

DPP - Daily Practice Problems

Chapter-wise Sheets

Date :

Start Time :

End Time :

CHEMISTRY (CC22)

SYLLABUS : The d- and f-Block Elements

Max. Marks : 180

Marking Scheme : + 4 for correct & (–1) for incorrect

Time : 60 min.

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

- Which one of the elements with the following outer orbital configurations may exhibit the largest number of oxidation states?
(a) $3d^5 4s^1$ (b) $3d^5 4s^2$ (c) $3d^2 4s^2$ (d) $3d^3 4s^2$
- The addition of excess of aqueous HNO_3 to a solution containing $[\text{Cu}(\text{NH}_3)_4]^{2+}$ produces
(a) Cu^+ (b) $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$
(c) $\text{Cu}(\text{OH})_2$ (d) $\text{Cu}(\text{NO}_3)_2$
- The "spin-only" magnetic moment [in units of Bohr magneton, (μ_B)] of Ni^{2+} in aqueous solution would be (At. No. Ni = 28)
(a) 6 (b) 1.73 (c) 2.84 (d) 4.90
- In the form of dichromate, Cr(VI) is a strong oxidising agent in acidic medium but Mo(VI) in MoO_3 and W(VI) in WO_3 are not because _____
 - Cr(VI) is more stable than Mo(VI) and W(VI).
 - Mo(VI) and W(VI) are more stable than Cr(VI).
 - Higher oxidation states of heavier members of group-6 of transition series are more stable.
 - Lower oxidation states of heavier members of group-6 of transition series are more stable.
- Of the following outer electronic configurations of atoms, the highest oxidation state is achieved by which one of them?
 - $(n-1)d^3 ns^2$
 - $(n-1)d^5 ns^1$
 - $(n-1)d^8 ns^2$
 - $(n-1)d^5 ns^2$

RESPONSE GRID

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

Space for Rough Work

6. $(n-1)d^{10}ns^2$ is the general electronic configuration of
 (a) Fe, Co, Ni (b) Cu, Ag, Au
 (c) Zn, Cd, Hg (d) Se, Y, La
7. In the following salts the highest value of magnetic moment is observed in
 (a) $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ (b) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
 (c) $\text{FeSO}_4 \cdot 6\text{H}_2\text{O}$ (d) $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$
8. Which one of the following transition metal ions shows magnetic moment of 5.92 BM?
 (a) Mn^{2+} (b) Ti^{3+} (c) Cr^{3+} (d) Cu^{2+}
9. Which of the following statements is incorrect?
 (a) Zn, Cd and Hg due to presence of completely filled d -orbitals $[(n-1)d^{10}ns^2]$ are not studied along with other transition metals.
 (b) Zn, Cd and Hg have low m.p and are comparatively softer than other transition metals.
 (c) Metallic bond made by elements with d^5 configuration is stronger as compared to metallic bond made by elements with d^3 configuration.
 (d) Metals of $5d$ series forms strong metallic bonds as compared with metals of $3d$ series.
10. Super conductors are derived from compounds of
 (a) p-Block elements (b) lanthanides
 (c) actinides (d) transition elements
11. Which of the following compounds has colour but no unpaired electrons?
 (a) KMnO_4 (b) K_2MnO_4
 (c) MnSO_4 (d) MnCl_2
12. What is the percentage of lanthanoid metal in mischmetal?
 (a) 90% (b) 20% (c) 5% (d) 95%
13. Which of the following in its oxidation state shows the paramagnetism?
 (a) Tb(IV) (b) Lu(III) (c) Ce(IV) (d) La(III)
14. In neutral or faintly alkaline medium, thiosulphate is quantitatively oxidized by KMnO_4 to
 (a) SO_3^{2-} (b) SO_4^{2-} (c) SO_2 (d) SO_5^{2-}
15. Wrought iron, pig iron and steel differ in properties due to
 (a) carbon content (b) malleability
 (c) conductivity (d) softness
16. The lanthanide contraction is responsible for the fact that
 (a) Zr and Zn have the same oxidation state
 (b) Zr and Hf have about the same radius
 (c) Zr and Nb have similar oxidation state
 (d) Zr and Y have about the same radius
17. KMnO_4 can be prepared from K_2MnO_4 as per the reaction:

$$3\text{MnO}_4^{2-} + 2\text{H}_2\text{O} \rightleftharpoons 2\text{MnO}_4^{2-} + \text{MnO}_2 + 4\text{OH}^-$$

