ULTIMATE KCET CRASHCOURSE 2026

CHEMISTRY

DPP: 1

D & F BLOCK ELEMENTS

Q1 In which of the following cases, the stability of two oxidation states is correctly represented ?

(A) $Ti^{3+} > Ti^{4+}$ (B) $Mn^{2+} > Mn^{3+}$

(C) $Fe^{2+} > Fe^{3+}$ (D) $Cu^{2+} > Cu^{+}$

Q2 In the transition elements, the incoming electron occupy (n – 1) d-orbital in preference to

(A) (n – 1) s-orbital

(B) (n – 1) p-orbital

(C) np-orbital

(D) ns-orbital.

Q3 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

(A) 3, 5, 4 and 1 (B) 4, 3, 1 and 5

(C) 1, 3, 4 and 5 (D) 5, 4, 3 and 1

Q4 Consider the following statements about transition 8. metals.

I. They are very much hard and have low volatility.

II. Their melting and boiling points are high.

The correct statement(s) is/are

(A) only I (B) only II

(C) both I and II (D) none of these.

Q5 Which of the following statements concerning lanthanide elements is false ?

(A) All lanthanides are silvery white soft metals and tarnish rapidly in air.

(B) More characteristic oxidation state of lanthanide elements is +3.

(C) Yb^{2+} which has f^{14} configuration is 2+ a reductant.

(D) Ionic radii of trivalent lanthanides steadily increases with increase in the atomic number.

Q6 Which of the following catalysts is not correctly matched with the reaction ?

(A) Vanadium (V) oxide in Contact process for oxidation of SO_2 to SO_3.

(B) Finely divided iron in Haber's process in conversion of N_2 and H_2 to NH_3.

(C) Iron (II) catalyses the reaction between iodide and persulphate ions.

(D) Ni in presence of hydrogen for conversion of vegetable oil to ghee.

Q7 If Hund's rule is not followed magnetic moment of Fc^{2+}, Mn^{+} and Cr all having 24 electrons will be in the order

(A) $Mn^{+} = Cr = Fe^{2+}$

(B) $Mn^{+} < Cr > Fe^{2+}$

(C) $Mn^{+} > Cr > Fe^{2+}$

(D) $Fe^{2+} > Cr > Mn^{+}$

Q8 Which of the following statements is not correct ?

(A) $La(OH)_3$ is less basic than $Lu(OH)_3$

(B) In lanthanoid series, ionic radius of Ln^{3+} ions decreases

(C) La is actually an element of transition series rather than lanthanoid series

(D) Atomic radii of Zr and Hf are same because of lanthanoid contraction

Q9 Which of the following is arranged in order of increasing oxidising power?

(A) $Cr_2O_7^{2-} < MnO_4^{-} < VO_2^{+}$

(B) $VO_2^{+} < Cr_2O_7^{2-} < MnO_4^{-}$

(C) $MnO_4^{-} < Cr_2O_7^{2-} < VO_2^{+}$

(D) $VO_2^{+} < MnO_4^{-} < Cr_2O_7^{2-}$

Q10 Following order is observed in oxidising power of certain ions :

$VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$

The reason for this increasing order of oxidising power is

(A) increasing stability of the lower species to which they are reduced

(B) increasing stability of the higher species to which they are oxidised

(C) increasing stability of the higher species to which they are reduced

(D) increasing stability of the lower species to which they are oxidised.

Q11 The pair of which salts is expected to have same colour in their freshly prepared aqueous solutions ?

(A) $VOCl_2$, $CuCl_2$ (B) $CuCl_2$, $FeCl_2$

(C) $FeCl_2$, $VOCl_2$ (D) $MnCl_2$, $FeCl_2$

Q12 What would happen when a solution of potassium chromate is treated with an excess of dilute nitric acid?

(A) Cr^{3+} and $Cr_2O_7^{2-}$ are formed .

(B) $Cr_2O_7^{2-}$ and H_2O are formed,

(C) $Cr_2O_4^{2-}$ is reduced to $+3$ state of Cr.

(D) $Cr_2O_4^{2-}$ is oxidised to $+7$ state of Cr.

Q13 Which of the following atomic numbers are the atomic numbers of the inner transition elements?

