

For practical convenience, the steel is usually plated first with nickel or copper and then by chromium because it does not adhere well on the steel surface.

Moreover, it allows moisture to pass through it and metal is stripped off. The nickel or copper provides adhesion and then chromium deposited over the adhesive layer of copper lasts longer. This type of electroplating resists corrosion and gives as bright Silvery appearance to the object.

Short Answer Questions

Q1. What is meant by electrochemistry?

Ans. The branch of chemistry that deals with the relationship between chemical reactions is called electrochemistry.

Q2. Define oxidation.

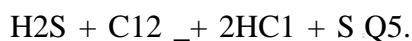
Ans. Oxidation is defined as the addition of oxygen or loss of electron or increase in oxidation number during chemical reaction.

02

Q3. Define reduction

Ans. Reduction is defined as removal of oxygen or addition of hydrogen or gain of electron number during a chemical reaction. $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$

Q4. What is meant by Redox?
Ans. Chemical reactions in which the oxidation state of one or more substances changes are called oxidation-reduction or Redox reactions.



Q5. What is meant by oxidizing agent? Give examples.

Ans. An oxidizing agent is a species that oxidizes a substance by taking electrons from it. The substance (atom or ion) which is reduced itself by gaining electrons is called oxidizing agent.

For example

- i) Concentrated sulphuric acid. H_2SO_4
- ii) Potassium permanganate. etc

Q6. What is meant by reducing agent? Give examples.

Ans. Reducing agent is the species that reduces a substance by donating electron to it. The substance (atom or ion) which is oxidized by losing electrons is called reducing agent. For example

- i) Hydrogen (H)
- ii) Hydrogen sulphide (H_2S) etc

Q7. What are spontaneous reactions?

Ans. Spontaneous reactions are those which take place on their own without any external agent.

Q8. What are non-Spontaneous reactions?

Ans. Non-spontaneous reactions are those which take place in the presence of external agent.

Q9. What is meant by Oxidation State?

Ans. Oxidation state or oxidation number is the apparent charge assigned to an atom of an element in a molecule or in an ion. For example in HCl, the oxidation number of hydrogen is +1 and chlorine is -1.

Q10. Define valency. Ans. The sign followed by the number i.e., 2+

The combining power of an atom another

Q11. What is meant by electrochemical cell? Ans. Electrochemical cell system in which two electrodes are dipped in the solution of an electrolyte which is connected to the battery.

OR

Electrochemical cell is an energy storage device in which either a chemical reaction takes place by using electric current or chemical reaction produces electric current.

(12. What are electrolytes?)

Ans. The substances, which can conduct electricity in their solutions or molten states, are called electrolytes. For example, solutions of salts, acids or bases are good electrolytes.

Q13. What are strong electrolytes?

Ans. The electrolytes which ionize completely in aqueous solution and produce more ions, are called strong electrolytes. For example, NaCl, NaOH, H₂SO₄ are strong electrolytes.

Q14. What are weak electrolytes?

Ans. The electrolytes which ionize to a small extent when dissolved in water and could not produce more ions are called weak electrolytes. For example, CH₃COOH, Ca(OH)₂ etc.

Q15. What are non-Electrolytes?

Ans. The substances, which do not ionize in solution and do not allow the current to pass through their solutions, are called non-electrolytes. For example, sugar solution, benzene etc.

Q16. What is meant by electrolytic cell?

Ans. The type of electrochemical cell in which a non-spontaneous chemical reaction takes place when electric current is passed through the solution, is called an electrolytic cell e.g., Down's cell.

Q17. Definition.

Ans. Chemical species which carries a positive charge. e.g., Na^+ , etc. Q18. Define anion.

Ans. Chemical species which carries a negative charge. e.g., O^{2-} , Cl^- etc.

Q19. Differentiate between Oxidation and reduction.

Oxidation	Reduction
Addition of oxygen	Removal of oxygen
Removal of hydrogen	Addition of hydrogen
Loss of electrons	Gain of electrons
Increase in oxidation number	Decrease in oxidation number

Q20. What is meant by galvanic cell?