 The reaction can go to completion by removing OH^- ions by adding.
 (a) KOH (b) CO_2 (c) SO_2 (d) HCl
18. On the basis of data given below,
 $E_{\text{Sc}^{3+}/\text{Sc}^{2+}}^\circ = -0.37 \text{ V}$, $E_{\text{Mn}^{3+}/\text{Mn}^{2+}}^\circ = +1.57 \text{ V}$
 $E_{\text{Cr}^{2+}/\text{Cr}}^\circ = -0.90 \text{ V}$, $E_{\text{Cu}^{2+}/\text{Cu}}^\circ = 0.34 \text{ V}$
 Which of the following statements is incorrect?
 (a) Sc^{3+} has good stability due to $[\text{Ar}]3d^04s^0$ configuration.
 (b) Mn^{3+} is more stable than Mn^{2+} .
 (c) Cr^{2+} is reducing in nature.
 (d) Copper does not give H_2 on reaction with dil. H_2SO_4
19. Green vitriol is
 (a) $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ (b) $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$
 (c) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (d) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
20. Number of moles of $\text{K}_2\text{Cr}_2\text{O}_7$ reduced by one mole of Sn^{2+} ions is
 (a) $\frac{1}{3}$ (b) 3 (c) $\frac{1}{6}$ (d) 6

**RESPONSE
GRID**

- | | | | | |
|------------------|------------------|------------------|------------------|------------------|
| 6. (a)(b)(c)(d) | 7. (a)(b)(c)(d) | 8. (a)(b)(c)(d) | 9. (a)(b)(c)(d) | 10. (a)(b)(c)(d) |
| 11. (a)(b)(c)(d) | 12. (a)(b)(c)(d) | 13. (a)(b)(c)(d) | 14. (a)(b)(c)(d) | 15. (a)(b)(c)(d) |
| 16. (a)(b)(c)(d) | 17. (a)(b)(c)(d) | 18. (a)(b)(c)(d) | 19. (a)(b)(c)(d) | 20. (a)(b)(c)(d) |

Space for Rough Work

21. Four successive members of the first series of the transition metals are listed below. For which one of them the standard potential $(E_{M^{2+}/M}^\circ)$ value has a positive sign?
- (a) Co (Z=27) (b) Ni (Z=28)
(c) Cu (Z=29) (d) Fe (Z=26)
22. Which of the following factors may be regarded as the main cause of lanthanoid contraction?
- (a) Greater shielding of 5d electrons by 4f electrons
(b) Poorer shielding of 5d electrons by 4f electrons.
(c) Effective shielding of one of 4f electrons by another in the subshell
(d) Poor shielding of one of 4f electron by another in the subshell
23. AgCl is soluble in NH_4OH solution. The solubility is due to the formation of
- (a) AgOH (b) Ag_2O
(c) $[\text{Ag}(\text{NH}_3)_2]^+$ (d) NH_4Cl
24. Oxidation states of the metal in the minerals haematite and magnetite, respectively, are
- (a) II, III in haematite and III in magnetite
(b) II, III in haematite and II in magnetite
(c) II in haematite and II, III in magnetite
(d) III in haematite and II, III in magnetite
25. In acidic medium KMnO_4 oxidises FeSO_4 solution. Which of the following statements is correct?
- (a) 10 mL of 1N KMnO_4 solution oxidises 10 mL of 5N FeSO_4 solution
(b) 10 mL of 1M KMnO_4 solution oxidises 10 mL of 5N FeSO_4 solution
(c) 10 mL of 1M KMnO_4 solution oxidises 10 mL of 1M FeSO_4 solution
(d) 10 mL of 1N KMnO_4 solution oxidises 10 mL of 0.1M FeSO_4 solution
26. In which of the following lanthanides oxidation state +2 is most stable?
- (a) Ce (b) Eu (c) Tb (d) Dy
27. Acidified solution of chromic acid on treatment with H_2O_2 gives blue colour which is due to
- (a) $\text{CrO}_3 + \text{H}_2\text{O} + \text{O}_2$ (b) $\text{CrO}_5 + \text{H}_2\text{O}$
(c) $\text{H}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O} + \text{O}_2$ (d) None of these
28. Which of the following is used in the preparation of chlorine?
- (a) Only MnO_2
(b) Only KMnO_4
(c) Both MnO_2 and KMnO_4
(d) Either MnO_2 or KMnO_4
29. An explosion takes place when conc. H_2SO_4 is added to KMnO_4 . Which of the following is formed?
- (a) Mn_2O_7 (b) MnO_2
(c) MnSO_4 (d) M_2O_3
30. Which of the following statements are correct?
- (i) Chromium has the highest melting point among the series I metals.
(ii) Number of unpaired electrons is greater in Cr than other elements of series I.
(iii) In any row the melting point of transition metal increases as the atomic number increases.
- (a) (i) and (iii) (b) (i) and (ii)
(c) (ii) and (iii) (d) (i), (ii) and (iii)
31. In the laboratory, manganese (II) salt is oxidised to permanganate ion in aqueous solution by
- (a) hydrogen peroxide (b) conc. nitric acid
(c) peroxodisulphate (d) dichromate

