Exercise-1

✍ **Marked Questions may have for Revision Questions.**

ONLY ONE OPTION CORRECT TYPE

Section (A) : Electronic configuration, atomic and ionic size, density, melting and boiling points

1. The transition elements have a general electronic configuration :
(1) $ns^2\ np^6\ nd^{1-10}$ (2) $(n-1)\ d^{1-10}\ ns^{0-2}\ np^{0-6}$
(3) $(n-1)\ d^{1-10}\ ns^{1-2}$ (4) none.

2.✍ The general electronic configuration of Zn, Cd and Hg is represented by :
(1) $(n-1)d^{10}\ ns^2$ (2) $(n-1)\ d^9\ 4s^2$ (3) $(n-1)\ d^{10}4s^1$ (4) $(n-1)\ d^{10}\ 4s^0$

3. The d-block of the periodic table contains the elements of the groups :
(1) 2 – 11 (2) 3 – 12 (3) 3 – 11 (4) 5–14

4. Which of the following statements is incorrect about transition elements ?
(1) The last electron enters into them in (n-1) d-orbital.
(2) Their properties are in between those of s- and p-block elements.
(3) The transition element with smallest atomic number is scandium.
(4) None of these

5.✍ The total number of electrons in (n–1) d-orbitals in each element, Pd, Ag and Cd respectively are :
(1) 8, 9, 10 (2) 8, 10, 10 (3) 10, 10, 10 (4) none

6.✍ Which of the following has largest metallic radius ?
(1) V (2) Mn (3) Ti (4) Co

7. Amongst the following metals, which has highest melting point ?
(1) Ti (2) Cr (3) Fe (4) Cu

8.✍ The melting point of Zn is lower as compared to those of the other elements of 3d series because :
(1) the d-orbitals are completely filled.
(2) the d-orbitals are partially filled.
(3) d-electrons do not participate in metallic bonding.
(4) (1) and (3) both.

9. Among the following series of transition metal ions, the one where all metal ions have $3d^2$ electronic configuration is :
(1) Ti^{3+} , V^{2+} , Cr^{3+} , Mn^{4+} (2) Ti^{+} , V^{4+} , Cr^{6+} , Mn^{7+}
(3) Ti^{2+} , V^{3+} , Cr^{2+} , Mn^{3+} (4) Ti^{2+} , V^{3+} , Cr^{4+} , Mn^{5+} .

Section (B) : Ionization enthalpy, oxidation state, Electrode potential and chemical reactivity

1. Which of the statements is **False** ?
(1) In 3d series, there is a regular increase in the first ionisation enthalpy of transition elements from left to right.
(2) In 3d series, the negative value of standard electrode potential (E/V) for M^{2+}/M decreases in the order Ti > Mn > Cr > Fe.
(3) The decreases in metallic radius coupled with increase in atomic mass results in a general increase in the density of transition elements from Ti to Cu.
(4) The higher oxidation state are favoured by the heavier elements (i.e. heavier members) in the groups of d-block.

2. Maximum oxidation sate is shown by :
(1) Os (2) Mn (3) Cr (4) Co

3. The highest oxidation state is exhibited by the transition metals with configuration :
(1) $(n-1)\,d^3ns^2$ (2) $(n-1)\,d^5ns^1$ (3) $(n-1)\,d^5ns^2$ (4) $(n-1)\,d^8ns^2$.

4. Low oxidation states are found in transition elements when a complex compound has :
(1) ligands capable of π acceptor character.
(2) ligands capable of σ donor character.
(3) ligands capable of π acceptor character as well as σ donor character.
(4) ligands incapable of π acceptor character as well as σ donar character.

5. Which of the following statements is correct ?
(1) The lesser number of oxidation states in 3d-series in the beginning of the series is due to the presence of too few electrons to loose or share
(2) The lesser number of oxidation states in 3d-series towards the end of the series is due to the presence of too many electrons and thus fewer empty orbitals to share electrons with the ligands
(3) (1) and (2) both
(4) None is correct

6. The stability of particular oxidation state of a metal in aqueous solution is determined by :
(1) enthalpy of sublimation of the metal (2) ionisation energy
(3) enthalpy of hydration of the metal ion (4) all of these.

7. Which of the following is true for the species having $3d^4$ configuration ?
(1) Cr^{2+} is reducing in nature. (2) Mn^{3+} is oxidising in nature.
(3) Both (1) and (2) (4) None of these

8. First IE of 5d series elements are higher than those of 3d and 4d series elements. This is due to :
(1) bigger size of atoms of 5d-series elements than 3d-series elements.
(2) greater effective nuclear charge is experienced by valence electrons because of the weak shielding of the nucleus by $4f$-electrons in 5d series.
(3) (1) and (2) both.
(4) None of these.

9. Which amongst the following can give the greater number of oxidation states ?
(1) V (2) Mn (3) Cr (4) Fe

Section (C) : Magnetic properties, formation of coloured ions.

1. Which of the following has the maximum number of unpaired d-electron?
(1) Zn^{2+} (2) Fe^{2+} (3) Ni^{3+} (4) Cu^{2+}

2. Magnetic moment of Cr^{+2} (Z =24), Mn^{+2} (Z = 25) and Fe^{2+}(Z = 26) are x,y,z. They are in order :
(1) x < y < z (2) x > y > z (3) z < x = y (4) x = z < y

3. Which one of the following transition metal ions is diamagnetic ?
(1) Co^{2+} (2) Ni^{2+} (3) Cu^{2+} (4) Zn^{2+}

4. Which of the following ions give colourless aqueous solution?
(1) Ni^{2+} (2) Fe^{2+} (3) Cu^{2+} (4) Cu^{+}

5. A metal ion from the first transition series has a magnetic moment (calculated) of 3.87 B.M. How many unpaired electrons are expected to be present in the ion?
(1) 1 (2) 2 (3) 3 (4) 4

6. The magnetic moment of $_{25}Mn$ in ionic state is 4.83 B.M, then Mn is in :
(1) +2 state (2) +3 state (3) +4 state (4) +5 state

7. The colour of transition metal ions is attributed to :
(1) exceptionally small size of cations (2) absorption of ultraviolet rays
(3) incomplete (n – 1) d - subshell (4) absorption of infrared radiations

Section (D) : Catalytic properties, formation of interstitial compounds, alloy formation.

