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The Weavers Institute

TARGET: Class 12th CBSE Boards 2024-25

Chemistry (D and F block)

BATCH: 12th

DURATION: 1 HR 30 min

MAX. MARKS: 35

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose

INSTRUCTIONS

Section A – From question 1 to 7 are MCQs and 8-9 are assertion and reason based of 1 mark each.

Section B – Question no. 10-12 are Very Short Answer Type Questions, carrying 2 marks each.

Answer to each question should not exceed 40 words.

Section C contains Q.13-14 are Short Answer Type Questions, carrying 3 marks each.

Answer to each question should not exceed 60 words

Section D – Questions no 15 are case based questions with three sub questions and are of 4 marks each.

Section-E - Question no. 16-17 are long answer type questions, carrying 5 marks each.

Answer to each question should not exceed 120 words

There is no overall choice in the question paper. However, an internal choice has been provided in few questions. Only one of the choices in such questions have to be attempted.

Section A

- The electronic configuration of Cu(II) is $3d^9$ whereas that of Cu(I) is $3d^{10}$. Which of the following is correct?
(A) Cu(II) is more stable
(B) Cu(II) is less stable
(C) Cu(I) and Cu(II) are equally stable
(D) Stability of Cu(I) and Cu(II) depends on nature of copper salts
Ans Option (A) is correct
- When $KMnO_4$ solution is added to oxalic acid solution, the decolourisation is slow in the beginning but becomes instantaneous after some time because:
(A) CO_2 is formed as the product.
(B) Reaction is exothermic.
(C) MnO_4^- catalyses the reaction.
(D) Mn^{2+} acts as auto-catalyst.
Ans Option (D) is correct
- Which set of ions exhibit specific colours? (Atomic number of Sc = 21, Ti = 22, V=23, Mn = 25, Fe = 26, Ni = 28 Cu = 29 and Zn =30)
(A) Sc^{3+} , Ti^{4+} , Mn^{3+}
(B) Sc^{3+} , Zn^{2+} , Ni^{2+}
(C) V^{3+} , V^{2+} , Fe^{3+}
(D) Ti^{3+} , Ti^{4+} , Ni^{2+}
Ans Option (C) is correct

4. Lanthanoid contraction is caused due to:
(A) Atomic number (B) Size of 4f orbitals
(C) Effective nuclear charge (D) Poor shielding effect of 4f electrons
5. In which of the following elements, 5f orbitals are progressively filled?
(A) Alkaline earth metals (B) Actinoids
(C) Lanthanoids (D) Transition elements

Ans. Option (B) is correct.

6. KMnO_4 is coloured due to:
(A) d-d transitions
(B) charge transfer from ligand to metal
(C) unpaired electrons in d orbital of Mn
(D) charge transfer from metal to ligand

Ans Option (B) is correct

7. When acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution is added to Sn salts then Sn^{2+} changes to:
(A) Sn (B) Sn^{3+} (C) Sn^{4+} (D) Sn^+

Ans Option (C) is correct.

8. Assertion: Transition metals have low melting points.

Reason (R): The involvement of greater number of $(n - 1)d$ and ns electrons in the interatomic metallic bonding.

Ans Option (D) is correct.

9. Assertion The highest oxidation state of osmium is +8.

Reason (R): Osmium is a 5d-block element.

Ans Option (B) is correct.

Section B

10. When MnO_2 is fused with KOH in presence of KNO_3 as an oxidizing agent, it gives a dark green compound (A). Compound (A) disproportionate in acidic solution to give purple compound (B). An alkaline solution of compound (B) oxidises KI to compound (C) whereas an acidified solution of compound (B) oxidises KI to (D). Identify (A), (B), (C) and (D).
11. Explain the following observation:
(i) Silver atom has completely filled d-orbitals ($4d^{10}$) in its ground state, yet it is regarded as a transition element.
(ii) E° value for $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is much more positive than $\text{Cr}^{3+}/\text{Cr}^{2+}$. Give reasons:
12. Suggest reasons for the following features of transition metal chemistry:
(i) The transition metals and their compounds are usually paramagnetic.
(ii) The transition metals exhibit variable oxidation

Section C

13. Give reasons for the following:

- (a) Transition metals have high enthalpies of atomization.
- (b) Manganese has lower melting point even though it has a higher number of unpaired electrons for bonding.
- (c) Ce^{4+} is a strong oxidizing agent.

14. Write the preparation of following:

- (i) KMnO_4 from K_2MnO_4
- (ii) Na_2CrO_4 from FeCr_2O_4
- (iii) $\text{Cr}_2\text{O}_7^{2-}$ from CrO_4^{2-}

Section D

15. Read the passage given below and answer the following questions:

The transition metals when exposed to oxygen at low and intermediate temperatures form thin, protective oxide films of up to some thousands of Angstroms in thickness. Transition metal oxides lie between the extremes of ionic and covalent binary compounds formed by elements from the left or right side of the periodic table. They range from metallic to semiconducting and deviate by both large and small degrees from stoichiometry. Since d-electron bonding levels are involved, the cations-exist in various valence states and hence give rise to a large number of oxides. The crystal structures are often classified by considering a cubic or hexagonal close-packed lattice of one set of ions with the other set of ions filling the octahedral or tetrahedral interstices. The actual oxide structures, however, generally show departures from such regular arrays due in part to distortions caused by packing of ions of different size and to ligand field effects. These distortions depend not only on the number of d-electrons but also on the valence and the position of the transition metal in a period or group.

Q. 1. Why does copper, which is in first series of transition metal exhibits +1 oxidation state most frequently?

Ans. Copper readily loses one electron from its 4s orbital, to form stable 3d electronic configuration.

Q. 2. The lowest oxide of transition metal is basic. Why?

Ans. The lower oxide of transition metals has low oxidation states. This means some of the valence electrons of the metal atoms do not participate in bonding. Thus, they can donate electrons and can behave as bases.

Q. 3. The variability in oxidation states of d-block different from that of the p-block elements. Explain.

Ans. In p-block, lower oxidation state is more stable due to inert pair effect, whereas in d-block elements higher oxidation states are more stable. In d-block, oxidation states differ by one, whereas in p-block, it differs by two.

Q. 4. Crystal structure of oxides of transition metals often show defects. Give reason.

The actual oxide structures, generally show departures from a regular array due in part to distortions caused by packing of ions of different size and to ligand field effects.

Section E

16. (a) Account for the following:

- (i) Transition elements 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 compare to $\text{Cr}^{3+}/\text{Cr}^{2+}$.

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

17. (a) What happens when

- (i) Manganate ions (MnO_4^{2-}) undergoes disproportionation reaction in acidic medium?
- (ii) Lanthanum is heated with sulphur?

(b) Explain the following trends in the properties of the members of the first series of transition elements:

- (i) $E^\circ (\text{M}^{2+}/\text{M})$ value for copper is positive (+0.34 V) in contrast to the other members of the series.
- (ii) Cr^{2+} is reducing while Mn^{3+} is oxidising, though both have d^4 configuration.
- (iii) The oxidising power in the series increases in the order $\text{VO}_2^+ < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$