Ans. The electrochemical cell in which a spontaneous chemical reaction takes place and generates electric current is called galvanic or voltaic cell e.g., Daniel cell.

Q21. What is half cell?

Ans. A galvanic cell consists of two cells one having cathode while the other having anode.
Ans.

end and which are connected with a salt bridge: Each of these known as half cell. Q22. Differentiate between Cathode and anode.

Cathode	Anode
Reduction always takes place at cathode	Oxidation always takes place at anode
Cathode carries negative charge in electrolytic cell	Anode carries positive charge in electrolytic cell

Cathode positive charge in galvanic cell	Anode carries negative charge in galvanic cell
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Q23. What is meant by salt bridge?

Ans. Salt-bridge is a U-shaped glass tube which consists of a saturated solution of strong electrolyte supported in a jelly type material. The ends of the U-shaped glass tube are sealed with a porous material like glass wool. The function of the salt bridge is to keep the solutions of two half cells neutral by providing a pathway for migration of ions.

Q24. Define corrosion.

Ans. It is a Redox reaction that takes place by the action of air and moisture with the metals. For example rusting of iron.

Q25. Differentiate between cation and anion. Ans..

Cation	Anion
A chemical specie which carries a positive charge	A chemical specie which carries a negative charge

During electrolysis it always move towards cathode electrode	During electrolysis it always move towards anode electrode
Examples: Na ⁺ , Ca	Examples: Cl ⁻ , O

Q26. What is meant by rust?

Ans. It is a Redox reaction that takes place when iron is exposed to air and moisture. The chemical formula of rust is Fe₂O₃. nH₂O.

Q27. Define electroplating.

Ans. Electroplating is depositing of one metal over the other by means of electrolysis.

Q28. Define alloy.

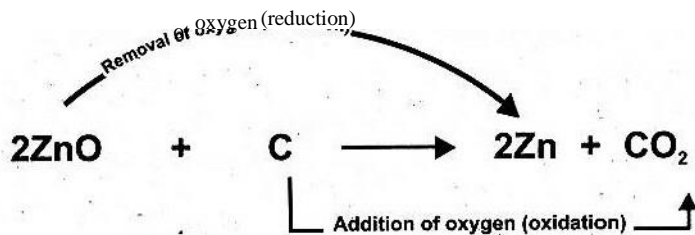
Ans. Alloy is a homogenous mixture of one metal metals. For example stainless steel is an alloy Q29.

Differentiate between Oxidizing Ans.

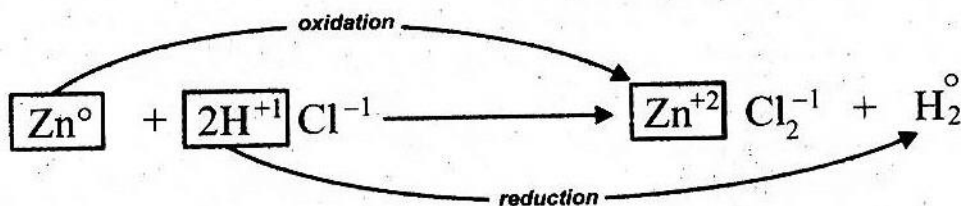
Oxidizing agent	Reducing agent
A specie that oxidizes a substance b taking electrons from it.	specie that reduces a substance by donating electrons to it.
A substance which is reduced itself by gaining electrons.	A substance which is oxidized by losing electrons.
A substance that reduces itself and oxidizes other.	A substance that oxidizes itself and reduces Other.
Examples are non-metals.	Examples are metals.

Q30. Justify the reaction between ZnO and C is Redox reaction.

Ans.



