



Attempt all questions before checking the answer key.
Give electronic configurations and balanced ionic equations where relevant.

A. Very short answers - 1 mark each

1. Define a transition element.
2. Why is Zn usually not regarded as a transition element?
3. What is lanthanoid contraction?
4. Which oxidation state is common to most lanthanoids?
5. Why do many transition-metal ions form coloured solutions?
6. State the formula for spin-only magnetic moment in terms of unpaired electrons.

B. Short answers / practice - 2 marks each

7. Write electronic configurations of Fe^{2+} and Fe^{3+} ; Fe has $Z = 26$.
8. Explain the variable oxidation states of transition elements.
9. Why do transition metals often act as catalysts?
10. Calculate the spin-only magnetic moment of an ion with five unpaired electrons.
11. Why are Cu^+ compounds generally colourless while many Cu^{2+} compounds are coloured?
12. Explain the tendency of transition metals to form alloys and interstitial compounds.
13. Find spin-only magnetic moment for two unpaired electrons.
14. Find d-electron count of Cr^{3+} , $Z=24$.
15. Is Zn^{2+} paramagnetic in its ground-state configuration?
16. State the oxidation number of Mn in MnO_4^- .
17. Find spin-only magnetic moment for one unpaired electron.
18. Explain why actinoids show a wider range of oxidation states than lanthanoids.

C. Short answers - 3 marks each

19. Explain why Cr^{2+} is reducing and Mn^{3+} is oxidising, referring to the stability of their products' configurations.

20. Compare lanthanoids and actinoids in oxidation states, radioactivity and bonding complexity.
21. Write the reaction showing interconversion of chromate and dichromate on changing pH. State the colours.
22. Balance the oxidation of Fe^{2+} by MnO_4^- in acidic medium and state the colour change.
23. Balance the oxidation of I^- by $\text{Cr}_2\text{O}_7^{2-}$ in acidic medium and identify oxidation-state changes.
24. Explain two consequences of lanthanoid contraction, including the similarity of Zr and Hf.

D. Long answers - 5 marks each

25. Discuss trends in atomic size, ionisation enthalpy, oxidation states and magnetic behaviour across the first transition series, with suitable examples and qualifications.
26. Describe preparation of $\text{K}_2\text{Cr}_2\text{O}_7$ from chromite ore through chromate. Give principal equations and one balanced example of its oxidising action in acid.
27. Describe preparation of KMnO_4 through manganate formation. Give principal equations and compare its reduction products in acidic and neutral/weakly alkaline media.
28. For Sc^{3+} , Ti^{3+} , Mn^{2+} , Fe^{3+} and Cu^+ , write d-electron counts and predict unpaired electrons and colour where a simple free-ion picture applies. Use atomic numbers 21, 22, 25, 26 and 29.
29. Explain lanthanoid contraction using shielding. Discuss its effects on ionic radii, separation of lanthanoids and basicity of lanthanoid hydroxides.
30. Explain why transition metals typically have high melting points, form complexes, show paramagnetism and exhibit catalytic activity. Give one specific example for each property.

ANSWER KEY - Numerical / short answers

10) $\sqrt{35} \approx 5.92$ BM. 13) $\sqrt{8} \approx 2.83$ BM. 14) d^3 . 15) No; d^{10} . 16) +7. 17) $\sqrt{3} \approx 1.73$ BM. 28) Sc^{3+} $d^0/0$; Ti^{3+} $d^1/1$; Mn^{2+} $d^5/5$; Fe^{3+} $d^5/5$; Cu^+ $d^{10}/0$. d^0, d^{10} generally colourless; others usually coloured.