Important Questions for Class 11

Chemistry

Chapter 8 - Redox Reactions

Very Short Answer Questions **1 Mark**

1. Define oxidation reaction?
Ans: A reaction in which oxygen gets added, or removal of a hydrogen atom takes place is called oxidation reaction.

2. Define reduction reaction?
Ans: A reaction in which oxygen gets removed, or addition of a hydrogen atom takes place is called oxidation reaction.

3. In the reactions given below, identify the species undergoing oxidation and reduction. $\mathbf{H_2S(g) + Cl_2 \rightarrow 2HCl(g) + S(s)}$
Ans: Chlorine, being an electronegative element is added to hydrogen, so H_2S is oxidised. Hydrogen is added to chlorine, hence it reduces.

4. What are the most essential conditions that must be satisfied in a redox reaction?
Ans: It should not conflict with the conservation of electrons. Total number of electrons lost should be equal to the total number of electrons gained by the oxidising agent.

5. In the reaction $\mathbf{MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O}$**, which species is oxidized?**
Ans: As addition of chlorine occurs in HCl, hence, it is the oxidising agent.

6. Why is the following reaction an example of an oxidation reaction? $\mathbf{CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O}$
Ans: It is so because addition of oxygen is observed in CH_4. Addition of oxygen signifies oxidation.

7. Define oxidation in terms of electron transfer.
Ans: Loss of electrons performed by the reducing agent is called oxidation. If the oxidation number of an element changes from 0 to +1, then it is said to be oxidised.

8. What is meant by reduction?

Ans: Gain of electrons performed by the oxidising agent is called oxidation. If the oxidation number of an element changes from 0 to -1, then it is said to be reduced.

9. Define an oxidizing agent. Name the best reducing agent.

Ans: A substance which can easily gain electrons is called an oxidising agent. Fluorine molecules are the best oxidising agent.

10. What is meant by reducing? Name the best reducing agent.

Ans: A substance which can easily lose electrons is called a reducing agent. Lithium is the best reducing agent.

11. What is the oxidation number of manganese in $KMnO_4$?

Ans: If 'x' is the oxidation number of manganese, then:

$1 + x + 4(-2) = 0$

$\Rightarrow x = +7$

12. What happens to the oxidation number of an element in oxidation?

Ans: Oxidation number increases during an oxidation. If the oxidation number of an element changes from 0 to +1, then it is said to be oxidised.

13. Name one compound in which the oxidation number of Cl is + 4.

Ans: ClO_2, here the oxidation number of chlorine is +4. It can be found out by taking the oxidation number as "x".

14. Indicate the oxidizing and reducing agents in the following reaction : $2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$.

Ans: Cu^{2+} is oxidising agent and I^- is a reducing agent. The copper ion gives electrons and the iodide ions accept electrons.

15. A metal ion M^{3+} loses 3 electrons. What will be its oxidation number?

Ans: The oxidation number will be $(3 + 3 = +6)$. Losing an electron means more positive charge on the atom, signifying that element is oxidised.

16. Name the different types of redox reaction

Ans:

- Combination reactions
- Decomposition reactions
- Displacement reactions

- Disproportionation reactions

17. Identify the type of redox reaction this reaction follows.

$\mathbf{3Mg(s) + N_2(g) \xrightarrow{\Delta} Mg_3N_2(s)}$

Ans: As in the reaction, 2 reactants form a single product on heating; it is a combination reaction.

18. The displacement reactions of Cl, Br, I using fluorine are not generally carried out in aqueous solution. Give a reason.

Ans: Fluorine being a reactive element replaces chloride bromide and iodide ions in solution and it reacts with water and displaces the oxygen present there.

19. Which is the strongest oxidizing agent?

Ans: F_2 is the strongest oxidising agent. It is the most electronegative element and undergoes reduction by accepting an electron.

20. Why $\mathbf{F^-}$ ions Cannot be converted to $\mathbf{F_2}$ by chemical means?

Ans: It is chemically impossible as fluorine is an oxidising agent, it does not lose electrons.

21. Define disproportionation reaction.

Ans: In a disproportionation reaction an element in one oxidation state is oxidized and reduced simultaneously.

22. Identify the reaction $\mathbf{2H_2O_2(aq) \rightarrow 2H_2O(g) + O_2(g)}$

Ans: It is a disproportionate reaction. It is so because hydrogen peroxide is getting both oxidised and reduced simultaneously.