1. The catalytic activity of the transition metals and their compounds is ascribed to :
(1) their chemical reactivity.
(2) their magnetic behaviour.
(3) their unfilled d-orbitals.
(4) their ability to adopt multiple oxidation state and their complexing ability.

2. Which forms interstitial compounds?
(1) Fe (2) Co (3) Ni (4) All

3. Which of the following statement is correct ?
(1) Transition metals and their many compounds act as good catalyst.
(2) The enthalpies of atomistation of the transition metals are high.
(3) The transition metals generally form interstitial compounds with small atoms like C, B, H etc.
(4) All of these

Section (E) : Important d-block metal compounds.

1. The yellow colour of chromates changes to orange on acidification due to formation of :
(1) Cr^{3+} (2) Cr_2O_3 (3) $Cr_2O_7^{2-}$ (4) CrO_4^-

2. When acidified solution of $K_2Cr_2O_7$ is shaken with aqueous solution of $FeSO_4$, then :
(1) $Cr_2O_7^{2-}$ ion is reduced to Cr^{3+} ions (2) $Cr_2O_7^{2-}$ ion is converted to CrO_4^{2-} ions
(3) $Cr_2O_7^{2-}$ ion is reduced to Cr (4) $Cr_2O_7^{2-}$ ion is converted to CrO_3

3. Which of the following compounds is used as the starting material for the preparation of potassium dichromate?
(1) $K_2SO_4.Cr_2(SO_4)_3.24H_2O$ (chrome alum) (2) $PbCrO_4$ (chrome yellow)
(3) $FeCr_2O_4$ (chromite) (4) $PbCrO_4.PbO$ (chrome red)

4. Manganous salt in presence of catalyst zinc sulphate or zinc oxide is oxidised by potassium permanganate in neutral of faintly alkaline medium to :
(1) MnO_2 (2) Mn_2O_7 (3) Mn_2O_3 (4) Can not be oxidised

5. $KMnO_4$ is the oxo salt of :
(1) MnO_2 (2) Mn_2O_7 (3) MnO_3 (4) Mn_2O_3

6. Which of the following statements is false ?
(1) An acidified solution of $K_2Cr_2O_7$ liberates iodine from potassium iodide
(2) In acidic solution, dichromate ions are converted to chromate ions.
(3) Potassium dichromate on heating undergoes decomposition to give Cr_2O_3 and O_2 gas.
(4) Potassium dichromate is used as a titrant of Fe^{2+} ion.

7. $KMnO_4$ on heating at temperature 513 K decomposes to give :
(1) K_2MnO_4, MnO_2 and O_2 (2) K_2O, MnO_2 and O_2
(3) K_2MnO_4, Mn_2O_7 and KO_2 (4) K_2MnO_4 and MnO_2

8. When SO_2 is passed through acidified $K_2Cr_2O_7$ solution :
(1) the solution turns blue. (2) SO_2 is reduced.
(3) green $Cr_2(SO_4)_3$ is formed. (4) the solution is decolourised.

9. Mohr's salt is :
(1) $Fe_2(SO_4)_3.(NH_4)_2SO_4.6H_2O$ (2) $MgSO_4.7H_2O$
(3) $FeSO_4.(NH_4)_2SO_4.6H_2O$ (4) $FeSO_4.7H_2O$

Section (F) : Lanthanoids and actinoids

1. The f-block of the periodic table contains those elements in which :
(1) only 4f orbitals are progressively filled in 6th period.
(2) only 5f orbitals are progressively filled in 7th period.
(3) 4f and 5f orbitals are progressively filled in 6th and 7th periods respectively.
(4) none

2. Among the lanthanoides the one obtained by synthetic method is :
(1) Lu (2) Pm (3) Pr (4) Gd

3. The most common lanthanoide is :
(1) lanthanum (2) cerium (3) samarium (4) plutonium

4. Across the lanthanide series, the basicity of the lanthanoide hydroxides :
(1) increases (2) decreases
(3) first increases and then decreases (4) does not change

5. The +3 ion of which one of the following has half filled 4f subshell ?
(1) La (2) Lu (3) Gd (4) Ac

6. Actinides :
(1) are all synthetic elements (2) includes element 104
(3) have only short lived isotopes (4) have variable valency

7. The lanthonoide contraction is reponsible for the fact that
(1) Zr and Y have about the same radius (2) Zr and Nb have similar oxidation state
(3) Zr and Hf have about the same radius (4) Zr and Ce have the same oxidation state

8. Lanthanoid and actinides resemble in :
(1) electronic configuration (2) oxidation state
(3) ionization energy (4) formation of complexes

9. The separation of lanthanoids by ion exchange method is based on
(1) sizes of the ions (2) oxidation state of the ions
(3) the solubility of their nitrates (4) basicity of hydroxides of lanthanides

Exercise-2

✍ **Marked Questions may have for Revision Questions.**

1. Amongst the following set of transition metal ions, the one in which all metal ions do not have d-electrons ?
(1) Cr(VI), Ti(IV), Mn (VII) (2) V(V), Mn(VI), Ni(IV)
(3) Sc(III), V (V), Ti (III) (4) Cr(VI), Sc(III), Mn(VI)

2. The radii (metallic) of Fe,Co and Ni are nearly same.
This is due to the fact that:
(1) lanthanide contraction
(2) increased interelectronic repulsion is balanced by increased nuclear charge.
(3) increase in radii due to increase in 'n' is compensated by decrease in radii due to increase in effective nuclear charge (Z).
(4) atomic radii do not remain constant but decrease in a normal gradation.

3. Which of the following statements is incorrect ?
(1) In each row i.e. transition series melting points of transition metals rise to a maximum at d^5 (excludes, Cr, Mn and Tc) and fall regularly as the atomic number increases.
(2) The transition metals are very much hard and have low volatility.
(3) The metals of the second and third series have greater enthalpies of atomisation than the corresponding elements of the first seires.
(4) None

4. Which of the following transition metal ions has the lowest density ?
(1) Copper (2) Nickel (3) Scandium (4) Zinc

5. The names transition and inner transition metals are used to indicate the elements of :
(1) d-block elements only (2) f-block elements only
(3) p- and d-blocks elements respectively (4) d- and f-blocks elements respectively

6. Which of the following does not belong to 3d series of transition elements ?
(1) Titanium (2) Iron (3) Palladium (4) Vanadium.

