2.** |  |
| 1. **POLYATOMIC IONS (more than one atom)**  * **The sum of the oxidation numbers(ON) of the atoms equals the charge of an ion.** | **CO32-= -2**  **SO42-= -2**  **NH41+ = +1** |
| 1. **SUM OF THE (ON) OF THE ATOMS IN A MOLECULE**  * **Always ZERO.** | **CO2 = 0**  **H2O = 0** |
| 1. **(ON) FOR GROUP 1: +1** | **Potassium : (ON) K =+1** |
| 1. **(ON) FOR GROUP 2 : +2** | **Magnesium : (ON)Mg =+2** |

**NOTE : OXIDATION STATE SIGN BEFORECa+2 ;**

**CHARGE OF AN ION HAS SIGN AFTER Ca2+**

**EXAMPLE :**

**Question : Calculate the oxidation number of Cl in ClO4-**

**Solution: Cl + 4O = -1**

**Cl + 4 (-2) = -1**

**Cl – 8 = -1**

**Cl – 8 + 8 =-1 + 8**

**Therefore , Oxidation Number for Cl = +7**

**Exercise 1: 1. Find the oxidation number of chromium(Cr) in CrO42-**

**2. State whether it is oxidation or reduction reaction: MnO4- Mn2+**

**LESSON 35**

**STRAND:3. REACTION**

**SUB-STRAND:3.2 OXIDATION-REDUCTION**

**LEARNING OUTCOME:**

* **Distinguish between some common oxidising and reducing agents**

**1.Oxidising Agents(OXIDANTS)**

**-are substances that allow(enhances) oxidation to take place but itself gets reduced.**

**2.Reducing Agents(REDUCTANTS)**

**-are substances that enhance reduction to take place but itself gets oxidized.**

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| **COMMON OXIDANTS** | | **COMMON REDUCTANTS** | |
| Oxygen | O2 | Metals | Zn ; Fe |
| Chlorine | Cl2 | Carbon | C |
| Permanganate ion | MnO4- | Sulphur dioxide | SO2 |
| Dichromate ion | Cr2O72- | Ferrous ion | Fe2+ |
| Hydrogen peroxide | H2O2 | Sulphite ion | SO32- |
| Dilute acids | H+ | Oxalate ion | C2O42- |
| Iodine | I2 | Thiosulphate | S2O32- |
| Iodate ion | IO3- |  |  |
| Copper(II) ion | Cu2+ |  |  |
| Hypochlorite | Cl- |  |  |

**EXERCISE 2**

1. **In the Redox Equation below , identify the oxidant and reductant.**

Cr2O72-(aq) +14 H++ 6Fe2+(aq) 6Fe3+(aq)2Cr3+(aq)+7H2O

**LESSON 36**

**STRAND:3. REACTION**

**SUB-STRAND:3.2 OXIDATION-REDUCTION**

**LEARNING OUTCOME:**

* **Balancing oxidation and reduction half equations**

**Identify and divide the main equation into two**

**HALF-EQUATION (REACTION):**

**1. Reduction**

**2.Oxidation]**

**EXAMPLE:** Main Equation:Cr2O72-(aq) + Fe2+(aq) Cr3+(aq)+ Fe3+(aq)

1. **Reduction** Cr2O72-(aq) Cr3+(aq)

2. **Oxidation** Fe2+(aq) Fe3+(aq)

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|  | **REDUCTION** | **OXIDATION** |
| **Balance atoms other than H and O** | Cr2O72-(aq) 2Cr3+(aq) balance Cr by adding 2 to Product | Fe2+(aq) Fe3+(aq) |
| **Balance O by adding H2O to the side that needs O** | Cr2O72-(aq) 2Cr3+(aq) + 7H2O | Fe2+(aq) Fe3+(aq) |
| **Balance H by adding H+ to the side that need H** | Cr2O72-(aq) +14 H+ 2Cr3+(aq) + 7H2O | Fe2+(aq) Fe3+(aq) |
| **Balance net charges by adding electrons.**  **( To the more positive side)** | Cr2O72-(aq) +14 H+ + 6e 2Cr3+(aq) + 7H2O  (-2) **+ (=14)= +12 - (+6) = 6** | Fe2+(aq) Fe3+(aq) + 1e |

