WEIRD CHEMIST

d-Block Elements

Oxidation States of Transition Elements

DPP – 03

Topic: Oxidation States | **Questions:** 53 Questions | **Exam:** NEET / JEE

▶ TYPE 1 : Why Oxidation States Are Variable (or Not)

Q1. Cu, Ni and Zn generally do not show an oxidation state greater than $+2$ mainly because–

(1) Their $(n-1)d$ orbitals are completely filled and hence chemically inert
(2) Their third ionisation enthalpy (IE_3) is exceptionally high
(3) They belong to the same group of the periodic table
(4) They have no vacant d-orbitals available for oxidation

Q2. The transition element which does not exhibit variable oxidation state is [NCERT Pg. 223]

(1) Sc (2) Fe (3) Mn (4) Co

Q3. Which transition element does not exhibit variable oxidation states, and why?

(1) Zn, because its $3d$ subshell is completely filled in every accessible state
(2) Cr, because its $(n-1)d$ and ns electrons are degenerate
(3) Sc, because after losing its 3 valence electrons ($4s^2 3d^1$) no further stable oxidation state is accessible
(4) Cu, because it exists only in the $+1$ oxidation state

Q4. The transition element which does not exhibit variable oxidation states is/are

(1) Mn
(2) Sc
(3) Cr
(4) Both (2) & (3)

Q5. Which of the following transition element does not exhibit variable oxidation state?

(1) Mercury
(2) Scandium
(3) Copper
(4) All of the above

Q6. Assertion: Transition metals shows variable valencies.
Reason: Transition metal have a large energy difference between the ns^2 and $(n-1)d$ electrons.

(1) Both Assertion and Reason are true, Reason gives correct explanation

(2) Both Assertion and Reason are true, it doesn't give correct explanation
(3) Assertion is correct but Reason is false
(4) Both Assertion and Reason are false

Q7. Assertion: Transition metals show variable valency.
Reason: Transition metals have a large energy difference between the ns^2 and $(n-1)d$ electrons.

This question is identical to Q.6 in this paper – retained here as it appears twice in the original source.

(1) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
(2) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
(3) If Assertion is True but the Reason is False.
(4) If both Assertion & Reason are False.

▶ TYPE 2 : Identifying Maximum / Highest Oxidation States

Q8. Which of the following shows maximum number of oxidation states?

(1) Cr (2) Fe (3) Mn (4) V

Q9. In the $3d$ series, Mn shows the highest oxidation state $(+7)$ among the elements. This is best explained by the fact that–

(1) Mn has the maximum number of unpaired electrons in the ground state
(2) The maximum oxidation state of reasonable stability equals the sum of the $4s$ and $3d$ electrons up to Mn
(3) Mn has the smallest atomic radius in the $3d$ series
(4) Mn achieves a stable d^5 configuration only in the $+7$ state

Q10. Which one of the elements with the following outer orbital configurations may exhibit the largest number of oxidation states? [AIPMT (Prelims)-2009]

(1) $3d^5 4s^1$
(2) $3d^5 4s^2$
(3) $3d^2 4s^2$
(4) $3d^3 4s^2$

Q11. Which one of the elements with the following outer orbital configurations may exhibit the largest number of oxidations states?

(1) $3d^2 4s^2$
(2) $3d^3 4s^2$
(3) $3d^5 4s^1$
(4) $3d^5 4s^2$

Q12. Which of the following configurations of $3d$ series metals exhibits the largest number of oxidation states?

Ar $3d^8 4s^2$
Ar $3d^{10} 4s^1$

Ar $3d^5 4s^2$
Ar $3d^7 4s^2$

Q13. In which of the following outer most orbit will show maximum number of oxidation states?

(1) $3d^5 4s^2$ (2) $3d^2 4s^2$ (3) $3d^3 4s^2$ (4) $3d^5 4s^1$

Q14. Which of following electronic configuration can show highest oxidation state?

(1) $(n-1)d^5\, ns^2$
(2) $(n-1)d^8\, ns^2$
(3) $(n-1)d^5\, ns^1$
(4) $(n-1)d^3\, ns^2$

Q15. Which one of the following exhibits highest oxidation state?

(1) Zr (2) V (3) Mn (4) Ni

Q16. The element which does not show d^0 configuration in its highest oxidation state

(1) V (2) Mn (3) Cr (4) Fe

▶ TYPE 3 : Extreme Oxidation States – $+8$ and Zero

Q17. $+8$ oxidation state is shown by

(1) Os (2) Mn (3) Cr (4) Co

Q18. Which pair of transition metals is well known to exhibit an oxidation state as high as $+8$?