7. Which of the following is the most suitable description of transition elements ?
(1) Low melting points (2) No catalytic activity.
(3) Show variable oxidation states. (4) Exhibit inert pair effect.

8. In which of the following pairs of elements, the (n–1) d-orbitals have same number of electrons ?
(1) Mn, Fe (2) Cr, Mn (3) Cu, Zn (4) (2) and (3)

9.✍ Which of the following factor may be regarded as the main cause of Lanthanide contraction ?
(1) Poor shielding by 4f-electrons as compared to the electrons in the other sub-shells.
(2) Effective shielding of one of the 4f-electrons by another in the sub-shell.
(3) Poorer shielding by 5d electron of 4f-electrons.
(4) Greater shielding of 5 d electron by 4f-electron.

10. Copper has higher second ionization energy than that of both adjacent elements. This is because of :
(1) smaller size of copper (I) ion. (2) d^{10} configuration of copper (I) ion.
(3) higher nuclear charge of copper (I) ion. (4) Larger size of copper (I) ion.

11.✍ $E^{\ominus}$ values for the couples Cr^{3+}/Cr^{2+} and Mn^{3+}/Mn^{2+} are – 0.41 and + 1.51 volts respectively. Considering these values select the correct option from the following statements.
(1) Cr^{2+} acts as a reducing agent and Mn^{2+} acts as an oxidising agent in their aqueous solutions.
(2) Cr^{2+} (aq.) is more stable than Cr^{3+} (aq.).
(3) Mn^{3+} (aq.) is more stable than Mn^{2+} (aq).
(4) None of these.

12. Which oxide of manganese is most acidic in nature ?
(1) MnO (2) Mn_2O_7 (3) Mn_2O_3 (4) MnO_2 .

13. The maximum oxidation state shown by V(Z = 23), Cr(Z = 24), Co(Z = 27), Sc(Z = 21) are respectively :
(1) + 5 , + 6 , + 3 , + 3 (2) + 3 , + 4 , + 5, + 2
(3) + 5, + 3 , + 2 , + 1 (4) + 4 in each case.

14. In which compound does vanadium have an oxidation number of + 4 ?
(1) NH_4VO_2 (2) $K_4[V(CN)_6]$ (3) VSO_4 (4) $VOSO_4$

15. In general, the transition elements exhibit their highest oxidation states in their compounds with elements like:
(1) C (2) S (3) S and P (4) F and O.

16. The $E^{\ominus}(M^{2+}/M)$ value for copper is positive (+ 0.34V). It is due to :
(1) its higher enthalpy of atomization. (2) its lower enthalpy of hydration.
(3) both (1) and (2) (4) none

17. Which of the following pairs of ions has magnetic moment of 5.93 B.M. ?
(1) Mn^{2+}, Fe^{3+} (2) Mn^{2+}, Cr^{3+} (3) Fe^{2+}, Co^{3+} (4) None

18. Amongst the following the lowest degree of paramagnetism per mole of the compound at 298 K will be shown by:
(1) $MnSO_4.4H_2O$ (2) $CuSO_4.5H_2O$ (3) $FeSO_4.6H_2O$ (4) $NiSO_4.6H_2O$

19. Compound that is both paramagnetic and coloured is :
(1) $K_2Cr_2O_7$ (2) $(NH_4)_2[TiCl_6]$ (3) $VOSO_4$ (4) $K_3[Cu(CN)_4]$

20. The ions from among the following which are colourless are :
(i) Ti^{4+} , (ii) Cu^{+1} , (iii) Co^{3+}, (iv) Fe^{2+} .
(1) (i) and (ii) only (2) (i), (ii) and (iii) (3) (iii) and (iv) (4) (ii) and (iii).

21. Which of the followig group of ions is paramagnetic in nature :
(1) Cu^{+}, Zn^{2+}, Sc^{3+} (2) Mn^{2+}, Fe^{3+}, Ni^{2+} (3) Cr^{2+}, Mn^{3+}, Sc^{3+} (4) Cu^{2+}, Ni^{2+}, Ti^{4+}

22. Of the ions Zn^{2+} , Ni^{2+} and Cr^{3+} (atomic number Zn = 30, Ni = 28, Cr = 24) :
(1) only Zn^{2+} is colourless and Ni^{2+} and Cr^{3+} are coloured.
(2) all three are colourless.
(3) all three are coloured.
(4) only Ni^{2+} is coloured and Zn^{2+} and Cr^{3+} are colourless.

23. Which of the following is more paramagnetic ?
(1) Fe^{2+} (2) Fe^{3+} (3) Cr^{3+} (4) Mn^{3+}

24. The highest number of unpaired elelctrons are in :
(1) Fe (2) Fe^{2+}
(3) Fe^{3+} (4) all have equal number of unpaired electrons

25. The least stable oxide at room temperature is :
(1) ZnO (2) CuO (3) Sb_2O_3 (4) Ag_2O

26. Titanium shows magnetic moment of 1.73 BM in its compound. What is the oxidation number of Ti in the compound ?
(1) +1 (2) +4 (3) +3 (4) +2

27. Which one of the following characteristics of the transition metals is associated with their catalytic activity ?
(1) Colour of hydrated ions. (2) Variable oxidation states.
(3) High enthalpy of atomization. (4) Paramagnetic behaviour.

28. Geman silver is :
(1) silver made in Germany (2) an alloy of silver
(3) an alloy of copper (4) a silver white paint.

29. Which one of the following alloys contain only Cu and Zn ?
(1) Bronze (2) Brass (3) Gun metal (4) Bell metal

30. Which of the following can be used for the conversion of potassium manganate to potassium permanganate?
(1) O_3 (2) Cl_2 (3) CO_2 (4) All.