**EXERCISE 3:**

1. **Balance the following half equations**
2. **SO32-  SO42-**
3. **NO3- NO2**

**LESSON 37**

**STRAND:3. REACTION**

**SUB-STRAND:3.2 OXIDATION-REDUCTION**

**LEARNING OUTCOME:**

* **Balancing Redox reaction.**

**STEPS IN BALANCING REDOX EQUATIONS IN:**

1. **ACIDIC SOLUTIONS**

|  |  |  |  |
| --- | --- | --- | --- |
| **STEPS** | | **EXAMPLE** | |
| **1.** | **Identify and divide the main equation into two**  **HALF-EQUATION (REACTION):**  **[1. Reduction ;**  **2.Oxidation]** | 1 | Main Equation:  Cr2O72-(aq) + Fe2+(aq) Cr3+(aq)+ Fe3+(aq)  HALF EQUATION:  1. Cr2O72-(aq) Cr3+(aq) (REDUCTION)  2. Fe2+(aq) Fe3+(aq) (OXIDATION) |
| **2.** | **Balance atoms other than H and O** | 2 | Cr2O72-(aq) 2Cr3+(aq) balance Cr by adding 2 to Product  . Fe2+(aq) Fe3+(aq) balanced |
| **3.** | **Balance O by adding H2O to the side that needs O** | **3** | Cr2O72-(aq) 2Cr3+(aq) + 7H2O |
| **4.** | **Balance H by adding H+ to the side that need H** | **4** | Cr2O72-(aq) +14 H+ 2Cr3+(aq) + 7H2O |
| **5.** | **Balance net charges by adding electrons.**  **( To the more positive side)** | **5** | Cr2O72-(aq) +14 H+ + 6e 2Cr3+(aq) + 7H2O  (-2) **+ (=14)= +12 - (+6) = 6**  Fe2+(aq) Fe3+(aq) + 1e |
| **6.** | **Multiply each half-reaction by a lowest common factor so that the number of electrons on the left hand side is equal to the right hand side.** | **6** | (Cr2O72-(aq) +14 H+ + 6e 2Cr3+(aq) + 7H2O)x1  (Fe2+(aq) Fe3+(aq) + 1e) x 6  6Fe2+(aq) 6Fe3+(aq) + 6e |
| **7** | **Add the two half-reactions together by cancelling the like terms (electrons, H2O, H+) on each side.** | **7** | Cr2O72-(aq) +14 H+ + ~~6e~~ 2Cr3+(aq) + 7H2O  6Fe2+(aq) 6Fe3+(aq) + ~~6e~~  cancel electrons as they are of the same number  OVERALL BALANCED EQUATION:  Cr2O72-(aq) +14 H++ 6Fe2+(aq) 6Fe3+(aq)2Cr3+(aq)+7H2O  Note: acidic solution due to the H+(proton donor) |

**Exercise 4:**

1. Balance half-equation and combine to give the overall REDOX reaction equation

**Fe2+ + MnO4- Fe3+ + Mn2+**

**LESSON 38**

**STRAND:3. REACTION**

**SUB-STRAND:3.2 OXIDATION-REDUCTION**

**LEARNING OUTCOME:**

* The application of redox reaction that is, Electrolytic processes in the production of aluminium and copper metals.

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|  | Production of Aluminium | Production of Copper |
| Sources | Mineral bauxite Al2.3H2O, Fe2O3 and SiO2 (mixture) | Chalcopyrite or copper pyrite (CuFeS2) |
| Ore | Alumina (aluminium oxide-Al2O3) | Cuprite (Cu2O) |
| Process | Electrolytic REDUCTION | Electro-deposition at the Cathode |
| Reaction | Ionisation of Alumina | Purification of Copper |
| Cathode | 4Al2+ + 12e 4Al **REDUCTION** | Cu2+ (aq) + 2e Cu(s) REDUCTION |
| Anode | 6O2- 3O2 + 12e **OXIDATION**  C + O2 CO2 | Cu(s) Cu2+ (aq) + 2e OXIDATION |

**EXERCISE 5:**

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| --- |
| Blistered copper, pure copper metal, acidified copper (II) sulphate solution, anode, cathode, cell. |

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|  |

1. Draw a diagram of the electro-deposition of copper and label the following components.