(A) Atomic number 29

(B) Atomic number 59

(C) Atomic number 74

(D) Atomic number 95

(E) Atomic number 102

(A) (C), (D) and (E)

(B) (A), (C) and (D)

(C) (B), (D) and (E)

(D) (A), (D) and (E)

Q14 Complete the following reactions.

(i)

$MnO_4^- + 2H_2O + 3e^- \rightarrow \ldots\ldots\ldots + 40H^-$

(ii)

$MnO_4^- + 8H^+ + 5e^- \rightarrow \ldots\ldots\ldots + 4H_2O$

(iii) $MnO_4^- + e^- \rightarrow \ldots\ldots\ldots$

(A) $MnO_2, Mn^{2+}, MnO_4^{2-}$

(B) $Mn^{2+}, MnO_2, MnO_4^{2-}$

(C) $MnO_4^{2-}, Mn^{2+}, MnO_2$

(D) $MnO_2, MnO_4^{2-}, Mn^{2+}$

Q15 The element present immediately below Zn in the periodic table in the same column, has atomic number equal to

(A) 48 (B) 40

(C) 50 (D) 30

Q16 The numbers of unpaired electrons in gaseous species of Mn^{3+}, Cr^{3+} and V^{3+} respectively are ..... and the most stable species is .....

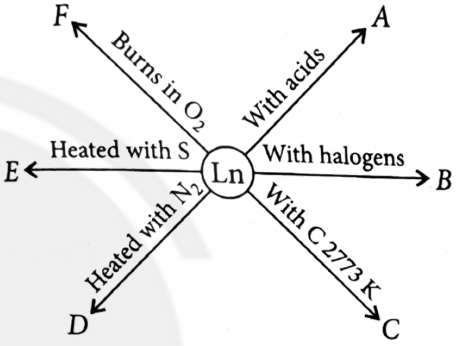
(A) 4, 3 and 2; V^{3+}

(B) 3, 3 and 2; Cr^{3+}

(C) 4, 3 and 2; Cr^{3+}

(D) 3, 3 and 3; Mn^{3+}

Q17



Here, A, B, C, D, E and F refer to

(A) $A - LnO_3$; $B - LnS_3$; $C - LnC_2$; $D - LnX_3$; $- E - I$

(B) $A - LnO_3$; $B - LnX_3$; $C - LnC_2$; $D - LnS_3$; $-E - H_2$; F

(C) $A - H_2$; $B - LnX_3$; $C - LnC_2$; $D - LnN$; $E - Ln_2S_3$; $F - I$

(D) $A - H_2$; $B - LnX_3$; $C - Ln_2C_3$; $D - LnN$; $E - LnS_2$; $F - L$

Q18 Manganate ion (1 mole) in neutral aqueous medium disproportionates to

(A) 2/3 mole of MnO_4^- and 1/3 mole of MnO_2

(B) 1/3 mole of MnO_4^- and 2/3 mole of MnO_2

(C) 2/3 mole of Mn_2O_7 and 2/3 mole of MnO_2

(D) 1/3 mole of Mn_2O_7 and 1/3 mole of MnO_2

Q19 When an electron from a lower energy d-orbital is excited to a higher energy d-orbital

I. the energy of excitation corresponds to the frequency of light absorbed

II. this frequency generally lies in the visible region

III. the colour observed corresponds to the complementary colour of the light absorbed

IV. the frequency of the light absorbed is determined by the nature of the ligand.

Choose the appropriate option for the above mentioned statements which are correct.

(A) I, II and IV

(B) I, II and III

(C) I, II, III and IV

(D) II and IV

Q20 Cu^+ ion is not stable in aqueous solution because

(A) second ionisation enthalpy of copper is less than the first ionisation enthalpy

(B) large value of second ionisation enthalpy of copper is compensated by much more negative hydration energy of $Cu^{2+}_{(aq)}$

(C) hydration energy of $Cu^{+}_{(aq)}$ is much more negative than that of $Cu^{2+}_{(aq)}$

(D) many copper (I) compounds are unstable in aqueous solution and undergo disproportion- ation reaction.