31. The number of moles of $KMnO_4$ that will be needed to react with one mole of sulphite ion in acidic medium is:
(1) 2/5 (2)3/5 (3) 4/5 (4) 1

32. In the iodometric estimation in the laboratory which process is involved ?
(1) $Cr_2O_7^{2-} + H^+ + I^- \longrightarrow 2Cr^{3+} + I_2$
$I_2 + S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + I^-$
(2) $MnO_4^- + H^+ + I^- \longrightarrow Mn^{2+} + I_2$
$I_2 + S_2O_3^{-} \longrightarrow S_4O_6^{2-} + I^-$
(3) $MnO_4^- + OH^- + I^- \longrightarrow MnO_2 + I_2$
$I_2 + S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + I^-$
(4) $Cr_2O_7^{2-} + OH^- + I^- \longrightarrow 2Cr^{3+} + I_2$
$I_2 + S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + I^-$

33. $K_2Cr_2O_7$ reacts with NH_4Cl in presence of H_2SO_4. The product formed is :
(1) chromyl chlorate with green vapour (2) chromous chloride with white vapour
(3) chromous chloride with blue vapour (4) chromyl chloride with deep red colour

34. Potassium dichromate can be converted into potassium chromate using :
(1) KOH (2) H_2SO_4 (3) KCl (4) KNO_2

35. When hydrogen peroxide is added to acidified potassium dichromate, a blue colour is produced due to formation of :
(1) CrO_3 (2) Cr_2O_3 (3) CrO_5 (4) Cr_4^{2-}

36. Which of the following statements is not correct ?
(1) $La(OH)_3$ is less basic than $Lu(OH)_3$
(2) In lanthanide series ionic radius of Ln^{3+} ions decreases
(3) La is actually an element of transition series rather than lanthanide series
(4) Atomic radii of Zr and Hf are same because of lanthanide contraction

37. Transuranic elements begin with
(1) Np (2) Cm (3) Pu (4) U

38. Lanthanide contraction is due to increase in :
(1) shielding by 4f electrons (2) atomic number
(3) effective nuclear charge (4) size of 4f orbitals

39. Which of the following is not an actinoide ?
(1) Curium (2) Californium (3) uranium (4) terbium

40. When MnO_2 is fused with KOH, a coloured compound is formed. The product and its colour is :
(1) K_2MnO_4, green (2) Mn_2O_3, brown (3) Mn_2O_4, black (4) $KMnO_4$, purple

41. Among the following, the coloured compound is :
(1) CuCl (2) $K_3[Cu(CN)_4]$ (3) CuF_2 (4) $[Cu(CH_3CN)_4]BF_4$

Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. Which of the following statement is not correct ? **[AIPMT 01]**
(1) $La(OH)_3$ is less basic than $Li(OH)_3$.
(2) In lanthaniode series, ionic radius of Ln^{3+} ion decreases.
(3) La is actually an element of transition series rather than lanthaniodes.
(4) Atomic radius of Zn and Hf are same because of lanthaniode contraction.

2. The transition metals are mostly **[AIPMT 01]**
(1) diamagnetic (2) paramagnetic
(3) neither diamagnetic nor paramagnetic (4) both diamagnetic and paramagnetic

3. General electronic configuration of lanthanides is: **[AIPMT 02]**
(1) $(n–2)\ f^{1–14}\ (n – 1)s^2\ p^6\ d^{0–1}\ ns^2$ (2) $(n–2)\ f^{10–14}\ (n – 1)d^{0–1}\ ns^2$
(3) $(n–2)\ f^{0–14}\ (n – 1)\ d^{10}\ ns^2$ (4) $(n–2)\ d^{0–1}\ (n – 1)\ f^{1–14}\ ns^2$

4. The correct order of ionic radii of Y^{3+}, La^{3+}, Eu^{3+} and Lu^{3+} is : **[AIPMT 03]**
(1) $Y^{3+} < Lu^{3+} < Eu^{3+} < La^{3+}$ (2) $Lu^{3+} < Y^{3+} < Eu^{3+} < La^{3+}$
(3) $Lu^{3+} < Eu^{3+} < La^{3+} < Y^{3+}$ (4) $La^{3+} < Eu^{3+} < Lu^{3+} < Y^{3+}$

5. The basic character of the transition metal monoxide follows the order: **[AIPMT 03]**
(At. no. : Ti = 22, V = 23, Cr = 24, Fe = 26)
(1) VO > CrO > TiO > FeO (2) CrO > VO > FeO > TiO
(3) TiO > FeO > VO > CrO (4) TiO > VO > CrO > FeO

6. Lanthanides are **:** **[AIPMT 04]**
(1) 14 elements in the sixth period (At. No. 90 to 103) that are filling 4f sublevel.
(2) 14 elements in the seventh period (At. No. 90 to 103) that are filling 5f subshell.
(3) 14 elements in the sixth period (At. No. 58 to 71) that are filling the 4f subshell.
(4) 14 elements in the seventh period (At. No. 58 to 71) that are filling the 4f subshell.

7. The correct order of decreasing second ionization enthalpy of Ti (22), V (23), Cr (24) and Mn (25) is : **[AIPMT 05]**
(1) Cr > Mn > V > Ti (2) V > Mn > Cr > Ti (3) Mn > Cr > Ti > V (4) Ti > V > Cr > M

8. Four successive members of the first row transition elements are listed below with their atomic numbers. Which one of them is expected to have the highest third ionization enthalpy ? **[AIPMT 05]**
(1) Vanadium (Z = 23) (2) Manganese (Z = 25)
(3) Chromium (Z = 24) (4) Iron (Z = 26)

9. The aqueous solution containing which one of the following ions will be colourless ? **[AIPMT 05]**
(At. No. Sc = 21, Fe = 26, Ti = 22, Mn = 25)
(1) Fe^{2+} (2) Mn^{2+} (3) Ti^{3+} (4) Sc^{3+}

10. In which of the following pairs are both the ions coloured in aqueous solution? **[AIPMT 06]**
(At. No. Sc= 21, Ti = 22, Ni = 28, Cu = 29, Co = 27)
(1) Sc^{3+}, Co^{2+} (2) Ni^{2+}, Cu^{+} (3) Ni^{2+}, Ti^{3+} (4) Sc^{3+}, Ti^{3+}

11. Identify the incorrect statement among the following. **[AIPMT 07]**
(1) Shielding power of 4f electrons is quite weak
(2) There is a decrease in the radii of the atoms or ions as one proceeds from La to Lu
(3) Lanthanoid contraction is the accumulation of successive shrinkages.