RESPONSE
GRID

21. (a) (b) (c) (d) 22. (a) (b) (c) (d) 23. (a) (b) (c) (d) 24. (a) (b) (c) (d) 25. (a) (b) (c) (d)
26. (a) (b) (c) (d) 27. (a) (b) (c) (d) 28. (a) (b) (c) (d) 29. (a) (b) (c) (d) 30. (a) (b) (c) (d)
31. (a) (b) (c) (d)

Space for Rough Work

32. Which of the following statements about the interstitial compounds is incorrect?
 (a) They are chemically reactive.
 (b) They are much harder than the pure metal.
 (c) They have higher melting points than the pure metal.
 (d) They retain metallic conductivity.
33. Which of the following elements shows maximum number of different oxidation states in its compounds?
 (a) Eu (b) La (c) Gd (d) Am
34. Identify the product and its colour when MnO_2 is fused with solid KOH in the presence of O_2 .
 (a) KMnO_4 , purple (b) K_2MnO_4 , dark green
 (c) MnO , colourless (d) Mn_2O_3 , brown
35. In the extraction of silver from argentite ore. The ore is treated with dil. solution of NaCN in water in the presence of Y, whereby the following reaction takes place:
 $\text{Ag}_2\text{X} + 4\text{NaCN} + 2\text{Y} \rightarrow 2\text{Na}[\text{Ag}(\text{CN})_2] + \text{Na}_2\text{XO}_4 \cdot \text{X}$ and Y in this reaction are respectively:
 (a) Sb and S (b) S and O_2
 (c) O and O_2 (d) O and S
36. Which of the following compound is called Turnbull's blue?
 (a) Ferricyanide (b) Ferrous ferricyanide
 (c) Ferrous cyanide (d) Ferri-ferricyanide
37. Which of the following element is responsible for oxidation of water to O_2 in biological process?
 (a) Fe (b) Mn (c) Cu (d) Mo
38. Consider the following statements
 (i) $\text{La}(\text{OH})_3$ is the least basic among hydroxides of lanthanides.
 (ii) Zr^{4+} and Hf^{4+} possess almost the same ionic radii.
 (iii) Ce^{4+} can act as an oxidizing agent.
 Which of the above is/are true?
 (a) (i) and (iii) (b) (ii) and (iii)
 (c) (ii) only (d) (i) and (ii)
39. For making Ag from AgNO_3 , which of the following is used
 (a) PH_3 (b) phosphonium iodide
 (c) Na_2CO_3 (d) NH_3
40. Which of the following conversions can be carried out by both acidified $\text{K}_2\text{Cr}_2\text{O}_4$ and acidified KMnO_4 ?
 (i) $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$
 (ii) $\text{I}^- \rightarrow \text{IO}_3^-$
 (iii) $\text{I}^- \rightarrow \text{I}_2$ (iv) $\text{H}_2\text{S} \rightarrow \text{S}$
 (a) (i) and (iii) (b) (ii) and (iv)
 (c) (i), (iii) and (iv) (d) (i), (ii) and (iii)
41. The catalytic activity of transition metals and their compounds is mainly due to:
 (a) their magnetic behaviour
 (b) their unfilled d -orbitals
 (c) their ability to adopt variable oxidation state
 (d) their chemical reactivity
42. Match the columns
- | Column-I | Column-II |
|---|---------------|
| A. Metal of the $3d$ -series which does not form MO type oxide. | I. Manganese |
| B. Metal of the $3d$ -series which forms most covalent oxide. | II. Vanadium |
| C. Metal of the $3d$ -series which forms the amphoteric oxide. | III. Scandium |
- (a) A – I; B – III; C – II (b) A – III; B – I; C – II
 (c) A – III; B – II; C – I (d) A – II; B – I; C – III
43. The basic character of the transition metal monoxides follows the order
 (Atomic Nos., Ti = 22, V = 23, Cr = 24, Fe = 26)
 (a) $\text{TiO} > \text{VO} > \text{CrO} > \text{FeO}$ (b) $\text{VO} > \text{CrO} > \text{TiO} > \text{FeO}$
 (c) $\text{CrO} > \text{VO} > \text{FeO} > \text{TiO}$ (d) $\text{TiO} > \text{FeO} > \text{VO} > \text{CrO}$
44. Excited state configuration of Mn^{2+} is
 (a) $1s^2 2s^2 2p^6 3s^2 3p^4$ (b) $1s^2 2s^2 2p^6 3s^2 3p^5$ (c) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ (d) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
45. What would happen when a solution of potassium chromate is treated with an excess of dilute nitric acid?
 (a) $\text{Cr}_2\text{O}_7^{2-}$ and H_2O are formed
 (b) CrO_4^{2-} is reduced to +3 state of Cr
 (c) CrO_4^{2-} is oxidized to +7 state of Cr
 (d) Cr^{3+} and $\text{Cr}_2\text{O}_7^{2-}$ are formed

