1. **Why does damaged tin plated iron get rusted quickly?**

Ans: **Damaged tin plated iron:** If the protective coating of tin is damaged then the iron comes in contact with moisture. A galvanic cell is established in which tin acts as a cathode and iron as an anode. The electrons move from iron to tin, where they discharge H^+ ions, leaving behind OH in the solution. These OH^- ions combine with iron and forms $Fe(OH)_3$, which dissolves rapidly in water.

$$Fe^{3+} + 3OH^- \longrightarrow Fe(OH)_3$$

So the damaged tin plated iron gets rusted more quickly due to the fact that water promotes the electrochemical oxidation of iron.

2. **Under what conditions does aluminum corrode?**

Ans: The main conditions for corrosion of Aluminum are

i) Presence of moisture
ii) Presence of impurities which must be less reactive than Al. eg. Zn. Cr Fe and Cd etc.
iii)Presence of air or oxygen

When an active metal Al comes in contact with less active metals like Zn, Cu, Fe, Sn i.e. having greater reduction potential than Al, a Galvanic cell is established in the presence of moisture. In this cell, Al acts as an anode while metals like Zn, Fe etc as cathode. In this process, active metal (Al) corrodes rapidly while the others remain intact.

3. **How does the process of galvanizing protect iron from rusting?**

Ans: Galvanizing protect iron from rusting: A clean sheet of iron is dipped in zinc chloride bath, the iron sheet is then removed, passed through the hot rollers and air cooled. This process is called galvanizing or zinc coating or anode coating. If the sheet of Zn is damaged a galvanic cell is established in the presence of moisture. Iron serves as a cathode and zinc as an anode. Electrons flow from Zn to iron, so Zn decays and Fe remains intact.

$$Fe^{3+} + Zn \longrightarrow Zn^{+2} + Fe$$

By this method the iron is protected from rusting.

4. **How chromate ions are converted into dichromate ions?**

Ans: In an aqueous solution, CrO_4^{2-} and $Cr_2O_7^{2-}$ ion exist in equilibrium with each other.

$$2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$$

When an acid is added in such a solution, then the H^+ ions from the acid increases in its concentration. According to Le-Chatelier's principle, if the concentration of reactants is increased at equilibrium stage, this will disturb the equilibrium position and the reaction is shifted in forward direction. So, in this way, chromate (CrO_4^{2-}) ions are converted into dichromate ions ($Cr_2O_7^{2-}$)

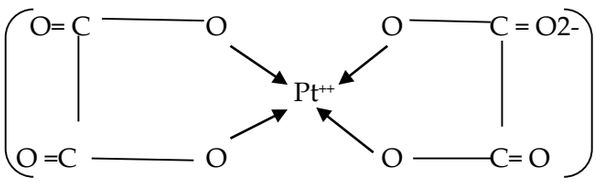
5. **Explain the term substitutional alloy with example?**

Ans: Alloy that is formed by the substitution of one metal atom by another in crystal lattice is called substitutional alloy .eg. Bronze, Brass.

6. **Explain chelates with examples.**

Ans: A complex compound formed by donation of electron pairs by all the donor atoms of a polydentate ligand is called Chelate. It contains one or more rings in its structure.

Examples: Dioxalato-platinate(II) ion, When both the donor atoms of two oxalate ligands $C_2O_4^{2-}$ (bi dentate ligand) donate electron pairs to Pt^{+2} ion, diaxolato palatinate (II) ion is formed. In this, we observe two five membered rings.



7. **"Dichromates are very powerful oxidizing agents". Prove the truth of this statement by given examples.**

Ans: Dichromates are powerful oxidizing agents: Dichromates are very powerful oxidizing agents in acidic solution. In this process hexa-valent chromium jon is reduced to trivalent chromium ion.

i) $K_2Cr_2O_7 + 3H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3S$

ii) $K_2Cr_2O_7 + 7H_2SO_4 \longrightarrow 3Fe_2(SO_4)_3 + Cr2(SO_4)_3 + K_2SO_4 + 7H_2O$

iii) $K_2Cr_2O_7 + 7HH_2SO_4 \longrightarrow 4K_2SO_4 + Cr_2(SO_4)_3 + 3I_2 + 7H_2O$

iv) $K_2\ Cr_2O_7 + 4NaCl + 6H_2SO_4 \longrightarrow 2KHSO_4 + 4NaHSO_4 + 3H_2O + 2CrO_2Cl_2$
(Chromyl Chloride)

In the above example, potassium dichromate oxidizes H_2S, $FeSO_4$, Kl and NaCl into S, $Fe_2(SO_4)_3$, I_2 and CrO_2Cl_2 respectively in the presence of H_2SO_4.