(4) As a result of lanthanoid contraction, the properties of 4d series of the transition elements have no similarities with the 5d series of elements.

12. Which of the following ions will exhibit colour in aqueous solutions ? **[AIPMT 10]**
(1) La^{3+} (Z = 57) (2) Ti^{3+} (Z = 22) (3) Lu^{3+} (Z = 71) (4) Sc^{3+} (Z = 21)

13. Which of the following ions has electronic configuration $[Ar]3d^6$? **[AIPMT 10]**
(1) Ni^{3+} (2) Mn^{3+} (3) Fe^{3+} (4) Co^{3+}

14. Which of the following pairs has the same size ? **[AIPMT 10]**
(1) Fe^{2+}, Ni^{2+} (2) Zr^{4+}, Ti^{4+} (3) Zr^{4+}, Hf^{4+} (4) Zn^{4+}, Hf^{4+}

15. For the four successive transion elements (Cr, Mn, Fe and Co), the stability of +2 oxidation state will be there in which of the following order ? **[AIPMT 11]**
(1) Mn > Fe > Cr > Co (2) Fe > Mn > Co > Cr
(3) Co > Mn > Fe > Cr (4) Cr > Mn > Co > Fe
(At. nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)

16. The d-electron configurations of Cr^{2+}, Mn^{2+}, Fe^{2+} and Co^{2+} are d^4, d^5, d^6 and d^7 respectively. Which one of the following will exhibit minimum paramagnetic behaviour ? **[AIPMT 11]**
(1) $[Mn(H_2O)_6]^{2+}$ (2) $[Fe(H_2O)_6]^{2+}$ (3) $[Co(H_2O)_6]^{2+}$ (4) $[Cr(H_2O)_6]^{2+}$
(At, nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)

17. Which one of the following does not correctly represent the correct order of the property indicated against it?
(1) Ti < V < Cr < Mn : increasing number of oxidation states **[AIPMT 12]**
(2) $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$: increasing magnetic moment
(3) Ti < V < Cr < Mn : increasing melting points
(4) Ti < V < Mn < Cr : increasing 2^{nd} ionization enthalpy

18. Four successive members of the first series of the transition metals are listed below. For which one of them the standard potential $\left(E^0_{M^{2+}/M}\right)$ value has a positive sign ? **[AIPMT 12]**
(1) Co (Z = 27) (2) Ni (Z = 28) (3) Cu (Z = 29) (4) Fe (Z = 26)

19. The catalytic activity of transition metals and their compounds is ascribed mainly to : **[AIPMT 12]**
(1) their magnetic behaviour (2) their unfilled d-orbitals
(3) their ability to adopt variable oxidation state (4) their chemical reactivity

20. Which of the following exhibit only + 3 oxidation state ? **[AIPMT 12]**
(1) U (2) Th (3) Ac (4) Pa

21. Which of the following lanthanoid ions is diamagnetic ? **[AIPMT 13]**
(At nos. Ce = 58, Sm = 62, Eu = 63, Yb = 70)
(1) Sm^{2+} (2) Eu^{2+} (3) Yb^{2+} (4) Ce^{2+}

22. Which of the following statements about the interstitial compounds is **incorrect** ? **[AIPMT 13]**
(1) They are chemically reactive.
(2) They are much harder than the pure metal.
(3) They have higher melting points than the pure metal.
(4) They retain metallic conductivity.

23. Magnetic moment 2.83 BM is given by which of the following ions? **[AIPMT 14]**
(At.nos.Ti=22, Cr=24, Mn=25, Ni=28)
(1) Ti^{3+} (2)Ni^{2+} (3) Cr^{3+} (4) Mn^{2+}

24. Which of the following processes does not involve oxidation of iron ? **[AIPMT-1 15]**
(1) Decolourization of blue $CuSO_4$ solution by iron

(2) Formation of $Fe(CO)_5$ from Fe
(3) Liberation of H_2 from steam by iron at high temperature
(4) Rusting of iron sheets

25. Gadolinium belongs to 4f series. It's atomic number is 64. Which of the following is the correct electronic configuration of gadolinium ? **[AIPMT-2 15]**
(1) [Xe]$4f^8 6d^2$ (2) [Xe]$4f^9 5s^1$ (3) [Xe] $4f^7 5d^1 6s^2$ (4) [Xe] $4f^6 5d^2 6s^2$

26. Which one of the following statements related to lanthanons is incorrect ? **[NEET-16]**
(1) Ce (+4) solutions are widely used as oxidizing agent in volumetric analysis.
(2) Europium shows +2 oxidation state.
(3) The basicity decreases as the ionic radius decreases from Pr to Lu
(4) All the lanthanous are much more reactive than aluminium

27. The reason for greater range of oxidation states in actinoids is attributed to : **[NEET -17]**
(1) The radioactive nature of actinoids
(2) Actinoid contraction
(3) 5f, 6d and 7s levels having comparable energies
(4) 4f and 5d levels being close in energies

28. Name the gas that can readily decolourise acidified $KMnO_4$ solution: **[NEET 2017]**
(1) CO_2 (2) SO_2 (3) NO_2 (4) P_2O_5

29. Match the might ions given in Column I with the spin magnetic moments of the ions given in Column II and assign the correct code : **[NEET 2018]**

Column I		**Column II**
(a)	Co^{3+}	(i) $\sqrt{8}$ B.M.
(b)	Cr^{3+}	(ii) $\sqrt{35}$ B.M.
(c)	Fe^{3+}	(iii) $\sqrt{3}$ B.M.
(d)	Ni^{2+}	(iv) $\sqrt{24}$ B.M.
		(v) $\sqrt{15}$ B.M.

	a	b	c	d		a	b	c	d
(1)	iv	v	ii	i	(2)	iii	v	I	ii
(3)	iv	I	ii	iii	(4)	I	ii	iii	iv

30. The manganate and permanganate ions are tetrahedral, due to: **[NEET-1- 2019]**
(1) The π–bonding involves overlap of d-orbitals of oxygen with d-orbitals of manganese.
(2) The π–bonding involves overlap of p-orbitals of oxygen with d-orbitals of manganese.
(3) There is no π–bonding.
(4) The π–bonding involves overlap of p-orbitals of oxygen with p-orbitals of manganese.