RESPONSE
GRID

32. (a) (b) (c) (d) 33. (a) (b) (c) (d) 34. (a) (b) (c) (d) 35. (a) (b) (c) (d) 36. (a) (b) (c) (d)
 37. (a) (b) (c) (d) 38. (a) (b) (c) (d) 39. (a) (b) (c) (d) 40. (a) (b) (c) (d) 41. (a) (b) (c) (d)
 42. (a) (b) (c) (d) 43. (a) (b) (c) (d) 44. (a) (b) (c) (d) 45. (a) (b) (c) (d)

Space for Rough Work

DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS

DPP/CC22

1. (b) $Mn - 3d^5 4s^2$

1	1	1	1	1
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The no. of various oxidation states possible are +2, +3, +4, +5, +6 and +7.
2. (b)
3. (c) The number of unpaired electrons in $Ni^{2+}(aq) = 2$
Water is weak ligand hence no pairing will take place
spin magnetic moment
 $= \sqrt{n(n+2)} = \sqrt{2(2+2)} = \sqrt{8} = 2.82$
4. (b)
5. (d) $(n-1)d^5 ns^2$ attains the maximum O.S. of +7.
6. (c)
7. (a) $Mn^{2+} = 3d^5$ i.e. no. of unpaired $e^- = 5$
 $Cu^{2+} = 3d^9$ i.e. no. of unpaired $e^- = 1$
 $Fe^{2+} = 3d^6$ i.e. no. of unpaired $e^- = 4$
 $Zn^{2+} = 3d^{10}$ i.e. no. of unpaired $e^- = 0$
 $Ni^{2+} = 3d^8$ i.e. no. of unpaired $e^- = 3$
Higher the number of unpaired electrons higher will be the magnetic moment. Hence Mn^{2+} having maximum unpaired electrons will have the maximum magnetic moment.
8. (a) Given magnetic moment of transition metal
 $= \sqrt{n(n+2)} = 5.92$
i.e., $n = 5$
Number of unpaired electrons in $Mn^{2+} = 5$
Number of unpaired electrons in $Ti^{3+} = 1$
Number of unpaired electrons in $Cr^{3+} = 3$
Number of unpaired electrons in $Cu^{2+} = 1$
Number of unpaired electrons in $Co^{2+} = 3$
Thus Mn^{2+} have magnetic moment = 5.92 BM
9. (a) Zn, Cd and Hg due to presence of completely filled d -orbitals in ground state as well as in their common oxidation states are not regarded as transition metals but they are studied along with the transition metals.
10. (d) Super conductors are derived from compounds of transition metals.
11. (a) Electronic configuration of Mn is $[Ar]3d^5 4s^2$. Being transition metal it has 7 valence electrons and all are involved in bond formation in MnO_4^- . Hence it has no unpaired electron