8. **Why puddling furnace have low roof?**

Ans: In manufacturing of wrought iron from cast iron, the roof of the puddling furnace is kept low to deflect the hot gases and flames downwards to melt the cast iron.

9. **Why the hearth of furnace is lined with Fe_2O_3?**

Ans: The hearth of the furnace is lined with hematite (Fe2O3). The cast iron is placed on the hearth, melted by hot gases and stirred with long iron rods called rabbles.

10. **What is the role of rabbles in puddling furnace?**

Ans: the rabbles are actually long iron rods which are hanging from the roof of the puddling furnace and are used for stirring or puddling of the mass present in hearth. These rabbles also help to take out the semi solid mass out of the furnace in the form of balls which are called blooms.

11. **What is forging of steel?**

Ans: The removal of impurities by applying pressure on hot and melted steel is forging.

12. **Why solubility of $KMnO_4$ is 7% in water at 20^0 C?**

Ans: The solubility of $KMnO_4$ is an endothermic process. It increases with the increase in temperature. At 20^0C, it is 7% soluble but at 63^0C its solubility can be increased up to 25%.

13. **Why transition elements compounds are coloured?**

Ans: In transition elements, the d orbitals are responsible for the colour development in their compounds. When these orbitals are involved in bonding, they split up into wto energy levels, one

set has a higher energy than the other. The electrons residing in low energy d-orbitals absorb a part of the visible light and jump to high energy d orbitals and transmit the remaining part of light. The process is called d-d transition, Fig. 6.5. The energy difference of d-orbitals varies from ion to ion. Thus, every ion absorbs a different wavelength and transmits the remaining set of wavelengths that gives different colours to the ions.

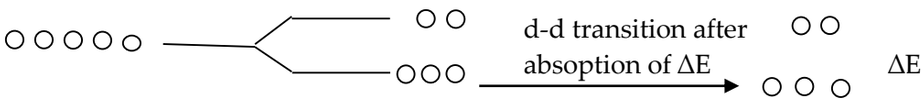


Figure absorption of yellow light by $[Ti(H_2O)_6]^{3+}$ ion

In $[Ti(H_2O)_6]^{3+}$, yellow light is absorbed, while most of the blue and red lights are transmitted, therefore the solution of $[Ti(H_2O)_6]^{3+}$ ions look violet in colour.

14. **What is chemical garden?**

Ans: **Chemical Garden:** When crystals of soluble coloured salts like nickel chloride, ferrous sulphate, copper sulphate or cobalt nitrate, etc. are placed in a solution of sodium silicate, they produce a very beautiful growth, like plant, which is called chemical graden.

15. **What are typical and non-typical transition elements?**

Non-Typical Transition Elements:

The elements of group II B (Zn, Cd, Hg) and group III B (Sc, Y La) are called non-typical transition elements.

Elements of **Group II B (Zn, Cd, Hg)** do not have a partially filled d-orbital either as element or in any of their oxidation state.

Elements of **Group III B (Sc, Y, La)** have one electron in the d-orbital of their atom. But in compounds, they mostly occur as tripositive ions **(Sc^{+3}, Y^{+3}, La^{+3})** having no d electrons. In this way they exhibit the property of main group elements.

Typical Transition Elements:

The elements of IB, IV B, V B, VI B, VII B and VIII B are called typical transition elements. These elements show typical properties of transition elements like coloured compounds, variable valencies, alloy formation, complex compounds formation etc.

16. **Explain coordination number and coordination sphere.**

Coordination Number: the no. of lone pair of electrons provided by the ligand to the central atom or ion is called coordination number. Of the central metal atom or ion.

Example: coordination no. of Fe in $K_4[Fe(CN)_6]$ is 6.

Coordination Sphere: The central metal atom or ion along with ligand is called the coordination sphere. It is usually placed in square brackets. It may anionic, cationic or neutral.

Example: In $K_4[Fe(CN)_6]$, **$[Fe(CN)_6]^{-4}$** is anionic sphere.

$[Cu(NH3)4]SO4$, **$[Cu(NH3)4]^{+2}$** is cationic sphere.

In $[Ni(CO)_4]$, **$[Ni(CO)_4]$** is a neutral ligand.

17. **What is wrought iron? Give its composition.**

The purest form of commercial iron is called wrought iron. It contains the lowest percentage of carbon and upto 0.3% of impurities like S, P, Si, and Mn etc.