23. Which gas is produced when less reactive metals like Mg and Fe react with steam?

Ans: $Mg + 2H_2O \xrightarrow{\Delta} Mg(OH)_2 + H_2 Fe + 3H_2O \xrightarrow{\Delta} Fe_2O_3 + 3H_2$

Dihydrogen gas is released.

24. All decomposition reactions are not redox reactions. Give a reason.

Ans: Decomposition of calcium carbonate is not a redox reaction. It is so because in the decomposition of calcium carbonate, because in the product side, there should be at least one substance in the elemental state.

25. Complete the following redox reactions and balance the following equations-

(i) $Cr_2O_7^{2-} + C_2O_4^{2-} \rightarrow Cr^{3+} + CO_2$ (in presence of acid)

Ans: In presence of acid, H^+ ions are available. The reactions are:

$$r_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O[C$$

$$_2O_4^{2-} \rightarrow 2CO_2 + 2e^-]\times 3$$

We multiply the second equation by 3 so as to balance the number of electrons, and we get the final equation as:

$$Cr_2O_7^{2-} + 14H^+ + 3C_2O_4^{2-} \rightarrow 2Cr^{3+} + 6CO_2 + 7H_2O$$

(ii) $Sn^{2+} + Cr_2O_7^{2-} \rightarrow Sn^{4+} + Cr^{3+}$ (in presence of acid)

Ans: In presence of acid, H^+ ions are available. The reactions are:

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

$$[Sn^{2+} \rightarrow Sn^{4+} + 2e^-]\times 3$$

We multiply the second equation by 3 so as to balance the number of electrons, and we get the final equation as:

$$Cr_2O_7^{2-} + 3Sn^{2+} + 14H^+ \rightarrow 2Cr^{3+} + 3Sn^{4+} + 7H_2O$$

26. Write correctly the balanced half – reaction and the overall equations for the following skeletal equations.

(i) $NO_3^- + Bi(s) \rightarrow Bi^{3+} + NO_2$ (in acid solution)

Ans: In acidic medium, H^+ is available.

The oxidation half is:

$$Bi(s) \rightarrow Bi^{3+} + 3e^-$$

The reduction half reaction:

$$[NO_3^- + 2H^+ + e^- \rightarrow NO_2 + H_2O]\times 3$$

The balanced equation is:

$$Bi(s) + 3NO_3^- + 6H^+ \rightarrow Bi^{3+} + 3NO_2 + 3H_2O$$

(ii) $Fe(OH)_2(s) + H_2O_2 \rightarrow Fe(OH)_3(s) + H_2O$ (in basic medium)

Ans: In basic medium, OH^- is available.

The oxidation half is:

$$[Fe(OH)_2 + OH^- \rightarrow Fe(OH)_3 + e^-]\times 2$$

The reduction half is:

$$H_2O_2 + 2e^- \rightarrow 2OH^-$$

The balanced equation is:

$$2Fe(OH)_2 + H_2O_2 \rightarrow 2Fe(OH)_3$$

27. Define half – cell

Ans: A half cell consists of conducting electrolyte and electrode structure, separated by a Helmholtz double layer.

28. Set up an electrochemical cell for the redox reaction

$\mathbf{Ni^{2+}(aq) + Fe(s) \rightarrow Ni(s) + Fe^{2+}(aq)}$

Ans: $Fe(s)\,|\,Fe^{2+}\,||Ni^{2+}(aq) + Ni(s)$

29. Can we store copper sulphate in an iron vessel?

Ans: Iron displaces copper from the solution and for this, holes will be created. It will form iron sulphate.

30. What is the role of a salt bridge in an electrochemical cell?

Ans:

- Provide electrical neutrality
- Prevents mixing of the electrolytes.

31. Which reaction occurs at cathode in a galvanic cell?

Ans: At cathode, reduction happens, whereas oxidation occurs in the anode. A galvanic cell consists of cathode, anode and electrolyte.

Short Answer Questions **2 Marks**

1. Why $\mathbf{ClO_4^-}$ does not show disproportionation reaction whereas $\mathbf{ClO^-, ClO_2^-, ClO_3^-}$ shows?

Ans: The chlorine atoms in ClO^-, ClO_2^-, ClO_3^- have an oxidation state of +1,+3+5 respectively. However, in ClO_4^-, the oxidation state of chlorine is +7, which is maximum. That is why it doesn't show a disproportionate reaction.