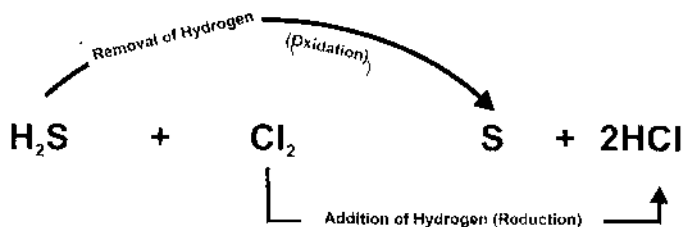
Q31. Justify the reaction between Zn and HCl is Redox reaction.



Ans.

(232. Justify the reaction between H₂S and Cl₂ is Redox reaction.

Ans.



Q39. Write construction of Down's cell?

Ans. This electrolytic cell is a circular furnace. In the center there is a large block of graphite, which acts as an anode while cathode around it is made of iron. Q40. Differentiate between Spontaneous and non-spontaneous reactions

Ans.

Spontaneous reactions	Non-spontaneous reactions
Those reactions which takes place on their own without any external agent	Those reactions which takes place in the presence of an external agent
Example: Galvanic cell	Example: Electrolytic cell

Q41. Give overall reaction for the preparation of sodium hydroxide.

Ans. $2\text{NaCl} + 2\text{H}_2\text{O} \longrightarrow \text{H}_2 + \text{Cl}_2 + 2\text{NaOH}$

Q42. Why the process of rusting does only occur on iron and not on the surface of aluminum?

Ans. Aluminum corrodes but it does not rust. Rust refers only to iron and steel corrosion. A very hard material aluminum oxide protect the aluminum from further corrosion. In comparison to that when iron corrodes, its color changes and produces large red flakes known as rust. Unlike aluminum oxide, the expanding and flaking of rust exposes new metal to further rusting.

Q43. Differentiate between Strong and Weak electrolytes.

Ans.

Strong electrolytes	Weak electrolytes
The electrolyte which ionizes completely in solution is called strong electrolyte.	The electrolyte which do not ionize completely in solution is called weak electrolyte.
It produces more ions in water	It produces less ions in water
Examples: NaOH, HCl etc	Examples: CH ₃ COOH,

Q44. What is meant by stainless steel?

Ans. It is an alloy which is made up of iron, chromium and nickel. Which does not corrode.

Q45. What is meant by galvanizing?

Ans. The process of coating a thin layer of zinc on iron is called galvanizing.

(246. How galvanizing process takes place?

Ans. This process is carried out by dipping a clean iron sheet in a zinc chloride bath and then heating it. After this iron sheet is removed, rolled into molten zinc metal bath and finally air cooled.

Q47. Write advantages of galvanizing.

Ans. A major advantage of galvanizing is that zinc protects the iron against corrosion even after the coating surface is broken.

Q48. What is the principle of electroplating?

Ans. The principle of electroplating is to establish an electrolytic cell in which anode is made of the metal to be deposited and cathode of the object on which metal is to deposit. The electrolyte is an aqueous solution of a salt of the respective metal.

Q49. Differentiate between Electrolytes and non-electrolytes. Ans.

Electrolytes	Non-Electrolytes
The substances, which can conduct electricity in their solutions or molten states, are called electrolytes	The substances, which cannot conduct electricity in their solutions or molten states, are called non-electrolytes
Examples: NaOH, HCl etc	Examples: Glucose solution, Benzene etc

Q50. Write a note on zinc electroplating.

Ans. A target metal is cleaned in alkaline detergent solution; and it is treated with acid, in order to remove any rust or surface scales. Next Zinc is deposited on the metal by immersing it in a chemical bath containing electrolyte zinc sulphate. A current is applied which results in zinc being deposited on the target metal i.e., cathode.

Q51. Write a note on tin electroplating.

Ans. Tin is usually electroplated on steel by placing the steel into a container containing a solution of tin salt. The steel is connected to an electrical circuit acting as cathode. While the other electrode made of tin metal acts as anode. When an electrical current passes through the circuit, tin metal ions present in the solution deposit on steel. Q52. Which material is used to make cathode in electroplating?

Ans. The cathode is made up of the object that is to be electroplated like some sheet made up of iron.