12. (d) Mischmetal consists of a lanthanoid metal (~95%) and iron (~5%) and traces of S, C, Ca and Al.
13. (a) $Tb^{4+} = 4f^7$ — 3 unpaired e^-
 $Lu^{3+} = 4f^{14}$ — 0 unpaired e^-
 $Ce^{4+} = 4f^0$ — 0 unpaired e^-
 $La^{3+} = 4f^0$ — 0 unpaired e^-
14. (b) In neutral or faintly alkaline medium thiosulphate is quantitatively oxidized by $KMnO_4$ to SO_4^{2-}
 $8KMnO_4 + 3Na_2S_2O_3 + H_2O \longrightarrow 3K_2SO_4 + 8MnO_2 + 3Na_2SO_4 + 2KOH$
15. (a) They contain different percentage of carbon.
16. (b) In vertical columns of transition elements, there is an increase in size from first member to second member as expected but from second member to third member, there is very small change in size and some times sizes are same. This is due to lanthanide contraction. This is the reason for Zr and Hf to have same radius.
17. (b) HCl and SO_2 are reducing agents and can reduce MnO_4^- . CO_2 which is neither oxidising nor reducing will provide only acidic medium. It can shift reaction in forward direction and reaction can go to completion.
18. (b) $Mn^{2+} (d^5)$ is more stable than $Mn^{3+} (d^4)$, thus
 $E_{Mn^{3+}/Mn^{2+}}^{\circ} = +ve$
19. (a) Green vitriol is $FeSO_4 \cdot 7H_2O$.
20. (a) $Cr_2O_7^{2-} + 6e^- + 14H^+ \rightarrow 2Cr^{3+} + 7H_2O$
 $Sn^{2+} \rightarrow Sn^{4+} + 2e^-$
one mole of Sn^{2+} provide 2 mole of e^- which will reduce $1/3 Cr_2O_7^{2-}$.
21. (c) $E_{Cu^{2+}/Cu}^{\circ} = 0.34 V$
other has -ve $E_{R.P.}^{\circ}$
 $E_{Co^{2+}/Co}^{\circ} = -0.28 V$
 $E_{Ni^{2+}/Ni}^{\circ} = -0.25 V$
 $E_{Fe^{2+}/Fe}^{\circ} = -0.44 V$
22. (b) In lanthanides, there is poorer shielding of $5d$ electrons by $4f$ electrons resulting in greater attraction of the nucleus over $5d$ electrons and contraction of the atomic radii.
23. (c) $AgCl(s) + 2NH_4OH(aq) \rightarrow [Ag(NH_3)_2]Cl(aq) + 2H_2O(l)$
24. (d) (i) Haematite is Fe_2O_3 in which Fe is present in III oxidation state.
(ii) Magnetite (Fe_3O_4) is an equimolar mixture of FeO and Fe_2O_3 .
Oxidation state of Fe in FeO is II.
Oxidation state of Fe in Fe_2O_3 is III.