2. How would you know whether a redox reaction is taking place in an acidic / alkaline or neutral medium?

Ans: Presence of an acidic solution can be indicated by the presence of H^+ ions. Presence of basic or alkaline solution can be indicated by the presence of OH^- ions. If both of these ions are absent in the chemical reaction, then it is a neutral solution.

3. Write the following redox reactions in the oxidation and reduction half reaction reactions in the oxidation and reduction half reactions.
(i) $2K(s) + Cl_2(g) \rightarrow 2KCl(s)$

Ans: $K(s) \rightarrow K^+(aq) + e^-$ (oxidation)

$Cl_2(g) + 2e^- \rightarrow 2Cl^-$ (reduction)

(ii) $2Al(s) + 3Cu^{2+}(aq) \rightarrow 2Al^{3+}(aq) + 3Cu(s)$

Ans: $Al(s) \rightarrow Al^{3+}(aq) + 3e^-$ (oxidation)

$Cu^{2+} + 2e^- \rightarrow Cu(s)$ (reduction)

4. An electrochemical cell is constituted by combining Al electrode ($E_0 = -1.66V$) and Cu electrode ($E_0 = +0.34V$). Which of these electrodes will work as a cathode and why?
Ans: Since the electrode potential of Al is lower than that of Cu, therefore, Cu has a higher tendency to get reduced and hence Cu electrode acts as a cathode, as reduction occurs in cathode.

5. The E_0 of Cu^{2+}/Cu is + 0.34V. What does it signify?

Ans: It signifies that Cu^{2+} have more reduction power, than that of hydrogen ions.

6. If reduction potential of an electrode is 1.28V. What will be its oxidation potential?
Ans: The oxidation potential will be ($0 - 1.28 = (-)1.28V$).

7. What is the electrode potential of a standard hydrogen electrode?
Ans: The electrode potential of a standard hydrogen electrode is 0V.

8. Define a redox couple.
Ans: A redox couple is defined as having together reduced and oxidised forms of a substance which takes part in an oxidation and reduction half reaction.

9. Explain why $3Fe_3O_4(s) + 8Al(s) \rightarrow 9Fe(s) + 4Al_2O_3(g)$ is it an oxidation reaction?
Ans: It is an oxidation reaction because aluminium is getting oxidised, it forms Al_2O_3 in the product, indicating that addition of oxygen has taken place.

Long Answer Questions 5 Marks

1. Balance the following equations by oxidation number method:

(i) $\mathbf{CuO + NH_3 \rightarrow Cu + N_2 + H_2O}$

Ans: Let us observe the chemical equation:

$$\overset{+2}{Cu}O + \overset{-3}{N}H_3 \rightarrow \overset{0}{Cu} + \overset{0}{N_2} + H_2\overset{-2}{O}$$

Oxidation number of copper decreases from +2 to O and that of nitrogen gets increased from – 3 to 0.

To balance, there should be three atoms of copper and two atoms of nitrogen.

$$3CuO + 2NH_3 \rightarrow 3Cu + N_2 + H_2O$$

Now, balancing the hydrogen and oxygen atoms, we get the final equation as:

$$3CuO + 2NH_3 \rightarrow 3Cu + N_2 + 3H_2O$$

(ii) $\mathbf{K_2MnO_4 + H_2O \rightarrow MnO_2 + KMnO_4 + KOH}$

Ans: Let us observe the chemical equation:

$$2K_2\overset{+5}{Mn}O_4 + H_2O \rightarrow \overset{+4}{Mn}O_2 + K\overset{+7}{Mn}O_4 + KOH$$

Oxidation number of manganese changes from +6 to +4, in one mole, and in the other mole, the oxidation number changes from +6 to +7. 1 mol acquires two electrons while the other loses 1 electrons. To balance the oxidation number of manganese, it is multiplied by 2:

$$K_2MnO_4 + 2K_2MnO_4 + H_2O \rightarrow MnO_2 + 2KMnO_4 + KOH$$

Further balancing the equation we have:

$$3K_2MnO_4 + 2H_2O \rightarrow MnO_2 + 2KMnO_4 + 4KOH$$