Q21 The atomic number of potassium is 19 and that of manganese is 25. Although the colour of MnO_4^- is dark violet, yet the K^+ is colourless. This is due to the fact that

(A) Mn is a transition element; while K^+ is not

(B) $[MnO_4]^-$ is negatively charged; while K^+ has a positive charge

(C) the effective atomic number of Mn in $[MnO_4]^-$ is 26; while for K^+ the effective atomic number is 18;

(D) the Mn in a high positive oxidation state allows charge transfer transitions.

Q22 Which of the following statements are correct when a mixture of NaCl and $K_2Cr_2O_7$ is gently warmed with conc. H_2SO_4 ?

I. A deep red vapour is evolved.

II. The vapour when passed into NaOH solution gives a yellow solution of Na_2CrO_4.

III. Chlorine gas is evolved.

IV. Chromyl chloride is formed.

Choose the correct option.

(A) I and II only

(B) I, II and III only

(C) I, II and IV only

(D) III and IV only

Q23 A violet compound of manganese (P) decomposes on heating to liberate oxygen and compounds (Q) and (R) of manganese are formed. Compound (R) reacts with KOH in the presence of air or potassium nitrate to give compound (Q). On heating compound (R) with conc. H_2SO_4 and NaCl, chlorine gas is liberated and a compound (S) of manganese along with other products is formed. Compounds P to S are respectively

(A) P Q R S $KMnO_4$ K_2MnO_4 $MnCl_2$ MnO_2

(B) K_2MnO_4 MnO_2 $KMnO_4$ $MnCl_2$

(C) $KMnO_4$ K_2MnO_4 MnO_2 $MnCl_2$

(D) K_2MnO_4 $KMnO_4$ MnO_2 $MnCl_2$

Q24 Most transition metals

I. form sets of compounds which display different oxidation states of the metal

II. form coloured ions in solution

III. burn vigorously in oxygen

IV. replace H_2 from dilute acids of these.

(A) I, II, III are correct.

(B) II, III, IV are correct.

(C) I, II are correct.

(D) All are correct

Q25 When a chromite ore (A) is fused with sodium carbonate in free excess of air and the product is dissolved in water, a yellow solution of compound (B) is obtained. After treatment of this yellow solution with sulphuric acid, compound (C) can be crystallised from the solution. When compound C is treated with KCl, orange crystals of compound (D) crystallise out. Identify A, B and D.

(A) A B D $FeO.Cr_2O_3$ $K_2Cr_2O_7$ Na_2CrO_4

(B) $FeO.Cr_2O_3$ Na_2CrO_4 $K_2Cr_2O_7$

(C) $Na_2Cr_2O_7$ Na_2CrO_4 $K_2Cr_2O_7$

(D) $FeO.Cr_2O_3$ $Na_2Cr_2O_7$ $K_2Cr_2O_7$

Q26 An inorganic compound on strong heating gave a blackish brown powder and two oxides of sulphur. The powder was dissolved in HCl and a yellow solution was obtained which gave a blood red coloured solution with thiocyanate ions. The inorganic compound may be

(A) $CuSO_4$ (B) $ZnSO_4$

(C) $NiSO_4$ (D) $FeSO_4$

Q27 Consider the following statements :

I. $La(OH)_3$ is 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 oxidising agent.

Which of the above is/are true ?

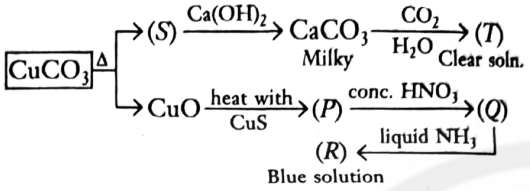
(A) I and III only

(B) II and III only

(C) II only

(D) I and II only

Q28



Identify P, R, S and T.

(A) P R S T Cu CO_2 $Ca(HCO_3)_2$ $[Cu(NO_3)_4]^{2+}$

(B) Cu_2S Cu Cu_2O $Ca(HCO_3)_2$

(C) Cu $[Cu(NH_3)_4]^{2+}$ CO_2 $Ca(HCO_3)_2$

(D) CO_2 $[Cu(NH_3)_4]^{2+}$ Cu_2O $Ca(HCO_3)_2$

Q29 In context with the transition elements, which of the following statements is incorrect?