Q53. Why is the anode made up of a metal to be deposited during electrolysis?

Ans. When current is passed, the metal from anode dissolves in the solution and metallic ions migrate to the cathode and discharge or deposit on the cathode.

Q54. What is the difference between corrosion and rusting?

Ans. Corrosion is slow and continuous eating away of a metal by the surrounding medium. It is a Redox chemical reaction that takes place by the action of air and moisture with metals. While, rusting is an example of corrosion. The condition for rusting is the moist air (air having water vapours in it).

(255. Differentiate between Electrolytic and galvanic cell.

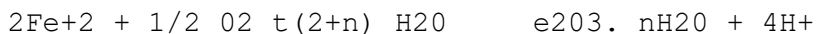
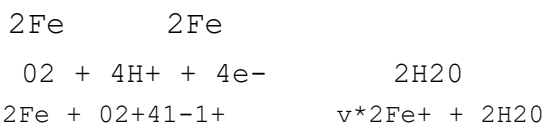
Electrolytic cell	Galvanic cell
It consists of one complete cell, connected to a battery	It consists of two half cells connected through a salt bridge
Anode has positive charge while cathode has negative charge	Anode has negative charge while cathode has positive charge
Electrical energy is converted into chemical energy	Chemical energy is converted into electrical energy
Current is used for a non-spontaneous chemical reactions to take place	Redox reaction takes place spontaneously and produces electric current
Examples: Nelson cell, Down cell	Example: Daniel cell, fuel cell

Q56. What happen to iron in the rusting process?

Ans. The rusting process continues until all the pieces of iron is eaten up.

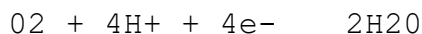
Q57. Rusting completes in how many Redox reactions?

Ans. Rusting completes in three Redox reactions



Q58. Explain the role of O₂ in rusting?

Ans. The free electrons move through iron sheet; until they reach to a region of relatively high oxygen concentration, near the surface surrounded by water layer. This region acts as a cathode and electrons reduce the oxygen molecule in the presence of ions.



Q59. State the best method for protection of metal from corrosion.

Ans. The best method for protection against the corrosion of metals exposed to acidic conditions is coating the metal. Corrosion resistant metals like Zn, Sn and Cr are used for this method.

Q60. Why tin plated iron is rusted rapidly when tin layer is broken?

Ans. When tin layer is broken and iron is exposed to the air and water, a galvanic cell is established and iron rusts rapidly.

Q61. Name the metal which is used for galvanizing iron?

Ans. Zinc metal is used for galvanizing iron.

Q62. Anode of Down's cell is made of a non-metal, what is its name? What is the function of this anode?

Ans. In Down's cell anode is made up of carbon (graphite). The Cl^- ions are oxidized to give Cl_2 gas at the anode.

Q63. Where does the sodium metal is collected in Down's cell?

Ans. In Down's cell Na^+ ions are reduced at cathode and molten sodium metal floats on the denser medium salt mixture from where it is collected in a side tube. Q64. What is the name of the by-product produced in the Down's cell? Ans. Chlorine gas is produced as a by-product in the Down's cell.

Q65. Are anodes of Down's cell and Nelson's cell made of same element? If yes, what is its name?

Ans. Yes, anodes of both Down's cell and Nelson's cell are made up of same element known as graphite.

Q66. What is the shape of cathode in Nelson's cell? Why is it perforated?

Ans. In Nelson's cell, cathode is internally lined with asbestos diaphragm. Cathode is a U-shaped perforated iron from where sodium hydroxide solution slowly percolates in a catch basin.

Q67. Which ions are discharged at cathode in Nelson's cell and what is produced at cathode?
Ans. Cl^- are discharged at cathode in Nelson's cell and chlorine gas is evolved from the electrode.

Q68. Why are the strong electrolytes termed as good conductors?

Ans. Strong electrolytes are termed as good conductors because they ionize completely in their solutions.

