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

2. The wrong statement regarding transition metals among the following is :
(a) 4s electrons penetrate towards the nucleus more than 3d electrons
(b) Atomic radii of transition metals increase rapidly with increase in atomic number because of poor shielding of nuclear attraction by (n – 1)d electrons
(c) Second and third transition series elements have nearly the same size
(d) Their densities are higher and densities of the 5d series elements are higher than those of 4d series elements.

3. 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?
(a) 1 (b) 2 (c) 3 (d) 4

4. Which of the following group of ions is paramagnetic in nature :
(a) Cu^+, Zn^{2+}, Sc^{3+} (b) Mn^{2+}, Fe^{3+}, Ni^{2+}
(c) Cr^{2+}, Mn^{3+}, Sc^{3+} (d) Cu^{2+}, Ni^{2+}, Ti^{4+}

5. $CuSO_4.5H_2O$ is blue in colour because
(a) It contains water of crystallization.
(b) SO_4^{2-} ions absorb red light.
(c) Cu^{2+} ions absorb red light.
(d) Cu^{2+} ions absorb all colours except red from the white light.

6. $KMnO_4$ is the oxo salt of :
(a) MnO_2 (b) Mn_2O_7 (c) MnO_3 (d) Mn_2O_3

7. The developer used in photography is an alkaline solution of
(a) Hydroquinone (b) Glycerol
(c) Phenol (d) Picric acid

8. CrO_3 dissolves in aqueous NaOH to give :
(a) CrO_4^{2-} (b) $Cr(OH)_3$ (c) $Cr_2O_7^{2-}$ (d) $Cr(OH)_2$

9. The compound that gets oxidised even on exposure to atmosphere is :
(a) $Co_2(SO_4)_3$ (b) $NiSO_4$ (c) $KMnO_4$ (d) $FeSO_4$

10. The f-block of the periodic table contains those elements in which :
(a) Only 4f orbitals are progressively filled in 6th period.
(b) Only 5f orbitals are progressively filled in 7th period.
(c) 4f and 5f orbitals are progressively filled in 6th and 7th periods respectively.
(d) None

11. Atoms of the transition elements are smaller than those of the s-block elements, because :
(a) There is increase in the nuclear charge along the period.
(b) Orbital electrons are added to the penultimate d–subshell rather than to the outer shell of the atom.
(c) The shielding effect of d-electrons is small.
(d) All of these

12. Which of the following transition element shows the highest oxidation state :
(a) Mn (b) Fe (c) V (d) Cr

13. Which one of the transition metal ions is coloured in aqueous solution?
(a) Cu^{+} (b) Zn^{2+} (c) Sc^{3+} (d) V^{4+}

14. Sodium thiosulphate is used in photography because of its :
(a) Oxidising behavior (b) Reducing behavior
(c) Complexing behavior (d) Photochemical behavior

15. Ammonium dichromate is used in some fire works. The green coloured powder blown in the air is
(a) CrO_3 (b) Cr_2O_3 (c) Cr (d) CrO (O_2)

16. The number of moles of $KMnO_4$ that will be needed to react completely with one mole of ferrous oxalate in acidic solution is :
(a) 3/5 (b) 2/5 (c) 4/5 (d) 1

17. Name the gas that can readily decolourise acidified $KMnO_4$ solution:

(a) CO_2 (b) SO_2
(c) NO_2 (d) P_2O_5

18. For decolorization of 1 mole of $KMnO_4$, the moles of H_2O_2 required is :

(a) 1/2 (b) 3/2
(c) 5/2 (d) 7/2

19. Among the following pairs of ions, the lower oxidation state in aqueous solution is more stable than the other, in :

(a) $T\ell^{+}$, $T\ell^{3+}$ (b) Cu^{+} , Cu^{2+}
(c) Cr^{2+} , Cr^{3+} (d) V^{2+}, VO^{2+}

20. $KMnO_4$ 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 :
(a) mol. wt. / 2 (b) mol. wt. / 3
(c) mol. wt. / 4 (d) mol. wt. / 7

21. 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

(a) 2 (b) 4
(c) 5 (d) 3

22. Which of the following ions has the maximum magnetic moment?

(a) Mn^{2+} (b) Fe^{2+}
(c) Ti^{2+} (d) Cr^{2+}.