S = 0.2 to 0.15%, Mn = upto 0.25%, P = 0.04 to 0.2%

18. **How $K_2Cr_2O_7$ can be converted into K_2CrO_4 and vice versa. Give equation**.

In an aqueous solution, CrO_4^{2-} and $Cr_2O_7^{2-}$ ion exist in equilibrium with each other.

$2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$

When an acid is added in such a solution, then the H^+ ions from the acid increases in its concentration. According to Le-Chatelier's principle, if the concentration of reactants is increased

at equilibrium stage, this will disturb the equilibrium position and the reaction is shifted in forward direction. So, in this way, chromate (CrO_4^{2-}) ions are converted into dichromate ions (Cr_2O7^{2-})

19. **Define sacrificial corrosion??**

Sacrificial corrosion: if a protective l;ayer of zinc is damaged, a galvanic cell is established in the presence of moisture. Iron acts as a cathode and zinc as an anode. Electrons flow from zinc to iron, as a result of which zinc decays while iron remain intact. This is called sacrificial corrosion.

$$Fe^{+2} + Zn \rightarrow Fe + Zn^{+2}$$

20. **Complete and balance the following equation.**

$KMnO_4 + FeSO_4 + H_2SO_4 \rightarrow$

$KMnO_4 + FeSO_4 + H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$

21. **Define interstitial compounds? Write one example.**

Interstitial compounds: when a small non-metal atom like H, B, C and N enter the interstitial of transition metals and impart useful features to them, they are called interstitial compounds. These are non-stoichiometric compounds. Sometimes they are also known as interstitial alloys.

22. **How are entrapped bubbles of gases removed during preparation of steel?**

In order to remove entrapped bubbles of gases, such as N_2, O_2 and CO_2 a little aluminum or ferro-silicon is added. Aluminum removes nitrogen as nitrides.

$$Al + N_2 \rightarrow 2AlN$$

23. **Write uses of $K_2Cr_2O_7$?**

i. $K_2Cr_2O_7$ is used in dying.
ii. It is used in leather industry for chrome tanning.
iii. It is used as an oxidizing agent.

24. ***Give any four properties of transition elements???***

i. ***Melting and Boiling Point:*** Transition elements have very high melting and boiling points due to strong binding forces between their atoms.
ii. ***Binding Energy:*** Transition elements are tough , malleable and ductile. The tuoughness of these metals indicate strong metallic binding. This is because apart from s eletrons of the outermost shell, the electrons of underlying shell, electrons of half filled d orbital also participate in binding.
iii. ***Oxidation State:*** transition elements exhibit variable valency or oxidation state. They show variable valencies because of the involvement of the unpaired d orbital electrons in the bond formation.
iv. ***Colour:*** in transition elements, the d orbitals are responsible for the colour development in their compounds. When these orbitals involved in bonding, they split up into two energy levels, one set has a higher energy than the other. The electrons in lower energy d-orbitals absorb visible energy and jump to higher energy d-orbitals. This process is called d-d transition.

25. **Differentiate between Wrought Iron and Steel .**

Wrought Iron: The purest form of commercial iron is called wrought iron. It contains the lowest percentage of carbon and upto 0.3% of impurities like S, P, Si, and Mn etc.

S = 0.2 to 0.15%, Mn = upto 0.25%, P = 0.04 to 0.2%

Steel: Steel is an alloy of iron containing 0.25 to 2.5% of carbon and traces of S, P, Si and Mn.

It has three types.

i. Mild Steel (0.1-0.2% C)
ii. Medium Steel (0.2-0.7% C)
iii. High Carbon steel (0.7-1.5% C)

26. ***Why does damaged tin plated iron go rusted quickly?***

If the protected layer of tin is damaged, then iron comes into contact with moisture. A galvanic cell is established in which tin acts as a cathode and iron acts as a anode. The electrons flow from iron to tin, where they discharge H^+ ions leaving behind OH^- in the solution. These hydroxide ions react with iron forming $Fe(OH)_3$ which dissolves rapidly in water. From this, it can be concluded that plated iron gets rust more quickly when the protective layer is damaged.

27. **Define ligands? Give two examples.**

Ligands: The atom, ion or neutral molecule which surrounds the central metal ion and donates electron pair to it are called ligands. They may be anion or neutral molecules.

Examples: In $K_4[Fe(CN)_6]$, CN^- is an anionic ligand.

In $[Ag(NH_3)_2]Cl$, NH_3 is a neutral ligand.