

1. Which of the following ions is colorless in aqueous solution?

- A. Cr^{3+}
- B. Sc^{3+}
- C. Fe^{2+}
- D. Ni^{2+}

Answer: B. Sc^{3+}

Explanation: Sc^{3+} has no d-electrons ($3d^0$ configuration), hence no d-d transitions \rightarrow colorless. Others have unpaired d-electrons causing colored solutions.

2. Which of the following elements shows maximum number of oxidation states?

- A. Mn
- B. Fe
- C. V
- D. Cr

Answer: A. Mn

Explanation: Manganese (Mn) shows oxidation states from +2 to +7 due to its half-filled $3d^5$ configuration.

3. Which property is responsible for the catalytic activity of transition metals?

- A. High atomic number
- B. Variable oxidation states
- C. Paramagnetism
- D. High ionization energy

Answer: B. Variable oxidation states

Explanation: Transition metals can lend and accept electrons easily in different oxidation states \rightarrow helps in catalysis.

4. Which d-block element has the highest melting point?

- A. Iron
- B. Chromium
- C. Manganese
- D. Vanadium

Answer: B. Chromium

Explanation: Strong metallic bonding and half-filled $3d^5$ configuration gives it high melting point ($\sim 1907^\circ\text{C}$).

5. Which ion shows maximum paramagnetism?

- A. Ti^{3+}
- B. V^{3+}
- C. Cr^{3+}
- D. Mn^{2+}

Answer: D. Mn^{2+}

Explanation: Mn^{2+} has 5 unpaired electrons ($3d^5$), thus highest magnetic moment.

6. The color of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is due to:

- A. Charge transfer
- B. d–d transition
- C. Ionization
- D. Ligand-to-metal bonding

Answer: B. d–d transition

Explanation: Ti^{3+} ($3d^1$) shows color due to d–d transition under ligand field of H_2O .

7. Which transition metal does NOT form colored ions?

- A. Cu
- B. Zn
- C. Fe
- D. Co

Answer: B. Zn

Explanation: Zn^{2+} has $3d^{10}$ configuration (full d-subshell) \rightarrow no unpaired electrons \rightarrow colorless.

8. Lanthanide contraction is due to:

- A. Poor shielding by 4f electrons

- B. Increase in nuclear charge
- C. High electronegativity
- D. Decrease in atomic volume

Answer: A. Poor shielding by 4f electrons

Explanation: 4f orbitals shield poorly → effective nuclear charge increases → smaller size across lanthanides.

9. Which among the following shows the maximum tendency to form complexes?

- A. Sc^{3+}
- B. Fe^{3+}
- C. Zn^{2+}
- D. Cu^{2+}

Answer: B. Fe^{3+}

Explanation: Fe^{3+} has small ionic radius and high charge density → strong tendency to form complexes.

10. Which of the following is NOT a property of transition metals?

- A. High melting and boiling points
- B. Formation of colored compounds
- C. High electropositivity
- D. Catalytic activity

Answer: C. High electropositivity

Explanation: Transition metals have moderate electropositivity, not very high like alkali metals.

11. Which of the following lanthanides is used in flint glass industry?

- A. Ce
- B. Gd
- C. Nd
- D. Eu

Answer: A. Ce

Explanation: Cerium oxide is used in polishing glass and flint glass production.

12. The actinoid contraction is greater than lanthanoid contraction. This is due to:

- A. Greater shielding by 5f electrons
- B. Poor shielding by 5f electrons
- C. Higher nuclear charge
- D. Both B and C

Answer: D. Both B and C

Explanation: Poor shielding and higher Z causes greater contraction in actinides.

13. Which element shows +7 oxidation state?

- A. Mn
- B. Cr
- C. Fe
- D. Co

Answer: A. Mn

Explanation: In KMnO_4 , Mn is in +7 oxidation state.

14. Which of the following pairs has highest number of unpaired electrons?

- A. Fe^{3+} and Mn^{2+}
- B. Co^{2+} and Ni^{2+}
- C. Cr^{3+} and Fe^{2+}
- D. Cu^{2+} and Zn^{2+}

Answer: A. Fe^{3+} ($3d^5$) and Mn^{2+} ($3d^5$) \rightarrow both have 5 unpaired electrons.

15. Which among the following is NOT a characteristic of lanthanides?

- A. Show +3 oxidation state
- B. Have f-electrons
- C. Are radioactive
- D. Show color due to f–f transitions

Answer: C. Are radioactive

Explanation: Lanthanides (except promethium) are mostly stable; actinides are radioactive.

16. Which of the following transition metals has the lowest enthalpy of atomization?

- A. Fe
- B. Mn
- C. Zn
- D. Cr

Answer: C. Zn

Explanation: Zn has completely filled $3d^{10}$ configuration \rightarrow weak metallic bonding \rightarrow lowest enthalpy of atomization.

