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CBSE 12th Chemistry

Chapter- 8 (The d- and f-Block Elements)

Solved Important Questions

SECTION A

(Each question in this section carry 1 mark)

- Q.1.** What are different oxidation states exhibit by lanthanides?
- Q.2.** What is meant by 'lanthanoids contraction'.

SECTION B

(Each question in this section carry 2 marks)

- Q.3.** Explain the following observations:
- (i) Generally there is an increase in density of elements from titanium ($Z = 22$) to copper ($Z = 29$) in the first series of transition elements.
 - (ii) Transition elements and their compounds are generally found to be good catalysts in chemical reactions.
- Q.4.** Assign reasons for the following:
- (i) Copper (I) ion is not known in aqueous solution.
 - (ii) Actaeonids exhibit greater range of oxidation states than Lanthanides.
- Q.5.** Complete the following chemical equations:
- (i) $Cr_2O_7^{2-} + H^+ + I^- \rightarrow$
 - (ii) $MnO_4^- + NO_2^- + H^+ \rightarrow$
- Q.6.** (a). What metal in the first transition series (3d series) exhibits + 1 oxidation state most frequently and why?
- (b). Which of the following cations are colored in aqueous solutions and why?
 Sc^{3+} , V^{3+} , Ti^{4+} , Mn^{2+} (At. nos. Sc = 21, V = 23, Ti = 22, Mn = 25)
- Q.7.** What are the transition elements? Write two characteristics of the transition elements.

Q.8. When chromite ore $FeCr_2O_4$ is fused with NaOH in presence of air, a yellow coloured compound (A) is obtained which on acidification with dilute sulphuric acid gives a compound (B). Compound (B) on reaction with KCl forms an orange coloured crystalline compound (C).

- (i) Write the formula of the compounds (A), (B) and (C).
- (ii) Write one use of compound (C).

Q.9. Complete the following chemical equations:

- (i) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow$
- (ii) $Cr_2O_7^{2-} + 3Sn^{2+} + 14H^+ \rightarrow$

Q.10. Write complete chemical equations for:

- (i) Oxidation of Fe^{2+} by $Cr_2O_7^{2-}$ in acid medium.
- (ii) Oxidation of $S_2O_3^{2-}$ by MnO_4^- in neutral aqueous medium.

Q.11. Complete the following chemical reaction equations:

- (i) $MnO_4^-(aq) + C_2O_4^{2-}(aq) + H^+(aq) \rightarrow$
- (ii) $Cr_2O_7^{2-}(aq) + Fe^{2+}(aq) + H^+(aq) \rightarrow$

Q.12. How would you account for the following:

- (i) Cr^{2+} is reducing in nature while with the same d-orbital configuration $(d^4)Mn^{3+}$ is an oxidizing agent.
- (ii) In a transition series of metals, the metal which exhibits the greatest number of oxidation states occurs in the middle of the series.

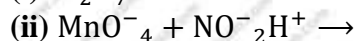
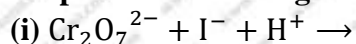
Q.13. Complete the following chemical equation:

- (i) $MnO_4^-(aq) + S_2O_3^{2-}(aq) + H_2O(l) \rightarrow$
- (ii) $Cr_2O_7^{2-}(aq) + 6Fe^{2+}(aq) + H^+(aq) \rightarrow$

Q.14. State reasons for the following:

- (i) $Cu(I)$ ion is not stable in an aqueous solution.
- (ii) Unlike Cr^{3+} , Mn^{2+} , Fe^{3+} and the subsequent other M^{2+} ions of the 3d series of elements, the 4d and the 5d series metals generally do not form stable cationic species.

Q.15. Complete the following chemical reaction equations:



Q.16. Write one similarity and 1 difference between the chemistry of lanthanoids and that of actinoids.

SECTION C

(Each question in this section carry 3 marks)

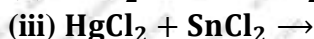
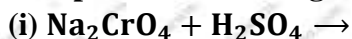
Q.17. How would you account for the following?

(i) The atomic radii of the metals of the third (5d) series of transition elements are virtually the same as those of the corresponding members of the second (4d) series.

(ii) The E^0 value for the $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is much more positive than that for $\text{Cr}^{3+}/\text{Cr}^{2+}$ couple or $\text{Fe}^{3+}/\text{Fe}^{2+}$ couple.

(iii) The highest oxidation state of a metal is exhibited in its oxide or fluoride.

Q.18. Complete the following chemical equation:



Q.19. How would you account for the following?

(i) Many of the transition elements are known to form interstitial compounds.

(ii) the metallic radii of the third (5d) series of transition metal are virtually the same as those of the corresponding group members of the second (4d) series

(iii) Lanthanoids form primarily +3 ions, while the actinoids usually have higher oxidation states in their compounds, +4 or even +6 being typical.

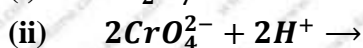
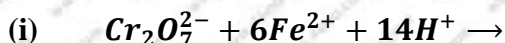
Q.20. How would you account for the following?