(1) Fe and Ru (2) Ru and Os (3) Rh and Ir (4) Mn and Tc

Q19. The highest possible oxidation state shown by osmium in its compound is

(1) $+4$ (2) $+8$ (3) $+6$ (4) $+10$

Q20. The oxidation state of Fe in $Fe(CO)_5$ is–

(1) $+2$ (2) $+3$ (3) Zero (4) -2

▶ TYPE 4 : Mn Oxides & Fluorides – Existence and Stability

Q21. Which of the following mangnese oxide is not formed?

(1) MnO (2) MnO_2 (3) Mn_2O_3 (4) Mn_2O_5

Q22. Which species doesn't exist?

(1) ZnO (2) CrO (3) ScO (4) V_2O_5

Q23. Which compound is non existing?

(1) MnO_3F (2) Mn_2O_7 (3) CrO_3 (4) MnF_7

Q24. The ability of fluorine to stabilize the highest oxidation states in CrF_6, VF_5 is due to–

(1) Oxidising property of higher oxidation states
(2) Higher lattice energy
(3) High bond enthalpy due to covalent character
(4) Ability to form multiple bond.

Q25. Highest stable Mn fluoride is MnF_4 where as highest Mn oxide is Mn_2O_7 due to–

(1) O atom is smaller the F.
(2) Oxygen has ability to form multiple bonds
(3) Mn^{7+} does not exist
(4) F can not-stabilise higher oxidation states.

Q26. Highest stable Mn fluoride is MnF_4 where as highest Mn oxide is Mn_2O_7 due to–

This question is identical to Q.25 in this paper – retained here as it appears twice in the original source.

(1) O atom is smaller than F.
(2) Oxygen has ability to form multiple bonds
(3) Mn^{7+} does not exist
(4) F can not-stabilise higher oxidation states.

Q27. Which statement is correct.

(i) Highest Mn fluoride is MnF_7
(ii) Highest Mn fluoride is MnF_4
(iii) Highest Mn oxide is Mn_2O_7
(iv) Mn_2O_7 is a covalent green oil

(1) i, iii (2) ii, iii, iv (3) i, iv (4) i, ii

Q28. Which statement is incorrect.

(i) Ferrates (VI) $[FeO_4]^{2-}$ are formed in alkaline medium but readily decompose to Fe_2O_3 and O_2

(ii) Oxidation state of V in VO_2^+ is $+5$
(iii) Oxidation state of V in VO_2^+ is $+4$
(iv) Oxidation state of Ti in TiO^{2+} is $+4$

(1) i (2) ii (3) iii (4) iv

Q29. Which statement is incorrect.

(1) Cu^{+2} oxidises I^- to I_2
(2) MnO_3F exist
(3) MnF_7 exist
(4) The high energy to transform Cu(s) to Cu^{2+}(aq) is not balanced by its hydration enthalpy.

Q30. Number of species which exist.

(i) MnF_7
(ii) MnF_4
(iii) MnO_3F
(iv) $NiCl_3$
(v) CoF_3
(vi) VCl_5
(vii) CuF_2
(viii) CoI_2

(1) 2 (2) 3 (3) 4 (4) 6

▶ TYPE 5 : Oxidising Power and Redox Behaviour

Q31. What is oxidation no. of Cr in $K_2Cr_2O_7$

(1) $+2$ (2) $+4$ (3) $+6$ (4) $+7$

Q32. The increasing order of oxidising power $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$ can best be explained by–

(1) Increasing atomic radius of the central metal atom down the series
(2) Increasing stability of the reduced (lower oxidation state) species formed
(3) Increasing number of oxygen atoms bonded to the central metal
(4) Decreasing electronegativity of the central metal atom

Q33. Which among the following order of oxidising power is correct?

(1) $CrO_4^- < MoO_4^- < WO_4^-$

(2) $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$
(3) $CrO_3 < MnO_2 < Fe_2O_3$
(4) $Pb^{4+} < Sn^{4+} < C^{4+}$

Q34. Which among the following order of oxidising character is correct?

(1) $CrO_3 > MoO_3$
(2) $K_2Cr_2O_7 > KMnO_4$
(3) $Fe(CO)_5 > Mn(CO)_5$
(4) $V_2O_3 > V_2O_5$

Q35. The pair of compounds that can exist together is [AIPMT-2014]

(1) $FeCl_3$, $SnCl_2$
(2) $HgCl_2$, $SnCl_2$
(3) $FeCl_2$, $SnCl_2$
(4) $FeCl_3$, KI

Q36. The tetrahedral $[MO_4]^{n-}$ ions known for.

(1) V(+5), Cr(+6), Mn(+5), Mn(+6), Mn(+7)
(2) V(+2), Cr(+3), Mn(+2)
(3) Sc(+3), Ni(+3), Zn(+3)
(4) None of these

Q37. Assertion: $KMnO_4$ is strong oxidising agent than $K_2Cr_2O_7$.
Reason: Cr has $+7$ oxidation state and Mn has $+6$ oxidation state.