17. What is the reason for the poor shielding effect of f-orbitals?

- A. Their spherical shape
- B. Their inner position and diffused shape
- C. Their high nuclear charge
- D. They are fully filled orbitals

Answer: B. Their inner position and diffused shape

Explanation: f-orbitals are buried deep inside and have diffused shape \rightarrow ineffective shielding.

18. Which metal forms a green precipitate with NaOH and dissolves in excess to form a dark green solution?

- A. Fe^{3+}
- B. Fe^{2+}
- C. Cr^{3+}
- D. Cu^{2+}

Answer: B. Fe^{2+}

Explanation: Fe^{2+} reacts with NaOH \rightarrow green ppt of $Fe(OH)_2$; dissolves in excess NaOH slowly forming green solution.

19. Which transition element is used in the galvanization of iron?

- A. Zn
- B. Cu

- C. Ni
- D. Cr

Answer: A. Zn

Explanation: Zn forms a protective layer over iron during galvanization to prevent rusting.

20. Which of the following is NOT a characteristic of transition elements?

- A. They form interstitial compounds
- B. They form colored ions
- C. They form ionic hydrides
- D. They act as good catalysts

Answer: C. They form ionic hydrides

Explanation: Transition metals typically form metallic or interstitial hydrides, not ionic ones.

21. Which of the following has the highest number of oxidation states?

- A. Fe
- B. V
- C. Cr
- D. Mn

Answer: D. Mn

Explanation: Mn shows oxidation states from +2 to +7.

22. What is the oxidation state of manganese in KMnO_4 ?

- A. +4
- B. +5
- C. +6
- D. +7

Answer: D. +7

Explanation: $\text{O} = -2 \times 4 = -8$. $\text{K} = +1$. So, $\text{Mn} = +7$.

23. Which of the following oxides of chromium is amphoteric?

- A. CrO
- B. Cr₂O₃
- C. CrO₃
- D. Cr₂O₇²⁻

Answer: B. Cr₂O₃

Explanation: Cr₂O₃ behaves both as acid and base → amphoteric.

24. Which ion among the following is pink in aqueous solution?

- A. Fe³⁺
- B. Cu²⁺
- C. Co²⁺
- D. Ni²⁺

Answer: C. Co²⁺

Explanation: Co²⁺ in aqueous solution appears pink due to d-d transitions.

25. Which of the following shows lanthanide contraction?

- A. From La to Lu
- B. From Sc to Zn
- C. From Ac to Lr
- D. From Cu to Zn

Answer: A. From La to Lu

Explanation: Gradual decrease in size due to poor shielding by 4f electrons.

26. The +3 oxidation state is most stable for:

- A. Transition metals
- B. Actinides
- C. Lanthanides
- D. Alkali metals

Answer: C. Lanthanides

Explanation: All lanthanides commonly exhibit +3 state due to loss of 6s² and one 4f electron.

27. The color of $K_2Cr_2O_7$ is:

- A. Purple
- B. Orange
- C. Green
- D. Blue

Answer: B. Orange

Explanation: Due to charge transfer transitions, $K_2Cr_2O_7$ appears orange.

28. Which transition metal forms an oxide that is used in green paints and as a catalyst in organic reactions?

- A. Mn
- B. Cr
- C. Cu
- D. Co

Answer: B. Cr

Explanation: Cr_2O_3 is used in green paints and as a catalyst.

29. Which of the following has the greatest tendency to form complex compounds?

- A. Zn^{2+}
- B. Cu^{2+}
- C. Sc^{3+}
- D. Fe^{2+}

Answer: C. Sc^{3+}

Explanation: Sc^{3+} is small and highly charged \rightarrow strong tendency to form complexes.

30. What is the coordination number of $[Fe(CN)_6]^{4-}$?

- A. 4
- B. 5
- C. 6
- D. 2

Answer: C. 6

Explanation: 6 cyanide ligands \rightarrow coordination number is 6.

31. Which of the following is paramagnetic due to presence of unpaired electrons?

- A. Zn^{2+}
- B. Cu^+
- C. Fe^{2+}
- D. Sc^{3+}

Answer: C. Fe^{2+}

Explanation: Fe^{2+} has $3d^6 \rightarrow 4$ unpaired electrons \rightarrow paramagnetic. Zn^{2+} , Cu^+ , and Sc^{3+} have all paired electrons.

32. Which lanthanide ion is colorless in aqueous solution?

- A. La^{3+}
- B. Sm^{3+}
- C. Eu^{3+}
- D. Tb^{3+}

Answer: A. La^{3+}

Explanation: La^{3+} has no unpaired electrons ($4f^0$) \rightarrow no f-f transitions \rightarrow colorless.