23. 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 ?

(a) Cr (b) Mn
(c) Fe (d) V

24. The lanthanide contraction is responsible for the fact that

(a) Zr and Y have about the same radius (b) Zr and Nb have similar oxidation state
(c) Zr and Hf have about the same radius (d) Zr and Zn have same oxidation state.

25. Lanthanoid contraction is caused due to :

(a) the appreciable shielding on outer electrons by $4f$ electrons from the nuclear charge

(b) the appreciable shielding on outer electrons by $5f$ electrons from the nuclear charge

(c) the same effective nuclear charge from Ce to Lu

(d) the imperfect shielding on outer electrons by 4f electrons from the nuclear charge

26. In context with the transition elements, which of the following statements is incorrect ?

(a) In the highest oxidation states, the transition metal show basic character and form cationic complexes.

(b) In the highest oxidation states of the first five transition elements (Sc to Mn), all the 4s and 3d electrons are used for bonding.

(c) Once the d^5 configuration is exceeded, the tendency to involve all the 3d electrons in bonding decreases.

(d) In addition to the normal oxidation states, the zero oxidation state is also shown by these elements in complexes.

27. The colour of $KMnO_4$ is due to :

(a) M $\rightarrow$ L charge transfer transition (b) d – d transition

(c) L $\rightarrow$ M charge transfer transition (d) $\sigma - \sigma^*$ transition

28. The element that usually does NOT show variable oxidation states is :

(a) Cu (b) Ti

(c) Sc (d) V

29. Consider the following reactions:

$NaCl + K_2Cr_2O_7 + H_2SO_4 \rightarrow$ (A) + side products
(conc.)

(A) + NaOH $\rightarrow$ (B) + Side products

(B) + H_2SO_4 + $H_2O_2 \rightarrow$ (C) + Side products
(dilute)

The sum of the total number of atoms in one molecule each of (A), (B) and (C) is_____

fuEufyf[kr vfHkfØ;kvksa ij fopkj dhft,%

$NaCl + K_2Cr_2O_7 + H_2SO_4 \rightarrow$ (A) + vfrfjDr mRikn

(a) 18 (b) 32

(c) 36 (d) 12

30. 5 gm of zinc is treated separately with an excess of

(a) dilute hydrochloric acid and

(b) aqueous sodium hydroxide.

The ratio of the volumes of H_2 evolved in these two reactions is:

(a) 1 : 2 (b) 2 : 1

(c) 1 : 4 (d) 1 : 1

1. (c)

General electronic configuration of transition elements is [Noble gas] $(n-1)\,d^{1-10}\,ns^{1-2}$.

2. (b)

(A) The order of penetration of the electrons present in different sub-shells of same energy level is s > p > d > f. (B) The decrease in size is small after mid way. In the begining, the atomic radius decreases with the increase in nuclear charge (as atomic number increases), where as the shielding effect of d-electrons is small. After mid way as the electrons enters the last but one shell, the added d-electron shields the outer most electrons. Hence with the increase in the d-electrons screening effect increases. This counter balances the increased nuclear charge. As a result, the atomic radii remain practically same after chromium.
(C) The filling of 4f before 5d orbital results in a regular decrease in atomic radii called
Lanthanoid contraction which essentially compensates for the expected increase in atomic size with increasing atomic number. The net result of the lanthanoid contraction is that the second and the third d series exhibit similar radii (e.g., Zr 160 pm, Hf 159 pm).
(D) In transition elements, the atomic volumes are large because the increased nuclear charge is poorly screened and so attracts all the electrons more strongly. In addition, the extra electrons added occupy inner orbitals. Consequently the densities of the transition metals are high. The densities of the second row are high and third row values are even higher because of lanthanoid contraction.

3. (c)

$3.87 = \sqrt{n(n+2)}$; n = number of unpaired electrons. So n = 3.