31. The number of hydrogen bonded water molecule(s) associated with $CuSO_4 . 5H_2O$ is – **[NEET-2- 2019]**
(1) 3 (2) 1 (3) 2 (4) 5

32. When neutral or faintly alkaline $KMnO_4$ is treated with potassium iodide, iodide ion is converted into 'X', 'X' is - **[NEET-2- 2019]**
(1) I_2 (2) IO_4^- (3) IO_3^- (4) IO^-

PART - II : AIIMS QUESTION (PREVIOUS YEARS)

1. MnO_4^{2-} (1 mole) in neutral aqueous medium disproportionates to: **[AIIMS 03]**
(1) 2/3 moles of MnO_4^- and 1/3 mole of MnO_2 (2) 1/3 mole of MnO_4^- and 2/3 mole of MnO_2
(3) 1/3 mole of Mn_2O_7 and 1/3 mole of MnO_2 (4) 2/3 mole of Mn_2O_7 and 1/3 mole of MnO_2

2. The colourless species is : **[AIIMS 03]**
(1) VCl_3 (2) $VOSO_4$ (3) Na_3VO_4 (4) $[V[H_2O]_6SO_4].H_2O$

3. For decolorization of 1 mole of $KMnO_4$, the moles of H_2O_2 required is : **[AIIMS 04]**
(1) 1/2 (2) 3/2 (3) 5/2 (4) 7/2

4. Among the following pairs of ions, the lower oxidation state in aqueous solution is more stable than the other, in : **[AIIMS 05]**
(1) $T\ell^+$, $T\ell^{3+}$ (2) Cu^+ , Cu^{2+} (3) Cr^{2+} , Cr^{3+} (4) V^{2+}, VO^{2+}

5. Which one of the following is not coloured ? **[AIIMS 10]**
(1) Cu^{2+} (2) Cu^+ (3) Ni^{2+} (4) Fe^{3+}

6. $KMnO_4$ acts as an oxidising agent in the neutral medium and gets reduced to MnO_2. The equivalent weight of $KMnO_4$ in neutral medium will be : **[AIIMS 10]**
(1) mol. wt. / 2 (2) mol. wt. / 3 (3) mol. wt. / 4 (4) mol. wt. / 7

7. Which of the following is an amphoteric oxide ? **[AIIMS 10]**
(1) CrO_3 (2) Cr_2O_3 (3) V_2O_3 (4) TiO

8. A compound of metal ion M^{x+} (Z= 24) has a spin only magnetic moment of $\sqrt{15}$ Bohr Magenetons. The number of unpaired electrons in the compound are **[AIIMS 13]**
(1) 2 (2) 4 (3) 5 (4) 3

9. **Assertion:** Magnetic moment values of actinides are lesser than the theoretically predicted value.
Reason: Actinide elements are strongly paramagnetic. **[AIIMS 13]**
(1) If both assertion and reason are true and reason is a correct explanation of assertion.
(2) If both assertion and reason are true but reason is not a correct explanation of assertion.
(3) If assertion is true but reason is false.
(4) If assertion and reason both are false.

10. Choose the incorrect statement among the following – **[AIIMS 16]**
(1) The chemistry of different lanthanoids is very similar
(2) 4 f and 5 f-orbitals are equally shielded
(3) d-block element show irregular and erratic chemical properties among themselves
(4) La and Lu have partially filled d-orbitals and no other partially filled orbitals

11. For the reaction, **[AIIMS 2017]**
$Cr_2O_7^{2-} \xrightarrow{pH=x} CrO_4^{2-} \xrightarrow{pH=y} Cr_2O_7^{2-}$ pH values 'x' and 'y' can be
(1) 4 and 5 (2) 4 and 8 (3) 8 and 4 (4) 8 and 9

12. Which of the following has maximum number of unpaired d-electrons? **[AIIMS 2017]**
(1) Fe^{2+} (2) Cu^+ (3) Zn (4) Ni^{3+}

13. **Assertion** : Separation of Zr and Hf is difficult **[AIIMS 2017]**
Reason : Zr and Hf lie in the same group of the periodic table.
(1) If both assertion and reason are true and reason is a correct explanation of assertion.
(2) If both assertion and reason are true but reason is not a correct explanation of assertion.
(3) If assertion is true but reason is false.
(4) If assertion and reason both are false.

14. Violet colour appear in glass when we add– **[AIIMS 2018]**
(1) Cr^{3+} (2) Mn^{4+} (3) I_2 (4) K^+

15. Which is least stable in aqueous medium **[AIIMS 2018]**
(1) Fe^{+2} (2) Co^{+2} (3) Ni^{+2} (4) Mn^{+2}

16. In acidic medium which of the following does not change its colour: **[AIIMS 2018]**
(1) MnO_4^- (2) MnO_4^{2-} (3) CrO_4^{2-} (4) FeO_4^{2-}

17. $AgNO_3$ does not decompose where : **[AIIMS 2018]**
(1) U.V. radiation (2) Skin (human) (3) Water 25ºC (4) Glucose

18. $KMnO_4$ is added to KOH, which of the following colour is observed **[AIIMS 2018]**
(1) Pale pink (2) Brown (3) Black (4) Green

PART - III : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. Number of electrons transferred in each case when $KMnO_4$ acts as an oxidising agent to give MnO_2, Mn^{2+}, $Mn(OH)_3$ and MnO_4^{2-} are respectively : **[AIEEE 2002]**
(1) 3,5,4 and 1 (2) 4,3,1 and 5 (3) 1,3,4 and 5 (4) 5,4,3 and 1

2. Which of the following ions has the maximum magnetic moment? **[AIEEE 2002]**
(1) Mn^{2+} (2) Fe^{2+} (3) Ti^{2+} (4) Cr^{2+}.