33. Which of the following oxoanion acts as a strong oxidising agent in acidic medium?

- A. MnO_4^-
- B. $\text{Cr}_2\text{O}_7^{2-}$
- C. $\text{Fe}(\text{CN})_6^{3-}$
- D. Co^{2+}

Answer: A. MnO_4^-

Explanation: MnO_4^- gets reduced from Mn^{7+} to Mn^{2+} , releasing electrons \rightarrow strong oxidizer.

34. The electronic configuration of Cu^+ is:

- A. $[\text{Ar}] 3d^9$
- B. $[\text{Ar}] 3d^8 4s^1$
- C. $[\text{Ar}] 3d^{10}$
- D. $[\text{Ar}] 3d^7$

Answer: C. $[\text{Ar}] 3d^{10}$

Explanation: $\text{Cu} = [\text{Ar}] 3d^{10} 4s^1 \rightarrow \text{Cu}^+$ loses $4s^1 \rightarrow 3d^{10}$.

35. Which among the following elements shows the maximum number of oxidation states?

- A. Fe
- B. V
- C. Cr
- D. Mn

Answer: D. Mn

Explanation: Mn shows oxidation states from +2 to +7 due to half-filled d-orbitals.

36. Lanthanide contraction leads to which of the following consequences?

- A. Decrease in basic strength of hydroxides
- B. Increase in atomic size
- C. Increase in reactivity
- D. Uniform size in d-block elements of same group

Answer: A. Decrease in basic strength of hydroxides

Explanation: Due to decrease in ionic size, basicity of hydroxides decreases from $\text{La}(\text{OH})_3$ to $\text{Lu}(\text{OH})_3$.

37. Which of the following is used as an oxidizing agent in acidic medium and gives green Cr^{3+} ion as product?

- A. $\text{K}_2\text{Cr}_2\text{O}_7$
- B. KMnO_4
- C. CrCl_3
- D. CrO_3

Answer: A. $\text{K}_2\text{Cr}_2\text{O}_7$

Explanation: Cr in +6 state in $\text{K}_2\text{Cr}_2\text{O}_7$ is reduced to $\text{Cr}^{3+} \rightarrow$ green solution.

38. The reason for complex formation by transition metals is:

- A. Small atomic size
- B. High ionization energy
- C. Presence of vacant d-orbitals
- D. Low nuclear charge

Answer: C. Presence of vacant d-orbitals

Explanation: Vacant d-orbitals accommodate lone pairs from ligands → complex formation.

39. Which of the following is NOT a lanthanide?

- A. Pr
- B. Pm
- C. Pa
- D. Tb

Answer: C. Pa

Explanation: Pa (Protactinium) is an actinide. Others belong to lanthanide series ($Z = 57-71$).

40. Which of the following transition metal ions is most stable in aqueous solution?

- A. Mn^{2+}
- B. Fe^{2+}
- C. Zn^{2+}
- D. Cu^+

Answer: C. Zn^{2+}

Explanation: Zn^{2+} has completely filled $3d^{10}$ configuration → highly stable.

41. Which metal shows maximum catalytic activity due to its highest surface area?

- A. Pt
- B. V
- C. Fe
- D. Ni

Answer: A. Pt

Explanation: Platinum has high surface area and adsorptive capacity → excellent catalyst.

42. Which ion gives blue color in aqueous solution due to d–d transition?

- A. Fe^{3+}
- B. Cu^{2+}
- C. Zn^{2+}
- D. Cr^{3+}

Answer: B. Cu^{2+}

Explanation: Cu^{2+} ($3d^9$) → absorbs red/orange → transmits blue color.

43. The actinoids exhibit greater range of oxidation states than lanthanoids due to:

- A. Their small size
- B. Lesser shielding of 5f orbitals
- C. Completely filled d-orbitals
- D. Strong metallic bonding

Answer: B. Lesser shielding of 5f orbitals

Explanation: Poor shielding by 5f \rightarrow variable effective nuclear charge \rightarrow more oxidation states.

44. Which pair is colored due to f-f transitions?

- A. La^{3+} , Lu^{3+}
- B. Cu^+ , Zn^{2+}
- C. Ce^{3+} , Nd^{3+}
- D. Fe^{3+} , Co^{2+}

Answer: C. Ce^{3+} , Nd^{3+}

Explanation: f-f transitions in lanthanides \rightarrow colored ions.

45. Which lanthanide is used in nuclear reactor control rods due to high neutron absorption?

- A. Sm
- B. Ce
- C. Eu
- D. Gd

Answer: D. Gd

Explanation: Gadolinium has very high neutron absorption cross-section \rightarrow used in control rods.