4. Transition and Inner transition elements.

1. What are transition metals? Give four examples.

The metallic elements that have incompletely filled d sub shell in the neutral or cationic state are called transition metals.

Examples: Cr, Fe, Zr, Mo.

2. Write the electronic configuration of Cu and Chromium?

- Expect electronic configuration of Cr - **[Ar] $4s^2 3d^4$**
- Actual electronic configuration is **[Ar] $4s^1 3d^5$**
- Expect electronic configuration of Cu -**[Ar] $4s^2 3d^9$**
- Actual electronic configuration is **[Ar] $4s^1 3d^{10}$**

3. Write the electronic configuration of $Ce4^+$ and; Co^{2+}?

- Electronic configuration of **Ce^{4+}- - [Xe] $4f^0$ $5d^0$ $6s^0$**
- Electronic configuration of **Co^{2+}- [Ar] $3d^7$ $4s^0$**

4. Which is more stable ion $Mn4^+$ or Mn^{2+}?

- Electronic configuration of **Mn^{4+} - [Ar] $3d^3$.**
- Electronic configuration of **Mn^{2+} - [Ar] $3d^5$.**
- **Mn^{2+}** -have more stable half-filled orbitals. So more stable.

5. Why transition elements have high melting point?

- ❖ Strong interaction between atoms.
- ❖ Strong metallic bond.

6. Which is more stable ion Fe^{2+}; or Fe^{3+}?

- Electronic configuration of **Fe $^{2+}$ - [Ar] $3d^6$**
- Electronic configuration of **Fe 3^+ - [Ar] $3d^5$**

Fe^{3+} -have half-filled orbitals. So more stable.

7. Why first ionization enthalpy of chromium is lower than that of zinc?

- Electronic configuration of **Zn - [Ar] $4s^2 3d^{10}$**
- Electronic configuration of **Cr - [Ar] $4s^1 3d^5$**

chromium has removed one electron become more stable **$4s^0 3d^5$**

8. Compare the ionization enthalpies of first series of the transition elements?

- ➢ In series ionization enthalpy is increased.
- ➢ Electron filled in d orbitals increase in nuclear charge.
- ➢ Along a particular series is not regular.
- ➢ The added electron enters (n-1)d orbital and the inner electron act as a shield and decrease the effect.
- ➢ To determine the thermodynamic stability.

9. Write a short note on variable oxidation of 3d series?

- ❖ The energy difference between **ns** and **(n-1) d** orbitals is very small.
- ❖ The number of oxidation state is increases with the increase number of electron.
- ❖ It decrease as the number of paired electron increases.

- The first and last elements show less oxidation state, middle elements with more oxidation state.

10. Transition elements act as a good catalyst. Why?

- Metals have energetically available d-orbitals to accept the electrons.
- Metals to form a bond with reactant molecules.
- They have variable oxidation states.

11. Which metal in the 3d series exhibits +1 oxidation state?

Cu is the only metal show +1 oxidation state.

After losing one electron it acquire a stable **$3d^{10}$**configuration.

12. Explain how form alloys?

- The crystal structure and valence solvent and solute almost same.
- By blending a metal with one or more other elements.

Ex: Au – Cu alloy.

14. Hume – Rothery rule to form alloys?

1. The difference between the atomic radii of solvent and solute is less than 15%.
2. Same crystal structure and valence.
3. The electro negativity difference must be zero..

15. Why d-block elements form complexes?

1. Small size.
2. High positive charge density.
3. Presence of vacant **(n-1)d** orbitals. Which accept the electron from ligand.

Ex:- **$K_4[Fe(CN)_6]$.**

16. Cr^{3+}-as a strong reducing agent but ; Mn^{3+}-Strong oxidising agent – Expalin?

Cr^{3+}- E_0 = -0.41 **V** but **Mn^{3+} - E_0 = +** 1.57 **V**

- Negative standard electrode potential value – strong reducing agent.
- **Cr^{3+}** - strong reducing agent.

17. Cr^{2+} and Fe^{2+} Which is strong reducing agent?

Cr^{2+}- E0 = - 0.91 V :; Fe^{2+} - E0 = - 0.44 V

- More negative standard electrode potential value of the metal – strong reducing agent.
- **Cr^{2+}** strong reducing agent.

18.Why Cu have a positive E_0 value.?