(i) Transition metals exhibit variable oxidation states.

(ii) Zr ($Z = 40$) and Hf ($Z = 72$) have almost identical radii.

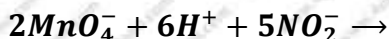
(iii) Transition metals and their compounds act as catalyst

Q.21. Complete the following chemical equations:



- Q.22. (a) How would you account for the following:**
 (i) Actinoid contraction is greater than lanthanides contraction.
 (ii) Transition metals form colored compounds.

(b) Complete the following equation:



- Q.23. How would you account for the following:**

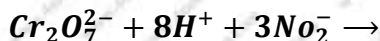
- (i) many of the transition elements and their compounds can act as good catalysts
 (ii) The metallic radii of the third (5d) series of transition elements are virtually the same as those of the corresponding members of the second series.
 (iii) There is a greater range of oxidation states among the actinoids than among the lanthanoids.

- Q.24. How would you account for the following:**

- (i) Among lanthanoids, Ln(III) compounds are predominant, However, occasionally in solutions or in solid compounds, +2 and +4 ions are also obtained.
 (ii) The $E_{\text{M}^{2+}/\text{M}}$ for copper is positive (0.34 V). Copper is the only metal in the first series of transition elements showing this behavior.
 (iii) The metallic radii of the third (5d) series of transition metals are nearly the same as those of the corresponding members of the second series.

- Q.25. (a) Account for the following:**

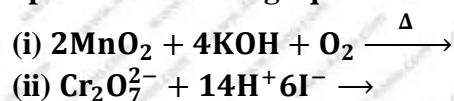
- (i) Cu^+ is unstable in an aqueous solution.
 (ii) Transition metals form complex compounds.
 (b) Complete the following equation:



- Q.26. (a) Account for the following:**

- (i) Mn shows the highest oxidation state of + 7 with oxygen but with fluorine it shows the highest oxidation state of + 4.
 (ii) Cr^{2+} is a strong reducing agent.
 (iii) Cr^{2+} salt is colored while Zn^{2+} salts are white.

(b) Complete the following equations:



Q.27. The elements of 3d transition series are given as:

Sc Ti V Cr Mn Fe Co Ni Cu Zn

Answer the following:

- (i) Write the element which shows maximum number of oxidation states. Give reason.**
- (ii) Which elements has the highest m.p.**
- (iii) Which element show only + 3 oxidation state.**
- (iv) Which element is a strong oxidizing agent in + 3 oxidation state and why?**

SECTION D

(Each question in this section carry 5 marks)

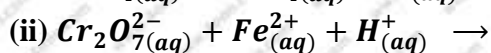
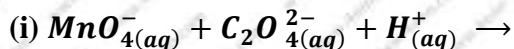
Q.28. Assign reason for the following:

- (i) The enthalpies of atomisation of transition elements are high.**
- (ii) The transition metals and many of their compounds act as good catalyst.**
- (iii) From element to element the actinoid contraction is greater than the lanthanoid contraction.**
- (iv) The E^0 value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} .**
- (v) Scandium ($Z = 21$) does not exhibit variable oxidation states and yet it is regarded as transition element.**

Q.29. Write down the number of 3d electrons in each of the following ions:

Ti^{2+} , V^{2+} , Cr^{3+} , Mn^{2+} , Fe^{2+} , Co^{2+} , Ni^{2+} and Cu^{2+} Indicate how would you expect the five 3d orbitals to be occupied for these hydrated ions (octahedral).

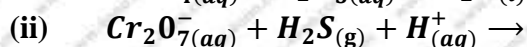
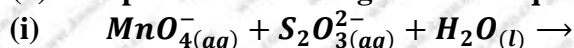
Q.30. (a) complete the following chemical reaction equations:



(b) Explain the following observations about the transition/inner transition elements:

- (i) There is in general an increase in density of element from titanium ($Z=22$) to copper ($Z=29$).**
- (ii) There occurs much more frequent metal-metal bonding in compounds of heavy transition element (3^{rd} Series).**
- (iii) The members in the actinoid series exhibit a larger number of oxidation states than the corresponding members in the lanthanoid series.**

Q.31. (a) Complete the following chemical equations for reactions:



(b) Give an explanation for each of the following observations:

(i) The gradual in size (actinoid contraction) from element to element is greater among the actinoids than that among the lanthanoids (lanthanoid contraction).

(ii) The greatest number of oxidation states are exhibited by the members in the middle of a transition series.

(iii) With the same d-orbitals configurations (d^4) Cr^{2+} ion is a reducing agent but Mn^{3+} ion is an oxidizing agent.

Q.32. (a) How to you prepare:

(i) K_2MnO_4 from MnO_2 ?

(ii) $Na_2Cr_2O_7$ from Na_2CrO_4 ?

(b) Account for the following:

(i) Mn^{2+} is more stable than Fe^{2+} towards oxidation to + 3 state.

(ii) The enthalpy of atomization is lowest for Zn in 3d series of the transition elements.

(iii) Actinoid elements show wide range of oxidation states.