3. Most common oxidation state fo Ce (Cerium) are : **[AIEEE 2002]**
(1) +3, +4 (2) +2, +3 (3) +2, +4 (4) +3, +5

4. The atomic numbers of V,Cr,Mn and Fe are respectively 23,24,25 and 26. Which one of these may be expected to have the highest second ionization enthalpy ? **[AIEEE 2003]**
(1) Cr (2) Mn (3) Fe (4) V

5. Which of the following group of transition metals is called coinage metals ? **[AIEEE 2003]**
(1) Cu, Ag, Au (2) Ru, Rh, Pb (3) Fe, Co, Ni (4) Os. Ir, Pt

6. The radius of La^{3+} (Atomic number of La = 57) is 1.06Å. Which one of the following given values will be closest to the radius of Lu^{3+} (Atomic number of Lu = 71) ? **[AIEEE 2003]**
(1) 1.60Å (2) 1.40Å (3) 1.06Å (4) 0.85Å

7. Cerium (Z = 58) is an important member of the lanthanoide. Which of the following statement about cerium is incorrect? **[AIEEE 2004]**
(1) The common oxidation state of cerium are +3 and +4.
(2) The +3 oxidation state of cerium is more stable than +4 oxidation state.
(3) The +4 oxidation state of cerium is not known in solution.
(4) Cerium (IV) acts as an oxidizing agent.

8. The lanthanide contraction is responsible for the fact that **[AIEEE 2005]**
(1) Zr and Y have about the same radius (2) Zr and Nb have similar oxidation state
(3) Zr and Hf have about the same radius (4) Zr and Zn have same oxidation state.

9. Which of the following factors may be regarded as the main cause of lanthanide contraction ?
(1) Greater shielding of 5d electrons by 4f electrons **[AIEEE 2005]**
(2) Poorer shielding of 5d electron by 4f electrons
(3) Effective shielding of one of 4f electrons by another in the sub-shell
(4) Poor shielding of one of 4f electron by another in the sub-shell.

10. The ''spin-only'' magnetic moment [in units of Bohr magneton, (μ_B) of Ni^{2+} in aqueous solution would be (atomic number of Ni = 28) **[AIEEE 2006]**
(1) 2.84 (2) 4.90 (3) 0 (4) 1.73

11. Lanthanoid contraction is caused due to : **[AIEEE 2006]**
(1) the appreciable shielding on outer electrons by $4f$ electrons from the nuclear charge
(2) the appreciable shielding on outer electrons by $5f$ electrons from the nuclear charge
(3) the same effective nuclear charge from Ce to Lu
(4) the imperfect shielding on outer electrons by 4f electrons from the nuclear charge

12. Identify the incorrect statement among the following. **[AIEEE 2007]**
(1) The chemistry of various lanthanoids is very similar.
(2) 4f and 5f orbitals are equally shielded.
(3) d-block elements show irregular and erratic chemical properties among themselves.
(4) La and Lu have partially filled d orbitals and no other partially filled orbitals.

13. The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because
(1) The actinoids are more reactive than the lanthanoids. **[AIEEE 2007, 3/120]**
(2) The 5f orbitals extend farther from the nucleus than the 4f orbitals.
(3) The 5f orbitals are more buried than the 4f orbitals
(4) There is a similarity between 4f and 5f orbitals in their angular part of the wave function

14. Larger number of oxidation states are exhibited by the actinoids than those by the lanthanoids, the main reason being. **[AIEEE 2008, 3/105]**
(1) lesser energy difference between 5f and 6d than between 4f and 5d orbitals
(2) more energy difference between 5f and 6d than between 4f and 5d orbitals
(3) more reactive nature of the actinoids than the lanthanoids
(4) 4f orbitals more diffused than the 5f orbitals

15. In context with the transition elements, which of the following statements is incorrect ? **[AIEEE 2009, 4/144]**
(1) In the highest oxidation states, the transition metal show basic character and form cationic complexes.
(2) In the highest oxidation states of the first five transition elements (Sc to Mn), all the 4s and 3d electrons are used for bonding.
(3) Once the d^5 configuration is exceeded, the tendency to involve all the 3d electrons in bonding decreases.
(4) In addition to the normal oxidation states, the zero oxidation state is also shown by these elements in complexes.

16. Knowing that the Chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statement is incorrect ? **[AIEEE 2009, 4/144]**
(1) The ionic sizes of Ln (III) decrease in general with increasing atomic number.
(2) Ln (III) compounds are generally colourless.
(3) Ln (III) hydroxides are mainly basic in character
(4) Because of the large size of the Ln (III) ions the bonding in its compounds is predominently ionic in character.

17. The correct order of $E^{\circ}_{M^{2+}/M}$ values with negative sign for the four successive elements Cr, Mn, Fe and Co is **[AIEEE 2010, 4/144]**
(1) Mn > Cr > Fe > Co (2) Cr > Fe > Mn > Co (3) Fe > Mn > Cr > Co (4) Cr > Mn > Fe > Co

18. In context of the lanthanoids, which of the following statement is not correct ? **[AIEEE 2011, 4/120]**
(1) There is a gradual decrease in the radii of the members with increasing atomic number in the series.
(2) All the member exhibit +3 oxidation state.
(3) Because of similar properties the separation of lanthanoids is not easy.
(4) Availability of 4f electrons results in the formation of compounds in +4 state for all the members of the series.

19. The outer electronic configuration of Lu (Atomic No : 71) is : **[AIEEE 2011, 4/120]**
(1) $4f^3\ 5d^5\ 6s^2$ (2) $4f^8\ 5d^0\ 6s^2$ (3) $4f^4\ 5d^4\ 6s^2$ (4) $4f^{14}\ 5d^1\ 6s^2$

20. Which of the following arrangements does not represent the correct order of the property stated against it ?
(1) $V^{2+} < Cr^{2+} < Mn^{2+} < Fe^{2+}$: paramagnetic behaviour **[JEE(Main) 2013, 4/120]**
(2) $Ni^{2+} < Co^{2+} < Fe^{2+} < Mn^{2+}$: ionic size
(3) $Co^{3+} < Fe^{3+} < Cr^{3+} < Sc^{3+}$: stability in aqueous solution
(4) Sc < Ti < Cr < Mn : number of oxidation states

21. Four successive members of the first row transition elements are listed below with atomic numbers. Which one of them is expected to have the highest $E^0_{M^{3+}/M^{2+}}$ value ? **[JEE(Main) 2013, 4/120]**
(1) Cr(Z = 24) (2) Mn(Z = 25) (3) Fe(Z = 26) (4) Co(Z = 27)