(1) Both Assertion and Reason are true, Reason gives correct explanation
(2) Both Assertion and Reason are true, it doesn't give correct explanation
(3) Assertion is correct but Reason is false
(4) Both Assertion and Reason are false

Q38. Assertion: Cr(VI) in the form of dichromate in acidic medium is a strong oxidising agent where as MoO_3 & WO_3 are not.
Reason: Mo(VI) & W(VI) are found to be more stable then Cr(VI).

(1) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
(2) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
(3) If Assertion is True but the Reason is False.
(4) If both Assertion & Reason are False.

▶ TYPE 6 : Stability and Reactivity of Cr^{2+}/Cr^{3+}

Q39. The stable oxidation state of Cr is.

(1) Cr^{2+} (2) Cr^{3+} (3) Cr^{4+} (4) Cr^{+5}

Q40. Which of the following is most stable

(1) Cr^{+4} (2) Cr^{+2} (3) Cr^{+3} (4) Cr^{+5}

Q41. Which of the following ions from most stable complex compound in aqueous solution.

(1) Cr^{+2} (2) Cr^{+3} (3) Cr^{+4} (4) Cr^{+5}

Q42. Cr^{2+} is reducing in nature because–

(1) In Cr^{2+}, configuration changes from d^4 to d^3 to achieve half filled t_{2g}.
(2) Cr^{2+} gain an electron to achieve d^5 configuration
(3) Cr^{2+} give an electron to achieve d^5 configuration
(4) In Cr^{2+} configuration changes from d^4 to d^3 to achieve half filled d-subshell.

Q43. Half filled t_{2g} orbitals are responsible for :–

(1) The stability of Cr^{2+} (aq.)
(2) The oxidising nature of Cr^{2+} (aq.)
(3) The reducing nature of Cr^{2+} (aq.)
(4) All of these

▶ TYPE 7 : Cu^{+}/Cu^{2+} – Stability, Disproportionation and Halides

Q44. Cu^{+} ion is not stable in aqueous solution, due to–

(1) d^{10} configuration
(2) Disproportionation
(3) Less charge
(4) Pseudo inert gas configuration

Q45. All Cu (II) halide are known, except it's iodide?

(1) Iodide is a larger ion
(2) Cu^{2+} oxidises I^{-} to I_2
(3) Hydration enthalpy of $Cu^{2+}_{(aq)}$ is highly negative
(4) Cu^{2+} is very small ion

▶ TYPE 8 : Matching, Mismatches and Element Identification

Q46. Most common oxidation states are matched below with the elements. Which one is mismatched?

(1) Iron (+2, +3)

(2) Chromium (+1, +2)
(3) Manganese (+2, +7)
(4) Titanium (+3, +4)

Q47. A transition element x has a configuration [Ar] $3d^4$ in its $+3$ oxidation state. Its atomic number is.

(1) 25 (2) 26 (3) 22 (4) 19

Q48. Match the column

Metal	Highest oxidation state
A. Sc	i. $+8$
B. Mn	ii. $+6$
C. Cr	iii. $+7$
D. Ru	iv. $+3$

(1) A–iii; B–iv; C–ii; D–i
(2) A–iv; B–iii; C–ii; D–i
(3) A–iv; B–iii; C–i; D–ii
(4) A–iv; B–ii; C–iii; D–i

Q49. Which among the following statements is incorrect

(1) In d-block elements oxidation state differ by unity.
(2) In p-block metals oxidation state differ by two units.
(3) In a group of p-block lower oxidation states are favoured by the heavier members.
(4) In a group of d-block higher oxidation states are favoured by the lighter member.

Q50. How many statements are incorrect?

(a) Mn^{+3} and Co^{+3} are strongest oxidising agent
(b) Ti^{+2}, V^{2+} and Cr^{2+} are strongest reducing agent
(c) CrO_3 is acidic in nature
(d) $E^{\circ}_{M^{3+}/M^{2+}} = -$Ve for Fe

(1) 2 (2) 1 (3) 4 (4) None

▶ TYPE 9 : Periodic Trends – Lanthanide Contraction and Group Position

Q51. Although Zirconium belongs to $4d$ transition series and Hafnium to $5d$ transition series even then they show similar physical and chemical properties because _____ :–

(1) Both belong to d-block
(2) Both have same number of electrons
(3) Both have similar atomic radius
(4) Both belong to the same group of the periodic table

Q52. The lanthanide contraction is responsible for the fact that :

(1) Zr & Y have about the same radius
(2) Zr and Nb have similar oxidation state
(3) Zr and Hf have almost the same radius
(4) Zr and Zn have the same oxidation state

Q53. The position of Cu, Ag and Au in the periodic table is in between :

(1) Alkali and alkaline earth metals
(2) Alkali metals and halogens
(3) VIII group and zinc metals
(4) Alkaline earth metals' and halogens