4. (b)

(A) $Cu^{+}[Ar]^{18}\,3d^{10}$, so n = 0 ; $Zn^{2+}\,[Ar]^{18}\,3d^{10}$, so n = 0 ; $Sc^{3+}\,[Ar]^{18}\,3d^{0}$, so n = 0
(B) $Mn^{2+}\,[Ar]^{18}\,3d^{5}$, so n = 5 ; $Fe^{3+}\,[Ar]^{18}\,3d^{5}$, so n = 5 ; $Ni^{2+}\,[Ar]^{18}\,3d^{8}$, so n = 2
(C) $Cr^{2+}\,[Ar]^{18}\,3d^{4}$, so n = 4 ; $Mn^{3+}\,[Ar]^{18}\,3d^{4}$, so n = 4 ; $Sc^{3+}\,[Ar]^{18}\,3d^{0}$, so n = 0
(D) $Cu^{2+}\,[Ar]^{18}\,3d^{9}$, so n = 1 ; $Ni^{2+}\,[Ar]^{18}\,3d^{8}$, so n = 2; $Ti^{4+}\,[Ar]^{18}\,3d^{0}$, so n = 0

5. (c)

Cu^{2+} ion ($3d^{9}$) absorbs red light from the visible region, for the promotion of 3d electrons, the ions reflect blue light and appear blue.

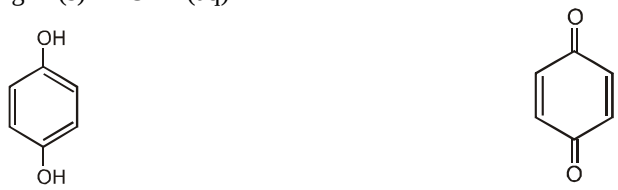
6. (b)

Mn_2O_7 is an acid anhydride of $HMnO_4$ and thus MnO_4^- is oxo-salt of Mn_2O_7.

$n_2O_7 + H_2O \longrightarrow 2HMnO_4$;

$2HMnO_4 + 2KOH \longrightarrow 2KMnO_4 + 2H_2O$.

7. (a)

$2AgBr\,(s) + 2OH^-\,(aq) +$  $\longrightarrow 2Ag\,(s) + 2H_2O + 2Br^-\,(aq) +$

hydroquinone quinone

8. (a)

CrO_3 is an acidic oxide and reacts with NaOH forming salt.

$CrO_3 + 2NaOH \longrightarrow Na_2CrO_4 + H_2O$.

9. (d)

$4FeSO_4 + 2H_2O + O_2 \longrightarrow 4Fe(OH).SO_4$ (basic ferric sulphate)

10. (c)

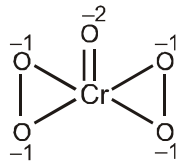
Electronic configuration of f-block element $(n-2)\,f^{1-14}$, $(n-1)d^{10}$, ns^2 f-block starts with 6^{th} period (n = 6).

11. (d)

The atomic radii of the transition metals lie in-between those of s- and p-block elements. In the begining, the atomic radius decreases with the increase in nuclear charge (as atomic number increases), whereas the shielding effect of d-electrons is small and orbital electrons are added to the penultimate d–subshell rather than to the outer shell of the atom.

12. (a)

(I) $[Cr(H_2O)_6]Cl_3$, x + 6(0) = +3 ; so x = +3 (II) CrO_5 ,



; so x = +6

(III) $K_3[CrO_8]^{3-}$ or $[Cr(O_2)_4]^{3-}$, here ligand is peroxo i.e. O_2^{2-} ; x + 4 (–2) = –3 ; so x = +5.

(IV) $(NH_3)_3CrO_4$ or $[Cr(O_2)_2]$, here ligand is peroxo i.e. O_2^{2-} ; x + 2 (–2) = 0 ; so x = +4.

13. (c)

(A) Valence shell electron configuration of V^{3+} is $[Ar]^{18}\ 3d^2$; so n = 2

(B) Valence shell electron configuration of Cr^{3+} is $[Ar]^{18}\ 3d^3$; so n = 3

(C) Valence shell electron configuration of Fe^{3+} is $[Ar]^{18}\ 3d^5$; so n = 5

(D) Valence shell electron configuration of Co^{3+} is $[Ar]^{18}\ 3d^6$; so n = 4

14. (c)

$Ag^+ + 2S_2O_3^{2-} \longrightarrow [Ag(S_2O_3)_2]^{3-}$; soluble complex is formed.