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25. (b) $1 \text{ M KMnO}_4 \equiv 5 \text{ N KMnO}_4 \equiv 5 \text{ N FeSO}_4$
 $\therefore 10 \times 1 \text{ M} \equiv 10 \times 5 \text{ N} \equiv 10 \times 5 \text{ N}$
 $\text{KMnO}_4 \quad \text{KMnO}_4 \quad \text{FeSO}_4$
26. (b) Eu^{2+} has electronic configuration $[\text{Xe}]4f^7$ hence stable due to half filled atomic orbitals.
27. (b) $\text{H}_2\text{Cr}_2\text{O}_7 + 4\text{O} \rightarrow 2\text{CrO}_5 + \text{H}_2\text{O}$
Blue peroxide
of chromium
28. (c) Both MnO_2 and KMnO_4 used for the preparation of chlorine by the action of conc. HCl
 $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$
 $2\text{KMnO}_4 + 16\text{HCl} \rightarrow 2\text{KCl} + 2\text{MnCl}_2 + 8\text{H}_2\text{O} + 5\text{Cl}_2$
 Chlorine is not obtained by dil HCl
29. (a) $2\text{KMnO}_4 + \text{H}_2\text{SO}_4 (\text{conc.}) \rightarrow$
 $\text{K}_2\text{SO}_4 + \text{Mn}_2\text{O}_7 + \text{H}_2\text{O}$
Explosive
30. (b) In any row the melting points of transition metals rise to a maximum at d^5 except for anomalous values of Mn and Tc and falls regularly as the atomic number increases.
31. (c) In laboratory, manganese (II) ion salt is oxidised to permanganate ion in aqueous solution by peroxodisulphate.
 $2\text{Mn}^{2+} + \text{S}_2\text{O}_8^{2-} + 8\text{H}_2\text{O} \rightarrow$
peroxodisulphate ion $2\text{MnO}_4^- + 10\text{SO}_4^{2-} + 16\text{H}^+$
32. (a) In interstitial compounds small atoms like H, B and C enter into the void sites between the packed atoms of crystalline metal. They retain metallic conductivity and are chemically inert.
33. (d)
- | Eu | La | Gd | Am |
|---------------|----|----|------------|
| O.S. = +2, +3 | +3 | +3 | +4, +5, +6 |
34. (b) $2\text{MnO}_2 + 4\text{KOH} + \text{O}_2 \xrightarrow{\text{dark green}} 2\text{K}_2\text{MnO}_4 + 2\text{H}_2\text{O}$
35. (b) $\text{Ag}_2\text{S} + 4\text{NaCN} + 2\text{O}_2 \longrightarrow$
 $2\text{Na}[\text{Ag}(\text{CN})_2] + \text{Na}_2\text{SO}_4$
36. (b) Ferrous ferricyanide is known as Turnbull's blue.
37. (b) Oxidation of water takes place in presence of Mn in biological process.
38. (b) As a result of lanthanide contraction Zr^{4+} and Hf^{4+} possess almost the same ionic radii. Ce^{4+} is an oxidising agent. Ce^{4+} gains electron to acquire more stable Ce^{3+} state. $\text{La}(\text{OH})_3$ is the most basic among lanthanide hydroxides.
39. (a) When AgNO_3 reacts with PH_3 , then Ag is obtained.
 $6\text{AgNO}_3 + 2\text{PH}_3 \longrightarrow$
silver nitrate phosphene
 $6\text{Ag} + 2\text{H}_3\text{PO}_3 + 6\text{NO}_2$
phosphorous acid
40. (c) I^- is converted to IO_3^- by neutral or faintly alkaline MnO_4^- as shown below.
 $2\text{MnO}_4^- + \text{H}_2\text{O} + \text{I}^- \longrightarrow 2\text{MnO}_2 + 2\text{OH}^- + \text{IO}_3^-$
41. (c) The transition metals and their compounds are used as catalysts. Because of the variable oxidation states they may form intermediate compound with one of the reactants. These intermediate provides a new path with low activation energy. $\text{V}_2\text{O}_5 + \text{SO}_2 \rightarrow \text{V}_2\text{O}_4 + \text{SO}_3$
 $2\text{V}_2\text{O}_4 + \text{O}_2 \rightarrow 2\text{V}_2\text{O}_5$
42. (b)
43. (a) The basic character of the transition metal monoxide is $\text{TiO} > \text{VO} > \text{CrO} > \text{FeO}$ because basic character of oxides decrease with increase in atomic number. Oxides of transitional metals in low oxidation state i.e., +2 and +3 are generally basic except Cr_2O_3 .
44. (b) After crystal field splitting, the five d-orbitals get separated as three t_{2g} and two orbitals. For Mn^{2+} , last shell has 5 e^- i.e., $3d^5 4s^0$. So according to Hund's rule of maximum multiplicity the excited state configuration will be $t_{2g}^3 e_g^2$.
45. (a) $2\text{K}_2\text{CrO}_4 + 2\text{HNO}_3 \rightarrow \text{K}_2\text{Cr}_2\text{O}_7 + 2\text{KNO}_3 + \text{H}_2\text{O}$
 $\Rightarrow 2\text{CrO}_4^{2-} \xrightleftharpoons{\text{H}^+} \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$