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

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

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

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

Q30 A solution of $KMnO_4$ is reduced to various products depending upon its pH. At pH < 7 it is reduced to a colourless solution (A), at pH = 7 it forms a brown precipitate (B) and at pH > 7 it gives a green solution (C). (A), (B) and (C) are

(A) (A) (B) (C) Mn^{2+} MnO_2 MnO_4^{2-}

(B) MnO_2 Mn^{2+} MnO_4^{2-}

(C) Mn^{2+} MnO_4^{2-} MnO_2

(D) MnO_4^{2-} Mn^{2+} MnO_2

Q31 When an oxide of manganese (P) is fused with KOH in the presence of an oxidising agent and dissolved in water, it gives a dark green solution of compound (Q). Compound (Q) disproportionates in neutral or acidic solution to give purple compound (R). An alkaline solution of compound (R) oxidises potassium iodide solution to a compound (S) and compound (P) is also formed. Compounds P to S are

(A) P Q R S MnO_4^- KIO_3 MnO_2 K_2MnO_4

(B) MnO_2 K_2MnO_4 MnO_4^- KIO_3

(C) MnO_2 MnO_4^- K_2MnO_4 KIO_3

(D) K_2MnO_2 MnO_2 MnO_4^- KIO_3

Answer Key

Q1	B
Q2	C
Q3	A
Q4	C
Q5	D
Q6	C
Q7	A
Q8	A
Q9	B
Q10	A
Q11	A
Q12	B
Q13	C
Q14	A
Q15	A
Q16	C
Q17	C
Q18	A
Q19	C
Q20	B
Q21	D
Q22	C
Q23	C
Q24	C
Q25	B
Q26	D
Q27	B
Q28	C
Q29	B
Q30	A
Q31	B

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

Mn^{2+} ($3d^5$) is more stable than Mn^{3+} ($3d^4$) .

Video Solution:

Q2 Text Solution:

The order in which the energies of the orbitals increase and order in which the orbitals are filled is as follows:

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, 7p.

Video Solution:

Q3 Text Solution:

$$Mn^{7+} + 3e^- \rightarrow Mn^{4+}$$
$$Mn^{7+} + 5e^- \rightarrow Mn^{2+}$$
$$Mn^{7+} + 4e^- \rightarrow Mn^{3+}$$
$$Mn^{7+} + e^- \rightarrow Mn^{6+}$$

Video Solution:

Q4 Text Solution:

The transition metals are very much hard and have low volatility. Their melting and boiling points are high which are attributed to the involvement of greater number of electrons from (n - 1)d in addition to the ns-electrons in the interatomic metallic bonding.

Video Solution:

Q5 Text Solution:

Ionic radii of trivalent lanthanides decrease with Increase in atomic number due to lanthanide contraction

Video Solution:

Q6 Text Solution:

Iron (III) catalyses the reaction between iodide and per sulphate ions.

$$2\,Fe^{3+} + 2I^- \rightarrow 2\,Fe^{2+} + I_2$$
$$2\,Fe^{2+} + S_2O_8^{2-} \rightarrow 2\,Fe^{3+} + 2\,SO_4^{2-}$$

Video Solution:

Q7 Text Solution:

$Mn^{+} : [Ar]3d^4 4s^2$

$Cr : [Ar]3d^4 4s^2$

$Fe^{2+} : [Ar]3d^4 4s^2$

Video Solution:

Q8 Text Solution:

$La(OH)_2$ is more basic than $Lu(OH)_3$ La^{2+} is larger in size than Lu^{3+} so that it has less polarising power and more ionic character which makes it more basic.

Video Solution:

Q9 Text Solution:

Due to the increasing stability of the lower species to which they are reduced.

$\overset{+5}{VO_2^+} \longrightarrow \overset{+4}{VO^{2+}}$

$\overset{+6}{Cr_2O_7^{2-}} \longrightarrow Cr^{3+}$

$\overset{+7}{MnO_4^-} \longrightarrow Mn^{+2}$

Increasing stability ↓

Video Solution:

Q10 Text Solution:

increasing stability of the lower species to which they are reduced

Video Solution:

Q11 Text Solution:

$VOCl_2$ contains V^{4+} ($3d^1$) with one unpaired electron.

$CuCl_2$ contains Cu^{2+} ($3d^9$) with one unpaired electron.

$FeCl_2$ contains Fe^{2+} ($3d^6$) with four unpaired electrons.

