

GOVT. MODEL SANSKRITI
SENIOR SECONDARY
SCHOOL

CHEMISTRY PROJECT ON
ELECTROCHEMICAL CELL

SUBMITTED BY Vipul

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CERTIFICATE

- This is to certify that the project entitled, "Electrochemical Cell" submitted by KaSingh in partial fulfilment of the requirements for CBSE in "PGNtatMoGahskriti Senior Secondary" is an authentic work carried out by him under my supervision. The best of my knowledge, the matter embodied in the project has not been submitted to any other institute

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INTRODUCTION

Electro Chemical Cell Whenever a redox reaction is allowed to take place directly in a single beaker, it is found that the solution becomes hot. For example, when zinc is placed in a copper solution, the solution is found to be warmer (as the reaction proceeds according to the equation. $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$) Similar results are observed when a rod of copper is placed in silver solution. The reaction taking place as follows: $Cu(s) + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$ Thus, we conclude that whenever a redox takes place directly in a single in a single beaker, chemical energy in the form of heat is produced. By suitable means it is possible to bring out the redox reaction indirectly so as to convert the chemical energy into the electrical energy. Representation of an Electrochemical Cell An electrochemical cell is represented in a manner as illustrated below. $Zn/Zn^{2+} \parallel Cu^{2+}/Cu$ i.e. by convention, the electrode on which oxidation takes place is written on the left-hand side and the other electrode on which reduction takes place is written on the right-hand side.

Right-hand side. The electrode of the left-hand side is written by writing the symbol of the metal first followed by the symbol of the ion with its concentration in brackets. The electrode on the right-hand side is written by first writing the ion along with its concentration in brackets followed by the symbol of the metal.

Experimental Setup

A zinc rod is placed in the zinc sulphate solution taken in a beaker. A copper rod is placed in the copper sulphate solution taken in another beaker. The two rods are connected by a wire and two solutions are connected by a salt bridge.

Salt bridge and Its Function

A salt-bridge is a U-shaped tube containing concentrated solution of an inert electrolyte like KCl, KNO₃, K₂SO₄ etc. An inert electrolyte is one whose ions do not take part in the redox reaction and also do not react with electrolyte used. The function of the salt bridge is to allow the movement of the ions from one solution to the other without mixing of the two solutions. Thus, whereas the electrons flow in the outer circuit in the wire, the inner circuit is completed by the flow of ions from one solution to the other through the salt bridge moreover, it helps to maintain the electrical neutrality of the solution of the two half cells.

thus, the main functions of the salt bridge are:

- To complete the electrical circuit by allowing the ions to flow from one solution to the other without mixing of the two solutions.
- To maintain the electrical neutrality of the solutions in the two half cells.

Let us see what would happen if the salt bridge were not used in the cells how in the following diagram. Electrons are given out by the zinc electrode where they will neutralize some of the Cu²⁺-ions of the solution. Thus SO₄²⁻-ions will not leave and the solution will acquire negative charge. At the same time, Zn²⁺ ions produced from zinc plate will enter ZnSO₄ solution. After some time, the flow of electrons will stop and hence the current stops flowing.

standard EMF of an Electrochemical Cell

electrochemical cell is based on reaction which can be split into two half reactions:

- Oxidation half reaction
- Reduction half reaction

Standard EMF of the cell: Where, E_{cell} = Standard Electrode Potential of cell I

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cathode Electrode Potential of the oxidation half reaction
Anode Electrode Potential of the oxidation half reaction
According to Nernst equation, the relation between concentration of electrode and the standard electrode potential can be given as:

$$E = E^\circ - \frac{RT}{4F} \ln \left(\frac{P_{O_2}}{P_{O_2}^\circ} \right)$$

Where,
 E Electrode Potential at non-standard conditions
 E° Electrode Potential at standard conditions
 n = Number of electrons transferred in the equation
 $[M]$ =concentration of the metal
 $[M^+]$ =concentration of metal ion

SOME IMPORTANT FEATURES

- The electrode at which oxidation takes place is called the anode. The electrode at which the reduction takes place is called the cathode.
- Since electrons are produced at the zinc electrodes, this electrode is rich in electrons, which pushes the electrons into the external circuit and hence it is designated as the negative pole. The other electrode, i.e. the copper electrode is in the need of electrons for the reduction of Cu^{2+} ions into the Cu.
- The electrons flow from the negative pole to the positive pole in the external circuit. However, conventionally, this current is set to flow in the opposite direction. Zn^{2+}
- The oxidation of Zn into ions produces excess of ions in the left beaker. This creates an unbalanced positive charge in the solution. To maintain electrical neutrality of the solution in the two beakers, the cations and anions move through the salt bridge.
- As copper from copper sulphate solution is deposited on the copper electrode and sulphate ions migrate to the other side, the concentration of the copper sulphate solution decreases. As the cell operates consequently, the current falls.
- Evidently, the weight of the copper rod will increase while that of zinc rod will decrease as the cell works.

PROCEDURE

- Take two clean beakers.
- In one beaker take 0.5M copper sulphate solution and in the other take 0.5M zinc sulphate solution.
- Take a copper strip and clean it using a sandpaper.
- Dip the copper strip into the beaker containing the 1M copper sulphate solution.
- Similarly, take a zinc strip and clean it using a sandpaper.
- Then dip into the beaker containing 1M zinc sulphate solution. Take a salt bridge and connect the two solutions using the salt bridge.
- Take a voltmeter and connect the copper strip to the positive terminal and the zinc strip to the negative terminal using connecting wires.
- Note the positive of the pointer in the voltmeter and record the reading. Repeat the experiment by taking different concentration of zinc sulphate and the copper sulphate solutions.

OBSERVATION

SNO.	M CuSO ₄	M ZNSO ₄	EMF
.	0.5.	0.5	0.98
.	0.5	0.25	0.81
.	0.25	0.25	0.90

Conclusion

With these observations, we conclude that EMF of the cell increases with decreases in the concentration of the electrolyte around the anode and the increase in the concentration of the electrolyte around the cathode.

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