15. (b)

$(NH_4)_2Cr_2O_7 \longrightarrow N_2 + Cr_2O_3 + 4\ H_2O.$

Green coloured powder blown in air is Cr_2O_3

16. (a)

$6KMnO_4 + 10FeC_2O_4 + 24H_2SO_4 \longrightarrow 3K_2SO_4 + 6MnSO_4 + 5Fe_2(SO_4)_3 + 20CO_2 + 24H_2O.$

$\therefore \frac{3}{5}$ mole of $KMnO_4$ for one mole ferrous oxalate.

17. (b) $KMnO_4$ is an oxidising so it can oxidise SO_2 readily.

$KMnO_4 + SO_2 \rightarrow Mn^{2+} + SO_3$

NO_2 is strong oxidizing agent, CO_2 is neither oxidising agent nor reducing agent,

18. (c) H_2O_2 reduces acidified $KMnO_4$ to colourless $MnSO_4$.

$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O_4 + 3H_2O + 5[O]$

$[H_2O_2 + O \longrightarrow H_2O + O_2] \times 5$

$2KMnO_4 + 5H_2O_2 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

Pink colourless

2 mol of $KMnO_4$ oxidise 5 mol of H_2O_2

$\therefore$ 1 mole of $KMnO_4$ will oxidise $\frac{5}{2}$ mole of H_2O_2.

19. (a) As we move down in 13, 14 and 15 groups the interness of s^2 electrons of valence shell increases and therefore, metals in the lower portion of the group show lower oxidation state e.g. lead show + 2 inspite of +4. Similarly + 3 oxidation state of bismuth is more stable than + 5 oxidation state. Thus, due to inert pair effect , titanium shows + 1 oxidation state rather than + 3.

20. (b) $MnO_4^- + 2H_2O + 3e^- \longrightarrow MnO_2 + 4OH^-$

Equivalent mass = $\frac{\text{molecular mass}}{3} = \frac{158}{3} = 52.66.$

21. (d) Magnetic moment $\mu = \sqrt{n(n+2)}$ where n = number of unpaired electrons $\sqrt{15} = \sqrt{n(n+2)}$ n =3

22. (a) Valence shell electron configuration of Mn^{2+} is $3d^5$, therefore, has the maximum number of unpaired electrons equal to 5 and, therefore, has maximum magnetic moment.

(b) Valence shell electron configuration of Fe^{2+} is $3d^6$, therefore, has the maximum number of unpaired electrons equal to 4.
(c) Valence shell electron configuration of Ti^{2+} is $3d^2$, therefore, has the maximum number of unpaired electrons equal to 2.
(d) Valence shell electron configuration of Cr^{2+} is $3d^4$, therefore, has the maximum number of unpaired electrons equal to 4.

23. (a) Cr^+ has stable half filled electronic configuration, $[Ar]^{18}\ 3d^5\ 4s^0$. the removal of one more electron from this stable half filled configuration will require higher energy.

24. (c) The atomic radii of the second and third transition series are almost the same. This phenomenon is associated with the intervention of the 4f orbitals which must be filled before the 5d series of elements begin. The filling of 4f before 5d orbital results in a regular decrease in atomic radii called **Lanthanoid contraction** which essentially compensates for the expected increase in atomic size with increasing atomic number. The net result of the lanthanoid contraction is that the second and the third d series exhibit similar radii (e.g., Zr 160 pm, Hf 159 pm).

25. (d) Lanthanoid contraction is due to ineffective shielding produced by larger f-subshell.

26. (a) The basic character of any element changes with the oxidation state, low oxidation states are more basic and high oxidation state are more acidic. For example, MnO and Mn_2O_3 are basic while Mn_2O_7 is acidic in nature.

27. (c) Colour of $KMnO_4$ is due to charge transfer from O^{2-} (ligand) to Mn(VII) (Central metal ion).

28. (c) Sc shows only +3 oxidation state.

29. (A) = CrO_2Cl_2

(B) = Na_2CrO_4
(C) = CrO_5

30. (d) $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$

$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$
According to stoichiometry in both the reactions, equal number of moles of H_2 are evolved.