Q69. Does non-electrolyte form ions in solution.

Ans. No, non-electrolytes do not ionize in solution and do not allow the current to pass through their solutions

(270. Identify a strong or Weak electrolyte among the following compounds.

- i) H_2SO_4 (Strong electrolyte)
- ii) H_2CO_3 (Weak electrolyte)
- iii) (Weak electrolyte)
- iv) HCl (Strong electrolyte)
- v) AgNO_3 (Strong electrolyte)

Q71. Which force drives the non-spontaneous reaction to take place?

Ans. Non-spontaneous reactions are those which take place in the presence of external agent. This external agent is known as electrical energy.

Q72. Which type of chemical reaction takes place in electrolytic cell?

Ans. Non-spontaneous chemical reaction takes place with the help of electricity in electrolytic cell.

Q73. What type of reaction takes place at anode in electrolytic cell?

Ans. The process of oxidation takes place at anode in electrolytic cell.

Q74. Why the positively charged electrode is called anode in electrolytic cell?

Ans. The electrode connected to positive terminal of the battery is called anode.

Q75. In the electrolysis of water, towards which terminal H^+ ions move?

Ans. In the electrolysis of water, H^+ ions move towards cathode and reduced to hydrogen gas and liberates.

Q76. In the electrolysis of water, where is the oxygen produced?

Ans. In the electrolysis of water, oxygen is produced at anode electrode.

Q77. Towards which electrode of the electrolytic cell moves the cations and what do they do there?

Ans. In electrolytic cell, cations move towards cathode electrode and they are reduced there.

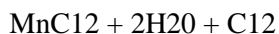
Q78. How the half cells of a galvanic cell are connected? What is function of salt bridge?

Ans. The half cells of a galvanic cell are connected electrically by a salt bridge. It is used to keep the solutions of two half cells neutral by providing a pathway for migration of ions.

Q79. In the following reaction, how can you justify that H₂S is oxidized and S₀₂ is reduced

Ans. As hydrogen is removed from H₂S, therefore H₂S is oxidized, while removal of oxygen takes place in S₀₂, therefore S₀₂ is reduced

Q80. The reaction between MnO₂ and HCl is Redox reaction written as balanced chemical equation.



Find out'

- The substance oxidized
- The substance reduced
- The substance which acts as oxidizing agent
- The substance which acts as reducing agent

Ans. (a) Cl is oxidized

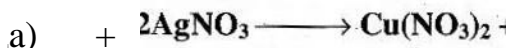
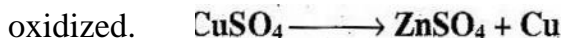
(b) Mn is reduced

(c) MnO₂ is oxidizing agent

(d) HCl is reducing agent.

(281. The following reactions are Redox reaction.

Find out the element which has been reduced and the element which has been oxidized.



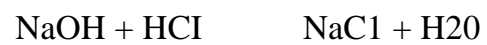
Ans. (a) Zn is oxidized and Cu is reduced

(b) Cu is oxidized and Ag is reduced

(c) Sulphur (s) is oxidized and Cl is reduced

Q82. Why the following reaction is not a redox reaction. Explain with reasons?

d.



Ans. Because, acid- base reactions are considered to be neutralization reactions. Whenever, acid reacts with bases, they form salt and water.

Q83. Find out the oxidation numbers of the following elements marked in bold in the formulae. $\text{Ba}_3(\text{PO}_4)_2$, CaSO_4 , , , NaSO_4 , HN_3 , KC_2O_7 , AgNO_3 , KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$, HN_2 , SO_2 , H_2SO_4 Ans.