- The elementary Cu is more stable than Cu^{2+}
- Cu^{2+} is easily reduced to elementary Cu.

19.How Magnetic moments are calculated?

Magnetic moment $=\sqrt{n(n+2)}\ \mu_B$

Diamagnetic – no unpaired electrons.

Paramagntic – Presence of unpaired electrons.

20. What are interstitial compounds?

- when small atoms like hydrogen, boron, carbon or nitrogen are trapped in the interstitial holes in a metal lattice.
- They are usually non-stoichiometric compounds.

TiC, ZrH1.92, Mn4 N etc .

21. Characteristics of interstitial compounds?

1. Hard
2. Thermal and electrical conduct.
3. High melting point.
4.Hydrides are strong reducing agents.
5. Chemically inert..

22. Cu^{2+} ion are coloured: but Zn^{2+} ion is colourless. Why?

- Electronic configuration of **Cu^{2+}** -is - **[Ar] $3d^9$**
  Presence of one unpaired electron, so colour.
- Electronic configuration of **Zn^{2+}** -is - **[Ar] $3d^{10}$**
  No unpaired electron, so colourless.

23. Calculate the number of unpaired electrons in Ti^{3+}, Mn^{2+} and calculate the spin only magnetic moment.

- The number of unpaired electrons in Ti^{3+} ($3d^1$) is one.

The spin only magnetic moment **(μs)**= $\sqrt{\boldsymbol{n(n+2)}}$

$$= \sqrt{1(1+2)}$$

$$\mathbf{=1.732BM.}$$

- The number of unpaired electrons in Mn^{2+} ($3d^5$) is five.

The spin only magnetic moment **(μs) =** $\sqrt{\boldsymbol{n(n+2)}}$

$$= \sqrt{5(5+2)}$$

$$\mathbf{=5.92BM}.$$

23. What are inner transition elements? And give examples?

The metallic elements that have incompletely filled f sub shell.

- **4f** series - Lanthanoids.
- **5f** series - Actinoids.

24. Zr and Hf have similar properties. Why?

3d and 4d elements have similar atomic radii due to lanthanides contraction.

25. Why europium (II) is more stable than Cerium (II)?

- Electronic configuration of Eu^{2+} is $[Xe]4f^7$.
- A half-filled 4f sub shell is present.so more stable
- Electronic configuration of Ce^{2+} is $[Xe]4f^15d^1$.
- Partially-filled 4f and 5d sub shells are present.
  So less stable .

26. Gd^{3+} colourless. Why?

- **Gd^{3+} -** have half-filled **$4f^7$** orbitals
- No **f - f** transition

27. Why actinoid contraction much larger than lanthanoids contraction?

- The screening effect of 4f electrons is high.
- The screening effect of **5f** electrons is low.

28. $Lu(OH)_3$ and; $La(OH)_3$ - which is more basic. why?

1. La (OH) 3- is more basic due to lanthanoid contraction.

2. The ionic radii of **La^{3+}** are large.

3. Ionic radii increases and basic nature also increase.

29. What are actinides? Give three examples ?

- The fourteen elements following actinium, i.e., from (Th) to (Lr) are called actinoids.
- All the actinoids are radioactive and most of them have short half lives.

  Examples: Th, U,Pu,Np,Am .

30. What is lanthanide contraction and what are the effects of lanthanide contraction?

- The atomic and ionic radii of lanthanoids decrease with increase in atomic number. This decrease in ionic size is called lanthanoid contraction.
- **Reason:** Screening effect of 4f- electrons.

<u>Consequences of lanthanoid contraction:</u>

1. La^{3+} to Lu^{3+} , the basic character of Ln3+ ions decrease. Due to the decrease in the size of Ln3+ ions.
2. Atomic and ionic radii decrease.
3. Decrease in reducing nature.
4. Increasing in covalent nature.
5. The elements of the second and third transition series resemble each other.

31. Compare lanthanides and actinides.

Lanthanides	Actinides
1. Electrons enters in 4f orbitals.	Electrons enters in 5f orbitals.
2. Binding energy is high.	Binding energy is low.
3. Less tendency to form complex.	Great tendency to form complex.
4. Colourless	Colour.
5. Do not form oxo cations.	Form Oxo cations.
6. Show +3 oxidation state. Few cases +2 and +4.	Show +3 oxidation state. And also have +4, +5, +6 oxidation states.