$MnCl_2$ contains Mn^{2+} ($3d^5$) with five unpaired electrons.

$VOCl_2$ and $CuCl_2$ with equal number of unpaired electrons are expected to have same colour.

Video Solution:

Q12 Text Solution:

Potassium chromate is oxidised to potassium dichromate on reaction with an acid.

i.e., $2\,CrO_4^{2-} + 2H^+ \rightarrow Cr_2\,O_7^{2-} + H_2O.$

Video Solution:

Q13 Text Solution:

Elements with atomic numbers 59, 95, 102 are Inner transition metals because they belong to lanthanoids and actinoids.

Pr (59)

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^3$

Am (95)

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^7$

No (102)

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 7s^2 5f^{14}$

Video Solution:

Q14 Text Solution:

$MnO_2, Mn^{2+}, MnO_4^{2-}$

Video Solution:

Q15 Text Solution:

The element present immediately below Zn in the
periodic table in the same column, has atomic number equal
to 48.
The atomic number of Zn = 30
30+ 6p e's + 2s e's + 10d e's = 48

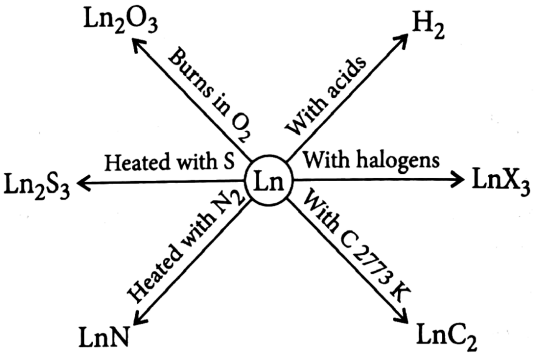
Video Solution:

Q16 Text Solution:

Mn^{3+} = $3d^4$ = 4 unpaired electrons, Cr^{3+} = $3d^3$ = 3 unpaired electrons, V^{3+} = $3d^2$ = 2 unpaired electrons. Cr^{3+} is most stable out of these in aqueous solution because it has half-filled t_{2g}. level $\left(i.e.,\ t^3{}_{2g}\right)$.

Video Solution:

Q17 Text Solution:



Video Solution:

Q18 Text Solution:

$3\,MnO_4^{2-} + 4H^+ \rightarrow 2\,MnO_4^- + MnO_2 + 2H_2O$

Video Solution:

Q19 Text Solution:

When an electron from a lower energy d-orbital is excited to a higher energy d-orbital, the energy of excitation corresponds to the frequency of light absorbed. This frequency generally lies in the visible region. The colour observed corresponds to the complementary colour of the light absorbed. The frequency of light absorbed is determined by the nature of the ligand.

Video Solution:

Q20 Text Solution:

The stability of $Cu^{2+}_{(aq)}$ rather than $Cu^{+}_{(aq)}$ is due to the much more negative D $\Delta_{hyd}H^{\circ}$ of $Cu^{2+}_{(aq)}$ than Cu^{+} which more than compensates for second enthalpy of Cu.

Video Solution:

Q21 Text Solution:

Almost all manganese compounds are coloured. For example, Mn^{2+} is pale pink, and MnO_2 is black, both because of d-d transitions.

The (+VII) oxidation state has d^0 configuration and would be expected to be colourless. In MnO_4^-, an electron is momentarily transferred from oxygen atom to the metal, thereby momentarily changing O^{2-} to O^- and reducing the oxidation state of the metal from Mn(+VII) to Mn(+VI) Change transfer requires that the energy levels on the different atoms involved are fairly close. Charge transfer always produces intense colour.

Video Solution:

Q22 Text Solution:

On warming the mixture of NaCl and $K_2Cr_2O_7$ gently with conc. H_2SO_4 a deep red vapour is evolved. When it is passed into NaOH solution gives a yellow solution of Na_2CrO_4 and chromyl chloride.