i) $\text{Ba}_3(\text{PO}_4)_2$

$$3[\text{O.N of Ba}] + 2[\text{O.N of P}] + 8[\text{O.N of O}] = 0$$

$$3[+2] + 2x + 8[-2] = 0$$

$$+6 + 2x - 16 = 0$$

$$2x = +10$$

ii) [O.N of Ca] + [O.N of S] + 4[O.N of O] = 0

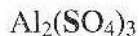
$$+2 + x + 4[-2] = 0$$

$$+2 + x - 8 = 0$$

$$x - 6 = 0$$

$$x = +6$$

$$x = +6$$



$$2[\text{O.N of Al}] + 3[\text{O.N of S}] + 12[\text{O.N of O}] = 0$$

$$2[+3] + 3x + 12[-2] = 0$$

$$+6 + 3x - 24 = 0$$

$$3x - 18 = 0$$

$$3x = +18$$

v) Na_2SO_4

$$2[\text{O.N of Na}] + [\text{O.N of S}] + 4[\text{O.N of O}] = 0$$

$$2[+1] + x + 4[-2] = 0$$

$$+2 + x - 8 = 0$$

$$x = +6$$

vi) HN_3

$$\text{ION of HI} + \text{to.N of NI} + 3 \times 10. \text{N of OI} = 0$$

$$[+1] + [N] +$$

$$+1 + N - 6 = 0 \quad 3 \times 1 - 2 \times 1 = 0$$

$$N - 5 = 0$$



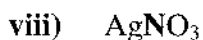
$$[\text{O.N of K}] + [\text{O.N of Cl}] + 3[\text{O.N of O}] = 0$$

$$[+1] + [\text{Cl}] + 3[-2] = 0$$

$$+1 + \text{Cl} - 6 = 0$$

$$\text{Cl} - 5 = 0$$

$$\text{Cl} = +5$$



$$[\text{O.N of Ag}] + [\text{O.N of N}] + 3[\text{O.N of O}] = 0$$

$$[+1] + [N] + 3[-2] = 0$$

$$+1 + N - 6 = 0$$

$$N - 5 = 0$$

$$N = +5$$



$$\text{ro.N of KI} + 10. \text{N of Mnl} + 4 \times 10. \text{N of OI} = 0$$

$$[+1] + [\text{Mn}] + 4[-$$

$$+1 + \text{Mn} - 8 = 0 \quad + 4 \times 1 - 2 \times 1 = 0$$

$$\text{Mn} - 7 = 0$$

$$\text{Mn} = +7$$



$$2 \times 10. \text{N of KJ} + 2 \times 10. \text{N of crl} + 7 \times 10. \text{N of OI} = 0$$

$$2 \times 1 + 2 \times \text{crl} + 7 \times 1 - 2 \times 1 = 0$$

$$+2 + 2\text{Cr} - 14 = 0$$

$$2\text{Cr} = 12 = 0$$

$$2\text{Cr} = +12$$

$$\text{Cr} = +6$$



$$\text{ION of HI} + \text{LO.N of NI} + 2 \times 10. \text{N of OJ} = 0$$

$$1 + 1 + 2 \times \text{NI} + 2 \times 1 - 2 \times 1 = 0$$

$$+1 + N - 4 = 0$$

$$N - 3 = 0$$

xii) H_2S

$$2[\text{O.N of H}] + [\text{O.N of S}] = 0$$

$$2[+1] + [\text{S}] = 0$$

$$+2 + \text{S} = 0$$

$$\text{S} + 2 = 0$$

$$\text{S} = -2$$

xiii) SO_2

$$[\text{O.N of S}] + 2[\text{O.N of O}] = 0$$

$$[\text{S}] + 2[-2] = 0$$

$$\text{S} - 4 = 0$$

$$\text{S} - 4 = 0$$

$$\text{S} = +4$$

xiv) H_2SO_4

$$2[\text{O.N of H}] + [\text{O.N of S}] + 4[\text{O.N of O}] = 0$$

$$2[+1] + [\text{S}] + 4[-2] = 0$$

$$+2 + \text{S} - 8 = 0$$

$$\text{S} - 6 = 0$$

$$\text{S} = +6$$

Q84. In a compound MX_3 , find out the oxidation number of M and X.

Ans. $\text{M} = +3$

$\text{X} = -1$

Q85. Why the oxidation number of oxygen in OF_2 is +2?