22. The colour of $KMnO_4$ is due to : **[JEE(Main) 2015, 4/120]**
(1) M $\rightarrow$ L charge transfer transition (2) d – d transition

(3) L → M charge transfer transition (4) σ – σ* transition

11. The highest value of the calculated spin–only magnetic moment (in BM) among all the transition metal complexes is : **[JEE(Main) 2019, 4/120]**

(1) 4.90 (2) 6.93 (3) 3.87 (4) 5.92

12. The transition element that has lowest enthalpy of atomisation, is : **[JEE(Main) 2019, 4/120]**

(1) V (2) Fe (3) Zn (4) Cu

13. The 71st electron of an element X with an atomic number of 71 enters into the orbital: **[JEE(Main) 2019, 4/120]**

(1) 6s (2) 5d (3) 4f (4) 6p

14. The element that usually does NOT show variable oxidation states is : **[JEE(Main) 2019, 4/120]**

(1) Cu (2) Ti (3) Sc (4) V

15. $\underline{A} \xrightarrow{4KOH,\ O_2} 2\underline{B} + 2H_2O$ **[JEE(Main) 2019, 4/120]**

(Green)

$3\ \underline{B} \xrightarrow{4HCl} 2\underline{C} + MnO_2 + 2H_2O$

(Purple)

$2\ \underline{C} \xrightarrow{H_2O,\ KI} 2\underline{A} + 2\ KOH + \underline{D}$

In the above sequenec of reactions,

A and D , respectively, are :

(1) KIO_3 and MnO_2 (2) MnO_2 and KIO_3 (3) KI and K_2MnO_4 (4) KI and $KMnO_4$

16. The pair of metal ions that can give a spin-only magnetic moment of 3.9 BM for the complex $[M(H_2O)_6]Cl_2$ is : **[JEE(Main) 2019, 4/120]**

(1) Cr^{2+} and Mn^{2+} (2) V^{2+} and Co^{2+} (3) V^{2+} and Fe^{2+} (4) Co^{2+} and Fe^{2+}

17. The correct order of atomic radii is : **[JEE(Main) 2019, 4/120]**

(1) Eu > Ce > Ho > N (2) N > Ce > Eu > Ho (3) Ce > Eu > Ho > N (4) Ho > N > Eu > Ce

Answers

EXERCISE - 1

SECTION (A)

1.	(3)	**2.**	(1)	**3.**	(2)	**4.**	(4)	**5.**	(3)	**6.**	(3)	**7.**	(2)
8.	(4)	**9.**	(4)										

SECTION (B)

1.	(1)	**2.**	(1)	**3.**	(3)	**4.**	(3)	**5.**	(3)	**6.**	(4)	**7.**	(3)
8.	(2)	**9.**	(2)										

SECTION (C)

1.	(2)	**2.**	(4)	**3.**	(4)	**4.**	(4)	**5.**	(3)	**6.**	(3)	**7.**	(3)

SECTION (D)

1.	(4)	**2.**	(4)	**3.**	(4)								

SECTION (E)

1.	(3)	**2.**	(1)	**3.**	(3)	**4.**	(1)	**5.**	(2)	**6.**	(2)	**7.**	(1)
8.	(3)	**9.**	(3)										

SECTION (F)

1.	(3)	**2.**	(2)	**3.**	(2)	**4.**	(2)	**5.**	(3)	**6.**	(4)	**7.**	(3)
8.	(1)	**9.**	(1)										

EXERCISE - 2

1.	(1)	**2.**	(2)	**3.**	(4)	**4.**	(3)	**5.**	(4)	**6.**	(3)	**7.**	(3)
8.	(4)	**9.**	(1)	**10.**	(2)	**11.**	(1)	**12.**	(2)	**13.**	(1)	**14.**	(4)
15.	(4)	**16.**	(3)	**17.**	(1)	**18.**	(2)	**19.**	(3)	**20.**	(1)	**21.**	(2)
22.	(1)	**23.**	(2)	**24.**	(3)	**25.**	(4)	**26.**	(3)	**27.**	(2)	**28.**	(3)
29.	(2)	**30.**	(4)	**31.**	(1)	**32.**	(1)	**33.**	(4)	**34.**	(1)	**35.**	(3)
36.	(1)	**37.**	(1)	**38.**	(3)	**39.**	(4)	**40.**	(1)	**41.**	(3)		

EXERCISE - 3

PART-I

1.	(1)	**2.**	(2)	**3.**	(1)	**4.**	(1)	**5.**	(4)	**6.**	(3)	**7.**	(1)
8.	(2)	**9.**	(4)	**10.**	(3)	**11.**	(4)	**12.**	(2)	**13.**	(4)	**14.**	(3)
15.	(1)	**16.**	(3)	**17.**	(3)	**18.**	(3)	**19.**	(3)	**20.**	(3)	**21.**	(3)
22.	(1)	**23.**	(2)	**24.**	(2)	**25.**	(3)	**26.**	(3)	**27.**	(3)	**28.**	(2)
29.	(1)	**30.**	(2)	**31.**	(2)	**32.**	(3)						

PART-II

1.	(1)	**2.**	(3)	**3.**	(3)	**4.**	(1)	**5.**	(2)	**6.**	(2)	**7.**	(2)
8.	(4)	**9.**	(2)	**10.**	(2)	**11.**	(3)	**12.**	(1)	**13.**	(2)	**14.**	(1)
15.	(1)	**16.**	(1)	**17.**	(3)	**18.**	(4)						

PART-III

1.	(1)	**2.**	(1)	**3.**	(1)	**4.**	(1)	**5.**	(1)	**6.**	(4)	**7.**	(3)
8.	(3)	**9.**	(4)	**10.**	(1)	**11.**	(4)	**12.**	(2)	**13.**	(2)	**14.**	(1)
15.	(1)	**16.**	(2)	**17.**	(1)	**18.**	(4)	**19.**	(4)	**20.**	(1)	**21.**	(4)
22.	(3)	**11.**	(4)	**12.**	(3)	**13.**	(2)	**14.**	(3)	**15.**	(2)	**16.**	(2)
17.	(1)												