Q.33. (i) Name the element of 3d transition series which shows maximum number of oxidation states. Why does it show so

(ii) Which transition metal of 3d series has positive $E^0 (M^{2+}/M)$ value and why?

(iii) Out of Cr^{3+} and Mn^{3+} which is a stronger oxidizing agent and why?

(iv) Name a member of the lanthanoid series which is well known to exhibit +2 oxidation state.

(v) Complete the following equation: $MnO_4^- + 8H^+ + 5e^- \longrightarrow$

Q.34. (a) Account for the following:

(i) Transition metals form large number of complex compounds.

(ii) The lowest oxide of transition metal is basic whereas the highest oxide is amphoteric or acidic.

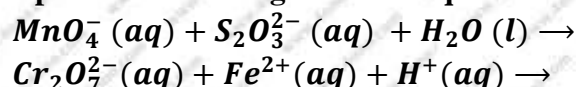
(iii) E^0 value for the Mn^{3+}/Mn^{2+} couple is highly positive (+1.57 V) as compared to Cr^{3+}/Cr^{2+} .

(b) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements.

- Q.35.** (a) (i) How is the variability in oxidation states of transition metals different from that of the p-block element
 (ii) Out of Cu^+ and Cu^{2+} , which ion is unstable in aqueous solution and why?
 (iii) Orange colour of $Cr_2O_7^{2-}$ ion changes to yellow when treated with an alkali. Why?
- (b) Chemistry of actinoids is complicated as compared to lanthanoids. Give two reasons.

- Q.36.** (a) Complete the following chemical equation.
 (i) $Cr_2O_7^{2-}(aq) + H_2S(g) + H^+(aq) \rightarrow$
 (ii) $Cu^{2+}(aq) + I^-(aq) \rightarrow$
- (b) How would you account for the following
 (i) The oxidizing power of oxyanions are in the order $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$.
 (ii) The third ionization enthalpy of manganese ($Z = 25$) is exceptionally high.
 (iii) Cr^{2+} is a stronger reducing agent than Fe^{2+} .

- Q.37.** (a). Complete the following chemical equations:



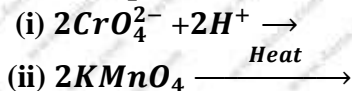
- (b). Explain the following observations:

- (i) La^{3+} ($Z = 57$) and Lu^{3+} ($Z = 71$) do not show any colour in solutions.
 (ii) Amount of the divalent cations in the first series of transition elements, manganese exhibits the maximum paramagnetic.
 (iii) Cu^+ ion is not known in aqueous solutions.

- Q.38.** (a) Give reasons for the following:

- (i) Mn^{3+} is a good oxidising agent.
 (ii) $E_{M^{2+}/M}^0$ value is not regular for first row transition metals (3d series).
 (iii) Although 'F' is more electronegative than 'O', the highest Mn fluoride is MnF_4 , whereas the highest oxide is Mn_2O_7 .

- (b) Complete the following equations:

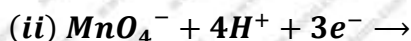
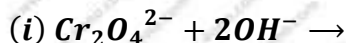


- Q.39.** (a) Why do transition elements show variable oxidation state.

- (i). Name the element showing maximum number of oxidation states among the first series of transition metals from Sc ($Z = 21$) to Zn ($Z = 30$).
 (ii) Name the element which shows only + 3 oxidation state.

- (b) What is lanthanoid contraction? Name an important alloy which contains some of the lanthanoid metals.

Q.40. (a) Complete the following equation:



(b) Account for the following:

(i) Zn is not considered as a transition element.

(ii) Transition metals form a large number of complexes.

(iii) The E° value for the $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is much more positive than that for $\text{Cr}^{3+}/\text{Cr}^{2+}$ Couple.

Q.41 (i) With reference to structural variability and chemical reactivity, write the differences between lanthanoids and actinoids.

(ii) Name a member of the lanthanoid series which is well known to exhibit +4 oxidation state.

(iii) Complete the following equation: $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow$

(iv) Out of Mn^{3+} and Cr^{3+} , which is more paramagnetic and why? Atomic nos.: Mn = 25, Cr = 24)

Q.42. (a) Account for the following:

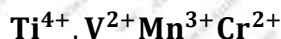
(i) Transition metals show variable oxidation states.

(ii) Zn, Cd and Hg are soft metals.

(iii) E° value for the $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is highly positive (+1.57 V) as compared to $\text{Cr}^{3+}/\text{Cr}^{2+}$.

(b) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements.

Q.43. (a) Following are the transition metal ions of 3d series:



(Atomic numbers: Ti = 22, V = 23, Mn = 25, Cr = 24)

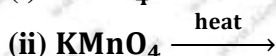
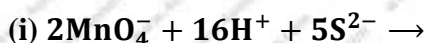
Answer the following:

(i) Which ion is most stable in an aqueous solution and why?

(ii) Which ion is a strong oxidising agent and why?

(iii) Which ion is colourless and why?

(b) Complete the following equations:



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