Ans. The oxidation number of oxygen on OF_2 is +2, because fluorine has a high electronegative value as compared to oxygen. Therefore, fluorine will carry negative (-1) charge while oxygen will carry (+2) charge on it.

Q86. An element X, has oxidation state 0. What will be its oxidation state when it gains three electrons?

Ans. When X will gain three electrons in its valence shell its oxidation state will become

(287. An element in oxidation state +7 gains electrons to be reduced to oxidation state +2. How many electrons did it accept?

Ans. When an element in oxidation state +7 gains electrons and reduced to oxidation state +2, it shows that it has accepted +5 electrons in its valence shell.

Q88. If the oxidation state of an element changes from +5 to -3. Has it been reduced or oxidized? How many electrons are involved in this process?

Ans. When the oxidation state of an element changes from +5 to -3, it is considered to be reduced. There are eight electrons involved in this process.

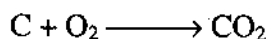
Q89. How can you justify that a reaction between magnesium and oxygen is a Redox reaction, while the reaction shows only addition of oxygen (oxidation).



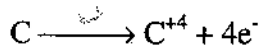
Ans. The above reaction is a Redox one, because oxygen tends to gain electron which is known as reduction, while magnesium tends to remove electron which is known as oxidation. The process is known as Redox.

Q90. A reaction between carbon and oxygen involved only addition of oxygen (oxidation), but it is called a Redox reaction. Comment on this.

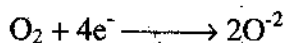
is.



Oxidation reaction



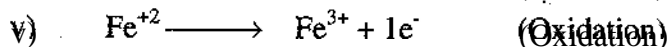
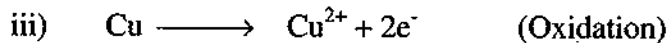
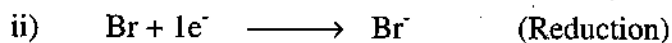
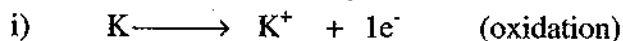
Reduction reaction



Overall reaction



Q91. Identify which of the following is oxidation or reduction reaction.

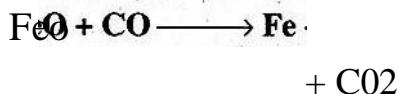


simultaneous oxidation-reduction Q90. A reaction between carbon and oxygen (oxidation), but it is called a Redox reaction. Comment Ans.

Q92. An element M reacts with another element X to form MX₂. In terms of loss or gain of electrons, identify the element which is oxidized and which is reduced.

Ans. When an element M loses its electron, oxidation process takes place. When this electron is gained by element X, reduction process takes place. Therefore, element M is oxidized while element X is reduced.

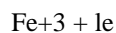
Q93. How can you justify that the following reaction is not only an oxidation reaction but also a complete Redox. reaction.



Ans. When FeO reacts with CO, oxygen is removed from FeO which shows reduction process. On the other hand when oxygen is added to CO it shows oxidation process. Therefore, it is a complete redox reaction.

Q94. Explain the term oxidation and reduction on the basis of electronic concept with an example.

Ans. Oxidation: A process in which loss of electrons takes place is called oxidation.



Reduction: A process in which gain of electrons takes place is called reduction.



Q95. Write applications of galvanic cell?

Ans. As a result of Redox reaction, electric current is produced. The batteries which are used for starting automobiles, running calculators and toys and to lit the bulbs work on the same principle.

Multiple Choice Questions

1. The branch of chemistry which deals with the relationship between electricity and chemical reactions.

- (a) Electrochemis
- (b) Thermochemts
- (c) Analytical chemistry
- (d) Industrial chemistry

Oxidation involves (a)
Removal of oxygen

(b) Addition of oxygen

(c) Gain of electron

(d) Addition of hydrogen

3. In HCl, oxidation number of H is:

4. The oxidation number of all elements in free state is:

- (a) One
- (b) Two