Video Solution:

Q23 Text Solution:

$P = KMnO_4, Q = K_2MnO_4, R = MnO_2, S = MnCl_2$

$$\underset{(P)}{2KMnO_4} \xrightarrow{\Delta} \underset{(Q)}{K_2MnO_4} + \underset{(R)}{MnO_2} + O_2$$

$$\underset{(R)}{2MnO_2} + 4KOH + O_2 \rightarrow \underset{(Q)}{2K_2MnO_4} + 2H_2O$$

$$\underset{(R)}{MnO_2} + 4NaCl + 4H_2SO_4 \rightarrow \underset{(S)}{MnCl_2} + 4NaHSO_4 + Cl_2 + 2H_2O$$

Video Solution:

Q24 Text Solution:

I. True, due to involvement of (n - 1) and ns-electrons in bonding.

II. True, due to unpaired electrons in d-orbitals.

III. They dont burn vigourously in oxygen.

IV. Since, $E°(M^{2+}/M)$ = +ve

$E°(M/M^{2+})$ = –ve

Thus metal is not easy. Thus, false.

They do not displace H_2 with dilute acids based on E° values. Thus false. Thus I and II are true.

Video Solution:

Q25 Text Solution:

$$\underset{(A)}{4FeO \cdot Cr_2O_3} + 8Na_2CO_3 + 7O_2\left(\text{fromair}\right) \rightarrow \underset{\substack{\text{Yellowsolution}\\(B)}}{2Fe_2O_3} + 8Na_2CrO_4 + 8CO_2$$

$$\underset{(B)}{2Na_2CrO_4} + H_2SO_4 \rightarrow \underset{(C)}{Na_2Cr_2O_7} + Na_2SO_4 + H_2O$$

$$\underset{(C)}{Na_2Cr_2O_7} + 2KCl \rightarrow \underset{\substack{(D)\\\text{Orange crystals}}}{K_2Cr_2O_7} + 2NaCl$$

Video Solution:

Q26 Text Solution:

$$2\,FeSO_4 \xrightarrow{\Delta} \underset{\text{blackish brown}}{Fe_2O_3} + SO_2 + SO_3$$

$$Fe_2O_3 + 6HCl \rightarrow 2\,\underset{\text{Yellow soln.}}{FeCl_3} + 3H_2O$$

$$FeCl_3 + 3\,SCN^- \rightarrow \underset{\text{Blood red coloured soln.}}{Fe(SCN)_3} + 3\,Cl^-$$

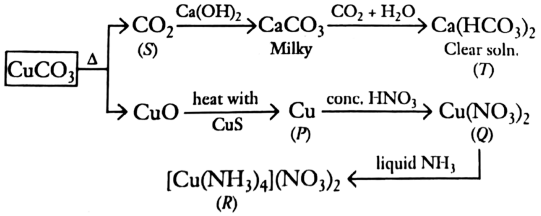
Video Solution:

Q27 Text Solution:

$La(OH)_3$ is most basic. Hence, (I) is wrong. (II) is correct due to lanthanoid contraction. (III) is correct because Ce^{4+} tends to change to stable Ce^{3+}.

Video Solution:

Q28 Text Solution:



Video Solution:

Q29 Text Solution:

In the highest oxidation states, the transition metals tend to accept electrons and show acidic charecter

Video Solution:

Q30 Text Solution:

At pH < 7, in acidic medium

$$MnO_4^- + 8H^+ + 5e^- \rightarrow \underset{\text{(colourless)}}{Mn^{2+}} + 4H_2O$$

At pH = 7, in neutral medium

$$MnO_4^- + 2H_2O + 3e^- \rightarrow \underset{\text{(brown precipitate)}}{MnO_2} + 4\,OH^-$$

At pH > 7, in alkaline medium

$$MnO_4^- + e^- \rightarrow \underset{\text{(green)}}{MnO_4^{2-}}$$

Video Solution:

Q31 Text Solution:

$P = MnO_2, Q = K_2MnO_4, R = KMnO_4, S = KIO_3$

$$2\,\underset{(P)}{MnO_2} + 4KOH + O_2 \rightarrow 2\,\underset{(Q)}{K_2MnO_4} + 2H_2O$$

$$3MnO_4^{2-} + 4H^+ \rightarrow 2\,\underset{(R)}{MnO_4^-} + MnO_2 + 2H_2O$$

$$2\underset{(R)}{MnO_4^-} + H_2O + KI \rightarrow \underset{(P)}{2MnO_2} + 2OH^- + \underset{(S)}{KIO_3}$$

Video Solution: